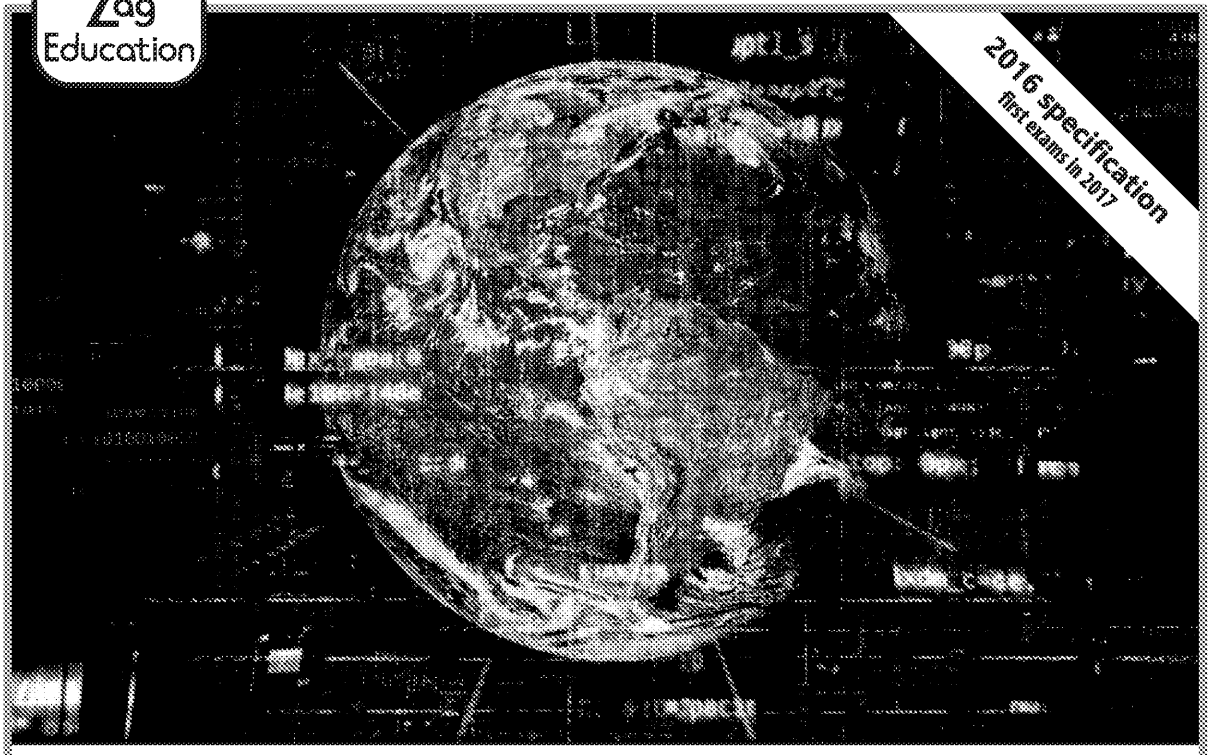
Zig Zag Education

IT

OCR Cambridge | Level 3 Technicals



LEVEL 3 CAMBRIDGE TECHNICALS IN IT

Learner Companion

Unit 2: Global Information

zigzageducation.co.uk

POD 11146

Contents

Teacher's Introduction

This companion has been written specifically for the Level 3 Cambridge Technicals in IT qualification (first teaching from September 2016). The theory notes and practice questions cover the essential knowledge and understanding prescribed in the Cambridge Technicals Unit 2 specification.

About Unit 2: Global Information

Unit 2 (90 GLH) is assessed using a 1-hour 30-minute (80-mark) written examination, which is set and marked by OCR. There are two opportunities for assessment each year – in January and in June.

Unit 2 is a mandatory unit in the *Certificate* (180 GLH), *Extended Certificate* (360 GLH), *Introductory Diploma* (360 GLH), *Foundation Diploma* (540GLH), *Diploma* (720GLH) and *Extended Diploma* (1080 GLH).

Each of the six *Learning Aims* (1–6) is given its own section in the resource. These are as follows:

① *Holding and Transmitting Global Information*
② *Styles, Classification and Management of Global Information*
③ *Uses and Benefits of Global Information*
④ *Legal and Regulatory Frameworks – Information Storage and Use*
⑤ *Information Flows*
⑥ *Principles of Information Security*

Remember!

Always check the exam board website for new information, including changes to the specification and sample assessment material.

Within each section, there are student notes covering the specification content and structure. These notes include descriptions of theory, supported with examples, diagrams and images where appropriate.

Questions are interspersed throughout the guide to test and develop understanding. Suggested answers are included at the back of this resource.

NB The intention of these is to save the teacher time, rather than to offer a comprehensive set of definite answers. In some cases, there are equally valid alternative answers to those that have been given.

October 2021

① Holding and Transmitting Global I

In this chapter you will learn:

- Who holds information, where it is stored, and how storage varies around the w
- The types of data storage media, and their advantages and disadvantages
- The types of storage devices, types of access, and their advantages and disadv
- What the Internet is, and the types of access
- The types of WWW technologies, and their uses and characteristics
- The different types of information format
- The advantages and disadvantages of W

1.1 Hol s of information

Information is everywhere! Every person, business and entity holds a variety of paper, electronic and online information. Some of that information is filed away in great archives, some of it will be forgotten about in the loft, and some will be spread across your devices and storage media, while new information will arrive through your door or in your inbox every day.

Categories

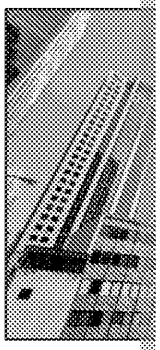
First, we will look at who holds information and suggest a few types of informat

Individual citizens

You, me and your family. This one should be familiar to you. Let's run through a few examples.

- Official documents – for example, birth and marriage certificates – they include your name, date and place of birth, your parents' names and even their occupations. You'll also have other documents in the course of your life, such as passports and driving licences.
- School and university certificates
- CVs, covering letters and application forms for the jobs you've applied for
- Utility bills, bank statements, shop receipts, insurance letters, etc.
- Emails and online calendar entries
- Your social media profile – you can ev load your entire Facebook p
- All of your digital photos (an those old prints of your great-grandpar
- Anything you've do saved and printed out from the web
- All of t ok wspapers and magazines in your house

Businesses



Businesses hold a phenomenal amount of information. That information is very precious to them – they use it every day and could go bankrupt without it, so they guard it against theft or modification and routinely create backup copies. Here are just a few types of information that a business holds:

- The personal details, CVs, copies of passports and qualifications of its staff, including their bank account details for payroll
- Accounts and other financial documents
- Customer and supplier details
- The business's **intellectual property** – the computer code, ideas, reports, work and drawings that thousands or millions of pounds have been spent creating
- Copies of legal documents and the regulations that the business must follow, everything from employment and safety to specific guidance for their sector

Education

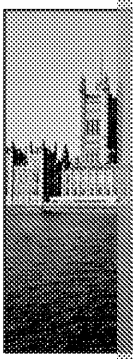
You might find this one easier!

- Again, the school has all of your personal information. It needs it to send to your exam boards so that you can sit your exams.
- Your teachers will have produced or purchased worksheets and learning materials, textbooks and the suite of materials provided from the exam boards, from the specifications to lesson plans to past exam papers.
- Don't forget all of the staff information, suppliers for paper, IT equipment, photocopiers and everything else that goes on in the school office and bursar's department.

Governments

Governments hold and **archive** vast quantities of data. And I mean vast quantities.

Our government will hold detailed records about everyone living here – that's over 66 million living people. This includes personal details, address histories and tax records.



The government also holds every birth, marriage and death certificate produced since 1837. There are huge archives that include all of the censuses starting in 1841 (apart from 1931, which was lost in a fire), military archives and [illegible]

Let's not forget all of the bills and laws passed in Parliament, the publications and reports produced for MPs, or all of the classified reports and materials in the heart of governments that include intelligence about other countries and people that influence domestic and foreign policies.

Charities and community organisations

Charities and community organisations hold data about their staff and volunteers, sponsors, as well as financial information. They also hold and produce informati

Healthcare services

Your doctor will hold a lot of personal information about you. Not only your nam
full medical history – what illnesses you've had, the medicines prescribed, repea
to medicines you have. Until fairly recently, all of this was on paper and each do
with filing cabinets, and your file had to be retrieved before the consultation. If
had to be passed to the new one. Now, all of the records are computerised.

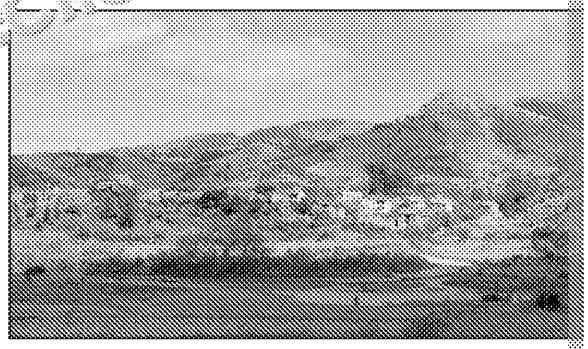
The NHS employs over 1.3 million staff – that's a lot of employee data. Doctors ar
drugs and procedures, and receive magazines such as the *BMJ*, and each provider

Locations

Information is not distributed evenly around the world. Information is concentra
in urban areas and large cities, and typically in the developed world.

Developed vs developing

One of the greatest differences in quality is between countries at different levels of development. You may have studied this in Geography classes, but a refresher is provided on the right.



A rural village in a developing country

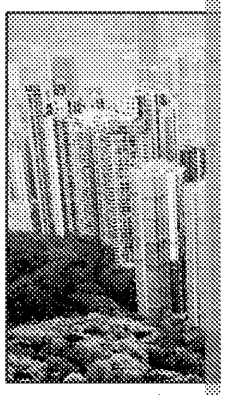
In **developed countries**, we have the money, resources and a stable electricity su
to set up powerful computerised networks, including fast Internet access. We ga
indefinitely, and set up large data centres to store personal and business files, h
streaming. We have been promised the paperless office for decades – but we pr
university took away staff printers, some of the staff brought in their own.

In **developing countries**, the use of technology is lower, creating an information

Urban (towns and cities) vs rural (countryside)

Information is concentrated into urban areas. Think of the number of homes and businesses in towns and cities – and remember that the world is rapidly urbanising. Nearly 84% of us living in the UK are urbanites. There are also large archives and libraries in cities, and Internet connections tend to be faster in cities than in rural areas.

But do remember that data centres are sometimes located in remote locations for extra securit



*Hong Kong, a city th
global centre of finan*

Home vs workplace

In 2020, the coronavirus pandemic forced millions of people to work from home, often for the first time. Staff were asked to work remotely w
had to open up their firewalls and add remote desktop or VPN (virtual private ne
flow of data (and also paperwork) into employees' homes. Data security may hav
not to work remotely in some circumstances. Governments have been campaign
infrastructure in both cities and the countryside in part to allow business and re
before the pandemic even started. As a result of remote work, employees started
into rural areas for a better lifestyle. Whether or not employers will allow long-t
approach is yet to be seen.

Technologies

In developed countries, most people have access to computers and laptops, tabl houses can access high-speed broadband Internet, and many of us have a data c us instant access to information when out and about.

Businesses are also largely computerised, taking full advantage of productivity an have a customer-facing website and do business online – communication with oth

In developing countries, with slower and less-reliable Internet access, and frequ proportion of business and government functions are conducted on paper. This c risks getting lost, and the information is harder to update.

As fixed broadband is expensive to install, especially in the countryside, develop Internet instead. Second-hand smartphones, specially designed cheap models are used to 'leapfrog' straight to the mobile world. Data contracts with phone co however, which can limit their uptake.

The fact that millions of people both globally and within the UK are cut off from poverty or age) creates a digital divide. There are many benefits of accessing on starkly highlighted in 2020 by the coronavirus pandemic – you heard news repo several school-aged children trying to do homeschooling without proper equipm smartphone), or the elderly being further isolated and sometimes humiliated wit or even being able to book a table or look at the menu at some restaurants.

Practice Questions – 1.1 Holders of information

1. Suggest two more examples of data that you will find in the home that a the list provided.
2. Identify two reasons why businesses back up their data.
3. Identify two reasons why governments hold so much data.
4. Explain why there is more information located in urban areas than rural a
5. Identify a problem caused by the digital divide.

1.2 Storage media

We use a variety of different storage media to store information. Sometimes specific purpose, and they generally have different advantages and disadvantage they are used.

Paper

Before we had computers, we used... well, paper! We wrote on paper by hand, or used a typewriter after they'd been invented in the 1860s. We could use carbon paper to make one or two copies, or a crude type of ink copier, but that was it. If you needed more copies, you'd need to rewrite or retype your document. If you wanted to correct the odd mistake, out came the correction fluid. And if there were lots of mistakes, time to retype. Move paragraphs around, and out came the scissors and glue (hence why we still say 'cut and paste').

Good l

Now we can print as many copies and do as many edits as we like, so our use of paper has increased in places. But as we move ever more online, s disappeared. Businesses still tend to print important business and legal docume particularly where signatures are required, and deliveries still come with paper

Sometimes it's more convenient and easier to fill in a form – such as a survey in down a quick note or shopping list. Paper is also necessary for people who don't equipment – relatively few in developed countries, but millions of people in dev

Even though we have GPS and satnav devices, many of us still use paper maps, an Ordnance Survey map when out walking or cycling. Mountain rescue teams t stranded without a backup paper map after the batteries in their GPS died or the access a map on their smartphone.

One thing that we don't use much is [illegible] directories – ask your parents an to be A4-sized books, perh[illegible]m black, delivered once a year (and rarely used exist, usually A[illegible]siz[illegible]ery thin.

Tickets are [illegible]oving away from paper – buses, trains and events are now mo (mobile) – a barcode or QR code is scanned directly from the screen.

Advantages and disadvantages of paper storage:

Advantages	Disadvant
✓ The content will always be readable – no incompatible storage media or file types to worry about	× Very heavy and bulky to store; may archive – whereas the same amou hard drive
✓ Less energy required to store the paper – just needs to be stored in a dry location – and no server costs	× Easy to damage or destroy (e.g. fire backup copy anywhere else
✓ Accessible – doesn't need technology to access it, don't need to know how to use a computer	× Time-consuming to physically loca needs a robust filing system – whe retrieved in seconds
✓ Secure – cannot be stolen in an online data breach	× Time-consuming to process, scan a
✓ Can be used in places without electricity	× Needs disposal – shredding and re with associated cost
	× Difficult to edit and update – the i
	× Paper, ink and toner are expensive environmental costs
	× Expensive to send through the pos
	× Time-co[illegible]n to send, update a
	× Pap[illegible]can go missing – a disa [illegible]existence!

Optical

These include the shiny silver plastic discs such as CDs (compact discs), DVDs (digital versatile discs) and Blu-ray discs (BD). Each was released at a different time, for a different purpose.

The disks are read by a laser – hence the term 'optical'. Their use has rapidly declined in recent years, and most consumer computers and laptops no longer have an optical drive fitted as standard.

Most commercially produced disks are printed at a factory and are called ROMs – read-only memory. The contents cannot be modified.

Home users can purchase writable (and rewritable) media such as CD-R and DVD different ways that the data can be written by the laser for DVDs, but most dr types of disk). These disks are typically less durable than factory-printed version

Each type has a different capacity:

- CD – 700 MB or 80 minutes of audio
- DVD (single layer) – 4.7 GB / (dual layer) – 8.5 GB (often called DVD-9)
- Blu-ray (single layer) – 25 GB / (dual layer) – 50 GB

A DVD drive can typically read CDs, and a Blu-ray drive can typically read DVDs read only CDs, and a DVD drive cannot read Blu-ray.

Each type also has different uses:

- **Commercial PC software and games** were once sold mostly on **CDs** (and became larger and DVD drives became common), but now they are most
- **Computer games for consoles** can still be purchased on disc (used to be typically **Blu-ray**) in addition to digital downloads from each 'store' set u
- **Music** was typically sold on **CD** from the 1990s (when CDs replaced viny most music is streamed or downloaded.
- **Films and TV series** were typically sold on **DVD** starting in the late 1990 2006), and later on **Blu-ray** for high-definition versions.

Over the years, individuals have sometimes used optical media to perform backu largely been replaced with hard disk or cloud-based alternatives.

Advantages and disadvantages of optical media:

Advantages	Disadvan
✓ No moving parts, so long-lasting if stored correctly ✓ Cheap to produce and to buy in bulk ✓ Easily recorded on standard equipment ✓ Minor scratches can be resolved using error correction ✓ Easy to transfer between devices	* Data transfer can be very slow co ne with transfer; limited storage single-layer DVDs * Recordable media can break dow or humidity * Easily scratched * Lots of plastic used – might be u for CD-R and DVD+/-R * Can 'skip' if there are deep scratc when in use * Fairly bulky form of media, espec even more plastic!

Magnetic

Magnetic storage uses a metallic oxide medium such as iron, which may be 'dop cobalt. As a magnetic write head moves across the surface of the tape or disk, cr become aligned according to the magnetic field. A read head can then read back

There are two modern uses of magnetic media:

1. **Mechanical hard drives** –use aluminium disks coated with the oxide (or sometimes glass or ceramic). The read-write head skates across the disk, hovering just above the surface (but doesn't touch the surface). If the head does touch the surface, the drive can be ruined. Cheaper consumer computers still use mechanical drives because they are cheaper than solid-state drives, and many servers still use large me cheapness and large capacity (they spin much faster than the ones in your h desktops are larger (3.5") while laptop versions are smaller (2.5"). You can a housed in a plastic case and plugged in by USB.

2. **Tape** – computers used to use open reels of plastic tape coated with the oxide for everyday storage – you see them in old films. But now the tape is housed inside cartridges, and they are used for backups, because they were a lot cheaper than backing up to hard drive (now hard drive prices have dropped making the prices more comparable and backups are often made to hard drive instead of tape). The tapes used to look like the cassette tapes you used to buy music on – but now they are just small boxes if you buy the 'LTO' (Linear Tape-Open) series of tapes (pictured). New versions of tap developed, offering greater capacity and faster speeds in the same small ca because they don't take up much space. Unlike disks, the heads actually tou occasionally require cleaning to remove a build-up of oxide particles.

There are other forms of magnetic media available, such as floppy disks with sto icon for most software packages if you've never seen a real one) and larger Zip d apart from in legacy systems.

Advantages and disadvantages of mechanical drives:

Advantages	Di
✓ Cheap; tried-and-tested technology ✓ Large-capacity drives are available, holding many terabytes ✓ Easy to set up in a RAID configuration using controller to use several disks to store redundant data, e.g. RAID 1 mirrored – two disks with an identical copy of data in case one fails, or other raids such as RAID 5, where data is spread in multiple locations so a disk can fail without data loss ✓ Good for servers, where special disks can spin at 15,000 RPM for fast access speed (a typical consumer drive might spin at 7,200 RPM) ✓ Can be bulk-erased using a magnet when being disposed of	× Use mechanical pa eventually fail × Old drives that hav time can stick and × The head can 'crash destroying the driv × Consumer drives m very slow read-writ installations and lo may feel sluggish o × Portable drives can × Drives require 'defr operating efficientl the seek time) – th automatically by th

Advantages and disadvantages of magnetic tape:

Advantages	Disadvantage
✓ Tapes are small and can easily be taken off-site for secure storage ✓ Good for backup storage when time is not important ✓ The data can be stored for decades if the tape is correctly stored ✓ Tapes are relatively cheap to replace	× Tape drives are very expensive (even thro × Newer versions of tape standards are con usually only backwards compatible with write and two generations for read × Older tapes have slow write-times – mea take longer than 24 hours × Read times are very slow – the tape migh metres or more betw n file locations – backups aft s at oss. Newer tapes are × Th ard drives has decreased, re × s can have a short lifespan when the

Solid sta

High-end modern devices, and many portable devices, use **flash memory** – there are no moving parts, hence 'solid state'. This memory retains the data when switched off (non-volatile) and can be used in place of a mechanical drive.

There are many modern uses of flash memory:

1. Hard drives – a much faster replacement for mechanical drives
2. Storage in portable devices (phones and tablets) and devices such as the Ra either built-in or using a removable card (e.g. SD or micro SD card)
3. Storage in cameras and other monitoring equipment (e.g. SD and other sim
4. USB flash drives (pen drives or thumb drives) – used for data transfer or sha

Advantages and disadvantages of solid state (flash memory):

Advantages	
✓ Very fast file access, boot times and software installation times ✓ Very durable as no moving parts and not susceptible to shock and vibration – could last longer than mechanical drives when archiving data ✓ Little heat generated, so less cooling required than for mechanical drives ✓ Use less electricity than mechanical drives ✓ Very small, lightweight, and highly portable – ideal f meras and portable devices ✓ Can get large sizes – a terabyte or m allowing replacement for hard disks and s ing of 4K video ✓ SD and micro SD c e cheap ✓ USB fl es e cheap and convenient	× Large more e mecha × USB fl misplac breach × The m numbe used t evenly the sa × Some write s

Practice Questions – 1.2 Storage media

1. Identify two situations where using paper is preferable to using compute
2. Explain why optical media have fallen in popularity.
3. Suggest why optical media are still used in games consoles.
4. Explain why mechanical drives are still widely used in commercial applic
5. Suggest whether solid-state drives will replace all other consumer storag

1.3 Storage and access types

The tables below show a range of information access and storage types, along w
and disadvantages.

Handheld devices

Examples/Purpose	Advantages	
Small tablet: Thin, portable device that is larger than a smartphone – usually with built-in Wi-Fi but not usually cellular access. Small tablets are used for light web browsing and email, gaming and some data entry, although not for desktop applicatio	✓ Very portable and lightweight ✓ Larger screen than a smartphone	× Very s not n keyb × Hard × Migh and s × Smal
Smartphone: A mobile telephone with a relatively small screen running an operating system such as Android or iOS. Smartphones typically have a touchscreen and on-screen keyboard rather than physical buttons. They are used for calls, texts, email and other communications. Social media, apps and web browsing connect to the Internet over Wi-Fi and mobile data networks.	✓ Uses mobile network for data when Wi-Fi is unavailable ✓ Pocket-sized and highly portable ✓ Always on and available – can be used to look something up quickly	× Easil × Smal impr × Diffic desk smal × Scre brea
Wearable devices **Smartwatch**: Used as a timepiece but paired with a phone to display messages and notifications (worn on the wrist, like a traditional clockwork or digital watch). May have a fitness tracker built in. **Fitness tracker**: Measures heart rate, number of steps taken, etc.	✓ Immediate access to information and notifications without having to reach for your phone or take out your phone in public ✓ Less likely to miss important calls ✓ Keeps track of activity, allowing you to improve your fitness or lifestyle	× Very from × Very charg × Your rece
e-reader: Small tablet-like device or e-ink device (to look like paper surface). E-books can be purchased directly on the device, as a replacement for paper books. Colour and black-and-white versions available.	✓ Books are delivered wirelessly ✓ No bulky storage of paper ✓ e-ink can be read in sunlight ✓ E-books are now VAT exempt, just like paper ones	× Requ book × Lack scre × No s book

Portable devices

Examples/Purpose	Advantages	
Laptop: A portable computer with a (touch)screen, touchpad and keyboard and IO such as USB and/or Thunderbolt ports. Provides much of the functionality of a desktop computer, but in a portable format, with Wi-Fi built in as standard. Often used in homes and businesses.	✓ Provides a good level of performance in a portable format ✓ Can use docks for easy use of screens and of peripherals such as keyboards and mice ✓ Less power consumption than a desktop, so cheaper to run	× × × ×
Large tablet: Larger and more powerful than smaller tablets, making it easier to use.	✓ Acts as a good bridge between a tablet and a laptop ✓ More powerful processor than small tablets ✓ Larger screen size, so easier to use, and for more purposes, such as graphic design	× ×

Fixed devices

Examples/Purpose	Advantages
Desktop computer: The traditional computer. Powerful processing and high-performance computing, consisting of a base unit, and peripherals such as a keyboard, mouse and large screen. Some desktop computers are built 'all in one' with a built-in screen. They must be connected to power at all times and are usually connected to the Internet and networked resources (printers and files) using an Ethernet cable.	✓ Can use very high-performance components ✓ Very easy to upgrade individual parts ✓ Hard to steal
Smart TV: Television with extra services – such as streaming apps and Web access (Wi-Fi and Ethernet usually built in)	✓ Optional devices, such as a set-top box or dongle, needed for streaming ✓ Wireless and Ethernet technologies are built in ✓ May be able to stream local media from a device on your network ✓ Very fast and responsive when switching between apps and inputs

Examples/Purpose	Advantages
Games console: Produced by companies such as Sony, Microsoft and Nintendo mostly for playing games, but can also be used for streaming TV, films and music, and for web access to a television set. Games consoles can resemble miniature desktop PCs (but usually with a more attractive case design). They are usually controlled with a wireless controller or game pad.	✓ Very powerful, produces excellent graphics (4K for some new consoles) and, as processing is local, doesn't need a fast Internet connection for streaming graphics generated by a server ✓ Easy-to-use, intuitive controllers ✓ Wireless and Ethernet built in ✓ No need to upgrade to play new games (unless they're for a new console generation) ✓ Cheaper than a gaming PC ✓ Easy to play online ✓ May offer backwards compatibility to play older games (e.g. latest generation PlayStation/Xbox consoles can play games from previous generation)

Shared devices

Examples/Purpose	Advantages
Database server: A powerful specialist computing device that is usually locked away in a server room, mounted into a rack with other servers and network equipment. Servers store and provide access to a large database, and the access is all done over the network.	✓ Provides back-end functions and processing ✓ Users can access the data on their own computers using a front end to view and input data
Data centre and cloud storage: Racks of servers for storing and distributing data. Usually housed in very secure buildings. Used to serve files used as cloud storage, websites and streaming services across the Internet. Servers for hosting and processing can be rented by companies.	✓ Easy for remote users to set up and access the storage – most of the work is done by staff at the data centre ✓ Much more flexible than a server in a business as can easily upgrade and downgrade the storage ✓ Processing can be completed on the powerful, off-site hardware ✓ Accessible 24/7/365 from anywhere in the world

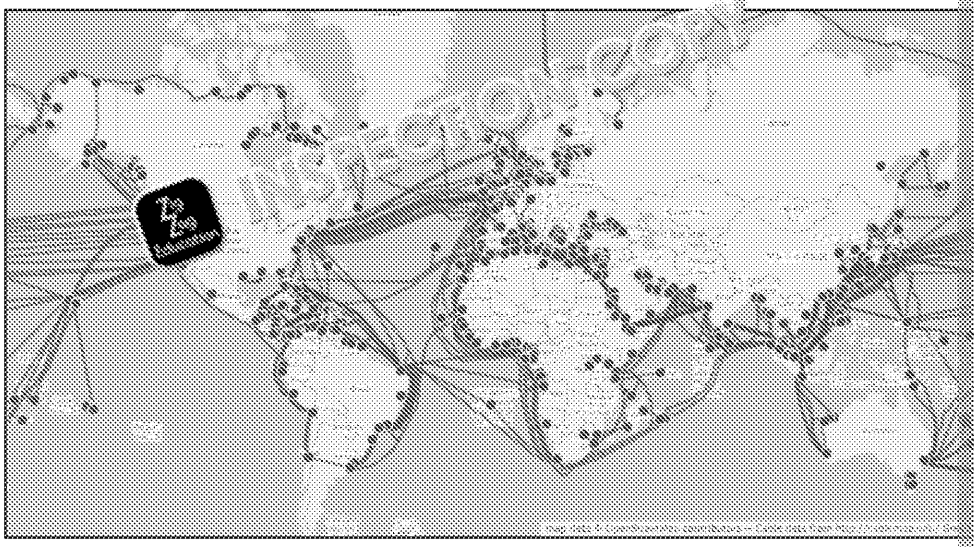
Practice questions – 1.3 Storage and access types

1. Explain why portable devices are often more convenient than fixed devic
2. A medical facility starts using cloud storage. Identify a risk of using a sha cloud storage.
3. Explain two limitations of using handheld devices.

1.4 The Internet

Many people confuse the Internet and the **web**. It probably didn't help that Micr called the web browser that they bundled with Windows 'Internet Explorer'.

The Internet is a global system of networks that use the **TCP/IP protocol**. It start the 1960s, was set up by the US military and was called ARPANET. Therefore, th Internet is much older than the web, but the Internet is the underlying network carries all of our web traffic, streamed TV and music, online communications suc email, **VoIP** and Internet Relay Chat (IRC), as well as file transfer (FTP) and other functions.



The underwater cables used to link the continents together

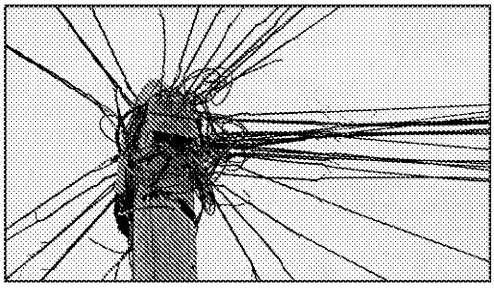
To access the Internet, customers need to contact an internet service provider (I such as BT, Virgin or TalkTalk. The ISP will provide the equipment needed to acc the Internet, as well as the cabling, unless the access will be provided using the existing phone line connected to your property.

Your ISP will own or rent a complex infrastructure of communications equipmen servers to street cabinets (the big grey or green boxes on the pavement – if you one, they have hundreds of wires inside with a connection to each house) to mo ultimately be connected to this infrastructure using a **modem** and **router** (usuall receives the data packets to and from your home, and creates a small network c devices can share.

The type of network is determined by the technologies available in your area, or pay. In an urban area, you might be able to get a fast but expensive fibre connec However, you may not need or be able to afford the fast access, so you may use rural areas, you might have access only via copper cable. In very remote location be satellite access.

Another form of internet access uses the mobile phone network. This can be thr your mobile phone or through a separate 4G router that acts as a normal home data receiver instead of using a cable.

Types of Internet connection and technology



Copper cable is convenient because it's already installed nearly everywhere – but it doesn't provide the best Internet connections

Copper cable

Uses the existing copper phone line t already installed in most homes and businesses. This led to the first wides Internet access using dial-up, and lat **ADSL** broadband.

The first widespread home Internet u of your day 'offline' and needed to co receive email or to surf the web. You perhaps 10 [illegible] en about 1p for e Co[illegible]e tio[illegible]eeds were very slow (up frequency of the connection used the [illegible]ce [illegible]e you could not make or receive phone when you were online. [illegible]s se[illegible]ce is still available to use in (mostly rura not available, but ver[illegible] [illegible]eople use it. The modern web is no longer designed that page l[illegible] ti[illegible]s are extremely long because of all of the large images, elements a[illegible]o.

Broadband is much faster. It uses higher frequency wavelengths to transmit the (outside the voice frequency), which means that phone calls can be made at the time. You may see a small box called an 'ADSL filter' hanging from your phone l – one cable goes to the phone and the other the router. This filters out the diffe phone and router so that the two devices don't interfere with each other.

To represent Internet on a copper phone line, think of a pipe with a small amou bottom – that water represents the voice frequency. But there's a lot more room the possible flow of broadband Internet.

The amount of data (technically the frequency range) that a cable can transmit i called the **bandwidth**. The larger the bandwidth, the more data that can be transmitted in a second. We refer to this in 'megabits per second' or 'gigabits pe second' – the number of bits carried in a second. Just like elsewhere, a gigabit is 1,000 times faster than a megabit. Remember that if your Internet service provi promises up to a 20 megabit download speed, you can download only at a maxi of 2.5 megabytes per second – as there are 8 bits to a byte.

Typically, the type of broadband provided by a copper phone line is called ADSL line). It's called 'asymmetric' because the download speed is much faster than th and the street cabinet use only copper cable, then your maximum speed will be download and one megabit for upload. One drawback of copper is that the more house and the street cabinet, the slower your connection spe d is because the s the people living at the end of your road closer to th[illegible]e might have slight people at the other end.

Over time, ADSL technology has i[illegible] twenty years ago, the maximum spe Also, as street cabinets a[illegible]ges get upgraded so that they are supplied b increases, e[illegible] ou[illegible] house is still connected by copper. You will connect called a rou[illegible] small box with wireless transmitters and transceivers, and usu

Advantages of ADSL (copper)

- ✓ Relatively cheap
- ✓ Copper is already installed nearly everywhere, so getting connected is very quick and easy – no new expensive cable to lay

Disadvantages of ADSL (co

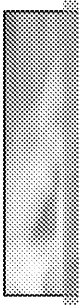
- × Speed varies greatly, the cabinet, the numb and even the quality (the telephone line
- × Can have high **latency**
- × Upload speeds are ve

Latency – The time taken for a signal or data request to a server to be returned to the originating device.

Fibre-optic cable (optical fibre)

The modern global Internet relies on glass fibre for its main infrastructure. This includes many of the undersea cables that connect countries. You occasionally see in the news that one of those cables has been accidentally cut by a ship, meaning that some countries' Internet connection has slowed down until the cable has been repaired.

Glass fibre uses pulses of light (hence 'optic') to transmit data very rapidly at, well, the speed of light! This allows for a very high bandwidth, with thousands of connections over a single cable.



Fibre-
very l

Over time, the core copper network in the UK is being repl[illegible]d with fibre – an expensive process as new trenches mu[illegible] o[illegible] to lay the expensive

There are two ways that customers b[illegible]it

A modern street cabinet using FTTC

1. **Fibre to the cabinet (FTTC)** – the copper cab[illegible] and the street cabinet is replaced with fibre. phone line from the cabinet to your house ([illegible] copper the speed is much faster than ADSL download. Because you are still using coppe[illegible] distance, as for ADSL – copper is definitely provide Internet over a thicker copper cable speeds than are possible on a regular phone
2. **Fibre to the home (FTTH)** (also called fibre t[illegible] home is directly connected to the fibre-opti[illegible] speeds are much faster (including upload). V[illegible] pay for different speeds that the provider of[illegible] only the base package, e.g. 50 megabits, bu[illegible] for several hundred megabits.

Fibre rollout now covers much of the UK. It is expected that over time more hou[illegible]

Advantages of fibre

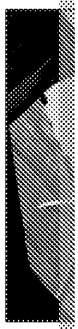
- ✓ Very fast and low latency
- ✓ Much higher upload speeds – good for uploading files to cloud storage, or
- ✓ Tiered pricing allows you to choose a package to suit you
- ✓ FTTH allows you to stop using a copper phone line and paying line rental if phone (and your router might allow you to connect a VoIP phone)

Disadvantages of fibre

- × Can be more expensive than ADS[illegible]
- × FTTH is not yet available everywhere
- × Maximum speed for FTTC is still reliant on the distance of your home from your p[illegible]ab[illegible]

Satellite

If you live in a very remote area where there are no phone lines or reliable mobile network, you might need to use satellite broadband.



You are probably familiar with, or have at least seen, satellite dishes attached to houses to receive TV. Satellite broadband uses similar dishes to receive Internet access, but, unlike TV receivers, the dishes need to be able to send data as well as receive it.

Advantages and disadvantages of satellite

- ✓ Sometimes your only option!
- × Very expensive compared to conventional Internet connections – perhaps £
- × Typically slow (max ADSL speed or less)
- × Often has limits on how much you can download – perhaps a few gigabytes
- × High latency – so not suited to some uses such as VoIP and online gami

However, this could all change very soon. Elon Musk's Starlink project (owned by thousands of satellites into space over the next few decades which will vastly in satellite Internet, and at a more-affordable cost.

Microwave

This is really only used in businesses to send data between different buildings – between offices – and is expensive. A fibre-connected microwave transmitter/re sends the Internet connection to and receives data from a transmitter/receiver o of sight over a short distance. There is only one customer, so it is expensive, but very fast and low latency, allowing a business to connect instead of using a fibre cable or communications over copper cable might be a cheaper option.

Mobile data

Internet access through either your smartphone or a dedicated router that acces Most of the time, you will access the data connection / Internet directly on the p might also 'tether' to another device which shares your phone's data connection such as a laptop, or through the USB connection.

You are limited to the monthly data allowance that is set in your phone contract quickly if this is your only source of Internet access. You are also limited by the you live, which could be patchy in rural areas, or even in densely packed cities.

Some business-grade Internet routers and packages come with a backup 4G or 5 cable service drops, the device automatically switches over to the cellular conne uninterrupted service.

Here is a summary:

Technology	Connection type	
Copper cable – ADSL	Wired using a standard phone line, available in most locations. Uses a DSL router (usually with a modem built in).	Can be fairly suitable for h and very sma Often unsuita
Copper cable (with FTTC)	Wired using a standard phone line that is already installed, or a thick coaxial cable. Not always available – depends on whether the street cabinet has been upgraded.	Faster than A households a
Fibre/FTTH	Fibre connection to the home or business directly using optical networking equipment. May be limited to large cities.	Very fast; sui well as house (have home o May form the infrastructure well as the g
Satellite	Uses a dish to send and receive data to a satellite.	Slow, expens latency at pr remote locati Largely unsu
Microwave	Uses dishes to send data between buildings.	Very expensi
Mobile data	The mobile (cellular) network is accessed through a smartphone, tablet or dedicated router in order to provide the network access (using a SIM card to provide an ID to the network). Sometimes, the access is tethered to another device.	Used by indiv Wi-Fi is unav employee de off-site. May replace with a router

Practice Questions – 1.4 The Internet

1. Which type of Internet connection do you have in your home? Give one
type of connection.
2. Explain why copper is a weak link in any netw
3. Identify two reasons why FTTC is an improvement over traditional ADSL
4. Identify and describe a suitable type of Internet connection for a busine
5. Explain why you might use a mobile Internet connection.

1.5 The World Wide Web (WWW)

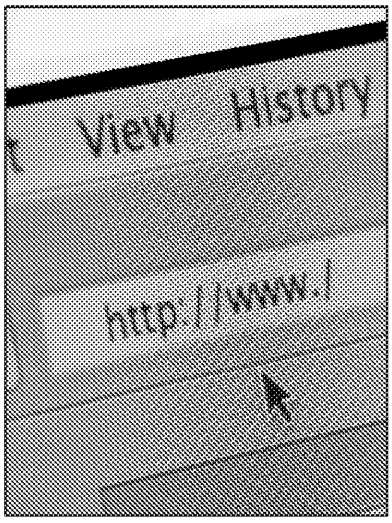
Now that we've covered how the Internet works, its role in carrying types of traf and how you get connected to it, we'll look at the bit that you're probably most familiar with – the web.

The web was invented by Sir Tim Berners-Lee in 1989 while he was working at in Switzerland. That's the organisation that built the Large Hadron Collider. Ber Lee wanted to create an electronic filing system consisting of linked pages of information.

Each web page is written in a language called **HTML** (Hypertext Markup Langua web **browser** (Chrome, Edge, Safari, Firefox, etc.) requ a page from its we server, and the HTML code instructs the brow er ho display the page on you screen. The modern web adds extra s echnology on top – such as extra and styles, and security la

You should fa il a with how web addresses are constructed, e.g. www.googl – www. means that it is on the web, google is the name of th site, and .co.uk means that the '**domain**' is specific to the UK. Non-specific (top-l (commercial) and .info. You might see the address referred to as a URL – uniform

Once you have typed the address into the browser, the request to load the page that the site is hosted on. But first, the correct web server must be identified. To converted to the site's public **IP address**. There are many servers that provide th They might be provided by your ISP. They are called DNS servers (domain name that request for www.google.co.uk becomes 172.217.14.195.



Network types

We access the web through several different n

Internet (public and open)

Most of the websites you use are publicly ava the standard access route for websites describ sites such as Google, meaning that they appea can access them – they are public and open. M organisations have a public site that customer access to learn about the company and its pro set up public websites about topics that intere

Only a small am t of the web is public, also think of h lit of an iceberg is above the w

Intranet (private and clos

An intranet is a seri w pages created for internal use by an organisation. regular we er

They are private and closed because only employees working inside the compan being hosted on the Internet, the intranet may be hosted on a web server within cut off from access to the public Internet.

Intranets allow staff to go about their jobs. They provide sources of information extra services such as clocking in and out, booking off annual leave, accessing in and providing functions to each department in the business.

Extranet (private but part-shared)

An extranet is a set of web pages set up by a company where its customers can [illegible] contained. It is hosted on the Internet, but it is private as only people with a reg[illegible] for the site can access it.

Your exam board, OCR, has an extranet that it calls 'Interchange'. This allows yo[illegible] training material and the latest set of past papers. The exam board doesn't put t[illegible] doesn't want you, the learner, to see that material. For example, your teacher m[illegible] exam as a mock – but it would be unfair if you had already seen the paper and [illegible] classmates hadn't.

You may have head the terms 'deep web' and 'dark web' used.

The deep web is any site that is not indexed by a search engine such as Google. [illegible] Google will provide you with the public log-in page. But your private email [illegible] public – so it's said to be on the 'deep web'. After you log in to online banking, y[illegible] Your access to these websites acts very much like an extranet. Most of the web is [illegible] which are legitimate and rightly private.

Similarly, the 'dark web' is not indexed or accessible through normal web brows[illegible] 'deep web', but it is to be avoided because it is mostly used by criminals for illeg[illegible]

Practice Questions – 1.5 The World Wide Web (WWW)

1. Describe how you access the web through the public Internet.
2. Explain why intranets are not accessible on the public Internet.
3. Give an example of an extranet and explain its purpose.

1.6 Information formats

The following table provides details about the different formats that are used on

Web pages

Description and purpose	Accessibility	Advantages
Perhaps the most widely recognised part of the web! Static websites are the same for each user and change only when the creator makes a change. Dynamic web pages may change each time the page is refreshed or display new content. Parts of the page might stay the same while other parts of the template change. For example, if you refresh the YouTube home page, new videos (thumbnails and titles) appear in the same place as the previous ones (but the sidebars don't change). If you are signed in, the content is personalised based on your subscriptions and previously watched videos. Sites are used by businesses to attract customers and provide services, and individuals set up personal sites to share their interests with others or create a portfolio for potential employers.	Ideally, sites should have a range of accessibility features, such as adjustable font size. Alternative text (Alt text) refers to captions that describe images for the blind or partially sighted. They're the yellow boxes that appear when you hover over some images. Screen readers are able to narrate the page content and Alt text. Some web browsers can display just the main text in a special reading mode.	✓ Most people are familiar with using and navigating web pages – over time, the styles have become easier to navigate ✓ Most sites have similar features, such as a clickable home icon, a menu, and links at the bottom of the page ✓ They can be used to incorporate other features, such as video boxes, and to link to downloads ✓ They can be highly personalised once a user has logged in ✓ They are fairly easy to create and update – there are lots of online website-building tools that don't require any knowledge of HTML ✓ They can use technologies such as CS ✓ They can be accessible to screen readers

Blogs (weblogs)

Description and purpose	Accessibility	Advantage
Blogs are often short 'diary'-style entries provided on a web page, with the most recent displayed first. They are typically hosted on platforms such as Blogger or WordPress, and include text and photographs. An individual might write a blog documenting a travel adventure or their everyday lives, or share recipes or experiences. Businesses also use blogs to provide updates to their customers and followers, including new product launches.	Blogs are usually simple web pages that are easy to read and navigate. There are usually simple buttons to view the next or previous pages, and they may have a simple search function. The blogs can be short articles in simple language – but personal blogs don't get proofread, and the language used might not be the first language of the author, so some might be hard to understand.	✓ Great for famil friends to keep those going tr ✓ Can be used to showcase skills for landing ne ✓ Easy to read a very entertain ✓ Useful for cust ✓ Useful for bus to promote pr a more person and appear in results

Podcasts

Description and purpose	Accessibility	Advantage
Podcasts are usually audio files (occasionally video) that an individual or a business uploads to the Internet for immediate download and that are played whenever is convenient to the listener. An individual might produce a podcast about a topic that interests them perhaps every two weeks or once a month. A business might release frequent podcasts as a cheap and fast method of providing news and information to customers.	Usually audio only – so unsuitable for the deaf or hard of hearing. Good for blind or partially sighted people.	✓ New episodes automatically downloaded to device when t become availa streamed onli ✓ Don't need an connection on downloaded ✓ Can be listene whenever con including whil performing otl such as cookin commuting – reading would difficult

TV, video and audio streaming

Description and purpose	Accessibility	Advantages
1. Video-sharing sites such as YouTube allow individuals, business and music artists to upload videos. Most content is free to stream, although there might be options to download or pay for extra services. 2. TV stations, e.g. the BBC and ITV, provide their own streaming to allow people to watch live TV, and also to catch up with a library of TV programmes, typically shown on their TV channel in the last few months or the past year. 3. Subscription services e.g. Netflix and Disney+ – viewers pay to watch content such as TV shows and films, and there are no adverts. 4. Audio streaming, e.g. Spotify – users can listen to music from most popular artists, and also podcasts. A free, limited service is funded by advertising, and a paid-for version removes advertising and adds extra features. 5. Internet radio – streamed through a browser or app across the internet to a computer, tablet or smartphone instead of tuning in with a wireless radio or hi-fi tuner.	Most of the content is watched or listened to, but many services offer captions (sometimes automatically generated) and audio descriptions.	✓ Available on many different devices, such as smart TVs, laptops, games consoles, tablets and phones ✓ Services usually have their own app for watching and downloading content ✓ HD (high-definition) and UHD (ultra-high-definition) options are available, including some shows in 4K ✓ Content is available on demand – no need to be around to watch it live – just catch up when convenient ✓ Some content can be downloaded – great when you're watching it on a train and don't have access to data or don't want to use your data limit

Social media channels

Description and purpose	Accessibility	Advantages
1. Facebook – good for staying in touch with family and friends, sharing news and photos, and following businesses and joining groups of like-minded people. 2. Twitter – short microblogs – good for keeping up with news, businesses and [illegible] figures you follow. 3. LinkedIn – the professional social network where you build up a profile showing your skills and past employment – a bit like a CV. You can endorse your colleagues to verify their skills, contact potential employers and view job postings. Employers can also contact you directly. 4. Discussion boards (forums) – sometimes about a certain topic – users post questions, and knowledgeable (and not-so-knowledgeable!) people reply.	Each platform has implemented its own set of accessibility features.	✓ Keep in touch with family and friends ✓ Easily follow businesses (businesses can use social media to drive website traffic and generate sales) ✓ Can be used to find new employment ✓ Start discussions with like-minded people ✓ You can get free help and advice on issues that you have

Document stores

Description and purpose	Accessibility	Advantages
Users upload documents and files to a cloud service such as Google Drive or Dropbox. Files can be either stored permanently online, stored as an online backup or synced to a device – a copy is stored in the cloud and on a device. If one of the versions is updated, the update is copied to the other location. Cloud storage is useful for personal users to back up files and photos (e.g. directly from your phone), and you can send links to view or download material with family and friends. Businesses find cloud storage very useful as it allows employees to share and work on files across different offices and locations.	File syncing is very easy to set up, but does require an Internet connection.	✓ Backups and syncing occur automatically ✓ Instant file sharing ✓ Can send files that are too big for email ✓ Storage space can be increased or decreased as required (scalability) ✓ Documents are available 24/7/365, anywhere in the world with an Internet connection ✓ Facilitates new ways of working and collaborating ✓ Always working on the current version of a document

RSS feeds (Really Simple Syndication or sometimes Rich Site

Description and purpose	Accessibility	Advantages
A person uses a reader to view news updates from the sites that they have followed by adding the site to their 'feed'. This means that they don't miss posts and articles that might interest them. The reader periodically checks to see whether new articles to display are available. Look out for ... icon ... sites – it ... e a Wi-Fi icon and is often orange. RSS feeds are good for keeping up with news and following the topics and businesses that you are interested in, and businesses can keep in touch with customers.	Users get to see all the information in one place rather than having to look at many different sites – much easier!	✓ Quick and convenient ✓ An extra marketing channel for businesses and increased traffic to their websites

Practice Questions – 1.6 Information formats

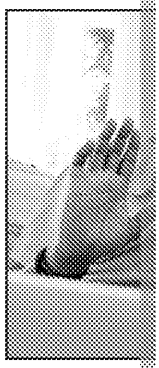
1. Identify a reason why a new company might not set up an RSS feed.
2. Identify an accessibility issue with podcasts.
3. Explain one advantage and one disadvantage for businesses of using on
4. Claire has a small business selling hand-knitted goods. Describe how Cl social media to promote her business.

1.7 Advantages of the World Wide Web

There is no doubt that the web has helped transform our lives. Most of us have t
parts of our time online, for learning, for looking up information, for admin tasks
for entertainment.

There are many advantages to being online. And perhaps we take it for granted.

Individuals



We use the web and its services for socialising. We don't need to write a letter, pay for a stamp, walk to the postbox and wait
week for a reply. We simply send a quick message through social
media or email and might get a reply within minutes.

On the web, we have instant access to news and information.
Want to see the latest headlines or the current football score? No
problem. Baking a cake and you need to convert cups to grams?
Just ask Google, Alexa or Siri, right from your phone or smart
speaker – no need to even type anything. The Internet is a very powerful tool for
and for research. You no longer have to buy a book (which is already out of date
online encyclopaedias and online journals on any topic.

More and more services are going online, which is very convenient to us. We can
without ever needing to go to a branch, apply for services, get help from compa
shopping! There's no need to stop off in a shop on your way home or spend hou
you can typically find the item for sale in seconds and order it quickly. But equal
such as eBay and Etsy to sell craftwork and find new homes for the things that h

We are also using the web for entertainment – very few of us buy DVDs or CDs a
films and music directly to our TVs and devices whenever we want them, and th
video recorder in order to watch a TV programme.

Organisations

Businesses have fully embraced the web and Internet to radically change their w
business. Businesses can rapidly share information and files and communicate w
businesses use the web to promote themselves through their websites, social m
marketing. Their online stores can accept orders 24/7/356 from customers all ov
accept donations.

Businesses have embraced online file storage, and new technologies have allow
business in new locations around the world, using flexible and remote working,
There is no need for expensive long distance calls or faxes, just an email or a ca

Practice questions – 1.7 Advantages of the World Wide Web

1. Explain how the web has transformed the way in which we access inform
2. Identify two ways that businesses have saved money by using the web ra
other services.

1.8 Disadvantages of the World Wide Web

For all of the advantages, there are also drawbacks!

Individuals

The cost of an Internet connection varies depending on where you live and whic
connection can cost each household £1 or more every day, especially when bun
Generally, our connections are very reliable, but we all know the frustration whe
important such as working or studying, or are on a call, and the signal drops out

But using the web doesn't cost just our wallets. There are effects on our mental

Mental health

- Too much use of social media – can be a big time waster. Looking at other people having fun can make us depressed, but remember – other people post only what they want others to see.
- Spending too long playing games online can make your school, college and work life suffer – playing for long hours is antisocial – you may lose friends, and also spend a lot of money buying the games and upgrades.
- Use of the web is a distraction from doing important tasks such as study or work.
- 'Cyberbullying', trolling and online stalking can cause a host of mental health issues ranging from anxiety and depression to self-harm.
- Greater risk of identity theft when using social media from people hacking very long time to resolve issues, such as a credit card or loan application ta very stressful.
- Lots of 'fake news' and misinformation – we read it unknowingly and may n to tell what news is real, especially articles posted on social media.
- Polarisation – viewpoints in comments and posts can often be extreme and

Physical health

The use of computers and other technology has reduced the time we spend outd
ensure that we take regular breaks away from our screens! There are studies tha
limit screen use due to the many hours we spend staring at a fixed distance, and
poor posture from sitting in inappropriate positions.

Organisations

Organisations must spend money to create and updat r websites, mainly th
time working on the site. Most of the updates will be minor, such as adding new
removing items that are no longer sold and updating anything that is out of date
company might want a major rework to modernise its site – as website design n
basic. The company has to purchase the domain names and pay for hosting

Companies may charge ongoing fees for the time spent crafting social media posts and
other forms of communication with customers – hopefully, that time will pay off
offset by increased sales.

Hackers can target a corporate site – for example, they can replace the site's co
about the company, or they can hijack the site to redirect customers elsewhere,
attack to take the site offline. This is rare, but it is an extra cost to the business
restore the site, and because of potential public relations damage. Malware atta
systems across the Internet.

Employees at the company can spend valuable time surfing the web or using so
and rogue staff could post offensive messages on the company's social media ac
platform also allows disgruntled customers to complain publicly– they expect t
complaint immediately because of the damage caused as other customers and t

Our online world now includes review websites – anyone can post a review of a
restaurant or hotel – one bad experience can now be read by thousands of peop
sales. There have even been reports of rival companies writing fake poor review
forms to create fake bookings at a rival restaurant during busy times.

Practice Questions – 1.8 Disadvantages of th[illegible]rld Wide Web

1. Identify a reason why access to [illegible] is not universal in the UK.
2. Identify and de[illegible] disadvantages for individuals of using the wel
3. Exp[illegible]o costs to a business of using the web.

② Styles, Classification and Managem
Global Information

In this chapter you will learn:

- The different styles and uses of information
- Classifications of information
- The importance of having quality information, and the consequences of poor-qu
- How information is collected, analysed, secured and tr[illegible]itted, and the costs o

2.1 Styles of inform[illegible]n and their uses

Text

Text means [illegible]n words or paragraphs; it is made up of letters. Any letter, nu character. W[illegible]e text anywhere that we want to convey written information – magazines; on web pages and social media platforms; in reports and journals; o including road signs... the list is endless!

You can open up a font from your font folder to see every character (sometimes view the font in Microsoft Word, for example. There are also entire fonts just de them 'dingbats' – your computer might have fonts such as Windings and Webdi

The collection of individual characters is called a character set. Over time, and throughout the world, different character sets have been used, with different methods of encoding them (the code that represents each character in the set).

For example:

- English and some European languages use varying Western character sets.
- Russia and the surrounding countries, and some Eastern and Southern European countries use Cyrillic character sets.
- Countries in the Middle East, North Africa and some others use Arabic character sets.

There are other character sets as well. Examples of Western, Cyrillic and Arabic characters are shown on the right.

Text can be expressed in different ways – u[illegible]ing d[illegible]ent typefaces or fonts app want to convey, and we can chang[illegible]z[illegible] of text (font size).

Graphic

Graphics ar[illegible]yp[illegible]or image; for example, a company logo; a photograph prin posted on a [illegible]r social media; an image used for advertising; or a diagram in illustrative purposes, to help explain text; to sell or demonstrate a product; to a educational tools (diagrams); or just to look pretty!

Video

Video is a series of images that are recorded and displayed very quickly (often b 'frames', per second). These images appear to move. This is how your TV display such as YouTube work.

Aside from entertainment (TV shows, movies and cat videos), videos are used fo
example, educational programmes; to demonstrate products and show you how
and for TV and web advertising.

Animated graphic
Similar to video, but generally very short and only a few frames. You will be fam
social media – often a second or two from a TV show. They can be used as chara
moving diagrams in education, such as a biological process, or a map that chang
has increased.

Audio
Media that we can hear; for example, a music track, a radio broadcast, a podcast
that accompanies TV, films and other video forma

Numerical
Any number – we see numbers in books, in statistical tables, within text, in spre
sheets, and anywhere that there is the time or date printed or displayed.

Braille text
Braille text is a series of raised dots that blind or partially sighted people use to
along the printed dots. It is possible to purchase books and reports printed on a
process called 'embossing', which presses into the paper. The books are very larg
text versions.

The use of Braille has significantly declined, especially among younger people, w
other text-to-speech technologies.

You will still see Braille text commonly printed on medicine boxes, and on some

Tactile images
Similar to Braille, tactile images are 3D representations of words, and are used b
people. For example, stars and galaxies can be rendered in 3D by building up la

Subtitles
Subtitles are used in TV and film. They are the words that are spoken on-screen,
of the screen. Often, the words are just printed in white text, but occasionally th
different characters or speakers, and sometimes sound effects are also included.
by a person or auto-generated by a computer (sometimes with hilarious results).
often a delay of a few seconds before the subtitles appear on-screen. They can b

There are several purposes:

- For deaf or the hard of hearing (in the same language as the broadcast)
- In noisy places or instances where sound would be inappropriate, such as a
- To translate the video into a different language; for example, turning on En
  are speaking in French. Sometimes in this case, the actors are 'dubbed', wh
  replace the voices of the actors.

Boolean
Information where there are only two possible options; for example, 'yes' or 'no'
ask 'Have you eaten popcorn in the last month?' You either have or you haven't.
The response can be only 'yes' or 'no'. Other variations could include 'true' or 'fal

Tables and spreadsheets
Tables are rows and columns of printed or displayed, tabulated data. They are us
amount of information, but they can be difficult to interpret.

They are used in company balance sheets, reports and accounting records, and t
experiments, included in journals and other scientific and technical websites. A
but many also display text.

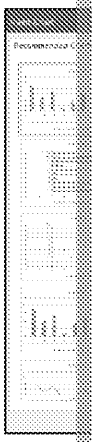
Tables can also be displayed in a ***spreadsheet***. Spreadsheets can be large stores
and columns (down), while each data point is called a 'cell'. Spreadsheets are so
Excel, or Pages on the Mac) that can be used to store and display data (including
mathematical formulae can be used to make calculations and analyse the data.

Spreadsheets are used by businesses to perform thousands of different function

The first ever spreadsheet software was called VisiCalc (visible-calculator) and w
computer, the Apple II, in 1979. It was so popular for generating sales projection
businesses purchased that computer just to use a spreadsheet! What-if analysis
seconds, rather than hours of hand calculations. Some of those first projections
based on the data that was fed into those early spreadsheets!

Charts and graphs

We have all collected and seen charts and graphs, which are visual representations of data. You've probably drawn them out on a sheet of graph paper or used a spreadsheet to show the results of a science experiment, or fieldwork data.



We use the terms 'graph' and 'chart' to mean the same thing – but there's a slight difference. A graph is technically the output of mathematical modelling, while a chart is just a way of displaying data.

There are lots of different types of chart, such as bar, pie and scatter – different types of chart will be appropriate for the type or format of data that we want to display.

Charts can be used to show trends in data that would be difficult to spot in a tab
data on the same chart or show two charts side by side to compare them.

Practice Questions – 2.1 Styles of information and their uses

1. Identify three styles of information that might be found on a website.
2. Explain two styles of information that might be found in a company repo
3. Explain one way that deaf person could still enjoy m.

2.2 Information classification

There are lots of different ways that we **classify** information. This depends on w what the information is about, who holds the information and whether the infor should be seen by other people or not.

Sensitive vs non sensitive

Sensitive information is any information that would damage a person, a busines information were viewed by someone who wasn't supposed to see it. This includ noted in the sections below, such as private, business, confidential and classifie

You might receive letters in the post such as bank st[illegible]nts and financial info the words '*Private and Confidential*' will be [illegible] the envelope because the and you wouldn't want anyone else t[illegible]. As an added security layer, you'll u printed on the inside of the envelope – that's to make it harder for someone to to the light.

For non-sensitive information, it doesn't matter who sees it – it's probably inten example, most company websites, news articles and press releases, and so on. E or company makes freely available for us to see. You can easily search for and fi address of your school is not sensitive, but your home address would be.

Private vs public

Private data is any data that is not shared with the public, i.e. you or me. For exa information within organisations and governments that wouldn't be shared. You details are private – think of anything that you wouldn't want to share on social

Public data can be classified in two ways – any data that is compiled by a gover available for us to view. There is an awful lot of data that you can freely access at ***https://data.gov.uk/*** to see what sort of things our government has released.

Personal vs business

Personal information is any information that can be used to personally identify y and date of birth. It is found on your passport, driving licence, bills and bank sta name and address printed on it (and including electronic communications).

There are many different entities that hold personal information, other than you employers, the government, banks, and the shops and online retailers that we've

This is sensitive information. Anyone else who gains access to it could use it aga information to make a false ID and use it for identity theft – using your details to services in your name.

Business information is generated through the everyday running of a business. It property and resources generated by the business, its accounting information, cl information gathered about its competitors, and so on. Some of that information competitors an edge if they saw it – and the business spent money compiling th salary, or by purchasing the information from other parties.

Confidential vs classified

Confidential information is any information that is not public and that is worthy
part actually means that when the information is passed on, the person giving th
the receiving person will keep that information private.

Classified information goes a step further and is largely held by governments and the military. Serious damage and even threats to national security could result if enemies, terrorists, other countries or even the pubic had access to the information, such as battle plans during a war or information about a suspect.

Anyone who needs to handle classified information must undergo strict personal and character checks to ensure that they are unlikely to leak that information. They will also be asked to sign the Official Secrets Act as a reminder not to divulge information. If they do release information and are caught, a criminal investigation will occur, and that person could spend time in

Many years, decades, after the information was first obtained, it no longer is then 'declassified' and may be placed in the public realm. This is how we know World War today than we did 50 years ago.

Partially and completely anonymised

Sometimes, information can be anonymised. This means that some or all inform removed or starred out.

If only some of that data is removed, then the anonymisation is only partial. If a anonymisation is complete.

If you completed a survey, and only your name was removed but not your addre your personal information was removed, then that would be complete.

When you perform a search on Google, the servers at Google log your IP address for. Your IP address could be used by law enforcement to track down your house data from your ISP. Your IP address can also tell which ISP you use and give an a period of time, Google removes the last few digits from the IP address – this is p now your ISP wouldn't be able to locate your house, but which ISP you use and t Google also anonymises other information such as the web browser you use, an complete anonymisation.

Here are some examples of partially and anonymised da

Original (not anonymised)	Partially anonymised	
Joe Bloggs	Joe *****	
101.203.1.xxx	101.203.1.xxx	
England	England	
10 Downing Street, London	Downing Street, London	
1st January 1970	** January 1970	

Impacts on stakeholders

Each **stakeholder** has a different use for the information. Anyone storing and usi
(processing) personal data must protect the data from being leaked, stolen or se
by others. There are large fines under the Data Protection Act for non-compliand
However, there are extra costs associated with protecting data, ranging from
installation and monitoring of firewalls and antivirus software, to shredding and
media, to training the staff. In terms of operations and workflow, the greater the
someone to do their job as efficiently – if material is not shared or is locked awa

Individuals and businesses are affected through the breaches of data – including
and identity.

Practice Questions – 2.2 Information classification

1. Explain why two different types of information are sensitive.
2. Describe how a company could make public information available for ac
3. Explain why holding information has an impact on shareholders.
4. Identify how data could be anonymised.

2.3 Information quality

In order to make the correct decisions based on information, the information mu
and unbiased – we must have a full, overall picture. It's difficult to satisfy all of
amounts of time checking things, but we should do the best we can. Remember,
in, garbage out'. If you put incorrect, out-of-date or incomplete information into
sales forecast isn't worth the paper that it's printed on.

Characteristics

For information to be of high quality, the following conditions must be met:

Validity – whether we can trust the information to be correct. We can perform ch
are typing telephone numbers into a database, we can set up a check that they a
and don't contain any letters. We can use other checks when entering the inform
use special checks such as an input mask or simply making sure that something
you'll see a star (*) next to any mandatory fields.

Bias – whether we have the full story – complete with information about all sid
account is deliberately biased depending on that person's viewpoint – they may
argument or may choose to omit information it. Likewise, if you're trying to sell me a
one's better because it has a faster processor', I might want to buy it. That is un
laptop has more RAM and doesn't have a solid-state drive – that's biased info
the worse bits.

Reliability – whether we are confident that the information is correct. This may b
from – if it came directly from a customer, a manufacturer's data sheet or a com
government source, we have more confidence in the accuracy than if the inform
webpage, or a data set where we don't know how and when the data was collec

Comparable –can we contrast and compare the data to another similar example?
a product and you click 'compare' on the website, the specifications should all li

Importance of quality information

Having quality information is important to stakeholders – that's anyone who has an interest in a business, which includes the staff, customers and **share**holders. Some of those people may have invested their own money in the business, if they have purchased shares. They needed quality information before they bought those shares to assess whether those shares were worth buying, and they need continued information such as company reports and finance information, otherwise they might sell those shares.

Those managing and making important decisions at the top of the business need to have large amounts of up-to-date and accurate information at their fingertips. Is the business is profitable and is meeting targets, which lines are selling well and which are not? to know the state of the market; which trends are taking off, and which are declining? Is it for a warehouse full of stock that nobody is buying, while a competitor launches a new product to the market with it.

Knowing this information allows the business to stay profitable, explore new sales opportunities and new growth strategies. If the business is less profitable, the managers need the information to find the problem and solve it quickly.

Consequences of poor-quality information

If the information used to make important decisions is inaccurate, biased or incomplete, then the decisions will be wrong. The business might bring out the wrong products or be unprofitable when it could be, or make a loss in one or more years. The company will, therefore, lose its reputation with its investors and shareholders. Large businesses that become less profitable make their staff redundant.

Practice Questions – 2.3 Information quality

1. Jade is entering data such as names, addresses and phone numbers into a form. Identify a way that the form could be set up to reject input that might be incorrect.
2. Explain two ways in which bias could be introduced into data.
3. Describe how a business could be impacted if key financial data were inaccurate.

2.4 Information management

In order to use the information for its intended purpose, the following steps must be carried out:

Collecting, storing and retrieving information

One of the fundamental ways of managing information is ***collecting*** information.

This can be achieved in many ways; for example:

- An online questionnaire, survey or sign-up form – this information can be recorded in a database automatically
- A paper-based questionnaire, or notes from a discussion, interviews or a focus group – the notes can be entered into a **database** system later
- Information downloaded from the Internet
- Printed material, including books, reports, letters, etc.
- Ideas and understanding provided by the staff within a business

Once the information has been obtained, it must be ***stored***. Electronic storage is accessed later. Small amounts of information could be stored within a spreadshe amounts of data are best stored in a database. The information can be entered a automatically.

Retrieving the information can be as easy as opening up a spreadsheet or docum and navigating to the correct tab or section of the document. In a database, the information can be selected using a **query**. This will output all of the data that m certain criteria; for example, the email addresses of each customer who has sign up to a service in the past month so they can be sent a newsletter, or a list of cu who have not paid their bills on time.

Of course, most businesses still collect and store information on paper. This met very inefficient – paper is bulky and must be located and retrieved manually. Ins quickly opening a file sitting at a desk, they must walk to the storage room, and through folders, files and pages to retrieve the information.

Manipulating and processing information

Once the data has been retrieved, it must be processed. This is a way of making understand or read. For example, the information could be reformatted or move information could also be ***processed*** – for example, displaying the information in

Analysing information

Analysing information is about working out what it means; for example, using th patterns – is there a 'correlation' or relationship between two variables? A super extra ice cream people buy depending if the temperature outside increases – th their past sales information to quickly increase the amount of ice cream in their and sunny weekend.

Securing information

We've already discussed the classification of data into sensitive, confidential, etc That data must be protected against hackers and other criminals.

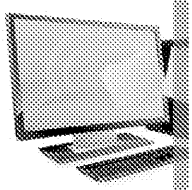
One way of protecting the data is to use **encryption**, particularly when sending a electronically across the Internet. Encryption is a way of modifying the contents so that it cannot be opened if it's obtained by a third party. We also encrypt files, and even entire drives when they are being stored – the data is said to be 'at rest'.

Secure databases are also necessary – sensitive information, including credit ca details and passwords, should always be encrypted, never saved in plain text. If not encrypted and the data is accessed by hackers, the company is liable to fines, and it will suffer damaged reputation as a breach of credit card inform would be in the news.

Additionally, there are different types of secure login to websites. If you sign up create a new password, the login is managed by that site. But sometimes, you ca Facebook or Google account. This means that you don't have to set up a separat the site doesn't need to store your password.

Other measures include using firewalls and anti-malware to protect the network limiting which usernames have access to networked file shares. Sensitive printe and sensitive data on electronic storage media should be shredded or wiped too

Transmitting information



We transmit information both electronically and on paper. The method used will vary based on the format of the information and the degree of sensitivity.

Examples include:

- Sending a document as an email attachment with an accompanying messag
- Downloading a document from cloud storage, directly from a website or us
- Sending a text message to remind a client of an upcoming dentist appointm
- Sending a patient's medical file to a new practice th[illegible]y have recently jo
- Sending a paper bill or bank statement to a [illegible]'s home address
- Email or paper communication to [illegible]om a school about an upcoming fi
- Sending classified mate[illegible]etw[illegible] different army bases using encrypted c

Impacts [illegible]ormation

Information is very powerful – for both people and businesses. But there are costs as

For example, the cost of keeping an IT system secure – ongoing maintenance a software and firewalls, and keeping up to date on current legislation. In 2018, th replaced with a stricter version. Every business in the UK had to ensure that the spending time to understand the new ones, to take stock of all of their existing new protection methods if required.

On an individual's level, information availability and storage are issues. For exam access to the Internet are at a disadvantage compared to those who do – in term opportunities. Those at home who create digital media are in charge of keeping regularly backing it up, securing and managing cloud storage accounts, and inst devices to reduce the threat of hackers gaining access. For example, users with devices are more at risk of ransomware attacks than those who keep their devic security flaws that can allow hackers access to a device still exist that would ha available patches or firmware updates.

Practice Questions – 2.4 Information management

1. Explain why a company would choose to store data in a database or spre on paper.
2. Identify one reason why data is [illegible]ed.
3. An investment [illegible]n needs to transmit data to a bank. Explain why t tra[illegible]d s[illegible]ely.
4. Identify two issues with storing login information.

③ Uses and Benefits of Global Inform

In this chapter you will learn:

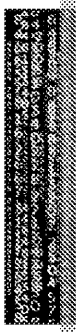
- ⓘ The difference between data and information
- ⓘ Types of data used by individuals and organisations
- ⓘ The stages of data analysis
- ⓘ How data is ana
- ⓘ How informatio

3.1 Data vs information

We often talk about data and information as if they were the same thing. They a linked, but not the same.

Data can be meaningless at first – it is described as 'raw facts' or 'bits of information' without significance. It can include numbers, text, phrases and characters, and has been collected in columns, strings or tables.

However, when we 'process' that data, we give it meaning through structure and **context** – the data becomes **information**. Information can include conclusions a ideas. Information can be used to make important decisions, which are based on processed data, but you can't make decisions just from raw data. A business mig need to know which lines are the top- and worst-performing – but the sales data must be processed to know that!



For example, data might appear to be random letters, numbers and characters. But if you label that data, provide headings, combine that data and infer meaning, you have meaningful information. You might collect data automatically using sensors or monitoring equipment.

Information could be written out in text. For example, you might have a list of numbers. Add to that list the names of each pupil in a class, and add a title to the data, e.g. Number of absences this term, and you're well on the way to having useful information. Let's then use that data to say, 'O three days this term', and that's valuable information. Another list of numbers co the class – on its own, the data is not particularly useful – but if I said that the a 1.2 metres and the range was 0.4 metres, that's useful information – and it has

You can also use data in a report. Imagine that you are in a Science lesson and y You might have recorded your results in a table – that's your data. You then nee plotting a chart, performing statistical analysis or using that data to test a hypot now you have information from that data.

We might use data to enable us to pick out a tren – to display a large amount format and pick out changes. For example, we could take thousands of temperat period and use that data to find a trend that the Earth is warming.

Data is essential for us to show supported conclusions and support our claims. I 'The sea level has risen 20 metres since yesterday' – but without data, such as a taken over the past few days, nobody should believe me, as data is needed to su

Practice Questions – 3.1 Data vs information

1. Identify the information from the following items: 2018, blue, my car is b manufactured in 2018, BMW.
2. Explain why you chose your previous answer.
3. Identify two ways that data can be turned into information.

3.2 Information categories (individuals)

As individuals, we take information from many different places, and also provide
many different benefits and limitations of that data.

Communication

We communicate with friends, family and businesses through a variety of methods, such as email, instant messaging and voice.

Emails are great for when you need to send a message to someone that is too long for an instant message or contains attachments, or when the other person is located in a different time zone. For example, you might send an email talking about your week, or the news, to an aunt or a cousin who lives abroad. The email reaches the recipient's inbox instantly, but an email could go
or the person might not read it or respond quickly.

Instant messaging can be an excellent way of talking to a friend to ask an impor
is in real time and can be easier than a phone call. But there may be no guarant
reply quickly – they might be at work or at school, or may not regularly look at t

We don't send as many letters as we used to – a letter is much more personal th
write it by hand (hopefully, someone else can read your writing!). Letters can be
businesses for important or legal matters. You can ensure that the letter arrives
signed-for service. However, letters can take several days to arrive, and postage
whereas emails are much cheaper (sometimes even free).

A telephone call can be very personal, and the meaning can be clear – the two in
and use information to make quick decisions – much quicker and easier than a ro
requires lengthy replies which could still be misunderstood. But those two people
same time, and the recipient might be busy at the time of the call or located in a d

Education and training

While you are studying at school, college or university, or for a professional qua
information in paper or electronic format. You're reading this information now!

For example, your institution will provide you with feedback on your work or ex
written comments. This could be instantly provided on a virtual learning enviro
this from any Internet-connected device. However, you might be given the feedb
wait until you get to school or to your college or university department in order
might have to wait for it to be delivered in the post.

Entertainment

We use lots of information when deciding what to watch on TV, which films are
watch or which games to play. Sometimes this might be as simple as reading the
through subscriptions to Netflix.

Alternatively, you might see a review in a magazine or newspaper, or someone might recommend something to you. You'll probably go to look up that film on the web using a review website. Or you might use a search engine to search for 'What are the best Christmas movies?' or 'What are the best action films?' Some sites can even recommend films and music based on their similarity to other films and music, or to what you've watched or listened to before and given high ratings for.

Using the web can be very quick and convenient, but remember that anyone can
opinions are very subjective and could be based on only a handful of reviews.

Planning

We can create a schedule using a diary or calendar – either on paper or using a
computer or a Google calendar on our phones. We can book in events and meeti
such as the time and place – and ensure that we don't double-book ourselves. T
electronic method – the software can tell us if there's a clash and give us remin
others can sometimes see whether we're available or not. We can add or remove
any time – no need for crossing things out on paper. But some people prefer to
all times.

We can also use other methods to plan meetings or events; for example, creat
messaging services.

Financial

We have access to a lot of financial information. For example, we may still choo
statements in the post or we may use online banking services. Using online serv
date information on how much money is available for us to spend. We can also c
accounts are as expected. We can use this information to check that we have en
account for a big transaction that we are planning to make, and transfer money
necessary, and this allows us to budget.

Using online banking is very convenient, but the security is tight – you may be r
information and codes that are sent to you in order to log in. Sometimes, it's eas
more people who exclusively use online banking, the more local branches of the

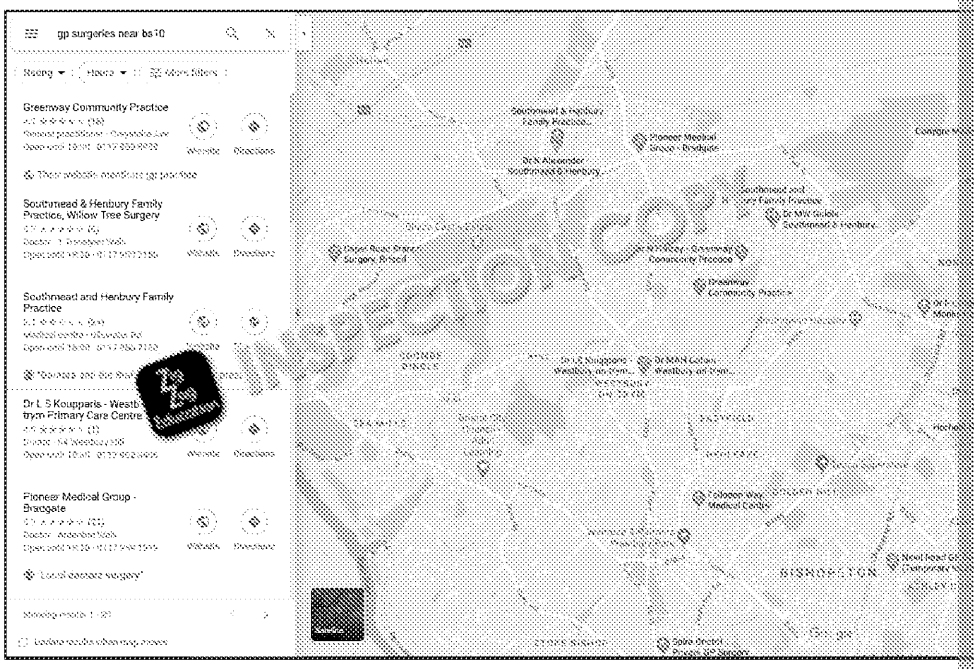
Some people buy stocks and shares – the value of which can change over time.
information on the current and past values of the shares, and supplementary inf
allowing you to make informed choices about whether you should buy, sell or h

Research

We use research all of the time – we may look up a recipe online or in a book, o
reviews and specification lists if we're buying a new product. And we might be s
that you're starting some DIY and you don't know how to hang wallpaper for you
which type of varnish to use on your floor, or you just want to learn how to croc
be found online – often in video format. It's much easier to watch a video of som
read about it in a book, which uses lots of technical knowledge, or 'jargon'. Just wa
lots of conflicting information as people discuss the best way of doing some

Location dependent

Typically, you'll want something that is local to you (unless you are planning a h
register with a doctor or dentist that's near where you live or work. You can use
local places that offer your services, which might be provided on a map, along w
information such as that given below.



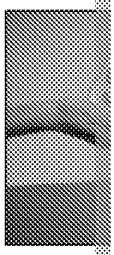
Or you might be ordering an item for click and collect and want to view the avai
closest stores to your house. One important consideration when searching onlin
it is relevant to your country – there's no point in learning about a law in a diffe
recipe that uses completely different measurements from those used in your cou

Practice Questions – 3.2 Information categories (Individuals)

1. Explain why voice communication can be more appropriate than email.
2. Describe how new learning methods, such as VLEs, have transformed le
3. Identify two ways that we can use technology for planning our lives.
4. Identify a disadvantage of using online finance platforms such as onlin
5. Explain an advantage of using location-dependent services.

3.3 Information categories (organisations)

Knowledge management and creation



Businesses generate, hold, manage and use vast amounts of information – both information that they have generated themselves and information that they have purchased from elsewhere. As businesses grow, so does the volume of information. They need that information to help navigate new markets, and they need to organise the information, and to make sure that valuable information is not lost. With kn ability to make successful forecasts and better business d ons – at the cost preventing intrusion.

Again, each category has benefits a if ons.

Manage ir formation systems (MIS)

A manageme formation system (MIS) is a complex computer system that tak provides analysis and information output, which is used by management teams t decisions. A lot of computing infrastructure is involved in such a complex systen The systems used to include large mainframes, but over time the technology has systems and is now moving into the cloud. A large company such as Amazon, wh each year, has a highly effective MIS to manage its fulfilment, distribution, retur marketing strategies around the world. Of course, much smaller systems do exis Therefore, an advantage is the greatly improved management on a sometimes g is the staff, infrastructure and processing cost involved.

Marketing, promotions and sales

You can have the best product in the world, but if nobody knows about it, then i bombarded with advertising every day – ads that play at the start of videos; ban media; emails from businesses; commercial breaks on TV; ads in newspapers an Those adverts are not cheap, however – some of the adverts cost millions of po prime-time TV ad breaks or advertising at sports venues costs a fortune.

Marketers use sales data and other data to target specific people or regions. For to sell well in a country and those sales targets aren't being met, the spending c increased or the price dropped slightly (a promotional offer). IT and print advert extent. A magazine has a target readership, and the ad e likely to be relat magazine and perhaps the gender of the read s, like TV ad breaks – expect products during a cookery show.

Using social media, adv can be highly specific based on the information example, a co even be targeted at specific age groups; for example, m

So, an advan e is being able to promote your brand to a highly specific demo there are many people who skip adverts at the earliest opportunity and disable t

Financial analysis and modelling

In order to stay profitable, businesses need constant access to their sales data so they can quickly pick up on issues and see which their top-performing products are. This data might be displayed as a series of graphs or reports – which could be automatically generated by a computer. This can be fed into decision-making, which we'll discuss in a minute. A manager or director could check this data daily, or sometimes weekly. Managers may also use data to generate reports showing the profitability of other products, or even show large-scale financial data for the business over several years. However, businesses need to be agile to remain competitive, and need to ensure that their information is up to da can't predict unforeseen events, such as a global pandemic.

Modelling is using that sales data to generate new information. For example, previous data could be used to project the number of future sales, or to change different va to see what happens – what-if analysis. While useful, these models migh be accurate, and they cannot forecast major events such as recessions and global pandemics.

Contact management

Over time, businesses build up a wide range of contacts – people and businesse provide a service. This ranges from people who supply the tea and coffee (very important!) and the stationery, the cleaners and the IT equipment suppliers, all t way up to investors, management consultants and financial advisers.

This information is essential to the effective everyday running of the business. Businesses tend to keep their contacts secret – they don't want a rival business know who their suppliers are or how much they pay for services.

In the old days, much of this was kept in a paper index, sometimes in a box or c was a very laborious system, and hard to update. Nowadays, many businesses st electronically, including in online address books so that it is accessible by all th information could be stored in an encrypted file, along with login details for onl people who have access to contact information, the greater the risk of someone they leave.

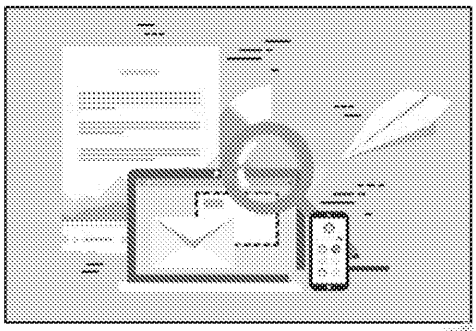
Another type of contact management is booking systems; for example, at a doct is kept of all patients, and appointments are booked onli over the phone, w appointment reminders sent. Nowadays, this is al co ri sed, but not so long would have been stored on paper – vast ro of ing cabinets filled with files

Decision-making

Managers a pany directors across all companies use information to inform company; fo ample, if a manager needs to plan where to build a new store, th information about the spending power of the people living nearby, the number o the closest branch of their own store in order to determine whether opening a n a manager might use data about staff in order to assess their performance – if t as a high productivity ranking or a high percentage of targets met, the manager employee and award pay rises or bonuses.

As you can imagine, this information has to be up to date and correct, and some from external sources – there is less control over the accuracy of that external d

Other examples of decision-making include a charity that needs to decide how m
disaster relief or where to send staff into the community, or a business that nee
the manufacturing processes and techniques based on the percentage of faulty p



Communication (internal and

The information sent between the staf
very different from the information wh
the company's employment (external);

Internal communication will include st
questions, bud s nd instructions fo
man ge ar eir staff; and company-
c pany directors. None of this inform
anyone outside the compar it is not shared with any external source (unle
through hacki or mployee; for example, an employee takes internal
them onlin te such as WikiLeaks).

External communications include letters, emails and personal communication w
social media accounts managed by the business; reports and other information
through the company's website.

Big data

As the name suggests, big data involves enormous data sets. Globally, we produce around 2 petabytes of data every minute. Big data includes, for example, all of the transactions made by customers across a chain of national supermarkets, or data about millions of social media users. This sort of data cannot be easily stored using conventional methods – it is much too large for a spreadsheet or a normal database.

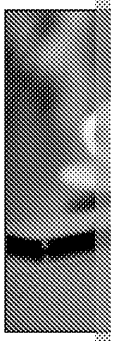
However, the data is still highly valuable. Small amounts of the data can be extr
a supermarket might need to pull out data (data mining) about how much of a c
the weeks before Christmas to ensure that it has enough stock this year, or to w
in particular stores – there's no point taking up valuable shelf space for a produ
reduced section or expires. But due to its large size, most big data will never be
be unstructured and difficult to analyse.

Practice Questions – 3.3 Information c es (organisations)

1. Describe what is meant gement information system (MIS).
2. Ide tv ages of using social media as a marketing tool.
3. Ex why modelling financial projections from data can be problem
4. Explain why big data is useful to large businesses.

3.4 Stages of data analysis

Data analysis is a process whereby data is turned into useful information. There are several steps needed for this process.



Identifying the information need

Before you can begin analysing the data, it is crucial that you know what you want to find out, and to check that the data that you need is available. If you're analysing the results of a questionnaire, it was important that you asked the right questions in order to generate the required data.

Defining the information scop

The scope is a set of constr as limit the data analysis. All data analysis tak the analysis t s, t staff salary must be paid in order to produce it. As s and the len ime to be spent are set early on. Of course, if the analysis is p constraints could be reduced and the scope increased.

Identifying the possible sources of information

The sources of information vary depending on what data is available and the typ For example, sales data could be provided by an MIS, or the data could be provi questionnaire carried out by the company.

Sourcing and selecting information

Once the data sources have been identified, the data must be selected. This cou MIS or from a spreadsheet, or by running a query within a database.

It is important that the best data for the task is selected and that we can be con are reliable. If you're looking at some data and there is a clear outlier – somethi might choose to ignore that outlier; otherwise, it could completely skew your re

Selecting the most appropriate data analysis tools

Charts and graphs

Charts and graphs are used to display the data visually. It's important to use the sort of data. Some charts can be used to display more than one type of data.

For example, we could use:

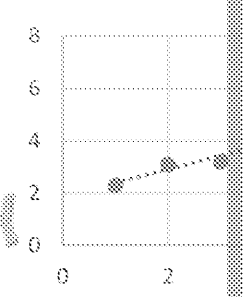
- Pie charts to show percentages or proportions
- Bar charts to show and compare different categories
- Histograms (like bar charts, but each bar touches the next) to show change over time
- Scatter plots to compare two variables
- Line charts to show a trend between two variables

Regression

Regression sounds scary, but it's simply a way of seeing whether one variable af and all of the points seem to form a line, the variables probably affect each othe regression (linear as you're drawing a straight line!).

You might expect there to be a relationship between outside temperatures and s
temperature, the more BBQs people have, so the more charcoal they buy. You w
x-axis and sales on the y-axis.

When you create a chart using a spreadsheet, the package will usually be able to
the points. The package will also be able to tell you how
good that line is; for example, by using an R^2 value.



Here's a very simple chart. A trend line and R^2 value are shown. The value is always between 1 and -1. The greater the relationship, the closer it is to 1 or -1. At 0.84, 84% of the data on the y-axis is related to the data on the x-axis. The number is positive, so the relationship is positive. Using regression, the x and y values can be swapped around.

Another type of regression is used to determine which variables have the greate
example, th ght be other variables in that example of BBQs and temperatu
wealth and a groups. For example, temperature and location could account fo
test a range of different variables – if one of the variables adds very little to the
ignore it.

Trend analysis

Correlation is similar to regression, but it is used to see whether there is a relati
(which might be random rather than changing proportionally to each other). Unli
doesn't prove that one variable has an effect on the other. Correlation just show
relationship.

When we draw a scatter plot, we can try to draw on a line ourselves – this migh
approximately half of the points on each side, or we might see that the line sho

Remember, when we use trend analysis, we are looking at how something chan
those results.

Processing and analysing data

The data can be processed using a simple spreadsheet; for example, by creating

Both spreadsheets and more complex statistical software can be used to genera
averages, and can be used for regression testing using many variables. We will a
such as a spreadsheet to store the collected and process d ta.

Recording and storing inf n

While charts and stati n be useful, it's very important that their meaning i
at school o e u produce charts and explain them.

In business, reports are produced which contain data tables and charts. These ar
data supports the information. Remember that a company director is a busy pers
graph with a short explanation so that they can make a decision quickly.

Sharing results

The results of the analysis could be sent to the company director, or they might shareholders. The report can be either printed or downloaded.

Sometimes, real-time information from a management system could be displaye displayed on a large TV screens throughout the building.

Practice Questions – 3.4 Stages of data analysis

1. Identify a scope of information collection.
2. Explain why data obtained from the Internet might be unreliable.
3. Identify a good type of chart to display the ethnicities of a group of peop
4. Describe what is meant by a data 'trend'.
5. Identify how data can be 'processed'.

3.5 Data analysis tools

Data tables

The simplest way of showing a lot of data is to include it as a simple table. This such as numbers with headings that look exactly like a spreadsheet (in fact, man a spreadsheet and into a word processor), but the formatting might be tidied up printed reports.

Tables can make it hard to visualise patterns and trends, but they are really usef be provided that would be difficult to obtain from reading them off a graph.

Data tables can be used to support information provided in a report. Large data back of a report in a separate section called an appendix. Not everyone will nee Data tables can also be viewed within a database.

Data visualisation

Data can be shown in the various types of chart described in the previous chapter. Each type of chart has a different purpose.

Here are some examples of charts:

- Sales numbers, production costs and the like from different products over time; for example, a line chart
- Weather data such as rainfall and temperature (e.g. a histogram) – useful to correlate, visualising sales of different products with temperature
- The number of sick days taken or the number of workplace accidents per m
- Profit and loss charts

Identifying trends and patterns

Lines of best fit can help show relationships, while regression can prove why th data across several months or years can be analysed; for example, a line graph c compare the different years.

Data cleaning

Information must be accurate and up to date to be useful. In the real world, thin people move house, get new phone numbers or email addresses, change jobs an Therefore, the underlying data used to make decisions could be incorrect. Also, t incorrect data if it is purchased or obtained from another company.

To 'correct' the data, or to remove old or incomplete data, we use a process calle methods by which the data can be cleaned:

- ✓ Removing very old or very incomplete records from the database – the data more, or it's not worth the time trying to update it
- ✓ Updating the record – for example, contacting th[illegible]sc[illegible] who provided the
- ✓ Removing duplicates – if two people manually entered the same data

Businesses will often check that their [illegible]s up to date. This can be done autom example, every six mon[illegible]ually a company might compile a list of custon letters that [illegible]ee returned to sender – the company can then choose to ren mailing list [illegible] orders in the last two years) or contact the customers using a updated contact details.

Geographic information systems (GIS) and location mapping

GIS

A geographic information system is a powerful mapping tool used for storage, analysis and display of map data. It is especially useful for showing layers of dat is used by thousands of businesses.

For example, you could add a base map such as a Google map or an Ordnance S map, or an aerial photo. On top, you add other layers, including data that you ha collected or data that has been provided by others. You can then see where the overlaps to draw out trends, anomalies and a wealth of useful information.

Going back to the example of the supermarket, one layer could be a plot of all o nearby shops, and another layer could show income. It would be useful to see th areas where there are higher income levels but few existing nearby shops.

If you're interested in GIS, have a look at Google Earth – it's essentially a form o different layers that are viewed on the base aerial photograph.

Location mapping

We can map in real time the position of goods an[illegible]rt using trackers.

For example:

- We can map the lo[illegible]shipping containers – very useful for busine[illegible]s s[illegible]here their goods are located, to estimate arrival times and to [illegible]ays in the network
- We can show the location of all aircraft at any time – there are several websites available that show the flight paths, and they often tell you the names and destinations of the aircraft
- We can track the current whereabouts of our parcels – each time the barcode is scanned, the time, date and location are recorded and uploaded onto the courier's website for the customer to track. Tracking gives the cust allowing them to be at home to receive the parcel if necessary.

Practice Questions – 3.5 Data analysis tools

1. A scientist is writing up a scientific paper. They want to display their dat scientist should use a table or a chart, or both.
2. Identify two advantages of data cleaning.
3. Describe an instance of where a company might want to use a GIS.

3.6 Information system struc

Open systems

An open information s is where all of the information can be accessed by t different de ents within a company, and also by external partners, such as marketing o isations (and also suppliers and customers). The system has acc to the Internet, and information flows in and out from many different sources.

- ✓ This is very useful – lots of new information can be added and it can be see lots of people, who can use the data and add their own ideas.
- ✓ There is no delay in accessing the data.
- × However, open systems can be used only for projects or situations with a lo level of commercial sensitivity – many people have access to the informati and because the system has access to the Internet the information could be stolen by hackers.
- × The data from external sources may be inaccurate as there is less control o sourced from.

Closed systems

The opposite is a closed information system. There is no external access to the s information sharing between the internal departments. This system is used whe commercially sensitive; for example, developing a new product ahead of the co

- ✓ Very secure – much less risk of the system being hacked and data stolen
- × Inflexible system with delays in data transfer

Practice Question – 3.6 Information system structure

1. Ide a t company which might use a closed system structure.

④ Legal and Regulatory Frameworks – Storage and Use

In this chapter you will learn:

- The different legislation and regulation operating in the UK to keep our data secu
- Global information protection
- The requirements and benefits of 'green' IT

4.1 UK legislation covering the storage and u

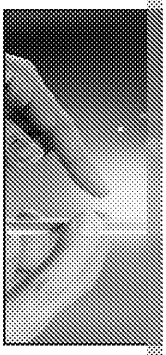
Personal data (the data about us) is very important and must be protected so tha theft. Businesses that hold our data are required by law to protect it. This chapte and regulation that applies to businesses and entities that hold data.

UK legislation and regulation

Legislation is laws that are passed by Parliament. Regulation ensures that busin essentially, a check that the legislation is being complied with.

Data Protection Act (2018)

One of the most recent changes for data holders was the Data Protection Act 20 Protection Act 1998.



In 2018, the UK was still part of the European Union (EU). The EU passed the General Data Protection Regulation (GDPR), and the Data Protection Act 2018 was set up in UK law in order to implement the requirements of GDPR.

The DPA 2018 built upon the protection of the older 1998 act. It gave people even greater control over how businesses could use or 'process' their personal data. The biggest change was the inclusion of 'the right to erasure' or 'the right to be forgotten'. This is when you c incorrect information about you if it is negatively affecting you. For example, if a articles that suggested that you were guilty of a crime, but you were later found saw those articles and it stopped you from getting a job, you could have those a search results.

Many businesses spent a long time, and consulted legal teams, over how t made compliance more expensive in addition to the new measures, processes a implemented. Many businesses sent out emails to all of their customers asking p because of the new rules over consent to store data.

The principles of the DPA and GDPR include:

- Processing of data should be lawful, and the data should be used only for t was collected.
- The least data possible should be collected – if it's not directly relevant, th
- The data stored should be as accurate and as up to date as possible – there checking this rather than the customer updating their information.

- Data should be kept for the least time possible – customers can ask to have that the company stops processing it in some cases.
- Customers can ask a company for a copy of all the data that the company h they can transfer their data to a rival company.
- Companies must keep data secure. Failure to do so, and withholding inform the ICO (Information Commissioner's Office), can result in major fines. All la a data protection officer.
- Companies can't transfer data to other countries which have less data prote agreement with the EU to transfer the data. This is why you cannot access s

Regulation of Investigatory Powers Act (RIPA) 2000

RIPA is legislation that allows public authorities (government departments) to monitor and intercept communications made by the general public in order to use in criminal and terrorism investigations. The legislation covers the additional methods of surveillance – such as intercepting and wiretapping phones, using informants and investigators, and bugging rooms and cars.

However, it's no coincidence that the legislation was enacted when Internet use started to increase. The legislation requires that ISPs and phone providers hand over call records and details of websites visited, forcing c keys. The legislation also allows collection of large volumes of data when it is b

The **Investigatory Powers Act 2016** amended the existing RIPA legislation. While allowing law enforcement to operate, it has received a severe backlash online fr surveillance aspect has led to it being branded as the 'Snoopers' Charter'. For thi started to use virtual private networks (VPNs) and apps such as WhatsApp (stron means that the business that created the app (Facebook) cannot read the messa

From a data holder point of view, ISPs must retain records of the sites visited by with requests to hand over personal information.

Protection of Freedoms Act 2012

This legislation affects data holders in several ways, including:

- The storage and destruction of biometric data (e.g. fingerprints and DNA) – removal of DNA from a central police database following no conviction for
- Changes to the surveillance of CCTV and automatic number plate recognitio
- Changes to acts such as RIPA and the Freedom of Information Act

Privacy and Electronic Communications Regulations 2003 (amended 201

This is a law which prohibits companies from sending direct marketing without contact details to a database without consent issues. The use of cookies, priva also covered by this act, hand in hand with the Data Protection Act and GDPR

Freedom of Information Act 2000

This law concerns data held by public authorities, such as government departme encouraged to publish certain information, and it allows the public to request sp (but not personal data). Sometimes, you'll read a newspaper article and it will sa provided following a Freedom of Information request.

Requests for sensitive information may be declined.

Computer Misuse Act 1990

This law relates to computer **hacking** and was passed just as people started usin Internet. The act makes it illegal to access a computer system without permissio access with the intention of causing other offences, and to modify files without permission. Varying fines and lengths of time in prison were set for each type of offence. However, many hacking attempts originate overseas (outside the UK's p or 'jurisdiction'), and many hackers get away with their crimes as they are rarely

More recently, the act of 1990 was updated by the Police and Justice Act 2006, v changed some of the wording, and the Serious Crime Act 2015, which made it a along with other new scope and tougher penalties.

Information Commissioner's Office (ICO) codes of practice

The DPA has a set of strict rules; how[illegible]way that businesses comply with the rules are followed by com[illegible]nce in spirit; i.e. by adhering to guidelines set

All organisa[illegible]th[illegible]personal data must register with the ICO, which is al and handlin[illegible]nes.

Copyright, Designs and Patents Act 1988

This law protects works from being copied, published or performed by others. Copyright covers books and printed publications, music, film and television, and other artistic works. All material is automatically covered and generally cannot be copied unto 70 years after the author's death (although there are limitations and different time periods).

If a company wishes to publish an extract of copyrighted material, it generally needs to ask permission from the owner, the 'rights holder'. The owner might give permission or ask for a fee. Sometimes, a small amount of the work can be 'fair dealing' or 'fair use' – but this can be used only for criticism or review. You discuss its strengths and weaknesses, or use an extract in a review – but that's a

For education and private study, you can usually photocopy 5% of a book.

Computer programs and the content of websites are also covered; computer pro Copyright (Computer Programs) Regulations 1992.

Equality Act (EQA) 2010

This Act was aimed to stop discrimination, victimisation and harassment, and to anti-discrimination laws. The Act means that you, as an employee or an individu discriminated against for things such as your age, sex or [illegible]al orientation. This discrimination – how you are treated – and indir[illegible]ination, e.g. a policy establishment.

For example, an employer [illegible]ot hire you when you apply for a job based on the sexual orient[illegible]n, if you have a disability but you are perfectly capable of doing likely to ne[illegible]ernity leave in the next few years.

Failure to comply with the Equality Act could lead to court proceedings and fine

Complying with UK legislation

All information holders (including businesses) must comply with the laws and sp
various changes. Companies who are abroad must also be aware of the laws in t
dealing with. As companies become more global, they will face greater challeng
the world.

The fines for businesses that do not comply with the laws can be very severe. Fo
available under GDPR is €20 million or 4% of annual global turnover – whichev
UK, you can see a list of fines given out by the ICO here: ***zzed.uk/11146-ICO***

Practice Questions – 4.1 UK legislation overning the storage and u

1. Identify the Act that makes it an offence to hack into a system and modi
2. Identify the Act that gives people more control over how companies hol
per ata.
3. Identify the Act that allows the public to request certain data from publi
4. Identify the Act that helps protect creative works.
5. Identify the Act that requires internet service providers to keep a log of t

4.2 Global protection legislation and regulat

Data protection laws are not the same throughout the world. Some countries have similar laws – such as the European Union countries through GDPR. The laws in some countries are less strict than in others.

Regulation and data protection outside the UK

The UK is covered under GDPR, which, following the Brexit transition period, was entered into UK law, and remains alongside the Data Protection Act 2018.

The USA, for example, has many different data protection laws that cover differe
states differently. China has a series of data protection laws, including the PRC C

Remember that under GDPR, personal data cannot be transferred to any country
are weaker – therefore, protection agreements must be put in place to allow da

Comparing different data protections outside the UK

If you visit *zzed.uk/[illegible]map*, you'll see a map of the robustness of data securi
Europe, No[illegible]erica, China and Australia have strong data protection laws (al
by GDPR) – but notice that there is very little data for Africa – the IT infrastructu
is limited.

Notice that India has only very limited data protection laws at present. It is perh
volume of scam telephone calls that originate in the country. However, many UK
their call centres to India, so those companies must uphold stricter rules than ar

UN Convention on the Rights of Persons with Disabilities (UN

In 2006, the United Nations (UN) set out to challenge the perception that disabl
instead, they are just like anybody else – 'subjects', who just happen to live with
disabilities should have equal rights to non-disabled people, and they should be
the same access to information in order to make decisions.

Information as a human right

Under the UNCRPD, the guidance states that disabled people should have equal
communication technology and the Internet (including electronic means), and th
implement accessibility measures as everyone should be able to express themse

Practice Questions – 4.2 Global protection, legislation and regulati

1. Sometimes, you visit a website that simply explains that the content is u
based on your location. Explain why this message is displayed.
2. Explain why access to online information/services is a human right.

4.3 Green IT

As our population grows and countries develop, the impact that we have on the environment increases. We are consuming more resources and energy than ever before, meaning that we are causing significant and perhaps irreparable damage to Earth's life support systems and our climate.

IT includes all of the computers and devices in the homes and offices all over the world – but there are also hidden uses of energy – all of the cloud servers, the Internet and communications networks that operate 24/7/365, and the transport used by the communications companies. About half
generated by the equipment in our homes and offices. The other half is used by
distribution networks.

But we must also consider other environmental factors across the entire **product**

- The metals and raw materials mined – water pollution and habitat destruct
use rare materials from all over the world
- The plastics required and their disposal
- Water used in the manufacture process
- Transport of materials, products and waste products
- The paper, ink and other consumables used by the equipment
- Disposal of the product, including recycling

Global requirements for organisations and individuals

Across the world, governments have created laws or regulations on the environm
reason why your computer is set to turn off the screen after 10 minutes of inacti
leave the screen on with the computer unplugged.

There are many different policies that have phased out the use of heavy metals
carcinogenic flame retardants and chemicals, and that ensure electronics are ea
rules that ensure that manufacturers take back waste equipment (WEEE) for recy

throw electronics in the general waste bin. Hundreds of fires break out in recycl lithium ion batteries. People put them in their recycling bins from laptops and s fire when the waste is shredded or crushed.

United Nations Climate Change Conferences

Each year, governments around the world meet to discuss climate change – one humanity – and these meetings are organised by the UN. Huge achievements ha ratification of the Paris Accord by many of the world's governments. The aim is t limit warming to 1.5°C from pre-industrial times. It is thought that further increa the planet's health and could produce irreversible damage. The Intergovernmen (IPCC), set up by the UN and the World Meteorological Organization, creates rep understanding and possible impacts of climate change. The manufacturers in co have signed up to agreements such as the Paris Accord have a duty to improve t to lower their CO_2 emissions – and IT is no exception.

UK government policy

The UK government aims to use IT to help meet its climate change targets – wh carbon in less than three decades' time. An update was published in September government: ICT and digital services strategy 2020-2025'.

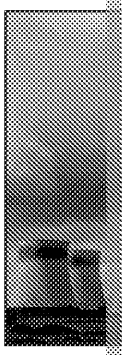
Some key highlights include:

- Consolidate data storage onto fewer data centres or the cloud to reduce the running, and remove duplicated files
- Remove older hardware, including legacy systems (old systems that still pro
- Improve monitoring and evaluation of the product life cycle and the supply
- Reuse IT equipment rather than disposing of it
- Choose suppliers of equipment that are more sustainable

Reducing 'carbon footprints'

The **carbon footprint** is the amount of the gas carbon dioxide (CO_2) that a perso business or sector (such as ICT) produces. The problem with CO_2 is that it's a greenhouse gas. The more we add to the atmosphere, the more severe the level climate change (global warming) will be.

We generate CO_2 when we burn fossil fuels such as coal, gas and oil. Many countries still generate their electricity from coal and gas – and all ICT equipment requires electricity. Even in the UK, we've largely phased out the worst pollutant, coal – but gas is still our largest source of electricity.



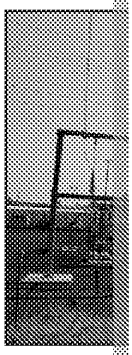
In 2018, 6 generated

ICT produc and 1.4% of the global CO_2 emissions. The company Ericsson pu ed a paper in 2018 that looked at the carbon footprint of IT equipment between 2010 and 2015. Despite an exponential growth in data transmission over that period, it concluded that very little extra CO_2 was generated.

We can reduce the carbon footprint by ensuring that new equipment is energy-e more powerful (processing) but use less energy than before – computers run a l

We have also seen major shifts in the IT industry towards lower-powered device

- Switch away from high power consumption desktops to laptops
- Switch from CRT monitors to LCD displays – LCDs initially used fluorescent now they use very cool and efficient LED backlighting
- Switch to tablets and smartphones
- Improve energy efficiency and software control
- Increase virtualisation and online applications – processing power is server-based, and thin client computers can be used



Data centre must run 2

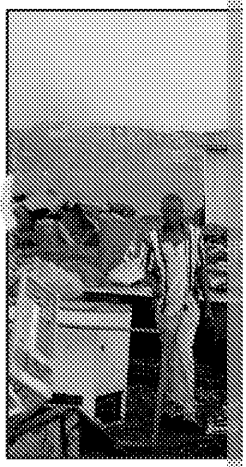
However... in recent years we have seen an even greater growth in the use of cloud storage, online applications and streaming TV services – so we are in danger of offsetting these positives on the consumer equipment side.

You may have heard that a few years ago Facebook opened a data centre in Lulea, northern Sweden, and more recently Microsoft experimented with a data centre capsule – putting a data centre in a cold place makes a lot of sense because conditioning to keep them cool.

Sustainability

The underlying principle of sustainability is meeting the needs of the present wi future generations to meet their needs. We can translate this into IT through:

- ✓ Reducing the amount of materials required to make new products – some o smartphones are mined only in a few specific locations, and the resources a
- ✓ Ensuring that products can be repaired and upgraded, rather than needing t again, reducing the amount of resources used
- ✓ Ensuring that hardware remains supported for many years, and that new so stop a fast upgrade cycle (built-in obsolescence)
- ✓ Ensuring that products are energy-efficient to reduce the impact on climate
- ✓ Promoting donation of working and usable IT equipment to charities for redistribution in the developing world
- ✓ Using less paper and ink (through enabling double-sided (duplex) printing) and using a lighter layer of ink/toner on the paper (and using recycled pape
- ✓ Ensuring that the products are easily recyclable – to reduce the space taken in landfill
- ✓ Recycling products effectively in the USA and Europe rather than exporting the waste to the developing world, where disposal can harm the environment and people's health, e.g. burning electrical cable to reveal the copper, or dumping waste in landfill



'Recycling' waste elect smoke from burning ca local people.

Benefits of green IT

There are many benefits to green IT, which include:

- ✓ Cheaper to run – lower energy costs
- ✓ Cheaper to recycle
- ✓ Ability to work from home – less time spent commuting
- ✓ Enhanced brand image and reputation – most companies have a sustainabi they show off their green credentials and environmental management syste
- ✓ Stakeholders and customers expect it – this is called a 'triple bottom line' o – go green or lose sales! Greenpeace used to rank the major electronics co they were.

Practice Questions – 4 ... re ...

1. Id... n ...ment of 'green IT' that can be implemented at the design
2. Exp... how the UK government plans to reduce its 'carbon footprint'.
3. Identify two problems with using large amounts of energy to run IT har
4. If you were purchasing a new printer, identify two requirements you co its sustainability.
5. Explain why purchasing new equipment might be cheaper than continu equipment.

⑤ Information Flows

In this chapter you will learn:

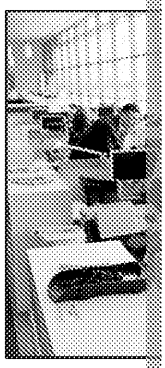
- How the different types of data and their sources vary
- How to interpret and draw data flow diagrams

5.1 Information sources and data types

Businesses generate their own internal information or they obtain it from outside different data types based on where and how the data was collected, and whether

Internal and external sources

Internal sources of information are generated within the business. For example, employees may use the company's sales data in order to produce a financial report or to recommend which products should be marketed or withdrawn from sale. The data used to compile that report would be based on information produced by the company; for example, extracted from a sales database.



Internal workers business

This type of data and information is likely to be highly accurate because the company controls how that data is collected and used. There are no using an external third party.

Another type of internal source of information is a company's analysis of its com employee could use the rival company's website to find out what the company s company is run. Staff could also pull together reports, news articles and press re the company. Certain types of company must publish annual financial accounts register of companies.

While the data might be from external sources, the assembly and analysis of tha were carried out internally.

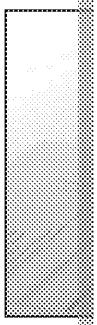
External sources come from outside the company. For example, a company might request a price list or a catalogue from a stationery company. The company will then look at that information and make a decision as to whether the products and prices are right for them.

Another external source would be a financial report produced by a third-party consultancy. This report might use information provided by the company, but the third party are the ones that produce the report. The third party might produce the report to the same standard as if it were produced in-house, or may not fully understand the business operations. Therefore, the company might have to go back to the third party and ask for corrections to be made.

Another external source would be data downloaded from the Internet or purcha has no way of knowing how accurate this data is, how it was produced or perhap

Primary vs secondary data

In your Geography lessons, you might have stood outside a shopping centre to ask shoppers where they travelled from, or sat at the side of a road counting cars. This is ***primary*** data because YOU collected it, for a specific purpose.



A surve collecti specific

In the same way, a business can collect primary data. This data might be captured automatically each time a sale is generated, through an online survey sent out to customers or information produced by an employee. The business knows exactly how that data was collected, understands the strengths and weaknesses of the data co[illegible]on, and can ask very specific questions (or run specific qu[illegible] f[illegible] a database) to extract the data that perfectly fits [illegible]k.

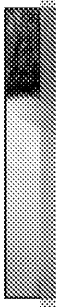
In contrast, ***secondary*** dat[illegible] [illegible]uced by someone else for a different purpos[illegible] purchase se[illegible]ry [illegible] complement their own data – to see whether their f[illegible] data or con[illegible]s, or to provide another data set to compare to, perhaps for a [illegible]

Secondary data can be useful and is much cheaper and more readily available th[illegible] business didn't produce it, there is less certainty over its reliability, and it may b[illegible]

Qualitative vs quantitative data

The final two data types relate to whether the data is described or measured.

Qualitative data usually describes something. I could ask you, 'What is your eye [illegible] saying 'dark brown', 'blue' or 'a delicate shade of hazel'. If you ask a customer fo[illegible] me why you rated our product 4 out of 10.' In that example, you want them to e[illegible] product so that you can improve it.



A jo qua but

Qualitative data can be very informative and useful – we want to know what people think and their reasons, and use this information to prove our theories – but it can be difficult to analyse. If you had a question about eye colour, you would probably have only a few categories in the end – brown and blue, and maybe also grey and hazel. But let's say you asked a thousand people about how to improve a product, you could get dozens of different answers. It would take much longer to read through each answer and extract the useful information.

Qualitative data can be very useful for job application form[illegible] including a couple of questions asking the candidate to descri[illegible] [illegible]selves or to explain why they are interested in the jo[illegible] [illegible]easier and more personal than having just tick boxes.

Quantitative d[illegible] is [illegible]ement. For example, you could go to a beach, pick [illegible] pebbles an[illegible]ure the weight or length of those pebbles. Or you could make [illegible] all of your fr[illegible]ds' birthdays. Or you could write a survey question that reads 'On [illegible] scale of 1–5, how likely are you to recommend this restaurant to a friend?' or 'H[illegible] have you travelled today?'

There are far fewer possible answers, and they can be analysed much more easil[illegible] qualitative data. You can make a list in a spreadsheet, order the responses by siz[illegible] date, and calculate the average and range. When producing a questionnaire or s[illegible] many qualitative questions are called '**open**' questions, while many quantitative questions are '**closed**' – there may be only two possible answers.

We can use quantitative data and qualitative data together. For example, you co
would be to recommend a restaurant to a friend on a scale of 1–5, but then you
that answer – which is qualitative.

Practice Questions – 5.1 Information sources and data types

1. Identify two examples of internal data.
2. Identify two examples of external data.
3. Explain two advantages of using secondary data.
4. Explain why qualitative data can be very useful but a challenge to inter

5.2 Data flow diagrams (DFDs)

We can visualise how data flows around a system using a data flow diagram.

Level 0 diagrams are a very simple way of representing how a system works.

Level 1 diagrams are much more complex and show specific flows, entities and
symbols and rules used when drawing level 1 DFDs.

External entities, processes, and stores and flows of data

Level 1 diagrams use the following categories, each with its own symbol:

Category	Description
External entity	An object that enters the system from outside. For example, t be a weather station on the roof of a building that provides temperature readings and wind speed, or simply an online ord system used by a takeaway to generate the customer orders.
Process	An important function of a system, where the data is changed modified – and displayed/outputted. For example, that weath station might produce a graph of temperature change over th that takeaway order system might show the order on a displa it to a receipt printer.
Store	The store is information or data generated by the external or a process – such as a record of weather data or a database orders and customer details are stored.
Flow	The movement of data between each of the external entities, and processes – for example, the flow of orders into the syste the flow of data to the screen or printer.

Connectivity rules, direction, labelling, flows and outputs fro

The following 'rules' must be obeyed when drawing a DFD. For example:

- In order to connect to the system and transmit data, external entities must
  input or an output.
- Each data flow can go in only one direction. If there is an input and an outp
  example, the data is different for each flow and travels in a different direct
  represented separately.
- Data must flow to each process (otherwise there is nothing to process).
- Data must flow out from a process – the result of processing.

Impacts affecting the flow of data

Data might not flow through a system as quickly as expected. For example, a se
might be offline, or a customer facing website might be down. This could either
system or cause larger parts of the system to fail.

Data might also be manually inputted incorrectly – staff might make a mistake
the wrong option on a drop-down list or click on the wrong checkbox. This coul
data to be processed correctly. Somebody might accidentally cancel the order, o
or click on the wrong item, quantity or payment when processing an order over
could make a mistake typing in their credit card number, causing the payment to

Practice Questions – 5.2 Data flow diagrams (DFDs)

1. Explain the difference between a level 0 and a level 1 DFD.
2. Identify an external entity within a DFD.
3. Identify what an arrow represents on a DFD.
4. Identify why separate arrows may go to and from a process on a DFD.
5. Identify a relationship between a store and a process within a DFD.

⑥ *Principles of Information Security*

In this chapter you will learn:

- ⓘ The principles of information security, including confidentiality, data integrity an
- ⓘ That there are risks associated with holding data
- ⓘ The impacts of data losses or breaches
- ⓘ Ways of physically preventing data damage
- ⓘ Ways of 'logically' protecting data using software and encryption
- ⓘ How data is encrypted
- ⓘ The importance of strong passwords

6.1 General principles of information security

Information be kept secure, up to date and readily available to those who n right things but they are strict requirements of the Data Protection Act, as

Confidentiality

We've already covered what is meant by confidential information. Confidential information still needs to be viewed and processed by people, and shared with the relevant departments and organisations.

The information can be protected in two ways:

- Through the actions of staff – a doctor isn't allowed to tell a friend about their patients, payroll staff shouldn't gossip and reveal anyone's pay, and staff in the HR department shouldn't leave CVs or personal information lying on the printer for a long time before they collect it.
- Through company controls – such as limiting shared network stores to only the relevant department, providing some staff with an individual printer (where shared, staff may need to go to the printer and release the print job with a smart card) and providing lockable filing cabinets. Some businesses have a 'clear desk policy', whereby all paperwork must be securely stored when staff are on lunch and overnight.

Integrity

In order for us to make the right decisions and take the right actions, data needs incorrect data is discovered, it should be corrected or flagged so that the person process can do their job of updating. There's no point sending out a letter whe sending an email only for or using old sales data to decide on a ma

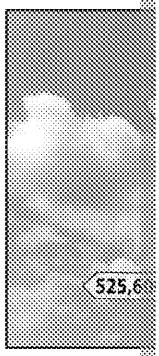
Businesses ely to have checks in place. For example, they could ask custo addresses, a l with post that has been returned. An HR department might of each employee's contact details for them to check, or request that they check company intranet. Some checks might take place every year or six months.

We can also use simple checks when inputting data to make sure it makes sense data and enter a baptism date that's before the date of birth, or a marriage date the system might flag a warning message to ask if you are sure – you can either or else check that you've not made a mistake, such as read from the wrong line

such as typing 2002 instead of 2003, or entered digits in the wrong order, e.g. 1
might not be wrong, though – some people do get married very late in life, but

We can say that accurate and updated data is 'fit for purpose' – because the dat
our needs.

Availability



Everyone who needs information must be able to access it when needed. For example, websites and online services are typically available 24/7/365.

Employees need access to the information in order to do their jobs. If the access is delayed, then important deadlines and targets may be missed. The employee might be inefficient if they are duplicating work or relying on outdated copies provided by an unauthorised person.

Let's imagine you are writing a company report that must be handed to you have an important meeting with an investor at 2pm. If that report requires acces which are unavailable to you, you might not be able to get that report written in data from two weeks ago – which might be different from last week's!

Practice Questions – 6.1 General principles of information securit

1. Explain why confidential data must be processed only by authorised per
2. Identify a way that a business could ensure that its data is up to date.
3. Explain a disadvantage of a business losing access to an important syste of information.

6.2 Risks

Every person or company that holds information risks that information being see see it, and risks losing the data or having someone else change it. Breaches of d the Data Protection Act.

Unauthorised data access

This can be as simple as a business having a poor inform policy in place that fails to recognise all of the stores of information so that staff inadvertently disclose sensitive information without meaning to, or having a policy that doesn't provide enough protection. Confidential information might be stored on a network drive that everyone has access to, or staff are not told what they should shred – meaning that anyone can look into the paper recycling bin and find copies of employee performance reports or financial information.

If the company has poor network security – for example, no firewall – then hack are more likely to gain access to the system. This could be lone individuals look for information or credit card details that they can sell on the black market, or ri companies looking for commercially sensitive information to gain information a their competitors. Some rogue governments also attempt to breach the internal networks used by governments and militaries – this is **espionage**.

Of course, employees can also test their internal systems to find out how much a discover that they have more access to information than they expected, snoop in alone in the office or steal somebody else's printouts.

Accidental data loss

People sometimes make mistakes and data is lost; for example, they might delet newer version with an older one, cut text from a document without pasting it ag information by mistake. They might also throw away the only copy of informatio written form or note – or leave a USB drive containing the only copy on a train. lost, not just a copy of it. Hopefully, the losses will be only minor (affecting sing lines to be retyped), or there will be a recent backup or shadow copy, or other te help prevent data loss – such as a digital recycle bin. Large-scale data losses m government department accidentally deletes thousands of important records.

Sometimes the data loss is because of a hardware failure – a drive or even a Businesses should never keep only a single copy of a file. There somewhere, including on a cloud server. If there isn't, this is a human overs

Intentional destruction of data

An example of a ransomware message

A common form of data loss is due t targeted malicious attack such as a v outbreak or a **ransomware** attack. Th files might be deleted, while encrypt means that the files are unrecoverab without paying a fee. If the fee is unaffordable and there is no backup particularly nasty virus could secretl up for several months – the company late and most of their recent backup sets have been affected. That's one reason backup system to make sure it's working. Also, a disgruntled employee could de staff might be escorted from the building the moment that they hand in their no month's notice period in order to cause damage to the system or steal data.

Intentional tampering with data

Tampering means changing some of the data but not deleting the file itself. Tam deleting – someone will quickly notice if a file is missing, but may not if a few c changed. An employee could tamper with a file in order to cause harm to the bus incorrect decisions as a result, or a hacker or a rogue government could modify t fraudulent activity. We saw how this breaches the Computer Misuse Act – modif

If you've ever seen the film *WarGames*, you'll have seen a high-school hacker log change his and a friend's grades. This should be a lot harder to do today as scho passwords are written down and placed on the desks, and password policies a

Practice Questions – 6.2 Risks

1. Identify two risks that could result from espionage.
2. Describe how data could be lost accidentally.
3. Explain why a hacker might want to delete or encrypt data.
4. Identify a consequence of data being tampered with.

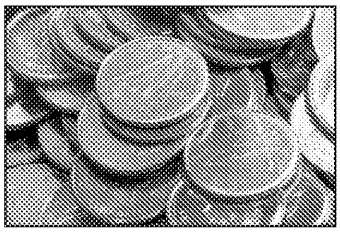
6.3 Impacts

Each loss or data modification has an impact – the amount of data lost and the s a direct effect on the impact. The impact can range from a small inconvenience, couple of files, up to large fines and damage to customer confidence.

Types of data and service loss and failure

The data owned by businesses is called **intellectual property** – IP for short (not t confused with the IP address of your computer). IP includes all of the proprietar information, designs, patents and copyrighted material that a company holds.

Some of that data might not be worth much or give away too much information. not be too big a deal – it might provide a good learning opportunity for the com defences being increased. Remember that businesses also store and handle third companies such as Google and Microsoft may host your files and documents in t belongs to you. You'd be very annoyed if those companies had accidentally given files. Now imagine how annoyed you'd be if you owned a business and your com been leaked. On a smaller scale, companies share documents with each other; fo are sent to the other teams working on a building, such as the engineers to plan systems, and eventually the contractor who needs to actually build it.

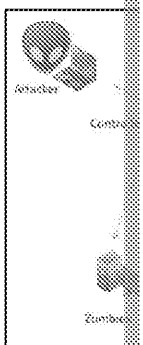


The effects of the loss of large volumes of data ca the product hasn't been released yet and is seen b used and accessed on a daily basis. Remember tha pounds are at stake – a large product such as a ne system or an AAA video game could have hundred – that's a lot of salary paid out!

Remember that the ICO can fine companies thousands of pounds following a data 4% of the previous year's global turnover can be requested as a fine. Such fines ar personal and confidential information are released, including names, addresses an

Sometimes, hacking or an attack on the business can cause a service to be lost o disrupted. Examples could include:

- Hacking into accounts and resetting passwords – ranging from wireless access points to servers, client computers and cloud services. Using a **brute force** password cracking attempt could cause users to be routinely locked out of their accounts. Both cause downtime for users, wasting company tim and money.
- Using a distributed **denial of service attack** (DDoS) – whereby a system is taken offline by using a large number of computers controlled by a hacker to send dummy data requests to a server. The server will be slow to respond or will be completely taken offline – causing the business to lose money while the platform is down.
- Hacking into cloud services or online platforms could get the account temporarily suspended if there were too many logins, or logins from an unspecified IP or region.
- Logging in to services and Wi-Fi would slow down the network or service, or take advantage of the service for free. This could cost the business, and the business's IT network could be used for illegal purposes. A company email server could be hijacked to send **spam email** – damaging the sender's reputation and causing legitimate business emails sent from the sender to be rejected by email services.



A DDoS attac that form a

Reputational loss

TalkTalk, a telecommunications provider, suffered a major data breach in 2015. 157,000 customers were stolen. The ICO issued a fine of £400,000 – one of the the breach possibly cost TalkTalk up to £80 million. Some of that increase is due The company had (and still has) millions of customers – but around 100,000 mo share price of TalkTalk dropped by 11% at the time. We will never know how ma been discouraged from moving to TalkTalk from other companies such as Virgin has since fixed the issue, but the fact you're reading about it more than five yea can be long-lasting.

Threats to national security

An evolving threat is cyberwarfare, espio[illegible]nd hacking. A national governme terrorist organisation could attempt to hack in to government and military serve obtain classified inform[illegible]about the government and the running of the coun and inform[illegible]bo[illegible]military institutions, all threats to **national security**.

During electi[illegible]campaigns in countries such as the UK and USA, there are often investigations to determine whether other governments are trying to interfere w

Terrorist organisations could also attempt infrastructure systems such as power grids successful, large parts of a country could l systems are taken down or infected by ma not come back on fully afterwards. Such a systems and cause needless deaths. Even which unintentionally hit the NHS comput deaths, a larger attack in the future could.

Examples of failures to protect information

We've already discussed TalkTalk. Back in 2016, £40,000 seemed like an eye-wa However, that was before the GDPR regulations came into force two years later. larger fines. The ICO fined British Airways £20 million after the theft of details c passengers. The hotel chain Marriott International was fined £18.4 million after were accessed six years previously – but this went undiscovered until 2018 and acquired the company that was responsible for the breach. The fines could have initially set at £99 million for Marriott and £183 million for British Airways!

It is important to remember that even fines on that scale [illegible]affordable for majo companies, which make annual profits of millions and sometimes billions of pou Smaller businesses tend to have a lot less cash and are much more likely t bust after an attack. To reduce their liability, businesses can take out insurance policies called 'cyber insurance' in order to help cover the fines.

Practice Questions – 6.3 Impacts

1. Explain why intellectual property (IP) is a valuable commodity.
2. Describe how an attacker can cause loss of service to a company resourc
3. Explain how a large data breach can affect a company financially.

6.4 Protection measures

Policies

Policies are the rules and procedures that businesses use in order to protect the
and data breaches, or to recover from an incident. These policies help ensure th
the government legislation that they are expected to follow, such as the Data Pr
regularly review and update each policy. Every relevant member of staff should
expected to follow them. Staff are often required to sign a document (either pap
they have read and agree to abide by the policies.

Staff access rights

We mentioned before that only the staff that need to access specific information
example, payroll information.

Staff responsibilit

Every mem staff has the responsibility to keep data and information secur

- Disposing of files and electronic media securely
- Setting a strong password
- Adhering to clear desk policies
- Locking screens when walking away from their desks
- Ensuring that information is not accidentally discarded or disclosed

Disaster recovery procedures

A business must continue to operate after a data breach, a system malfunction o
disaster such as a flood. The **disaster recovery** plans will range from a simple res
from backups all the way to moving to a new location if the current building is
damaged or destroyed by a flood or a fire. The faster the business is able to reco
the sooner normal work resumes, and the less money is lost.

Therefore, businesses develop detailed plans about how to manage such a disas
specific tasks for each person to complete in a specific order. The plan won't co
must be informed, and there will be instructions about how to brief the general
how to temporarily do their jobs while crucial IT infrastructure is down, and wha
reporters – who might try to interview staff if the breach or disaster has gone pu

The plans won't have a person's name associated with them – they'll have a job
employee leaves the company, the procedures don't need updating every time, a
who will perform the tasks. Of course, the plan must be regularly reviewed and u
and it's important to test that the plans work. After a recovery has been complet
and improvements made.

In order to facilitate the recovery, frequent **backups** are made of all of the files o
the system.

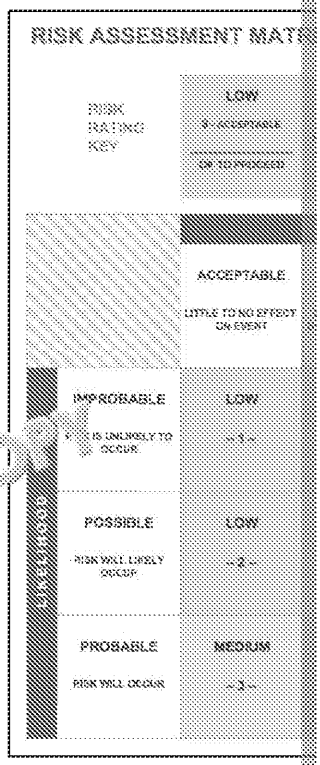
Following a suspected data breach or cyberattack, a strict set of containment,
investigation, reporting and mitigation stages should be followed – if the breac
personal data, the ICO must be informed quickly to reduce fines and limit reputa
a small IT department might need to bring in external consultants (perhaps the
externally).

If the building is damaged, plans for staff to work at home temporarily should be
need to work with suppliers to purchase and install new equipment, and, in extr
building altogether.

Risk assessments

Businesses need to assess all of the risks that could affect the businesses, and work out how to minimise each risk.

The risks can be displayed in a grid (sometimes called a matrix), based on the severity of each risk and its likelihood of occurring. The grids are often colour-coded so that the biggest risks are quickly identified.



An example matrix – a real or

Protection measures

The protection measures should be regularly tested to ensure that they are effective. For example, a business might employ someone who doesn't know anything about the business's systems) to attempt to break into the systems to find weaknesses that are then fixed. This is called penetration testing (or a 'pen test').

Staff training

All staff must be trained when they join the company; otherwise, they won't be familiar with the different policies – it is ess active, and not gather dust in the filing cabinet. Staff may also require annual re

Practice Questions – 6.4 Protection measures

1. Identify a correct level of network access required for a junior member of company position.
2. Explain two responsibilities that all staff should hold.
3. Identify two requirements of disaster recovery policies.
4. Describe the purpose of a risk assessment.

6.5 Physical protection

The following are measures that protect data and equipment from threats.

Physical locks on equipment and rooms

We can use traditional locks and metal keys, swipe cards and **biometric** locks (w scan a user's fingerprints or iris) to:

- Physically lock the room where data is stored (e.g. the server room)
- Secure access to the building (including windows) – especially overnight, w

Highly secure facilities, such as data centres, have very few external doors. They which can be weak points in the building's security. Sh s may also be used a

We can also lock down computers and dev s. For example, laptops, computers and other devices can be to a desk or an immovable object, or placed inside a secured with a tough metal cable. When they are loc ow mechanism to open the cases of desktop computers disabled, meaning that hard drives cannot be removed.

Many devices such as laptops and phones also have a fingerprint sensor – often built in to the power button. You might be able to use a camera to log in – facial recognition – or say a password which uses the pattern of your voice

Some systems use **two-factor authentication** – a combination of a password and smart card or a key generator. This adds security if the device is stolen, as both t password and the card or key generator must be obtained.

Keys and swipe cards or smart cards can be stolen or borrowed. Biometric securi can be more secure, but some older systems could be hacked with a detailed photograph (modern systems have removed this limitation as the points are viev in 3D). Some users have privacy concerns over companies storing personal data systems may not recognise a person if they choose to alter their appearance, an if the user has a cold.

Flooding

The server room might be located in a basement, and many companies place the floor. This can be an issue if there is a flood.

Floods happen when a river bursts its banks, a water main outside or a water or breaks, or the roof leaks.

Electronics and water don't mix – as anyone who has droppe their phone in the well (and has then spent a few days with their phone in bag of rice). To reduce can be moved onto desks or an upper floor rs can be mounted in racks reasonable estimated flood level

Off-site backup

One set of b s should always be stored off-site, or in the cloud, so that the on-site backups have been destroyed. Some people say that you should have tw hard drive), and at least three copies of the data. Tapes and hard drives are fairly take up much space.

If a complete backup is made five days a week, one or two of those backups mig example a Monday and Wednesday, or a Wednesday and Friday. This minimises data that could be lost. Off-site storage could include a safe within a home own trusted senior staff member, or a safety deposit box at a bank. An annual backup archived for many years.

Security staff

To protect a site from intrusion, security staff might be employed. This could inc

- Staff standing at the entrances to a building, checking or watching people who enter and leave
- Staff who patrol the site at night. You might see small barcodes attached to door frames – when a security guard patrols the site, they scan each barcode so that management can check that each area has been regularly searched.
- Live monitoring of CCTV footage – either by staff on site or remote monitoring – if suspicious activity is seen, a unit of officers can be quickly dispatched
- Sometimes, patrol officers are equipped with guard dogs

In addition, all staff should be aware of intruders. Staff working in reception sho is entering a building (a burglar might dress up as a delivery person and carry a suspect something bringing things in to a building!).

General staff should be told to watch out for people who try to follow them thro check (a key-coded or swipe-carded door, typically the front door) – called 'tailg anyone who asks to borrow keys or cards, or who appears to act suspiciously.

Paper shredding

Printed papers which contain sensitive information must be shredded so that ot access the paperwork. Each employee should be made aware of what types of in example, financial data, payroll information, personal data and job applications from rejected candidates.

Locked shredding bins are used to store the paper for shredding. These look a lot like postboxes – just a small slit at the top to push the paper through, or a locked wheelie bin with a slot on top.

Shredding is done either by internal staff on-site or by an external company. Once the paper is shredded, a certificate is provided to say that the material has been destroyed.

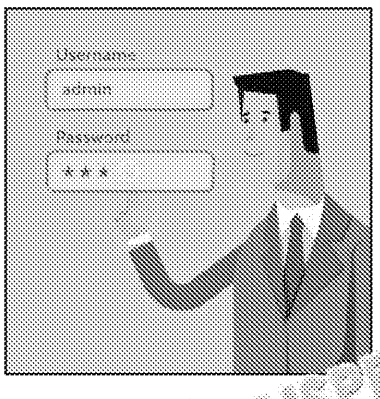
Other materials such as tapes, hard drives and disks can also be shredded or ma data that they contain.

Practice Questions – 6.5 Physical prote

1. Explain why biometric security can be more secure than traditional phys
2. Identify an example of where two-factor authentication could be used.
3. Off-site backups can be stored in a safe in a secure location. Explain why are important.
4. Describe how an office could be protected by security staff.
5. Identify a type of document that would need to be shredded before disp

6.6 Logical protection

We can use a combination of software and hardware to prevent unauthorised pe
and the sensitive information contained.



Tiers of access

We can limit the access that a user has based o
when setting up a network, specific users, or m
be given access to specific systems and networ
whether particular users can read or write to a
against accidental delet[illegible]nd tampering with
write access. Ve[illegible]taff should have access

It's [illegible]ally important to give individuals the
[illegible]ssible access to a network – the '**least privile**

If a hacker [illegible]ba[illegible]mployee login, they may not have access to many drive
resources, l[illegible] the amount of data they can steal or access, and their ability
install malware.

Network admins have a powerful set of tools at their disposal to lock down the
admins can implement a feature called 'Group Policy', which can disable some f
the ability to copy files to a USB flash drive, install software and access the com
Each time the user logs in, the policy is updated, and it cannot be changed by th

Firewalls

Firewalls block traffic from entering or leaving a network or device. Firewalls ha
allowed and what should be rejected. Anything that doesn't meet the rules is au
help stop hackers and malware from entering a network.

While most firewalls are preconfigured, network admins are able to configure or
monitor incoming traffic, and some monitor outgoing. It's useful to block some
is infected with malware, then the malware can by stopped from connecting to
or downloading more malware.

Examples of firewall rules could include:

- Allow full network access to the program 'Skype.exe'
- Reject all incoming traffic from the IP range 45.487.5.0 to 45.487.5.255
- Block all incoming traffic to port 3399
- Allow all outgoing traffic
- Allow all incoming TCP traffic on po[illegible]an[illegible]45 from any location or IP

There are two types of firew[illegible]

Hardware: A [illegible]ca[illegible]hat separates the router (and Internet) from the rest o
network tra[illegible]ses through the device, and both incoming and outgoing traff
boxes are used in businesses, and not typically in homes.

Many routers act like a firewall as any unrequested incoming traffic is filtered ou
know which device on the network the traffic should be sent to.

Software: Programs are installed on the devices to filter out traffic being sent to
network. The firewalls can be built in to the operating system (in Windows, the f
traffic) or purchased from a third party that might block incoming and outgoing
layer of security when used in combination with a hardware firewall.

Software firewalls also protect against a device on the network that is infected b
incoming traffic, that device can still distribute the malware to other devices on

Anti-malware

Anti-malware (usually called **antivirus** software) is software that detects and blo
viruses, worms, Trojans and other malware from entering the device. The softwa
can also scan incoming files and downloads, and files when they are opened, to
check that there is no malware attached.

Most antivirus software is always active and scans files in real time. The softwar
or 'signatures' which tells the software what to look for to identify the threat. Ne
therefore, the software downloads update files to include the new viruses. But t
Microsoft, Symantec or McAfee – must be aware of the new viruses and cr

Because of the time delay, software also looks out for suspicious activity, su
lots of RAM, sending a lot of network traffic or attempts to modify files. The
'heuristics' to automatically assess whether the file or program is a threat.

Samples of suspicious files can be sent back to the software company for analys

Once the software detects a threat, it can take different actions:

- Block incoming traffic or cancel a download from an untrusted site
- Delete the file
- Disinfect the file (remove the virus attached to the file)
- Move the file to a special 'quarantine' area which stops the file from being opened or run – it is likely to take this option if the file is suspicious and doesn't know if it's malicious yet – or requires the user or systems admin to make a choice

Sometimes, the software can detect and quarantine a 'false positive' – a misiden
third-party company such as Spotify can update its software and suddenly every
product installed can no longer use Spotify until the antivirus is told that the so

Obfuscation

Obfuscation is where software code is made more complex than necessary (ofte
automated process) to discourage humans from reading and understanding the c
This is done as a security measure to stop other people from altering the code o
understanding its purpose.

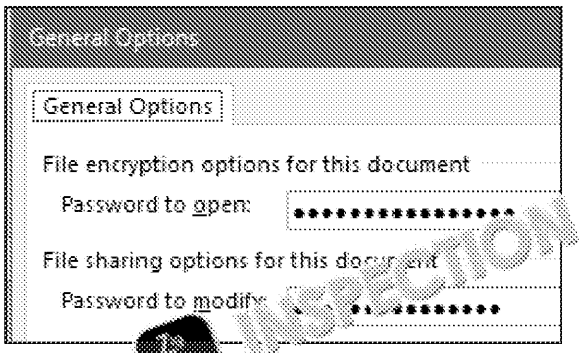
Encryption

Encryption is where [illegible] data transmission is scrambled into 'ciphertext' usin
long numb[illegible]d a key'. The makes it very hard, and often impossible, to
unscramble or 'decrypt' the data without the correct key as millions of combinat
of numbers must be used. A system that uses two different keys is more secure t
system that uses one key to both encrypt and decrypt. There are several types of

Storage

We can use third-party software to encrypt files and folders that are stored on o
to use.

Important files can be password protected – this can deter people or slow them
You can set passwords for specific documents, including popular office software
can encrypt an entire drive in Windows 10, both shown below.



Transmissi

We can use a secure or an encrypted method of sending data so that if it is interce
unreadable. For example, the data that we send across the Internet is encrypted w
padlock in your browser. Most websites, and certainly all good banking and online

This means that if anyone was on your network and monitoring the traffic, all th
address of the website, and not the contents.

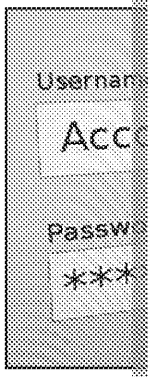
Most modern apps now encrypt their network traffic too. Every day, people are c
communication channels, such as using WhatsApp. This is a trend that has conce
are less able to intercept the contents of messages used in criminal activities. Te
started using technologies such as 'end-to-end' encryption, which means that th
is unable to provide decryption to law enforcement.

Businesses require strong encryption when transmitting data – between staff w
send information to clients, customers and third parties; and for online applicati

Businesses typically use an encrypted network tunnel called a virtual private network (**VPN**), which allows staff to securely work off-site.

Passwords

We use passwords to log in to websites, services such as email, and devices. They are strings of letters, numbers and s
characters. They're often not particularly secure because we're terrible at remembering strong pass



*OJeY 2DXR*1£d)2r%aWc* is a strong password – it's long and contains a mix of capital and lower-case letters, numbers and symbols. It would take a computer billions of years to try different combinations to find it. The problem is that it's terribly tricky to remember. Imagine if you are trying to remember 20 or 30 of those passwords... So people often use more simple passwords. The most comm
not joking – 123456, password, 11111111, qwerty, abc123 and password1. If yo
change it now!

When you sign up to sites, there are typically requirements such as a minimum o
people use the same password across many different services – because it's eas

– if your password is leaked and someone can guess or find your email address, password, then they have access to many of your accounts. They can just use pa any services that don't use two-factor authentication...

People also recycle passwords – they just add another number to the end. Some password2 or password12 – if someone found your original password, that's the should also regularly change your passwords as an added precaution – just in ca already log into your account.

The more secure a system, the more frequently users are required to change it – every three months, or every year.

You should never write down your passwords or store them in a document on yo desktop. The best solution is to use a password manager that you set one long b to – that software will store all of your passwords in an encrypted file, and you c those passwords into sites and services.

You could use a mnemonic to remember a long password, e.g. *When I was f Primrose Dr... London; it was great!* would become WIw5Imt#63PDL;iwg! Accord ***https://howsecureismypassword.net/*** it would take about three hundred quadrillio cracked. Needless to say, nobody will be guessing that any time soon!

Practice Questions – Logical protection

1. Explain the purpose of a firewall.
2. Identify an advantage of using a two-way software firewall.
3. Companies use encryption when transferring data. Describe how encryp it is being transferred.
4. Describe one benefit and one limitation of using strong passwords.

Answers

Learning Aim ①

Section 1.1

1. Any two suitable suggestions – such as schoolwork – books, worksheets, scho
etc.; paper diaries, calendars, notebooks and journals, notes, personal letters,
(1 mark each, max. 2 marks)

2. Businesses need access to information each day to function – without it, the
function efficiently (if at all) and will have to rely on pa
been deleted. The business will need to restor
and cost.
(max. 2 marks)

3. Individual data
depart
for hea
(max. 2 marks)

4. Larger population (highly urbanised in countries such as the UK) and more bu
more holders of information; also, centres of government, and archives and k
(max. 4 marks)

5. Huge inequality and hindered development potential / growth rate in the dev
countries such as the UK, can create vast inequalities, such as access to inform
(1 mark)

Section 1.2

1. For 'offline' settings, where access to a device is not possible or difficult; for l
countries, etc.
(1 mark each, max. 2 marks)

2. Replacement with newer/faster/easier technologies – e.g. streaming film and
digital downloads of software, games, etc. Instant purchase – no need to buy
to arrive in the post.
(1 mark for a reason, and 1 mark for an explanation)

3. Downloads can be very large / unsuitable for slower Internet connections in r
data connections, when a large game can be delivered on a single dual-layer
(1 mark for a reason, and 1 mark for an explanation)

4. Very low cost and high data capacity co
demand for server space is in
(1 mark for a reason

5. As the
use is r
home – only businesses use tape for backup. Cloud storage use will also incre
(1 mark for a suggestion, and 1 mark for an explanation)

Section 1.3

1. Easier to move from one area to another – e.g. take a laptop to a meeting or
   Provide nearly as much performance as fixed devices. Not limited to working
   (max. 4 marks)

2. Less control / trusting others with sensitive data.
   (1 mark)

3. Small screen sizes – the interface is much smaller, which can cause eye strain
   but that could allow fewer features to be visible on the screen) or make work
   a 24" display using a desktop computer – less ergonomic, etc.
   Limited by battery life – might be relatively short / need charging every night
   (2 marks each)

Section 1.4

1. Answers will be given to each learner. e.g. We have ASDL – it's not the best
   cheape[illegible] fibre connection. Or: We have a fibre connection, which is gre
   and gaming online.
   (1 mark for identification, and 1 mark for a reason)

2. Lower bandwidth than fibre; always decreases the speed, especially with long
   (1 mark for a reason, and 1 mark for an explanation)

3. Improves the speed by removing some of the copper from the network.
   Allows for much faster upload speeds (faster than the 1 megabit associated w
   (max. 2 marks)

4. e.g. FTTP or microwave because of fast speed and low latency (will have many
   online applications; may be transferring large files to and from cloud storage
   (1 mark for identification, and 1 mark for a reason)

5. When wired connections are unavailable, e.g. while on the road, or if your ho
   connection, or if your normal fixed Internet connection is not working.
   (max. 2 marks)

Section 1.5

1. By typing the address (URL) of the website into a web browser on an Internet
   (1 mark per point; 2 points are required)

2. They are often located within the corporate network so are not exposed to th
   for example, there is less risk of hacking as intranets contain confidential and
   information.
   (max. 2 marks)

3. Answers will be given to each learner, e.g. used by a specific business to sh
   custom[illegible] subscribers, or by an exam board that produces material that
   teacher[illegible] log in to the extranet using a username and password.
   (1 mark for an example, and 1 mark for an explanation)

Section 1.6

1. User base is in decline / relatively small audience / more effective ways of co as using social media / not worth the cost of setting up and maintaining.
   (1 mark)

2. Not suitable for a deaf audience / there is not usually a transcription made o
   (1 mark)

3. Accessible anywhere in the world, allowing a great deal of flexibility for the c
   But concerns over security/hacking, etc.; the premises must have a fast and r
   (1 mark for an example, and 1 mark for an explanation x 2)

4. Post photographs on a corporate social media page for potential customers a account to drive traffic to her site, offers and updates or promotions, etc
   (max. 3 marks; must include an example)

Section 1

1. Information is typically instantly available and up to date – no need to look th copies. Accessing services is quicker – applications and services are online, m when convenient, e.g. outside office hours – no need to call up a business us
   (1 mark for identification, and 1 mark for a reason)

2. For cheaper business communications, including through instant messaging disputes; for cheaper and faster access to information; to provide cheaper inf information available on their website rather than having to send mailings to
   (1 mark for a reason, and 1 mark for an explanation)

Section 1.8

1. Cost of access (allow availability of an Internet connection especially in rural a in most areas using mobile or satellite Internet as a last resort where cabling mobile data can be very patchy in rural areas).
   (1 mark)

2. Effects of overuse of social media and the web and the negative effects that t life, affecting performance and sleep.
   Effects on mental health and well-being of overuse of social media and of cy depression, leading to a spiral of decline.

   (3 marks each; learner must specify a disadvantage and explain why there is a refers to)

3. Cost of the infrastructure, monthly usage fees, cost of generating the onl fees, cost of network security and monitoring.
   Reputation loss through breaches of online data, customers can use public accessible online reviews, etc.
   (2 marks each)

Learning Aim ②

Section 2.1

1. Any three suitable suggestions – text, images (including animated and graph
and graphs could also be displayed.
(max. 3 marks)

2. Text will make up the main bulk of the report and convey much of the inform
Text will be supported with images, tables and graphs to help explain the tex
Charts can show trends, such as sales data.
(2 marks each)

3. Use of subtitles to display the words spoken by the actors and to describe th
and musical effects.
(max. 2 marks)

Section 2.2

1. Personal information is sensitive because if stolen, that data could be used fo
in the name of the person.
Proprietary information or intellectual property is sensitive because if seen by
competitors an advantage in the marketplace.
Some information held by governments and the military is highly sensitive if it pe
(2 marks each)

2. Post the information on a publicly accessible platform, such as its website or
release. The information could also be produced in printed reports, or downl
corporate site, or uploaded to a site where magazines and other material are
(max. 2 marks)

3. Shareholders could lose money if the share price drops following a data brea
Stakeholders also include the staff who must implement policy and are affect
after a breach.
(max. 2 marks)

4. Learners should identify a method of either separating data from identifiable
personal data, or deleting the identifiable information in its entirety.
(1 mark)

Section 2.3

1. Reject input such as letters in the telephone number field, or if numbers are t
something doesn't seem correct for an address, confirm manually.
(1 mark)

2. The data could be incomplete, meaning that only part of the story is told – th
been filled in by only a few respondents.
There could be missing or opposing data, either accidentally or on purpose –
because certain age groups have not responded to the survey, meaning that
particular age group or category.
(2 marks each)

3. Make poor or incorrect business choices which could cost the business mone
could purchase more stock based on a line that isn't selling well, hire extra st
redundant if there were a major error in the data that the company's forecast
(max. 3 marks)

Section 2.4

1. Easier to access, share and update between different departments and location staff costs and lower costs of paper and toner/ink; much less storage space req *(max. 2 marks)*
2. To stop others from accessing the data if it is intercepted or stolen. *(1 mark)*
3. The data is sensitive/confidential, meaning that if intercepted without encryp third party – resulting in fines and loss of company reputation. *(max. 3 marks)*
4. Risk of data breaches; the information must be stored carefully to ensure tha easily; loss of reputation if password data is/are breached. *(max. 2 marks)*

Learning Aim ③

Section 3.1

1. my car is blue and was manufactured by BMW in 2018. *(1 mark)*
2. There is context provided – we know what two of the data items (blue and 20 *(max. 2 marks)*
3. Combine the data (processing), giving the data structure. *(max. 2 marks)*

Section 3.2

1. Quicker and easier to discuss an issue or ensure meaning is understood than over many emails to make a decision or clarify things. *(max. 2 marks)*
2. Can be used either as a tool for distance learning or to supplement face-to-fa notes, to facilitate handing in assignments and to conduct tests online. Learn in the world rather than being based in a specific city. *(max. 3 marks)*
3. Online/electronic diary or calendar system / share yo ry with friends, or and comparison websites. Allow any other sui s gestions. *(max. 2 marks)*
4. Financial risk (e.g. co cted with malware, e.g. key-logging software be a log you need to visit the bank, etc. *(1 mar*
5. Only the most relevant data is provided to you – the nearest locations, or in y time scrolling down a long list of irrelevant search results. *(max. 2 marks)*

Section 3.3

1. Computer system that manages the flow of important data around a busine running and a high degree of accurate data for important business decision strength and weakness within the business operations.
(max. 2 marks)

2. Can create highly targeted adverts that are guaranteed to reach a specific a cheaper than running print or billboard advertising.
(max. 2 marks)

3. The data used to create the model might have imperfe ons, e.g. biased, u means that the forecast will be wrong. Even if the d a is reliable, the mark radically change, meaning that the p o on't come true.
(2 marks each)

4. Highly s fic can be run based on years' worth of data. For examp weath ast to plan availability of stock – e.g. how much of a product temper e is 17 °C?
(max. 2 marks)

Section 3.4

1. Any suitable limitation, such as time or level of detail required.
(1 mark)

2. We might now know the source of the information, such as where and when th collection techniques may not be to a high standard or may be flawed, or the c country, meaning that it would be difficult to compare to primary study.
We may not know the age of the data – it might be very out of date, and, there or very inaccurate.
(2 marks each)

3. Pie (distinct categories with %) or bar chart (distinct categories).
(1 mark)

4. A pattern within the data – such as working out that as one variable increases also changes.
(max. 2 marks)

5. Using appropriate software / spreadsheets / statistical programs.
(1 mark)

Section 3.5

1. Tables are good for showing a l d , but they make it hard to identify Charts allow easy analysis the t nds and could be included in the main bod The scientist m t to include both for academic rigour and peer revie see th t might end up at the end, in an appendix.
(2 mark)

2. Removes old data that is irrelevant or could skew the results; also a require by removing / stopping processing obsolete data.
(max. 2 marks)

3. Learner should provide any suitable suggestion and explain why being able overlap and items spatially would be useful.
(max. 3 marks)

Section 3.6

1. Any highly secure organisation such as a financial institution or a defence co
   (1 mark)

Learning Aim ④

Section 4.1

1. Computer Misuse Act 1990 (also accept the Police and Justice Act 2006 or th
   (1 mark)
2. Data Protection Act (2018) (accept GDPR)
   (1 mark)
3. Freedom of Inform[illegible] Act 2000.
   (1 mark)
4. Copyright, Designs and Patents Act 1988.
   (1 mark)
5. Regulation of Investigatory Powers Act (RIPA) 2000 (or the Investigatory Pow
   (1 mark)

Section 4.2

1. The website is hosted outside the EU. The country that would process identifi
   address, does not have the required level of data protection to meet GDPR / D
   Processing of data from a European citizen would not be permitted at that ti
   (max. 2 marks)
2. The Internet has transformed the way that we live and has made many aspect
   should be left behind – everyone should have the same level of access and op
   and make decisions for themselves.
   (2 marks each)

Section 4.3

1. Any suitable suggestion such as use fewer resources, low energy, easy to disa
   (1 mark)
2. e.g. consolidate material onto fewer servers / deduplicate information to redu
   Replace old, inefficient equipment with new, more efficient equipment. In bo
   energy costs (and, therefore, greenhouse gas emissions).
   (max. 2 marks)
3. Fossil fuels are a finite resource and are being depleted; using fossil fuels gen
   which could cause dangerous levels of climate change if not controlled.
   (max. 2 marks)
4. Ability to print on both sides automatically (auto-duplex), energy use in stand
   refillable or use once and discard – etc.
   (max. 2 marks)
5. New equipment tends to be more energy-efficient, i.e. runs at a lower wattage
   (max. 2 marks)

Learning Aim ⑤

Section 5.1

1. Sales data, staff information and salary, proprietary data and IP, etc.
   (max. 2 marks)

2. Information from clients, suppliers, other companies, the Internet, etc.
   (max. 2 marks)

3. Secondary data is often available for free, meaning that it is very cost-effectiv as there is no waiting time for the data to be collected. The secondary data ca with primary data sources.
   (2 marks each)

4. Qualitative data provides a lot of useful information – often unique answers t of possibilities and valuable insights. But there could be many different answe long time to organise and 'code', meaning that qualitative data costs more to workin similarities between answers provided, the responses might prov can be difficult to assess the relative importance of responses.
   (2 marks each)

Section 5.2

1. Level 0 is very basic / general overview, whereas a level 1 diagram gives much each process and subprocess.
   (max. 2 marks)

2. Any example of input from outside the system.
   (1 mark)

3. Data flow.
   (1 mark)

4. Only one direction of data flow is permitted.
   (1 mark)

5. Data must travel from a store to be processed / the data outputted by the pr store.
   (1 mark)

Learning Aim ⑥

Section 6.1

1. The data must not be disclosed to an because of its sensitive nature requirement, but a moral requirement too.
   (max. 2 marks)

2. Asking staff and customers to update their information. Information that i (and unnecessary) could be deleted.
   (1 mark)

3. Staff might not be able to do their jobs at all without this information source, inefficient. This costs the business money through wasted staff salary.
   (max. 2 marks)

Section 6.2

1. State and military secrets are at risk of being obtained. This is a threat to nati
   (max. 2 marks)

2. As simply as deleting the only copy of data by mistake, or overwriting it. Files
   deletion, or a technician could delete the wrong files with a single command.
   (max. 2 marks)

3. Deleting the data using a virus could be done just out of malicious spite agai
   targeted at a specific industry. Encrypting data using ransomware is a metho
   the fees paid to decrypt the data.
   (max. 2 marks)

4. The modified data might not be discovered for a long time after the event, o
   make the wrong business decisio
   (1 mark)

Section

1. Cost of time and salary to create it; its product might be better than a compe
   trade secrets and other highly sensitive commercial information.
   (max. 2 marks)

2. Through the use of a distributed denial of service attack, where a server is flo
   from a network of controlled computers in order to take it offline.
   (max. 2 marks)

3. Financially through fines from bodies such as the ICO for allowing there to be
   security, or failure to notify in a suitable time frame.

   Loss of reputation and customers (also financial) through reduced sales if exis
   / choose to go with a competitor instead.
   (2 marks each)

Section 6.4

1. Will have the least access possible / access only to the relevant files needed i
   access to files that the employee doesn't need to modify.
   (1 mark)

2. Staff should be responsible for maintaining the required level of security – su
   and keeping it secure. Staff should also be on the lookout for suspicious activ
   gain access to the building or a room, or someone asking for personal details
   Staff should also follow the rules and policies set by the company, such as ho
   (2 marks each)

3. Any two suitable suggestions, such as creating backups and restoring backups, c
   procedures, people named in job role, frequent checking that the procedures
   (max. 2 marks)

4. Identify the severity of risks, allowing staff to plan appropriate mitigation o
   (max. 2 marks)

Section 6.5

1. Traditional physical security measures can be used by anyone who has a key
door code. This information or a physical key can be easily stolen, or a door c
(shouldering). Therefore, an intruder could gain access very easily.

   Biometrics tend to be more secure because the person with authorised acces
entry. There is only one unique key that cannot be borrowed or stolen. Howe
authorised person could be coerced to allow access, and, in some cases, the s
unnecessary access.
   (max. 4 marks)

2. Any relevant example, e.g. signing in to a new device or when transferring m
can be sent to the phone number registered with an account.
   (1 mark)

3. The on-site backups could be destroyed by a fire, flood or natural disaster, or
on-site is destroyed, the off-site backup should still be available. The off-site
to restore data, potentially at a new site if the existing site is damaged to the
   (max. 3

4. Staff could watch CCTV / patrol the site on location. Staff could also monitor
security guard to the site should suspicious activity be detected on CCTV or a
   (max. 2 marks)

5. Any suitable suggestion such as CVs, application forms, personnel files and re
internal reports.
   (1 mark)

Section 6.6

1. To block malicious incoming traffic, and also outgoing traffic in some cases. T
ports or IP addresses, etc.
   (max. 2 marks)

2. To help stop or slow the spread of malware within an internal network.
   (1 mark)

3. The internal make-up of the communication is scrambled, meaning that if int
communications cannot be read. The communications could be made throug
HTTPS) or using a secure network tunnel called a VPN.
   (max. 3 marks)

4. Benefit – secure passwords are very difficult to crack using brute force metho
must be tried. After a set number of incorrect password entries, the system m
any case, the password would take an impossibly long time to crack.

   Weakness – secure passwords are difficult to remember – so they might be w
non-encrypted form (for example, meaning that the passwords must be reset
their acc
   (2 mar