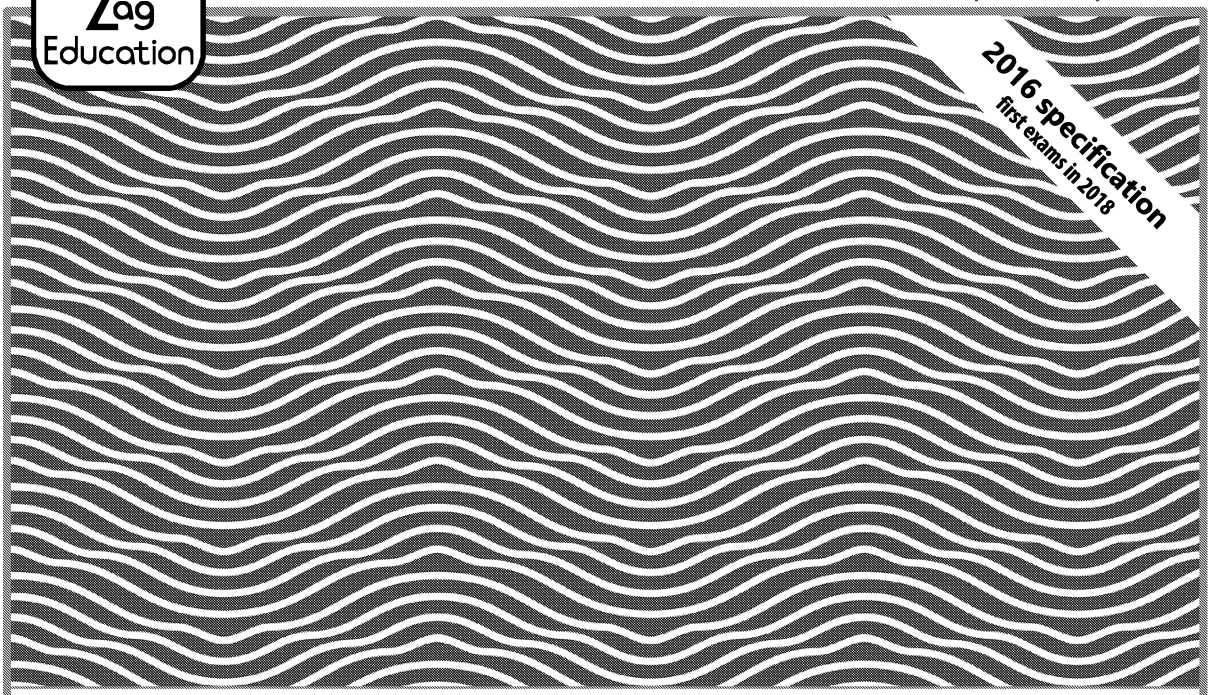
Zig Zag Education

Combined Science GCSE (9–1) | AQA | 8464



End-of-Topic A4 Quick-Mark Homeworks

for GCSE AQA Combined Science

Physics Topics 5–7

zigzageducation.co.uk POD 12920

Contents

Teacher's Introduction

These End-of-Topic Revision Quick-Mark Homeworks are designed to test and consolidate students' knowledge of the **AQA GCSE (9–1) Combined Science** course, **Physics Topics 5–7**.

The second half of the course is split into seven topics, six of which are covered by at least 40 questions, with one shorter 22-question test for a total of over 270 questions.

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

The questions increase in difficulty across each homework, with an extension section at the bottom of each homework. The **Fundamentals** section on each homework is targeted at students aiming for grade 4–5. The **Challenge** section is targeted at students aiming for grade 6. The **Extension** section is targeted at students aiming for grade 7 and above. All Higher-tier-only content is in the extension section, so the main body of the homework is suitable for students completing Foundation-tier exams.

Maths questions and some shorter-answer questions may contain working or explanation that is not required in the answer so that students can more easily understand and follow difficult answers.

The homeworks are intended to be used at the end of each topic, but they can also be used at the end of the course to aid revision. Alternatively, you may choose to use them as tests in class or for students to work through by themselves or in pairs to test their understanding of the course material.

The first set of fundamentals questions for each homework are presented in the second section for use with weaker students who may struggle with the full homework. These can be cut down the middle to use one test at a time or test two topics at a time.

Answers are presented at the back of the resource, enabling students to check their answers, or teachers to mark students' work quickly and easily.

I hope you find this resource useful in your teaching.

April 2025

Specification Reference Table

Homework	Title	Specification Reference
1	Forces, Energy Transfer and Elasticity	6.5.1–6.5.3
2	Speed and Braking	6.5.4.1, 6.5.4.3
3	Newton's Laws and Momentum	6.5.4.2, 6.5.5
4	Wave Fundamentals	6.6.1
5	Electromagnetic Spectrum	6.6.2
6	Magnets and Electromagnets	6.7.1, 6.7.2.1
7	Electric Motors	6.7.2.2–6.7.2.3

Topic 1 — Forces, Energy Transfer a

Fundamentals

1. Is friction a contact or non-contact force?
2. What is the unit for mass?
3. What is the unit for weight?
4. Which energy transfers occur when a for[illegible] is applied to the brakes of a moving car?
5. What is the unit for 'w[illegible]ne'?
6. Which fo[illegible]ul[illegible] t[illegible]ass, gravitational field stren[illegible] w[illegible]ght?
7. Which [illegible]istance and displacement is a vector quantity?
8. A string holding an object from the ceiling is an example of which force?
9. What is the force produced by wings and rotating blades?
10. Air resistance and water resistance are also known as...
11. Name a contact force
12. Which equation relates force, spring constant and extension?
13. How do you work out the extension of a spring?
14. What unit should you use for spring extension in calculations?

[illegible]

1. Name a nor[illegible]
2. What does t[illegible]
3. What does t[illegible]
4. What is 660[illegible]
5. What is the [illegible] vector quan[illegible]
6. What is mea[illegible]
7. A change in [illegible]
8. This type of [illegible] object retur[illegible] force is rem[illegible]
9. Is force a ve[illegible]
10. What is the [illegible] gravitationa[illegible]
11. A force exe[illegible] the surface [illegible]
12. What is 26 [illegible] and to 2 s.f.?
13. What is the [illegible] Moon wher[illegible]
14. The gravita[illegible] force when [illegible] true or false

Extension

1. State [illegible]'s l[illegible]w
2. Non-c[illegible]t forces are due to the action of...
3. A material that obeys Hooke's law demonstrates which type of extension?
4. What is the normal contact force?
5. The point on a force extension graph where the graph changes from linear to non-linear extension is...
6. What is the unit for gravitational field strength?
7. Can the shape of an object be changed by stretching, compressing or bending due to a single force?
8. What is weight?
9. What is the type [illegible] an object whose [illegible] by a force?
10. The work done o[illegible] elastic limit is th[illegible]
11. How many force[illegible] object in order t[illegible]
12. How much work [illegible] to accelerate a 1[illegible] distance of 35 m[illegible]

Topic 2 — Speed and Braki

Fundamentals

1. How do you calculate average speed?
2. What is a typical walking speed?
3. What is the unit for acceleration?
4. What is the speed of a stationary object?
5. What is the unit for distance?
6. Stopping distance = _____ + _____
7. How ca[illegible] increase the stopp[illegible]ance of a car?
8. An obj[illegible] travels 120 m in 6 seconds. What is its speed?
9. What are the units of velocity?
10. Convert 20 km/s into m/s
11. A horizontal line on a distance–time graph indicates that the object is…
12. What will poor brakes affect: the thinking distance or the braking distance?
13. Is acceleration a vector or a scalar quantity?
14. Which formula relates acceleration, velocity and time?
15. What is deceleration?

Ch

1. What is velocity?
2. If an object undergoe[illegible] direction it is said to b[illegible]
3. What is the size of the terminal velocity?
4. What is the difference
5. The gradient on a velo
6. The gradient on a dist
7. Which factor affects b stopping distance of a
8. A car's velocity change a minute. Calculate its
9. A negative acceleratio
10. Which two forces deter
11. An object travels 100 2 m/s^2. What is its fina
12. What does 'uniform' a
13. A negative value of ve
14. The speed of sound in sound travel 2 miles (1
15. The distance travelled it displacement. Why

Extension

1. Rearran[illegible]^2 - [illegible]2 - [illegible]o find acceleration (a)
2. What [illegible]alculating the area under a velocity–time graph tell you about an object's motion?
3. For a given braking force, doubling a car's speed increases the braking distance by a factor of…
4. An object is moving in a circle at 30 m/s – what is happening to the object's speed and velocity?
5. How do you calculate instantaneous speed on a curved distance–time graph?
6. An object accelerates from 2.5 m/s to 20 m/s in 2.5 s. What distance does it travel?
7. A beta particle travels at 270 000 km/s. What percentage of the speed of light (3×10^8 m/s) is this?
8. A skydiver wears a he time taken to reach te
9. A car travels 7 m in 0.5 speed limit is the car?
10. A stopwatch adds 0.0 stop button is pressed.
11. What is the average s at 3 m/s^2 for 4 s from a
12. Light (speed = 3×10^8 8 minutes to reach Ea
13. The moon is 384 400 k distance in metres and
14. For a given braking fo creases the braking
15. A ball is launched from The maximum height t

Topic 3 — Newton's Laws and M

Fundamentals

1. Which formula relates force, acceleration and mass?
2. Compare and contrast the two forces in an interaction pair
3. An object is stationary and has a resultant fo[rce] zero acting on it. What happens to [it]?
4. Acceleration is caused by
5. What force is r[equired] to give a 10 kg object an accel[eration] of 5 m/s²?
6. Newt[on's] [fi]rst law states that...
7. Newton's second law states that...
8. Newton's third law says that whenever two objects interact they...
9. The acceleration of an object is inversely proportional to the...
10. The Earth exerts a 2 N force downwards on a pear. What force does the pear exert on the Earth?
11. A trolley of mass 10 kg accelerates at 4.2 m/s². What size resultant force is acting on the trolley?
12. A tennis ball of mass 0.1 kg is hit with a force of 23 N. What is its initial acceleration?
13. One force in an interaction pair is an electrostatic force, the other force is...
14. An object travelling at terminal velocity is an example of which of Newton's la[ws]
15. Forces in an interaction pair act at right angles to each other – tr[ue] or false?

Extension

1. If an object increases its speed then the air resistance that object experiences will...
2. An object is moving and has a resultant force of zero acting on it. This means it will...
3. What is the effect of an airbag on the momentum of a passenger in a road accident?
4. A cannonball is shot from a cannon with a momentum of 3000 kgm/s. What is the cannon's momentum?
5. The cannon in question 4 has a mass of 1500 kg. What is its velocity when it recoils?
6. A resultant force of 10 000 N accelerates an obje[ct] at 2.5 m/s². What is its momentum after 5 se[con]ds?
7. The mass of Earth is 6.0 × 10²⁴ [kg]. What acceleration does a 50 g apple ex[ert]?
8. A student noti[ces] zero with no m[otion]
9. Why will all ca[rs]
10. An object with [mass] experiences a [force] stopping time [is]
11. A rock of weig[ht] of 17 m/s. Wha[t]
12. As F = ma and a
13. What force is [re]travelling at 70[0]

Topic 4 — Wave Fundamen

Fundamentals

1. Peaks and troughs are features of which type of wave?
2. Compressions and rarefactions are features of which type of wave?
3. What unit is used to describe wa… re…cy?
4. Describe how to find the wavelength on a diagram of a tra… wave
5. The r… m …placement of a transverse wave (undis… position to peak or trough) is the:
6. Which quantity does the symbol 'λ' represent?
7. What is the wave equation?
8. What does a wave transfer?
9. Water ripples are an example of which type of wave?
10. Sound waves are an example of which type of wave?
11. The number of waves passing a point each second is referred to as what?
12. Describe the pressure and how the particles are arranged in a compression of a longitudinal wave
13. Describe the pressure and how the particles are arranged in a rarefaction of a longitudinal wave
14. What does perpendicular mean?
15. What does oscillate mean?

C…

1. In a transverse w… in relation to the …
2. In a longitudinal … oscillate in relati…
3. What is the perio…
4. Convert 1.5 MHz …
5. A wave is measu… What is the amp…
6. Which word des… by earthquakes?
7. Period × Frequen…
8. The frequency o… period of the wa…
9. What is the amp…
10. The frequency of …
11. Are S-waves long…

Extension

1. What … tionship do wavelength and frequency have to each other?
2. Are P-waves longitudinal or transverse?
3. Which of the two types of seismic waves can be detected on the opposite side of the world?
4. Compare and contrast how S-waves and P-waves travel through solids and liquids
5. Measuring 10 wavelengths in a ripple tank is a way to reduce what?
6. The length of 10 waves produced by a 55 Hz generator is measured with a ruler to be 45 cm. Wave speed to 2 s.f. =
7. Refraction of a wave at a boundary is due to a change in what feature of a wave?
8. The period of a w… what is the wavel…
9. How can you show … are not transferred…
10. How can you show … wave are not tran…
11. Convert 2600 nm i… standard form
12. The period of a wa…
13. What are shadow z…
14. A wave travelling a… 2 m. What is its pe…

Topic 5 — Electromagnetic Spe

Fundamentals

1. What is the order of the electromagnetic spectrum from shortest to longest wavelength?
2. As wavelength increases in the electromagnetic spectrum, the frequency…
3. Microwaves are used for cooking and what else?
4. Which illness is high exposure to ultraviolet radiation particularly associated with?
5. Which part of the electromagnetic spectrum are used in medical treatments and imaging?
6. Which is the only part of the electromagnetic spectrum that our eyes can detect?
7. How does the speed of waves in the electromagnetic spectrum in a vacuum compare?
8. What is a use of radio waves?
9. Radiation dose is measured in…
10. What type of waves are electromagnetic waves?
11. What do we call something that produces electromagnetic waves?
12. What do electromagnetic waves transfer?
13. All hot objects emit…
14. What has a greater frequency: ultraviolet or infrared?
15. Which type of radiation has a longer wavelength: radio waves or microwaves?

C

1. Fibre optics make
electromagnetic
2. What is the speed
in a vacuum?
3. Ultraviolet, X-ray
what type of radi
4. What is ionising
5. How do electron
6. Why are radio w
in communicatio
7. Calculate the fre
wavelength of 10
8. Gamma rays are
9. Convert 250 mSv
10. Which form of ra
age prematurely?
11. Electromagnetic
source to an…
12. Radio waves can
in an electrical c
13. Why is radiation
14. What carries mo
visible light?
15. Which form of e
for sterilising me

Extension

1. What is created when radio waves are absorbed by a conductor?
2. What happens to the internal energy of substances when they absorb electromagnetic radiation?
3. From where do gamma rays originate in the atom?
4. Why are microwaves superior to radio waves for satellite communications?
5. Which property of EM waves affects whether they are absorbed, reflected, transmitted or refracted?
6. Explain how a ligh
will be refracted
7. Refraction is a co
in _____ of a w
new substance
8. Which type of ele
a remote control?
9. Why are X-rays us
10. Why would using
communication re

Topic 6 — Magnets and Electro

Fundamentals

1. By which term are the ends of a magnet referred to?
2. Why does a compass needle point towards the Earth's North pole?
3. As you get closer to a magnet, the strength o the magnetic field…
4. The field around a bar ma t ca e shown by iron…
5. A magnetic fie ____, the further its field lines rt
6. What magnet is a bar magnet – permanent, induced or electromagnet?
7. Name one magnetic material
8. What will decreasing the current in a wire do the strength of the magnetic field around it?
9. What do the arrows on magnetic field lines tell you?
10. How can a conducting wire be made to produce a magnetic field?
11. The north pole of a magnet and a south pole of another magnet will do what to each other?
12. Are magnetic attraction and repulsion examples of contact or non-contact forces?
13. The strength of a magnetic field around a bar magnet _____ as you move away from it
14. A magnet is attracted to a refrigerator do r; thi type of magnetism is this an exa e
15. A door is locked and un d is g a switch; which type of magnet is to be used in the door?

Extension

1. If the current is kept the same, a magnetic field around a solenoid can be increased in strength by…
2. The shape of the magnetic field for a solenoid is similar to…
3. A student says 'an induced magnet repels the magnet placed by it'. Explain why the student is wrong.
4. Which has a stronger magnetic field when carrying a current: a solenoid or a straight wire?
5. How does a compass disagree with geographical polarity?
6. Compasses arranged around a i al e all point clockwise – whic is current flowing?
7. The force betwee induced magnet i
8. What does magne magnetic field
9. A uniform magne
10. What is the magn
11. Convert $1.6 \times 10^{-}$
12. A 12 cm wire carry force of 2×10^{-2} N
13. For the wire in Q12 force is current wa
14. What is the symbo
15. What is the moto

Topic 7 — Electric Motor

Fundamentals

1. What is alternating current?
2. What is direct current?
3. Electric motors transfer energy to their kinetic energy store by which pathway?
4. The north poles of two magnets are moved close together. What do the north poles do to each other?
5. True or false – all metals are attracted to magnets?
6. Which type of magnet is most appropriate in a security gate lock?
7. Is magnetic force a contact or non-contact force?
8. Which of alpha, beta and gamma radiation will not be deflected by a magnetic field?
9. A magnetic field can induce current to flow. Which subatomic charges typically flow in circuits?
10. A piece of metal (in elemental form) appears to respond to a magnet. Which metal might it be?
11. A permanent magnet is repelled when moved close to material X. Is material X an induced magnet?

[illegible]

1. How many coils
2. What does a st
potential differe
3. How can a magn
permanent mag
4. A current can be
it in a magnetic f
5. What is the uni
6. Primary coil = 1
turns. Is this a st
7. A wire has a ma
force of 0.04 N

Extension

1. What does a step-down transformer do to current?
2. In a generator, which coil position produces the greatest potential difference?
3. Which rule helps you
forces produced in
4. A step-up transfor
battery – what hap

Fundamentals Tests

Topic 1 — Forces, Energy Transfer and E

1	Is friction a contact or non-contact force?
2	What is the unit for mass?
3	What is the unit for weight?
4	Which energy transfer occurs when a force is applied to the brakes of a m
5	What is the ... for work done'?
6	Which formula relates mass, gravitational field strength and weight?
7	Which of distance and displacement is a vector quantity?
8	A string holding an object from the ceiling is an example of which force?
9	What is the force produced by wings and rotating blades?
10	Air resistance and water resistance are also known as…
11	Name a contact force
12	Which equation relates force, spring constant and extension?
13	How do you work out the extension of a spring?
14	What unit should you use for spring extension in calculations?

Topic 2 — Spee[illegible] and Braking

1	How do you calculate average speed?
2	What is a typical walking [illegible]
3	What is the unit for acceleration?
4	What is the speed of a stationary object?
5	What is the unit for distance?
6	Stopping distance = _____ + _____
7	How can alcohol consumption increase the stopping distance of a car?
8	An object travels 120 m in 6 seconds. What is its speed?
9	What are the units of velocity?
10	Convert 20 km/s into m/s
11	A horizontal line on a distance–time graph indicates that the object is…
12	What will poor brakes affect: the thinking distance or the braking distance
13	Is acceleration a vector or a scalar quantity?
14	Which formula relates acceleration, velocity and [illegible]
15	What is deceleration?

Topic 3 — Newton's Laws and Mome

1	Which formula relates force, acceleration and mass?
2	Compare and contrast the two forces in an interaction pair
3	An object is stationary and has a resultant force of zero acting on it. Wha
4	Acceleration is caused by…
5	What force is required to give a 10 kg obj[illegible] n [illegible]celeration of 5 m/s²?
6	Newton's first law states that…
7	Newton's second la[illegible]es t[illegible]at…
8	New[illegible] t[illegible] [illegible]ays that whenever two objects interact they...
9	The[illegible]ration of an object is inversely proportional to the…
10	The Earth exerts a 2 N force downwards on a pear. What force does the p
11	A trolley of mass 10 kg accelerates at 4.2 m/s². What size resultant force
12	A tennis ball of mass 0.1 kg is hit with a force of 23 N. What is its initial a
13	One force in an interaction pair is an electrostatic force, the other force i
14	An object travelling at terminal velocity is an example of which of Newto
15	Forces in an interaction pair act at right angles to each other – true or fa

Topic 4 — Wave Fundamentals

1	Peaks and troughs are features of which type of wave?
2	Compressions and rarefactions are features of w[illegible]ype of wave?
3	What unit is used to describe wave fr[illegible]qu[illegible]nc[illegible]?
4	Describe how to find the w[illegible]e[illegible]h[illegible]on a diagram of a transverse wave
5	The maximum di[illegible]m[illegible]t of a transverse wave (undisturbed position t
6	Wh[illegible]an [illegible]oes the symbol 'λ' represent?
7	Wha[illegible]e wave equation?
8	What does a wave transfer?
9	Water ripples are an example of which type of wave?
10	Sound waves are an example of which type of wave?
11	The number of waves passing a point each second is referred to as what?
12	Describe the pressure and how the particles are arranged in a compressio
13	Describe the pressure and how the particles are arranged in a rarefaction
14	What does perpendicular mean?
15	What does oscillate mean?

Topic 5 — Electromagnetic Spectr

1	What is the order of the electromagnetic spectrum from shortest to longes
2	As wavelength increases in the electromagnetic spectrum, the frequency...
3	Microwaves are used for cooking and what else?
4	Which illness is high exposure to ultraviolet radiati... particularly associate
5	Which parts of the electromagnetic spect...um ar... used in medical treatmen
6	Which is the only part of the ...tr...agnetic spectrum that our eyes can d
7	How does the sp... ...ves in the electromagnetic spectrum in a vacuu
8	W... ...a u... ...radio waves?
9	Ra... dose is measured in...
10	What type of waves are electromagnetic waves?
11	What do we call something that produces electromagnetic waves?
12	What do electromagnetic waves transfer?
13	All hot objects emit...
14	What has a greater frequency, ultraviolet or infrared?
15	Which type of radiation has a longer wavelength: radio waves or microwav

Topic 6 — Magnets and Electromag

1	By which term are the ends of a magnet referred to?
2	Why does a compass needle point towards the E...'s North pole?
3	As you get closer to a magnet, the st...th ...ne magnetic field...
4	The field around a bar ma... ...e shown by iron...
5	A magnetic fiel... _____, the further its field lines are apart
6	W... ...pe ...agnet is a bar magnet - permanent, induced or electrom
7	Na... ...e magnetic material
8	What will decreasing the current in a wire do the strength of the magne
9	What do the arrows on magnetic field lines tell you?
10	How can a conducting wire be made to produce a magnetic field?
11	The north pole of a magnet and a south pole of another magnet will do
12	Are magnetic attraction and repulsion examples of contact or non-cont
13	The strength of a magnetic field around a bar magnet _____ as you mo
14	A magnet is attracted to a refrigerator door; which type of magnetism
15	A door is locked and unlocked using a switch; which type of magnet is

Topic 7 — Electric Motors

1	What is alternating current?
2	What is direct current?
3	Electric motors transfer energy to their kinetic energy store by which pa
4	The north poles of two magnets are moved close t ether. What do the
5	True or false - all metals are attracted to ma ?
6	Which type of magnet is ma op ate in a security gate lock?
7	Is magnetic force a or non-contact force?
8	W f a eta and gamma radiation will not be deflected by a ma
9	A n tic field can induce current to flow. Which subatomic charges t
10	A piece of metal (in elemental form) appears to respond to a magnet. W
11	A permanent magnet is repelled when moved close to material X. Is ma

Answers

Topic 1 — Forces, Energy Transfer and Elastic

Fundamentals

1. Contact
2. Kilograms
3. Newtons
4. Transfer from the kinetic [illegible] of the vehicle to the thermal store of the brak
5. Joules
6. W = mg [illegible] (weight = mass × gravitational field strength)
7. Displace
8. Tension
9. Lift
10. Drag
11. Any one of friction, air resistance, tension, thrust, normal contact force, upthrust
12. F = k e (Force = Spring constant × Extension)
13. Stretched length – Original length
14. Metres (m)

Challenge

1. Any one of: gravitational force, electrostatic force and magnetic force
2. That two quantities are proportional to each other
3. How stiff a spring is
4. 660 joules
5. Scalar quantities only have a magnitude, vector quantities have a magnitude and a d
6. It is the point through which an object's weight appears [illegible] considered to) act
7. Deformation
8. Elastic
9. Vector
10. 9.8 m/s^2
11. Normal [illegible]
12. 27 kN
13. 12 N
14. False

Extension

1. The extension of an elastic object is directly proportional to the force applied as long not been exceeded
2. Fields
3. Linear
4. A force exerted by a surface in contact with an object – this force is exerted at 90° to
5. Limit of proportionality
6. N/kg
7. No
8. The force applied by a gravitational field acting on a mass
9. Plastic
10. Elastic potential energy store
11. More than one
12. 5.1 kJ

Topic 2 — Speed and Braking

Fundamentals

1. Distance ÷ Time
2. 1.5 m/s
3. m/s^2
4. 0 m/s
5. Metres (m)
6. Thinking distance + Braking distance
7. Alcohol consumption can slow reaction times: this can increase the time taken to a
   distance) so the car travels further in this time
8. 20 m/s
9. m/s
10. 20 000
11. Stationary
12. Braking distance
13. Vector
14. Acceleration = Change in velocity ÷ Change in time
15. When an object slows down

Challenge

1. Displacement ÷ Time **OR** Speed in a certain direction
2. Accelerating
3. 0
4. Speed only has a magnitude whereas velocity has a magnitude and a direction
5. Acceleration
6. Speed
7. The speed
8. $35 \div 30 = 1.17\ m/s^2$
9. Slowing down
10. Weight and air resistance (drag)
11. 20 m/s
12. A constant rate of
13. Travelli e opposite direction
14. 9.70s
15. Because displacement is the distance from a given point in a certain direction – an o
    its direction while maintaining or reducing its overall displacement

Extension

1. $a = \frac{(v^2 - u^2)}{2s}$
2. Displacement
3. 4
4. Velocity is changing because of the change of direction, speed is constant
5. Draw a tangent to the graph at the desired time – calculate the gradient of the tang
6. 28 m
7. 90%
8. It will decrease it
9. 1.5 mph (2.4 km/h)
10. Systematic
11. 8 m/s
12. 1.44×10^{11} m
13. 380 000 000 m
14. 9
15. 45.9m

Topic 3 — Newton's Laws and Momentum

Fundamentals

1. Force = mass × acceleration
2. The forces are equal in size and opposite in direction
3. It will remain stationary
4. The resultant force
5. 50 N
6. If the sum of all forces on an object is zero, its velocity will remain constant
7. The acceleration on an object is proportional to the resultant force applied to it
8. Exert equal and opposite forces on each other
9. Mass of the object
10. A 2 N force
11. 42 N
12. 230 m/s^2
13. Also an electrostatic force
14. First
15. False (forces act in the same plane, in different directions)

Challenge

1. The tendency of an object to remain at rest or continue its uniform motion
2. In a closed system the total momentum before an event is equal to the total momen
3. That it will remain constant
4. kg m/s
5. 22 500 kg m/s
6. It will change
7. 0
8. Newton's third law
9. They must be unbalanced
10. 0 kg m/s
11. Vector
12. Different parts of the object move in different directions (so cancel out)
13. F = ma

Extension

1. Increase
2. Continue to move at the same speed and in the same direction
3. The airbag decreases the rate of change of momentum the passenger experiences
4. -3000 kgm/s
5. -2m/s
6. 50 000 kgm/s
7. 8.2×10^{-26} m/s^2
8. Zero error (systematic)
9. Because there will be a point where the maximum driving thrust from the engine is friction and air resistance – the car will reach terminal velocity
10. 87.3 s
11. 34 000 kgm/s (mass of the object = 19600/9.8)
12. $F = \frac{m\Delta v}{t}$
13. 350 N

Topic 4 — Wave Fundamentals

Fundamentals

1. Transverse
2. Longitudinal
3. Hertz (Hz)
4. Find the distance between the same point on two adj[illegible] waves (i.e. peak to peak)
5. Amplitude
6. Wavelength
7. $v = f\lambda$ (wave speed = frequen[illegible] × wa[illegible]ength)
8. Energy
9. Transve[illegible]
10. Longitu[illegible]
11. Frequen[illegible]
12. Particles are close together (high pressure region)
13. Particles are spread further apart (low pressure region)
14. At 90° (right angles)
15. Vibrations around a fixed point

Challenge

1. Perpendicular
2. Parallel to
3. The time taken for one complete wave to pass a point
4. 1 500 000 Hz
5. 21 m
6. Seismic
7. 1
8. 0.01 s
9. Metres
10. 6.7×10^{-8} s
11. Transverse

Extension

1. Inversel[illegible]rti[illegible]al
2. Longitud[illegible]
3. P-waves
4. S-waves cannot travel through liquids, P-waves can travel through both solids and liq[illegible]
5. Percentage error
6. 2.5 m/s
7. Velocity
8. 93 m
9. Set up a float; as the wave passes through the float moves up and down
10. Set up a balloon next to a speaker; as a sound is played the balloon will move backwa[illegible]
11. 2×10^{-6} m
12. 3.3×10^{4} Hz
13. Areas where no P-waves are detected following an earthquake
14. 8 milliseconds

Topic 5 — Electromagnetic Spectrum

Fundamentals

1. Gamma, X-rays, ultraviolet, visible light, infrared, microwaves, radio waves
2. Decreases
3. Satellite communications
4. Skin cancer
5. Gamma and X-rays
6. Visible light
7. They all have the same speed
8. Television and radio signals for communications
9. Sieverts (Sv)
10. Transverse
11. A source
12. Energy
13. Infrared
14. Ultraviolet
15. Radio waves

Challenge

1. Visible light
2. 3×10^8 m/s
3. Ionising
4. Radiation that can remove electrons from atoms
5. When they move between energy levels
6. Can travel long distances in air
7. 30 000 Hz
8. Changes in the nucleus of an atom
9. 0.25 Sv
10. UV
11. Absorber
12. Oscillations
13. It tells you the risk of death from exposure to a particular form of radiation
14. Ultraviolet
15. Gamma

Extension

1. Alternating current
2. It increases
3. Nucleus
4. Microwaves can penetrate the atmosphere
5. Wavelength
6. It will not as refraction occurs when a wave crosses a boundary at an angle
7. Velocity
8. Infrared
9. Can penetrate soft tissue but are absorbed by bone – so can show breakages
10. Visible light is absorbed/affected by:
    - weather/clouds
    - atmospheric disturbances

Topic 6 — Magnets and Electromagnets

Fundamentals

1. Poles (north and south)
2. Because the needle is a bar magnet
3. Increases
4. Filings
5. Weaker
6. Permanent
7. Any one of: iron, steel, nickel or cobalt
8. Reduce it
9. The direction of the force exerted by the north pole (of the magnet)
10. By passing current through it
11. Attract
12. Non-contact
13. Decreases
14. Induced
15. An electromagnet

Challenge

1. Permanent
2. Induced
3. At the poles
4. Solenoid
5. Electromagnet
6. A region around a magnet where a magnetic material experiences a force
7. An electromagnet can be turned on and off – so it can be used for specific functions (e.g. magnetic materials)
8. How close that point is to the wire (the closer, the stronger) and the size of the current
9. Move a plotting compass around the magnet, marking the ends of the needle each time to map the field lines
10. It loses its magnetism very quickly / almost immediately
11. Wrap an insulated wire around a nail and attach the ends to a battery
12. North to south
13. Circular
14. Because it contains iron
15. Clockwise

Extension

1. Adding an iron core **OR** Increasing the number of turns in the solenoid
2. A bar magnet
3. Induced magnetism always creates a force of attraction as the induced poles are opposite to it is placed
4. A solenoid
5. A compass points to the geographic north pole which is a magnetic south pole
6. Down
7. Attractive
8. Its strength
9. Constant strength
10. Uniform
11. 16 μT
12. 0.14 T
13. Force would increase / 5 times
14. B
15. When a force is exerted on a conductor in a magnetic field

Topic 7 — Electric Motors

Fundamentals

1. Current that reverses its direction several times per second
2. Current that flows in one direction round a circuit
3. Electric current
4. Repel
5. False
6. Electromagnet
7. Non-contact
8. Gamma
9. Electron
10. Iron, cobalt, nickel
11. No

Challenge

1. Two (one primary and one secondary)
2. It decreases it
3. If it repels another magnet it is a permanent magnet
4. Generator effect
5. Tesla
6. Step-down
7. 4 m/s²

Extension

1. It increases it
2. 90° to the field (also 270°)
3. Fleming's left hand rule
4. Nothing happens as transformers only work with AC supplies – a battery provides DC