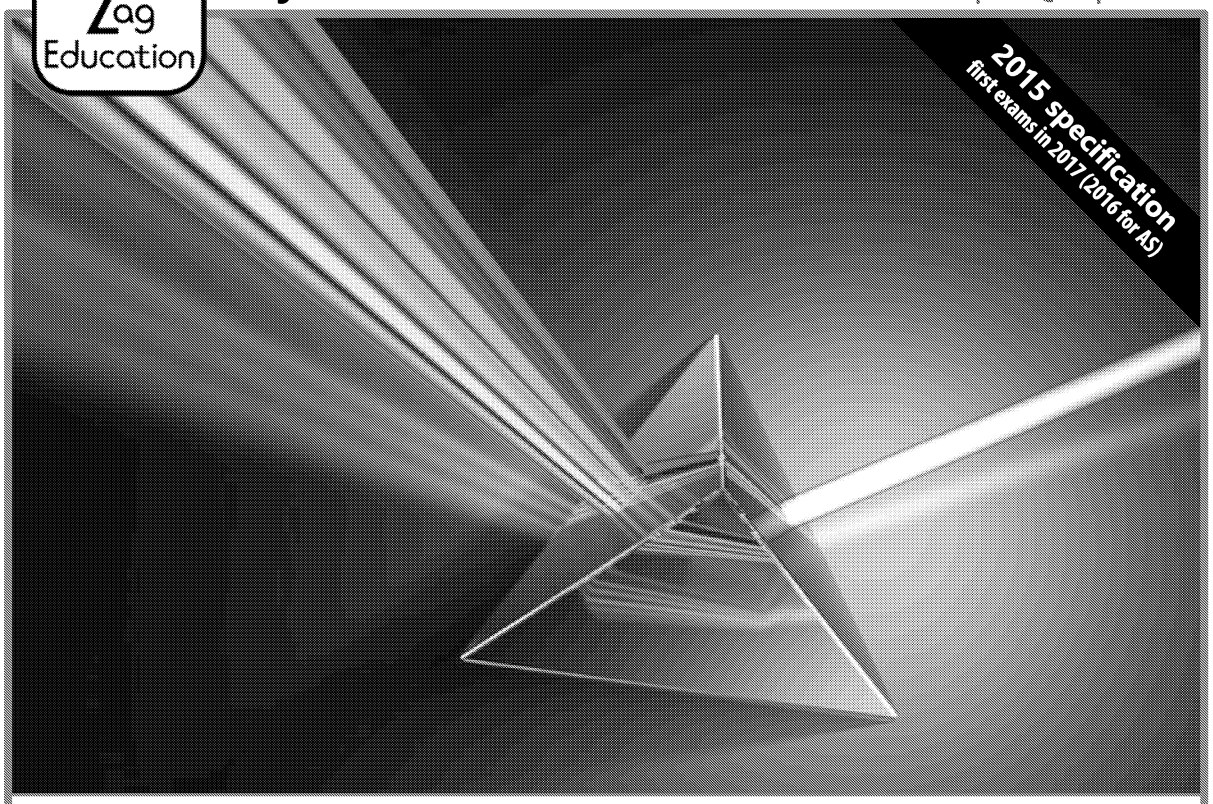
Zig Zag Education

Physics

AS/A Level Year 1 | AQA | 7407



Multiple-Choice Practice Questions

for AS / A Level Year 1 AQA Physics

Update v1.2, October 2024

zigzageducation.co.uk

POD 6801

Contents

Teacher's Introduction

For the AS and A Level Year 1 Physics course, the AQA exam board includes strong emphasis on multiple-choice questioning which is assessed in Section C of Paper 2. The assessment marks awarded for the multiple-choice section are 30 marks out of an available 70 marks for the whole of Paper 2.

Physics students sometimes find the multiple-choice questions testing, the format of the questions often challenges how complete the students' understanding is of the course and requires quick and accurate problem solving to complete all the questions in the time given. This multiple-choice bank resource has been designed with the intention of providing students with the opportunity to review their multiple-choice skills and to practise and familiarise themselves with the questioning format with an extensive spread of multiple-choice questions from sections 1 to 5 of the AS and Year 1 A Level courses.

The resource is split into two sections:

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

Section One: Multiple-choice Question Bank 1
This section includes 100 multiple-choice questions that span each topic making up the AS and Year 1 A Level course. The questions mimic the exam style of the AQA exam board and reflect the depth, difficulty and format of the questions the student will face in their upcoming exam.

A mark scheme is provided at the end of the resource, which includes the answers along with worked solutions. The step-by-step solutions, and additional commentary to accompany them, give students an opportunity to identify the areas that still need improvement, and also to see where any mistakes were made and correct themselves for next time.

Section Two: Multiple-choice Question Bank 2
This section includes another 100 multiple-choice questions that similarly span each topic that makes up the AS and Year 1 A Level course. The questions deliberately mimic those presented to the student in Section 1; this has been done so that, after working through the worked solutions of Section 1, students can complete another set of questions and directly compare their attempts. The format allows students to correct their mistakes from Section 1, identify areas where they have improved their understanding and highlight areas that still require further work.

A mark scheme for Section 2 is also provided at the end of the resource. The mark scheme does not include worked solutions.

This is followed by:

- The **Mark Scheme for Multiple-choice Question Bank 1** which provides a mark scheme with step-by-step solutions and additional accompanying commentary that gives students an explanation for the given solution.
- The **Mark Scheme for Multiple-choice Question Bank 2** which provides the answer to each question but does not provide step-by-step solutions.

August 2016

Update v1.1, 12 September 2017
- p. 21, q. 14 and p. 95, q. 9 – ms^{-1} corrected to ms^{-2}

Update v1.2, 30 October 2024
- Wording of questions improved for p. 7 q. 4, p. 16 q. 18, p. 85 q. 13, p. 93 q. 3 and p. 97 q. 15
- Answers corrected for pp. 57–58 q. 18, pp. 76–77 q. 14, p. 93 q. 3 and p. 103 q. 14

Student's Introduction

Aim:
The pack is designed to help you practise your multiple-choice questions a
solutions, allow you to build effective strategies for completing these ques
questions now make up 30 of 70 marks on AS and A l Year 1 Physics
pack aims to provide you with the tools to co fi ly tackle your upcom

Structure:
The pack is compri of wo sections. Each section contains 100 multiple
the structu l level of the questions you will see in your exam. The 10
cover all fiv pics that make up the AS and A Level Year 1 Physics cours

- **Topic 1**: Use of SI Units and their Prefixes
- **Topic 2**: Particles and Radiation
- **Topic 3**: Waves
- **Topic 4**: Mechanics and Materials
- **Topic 5**: Electricity

After the questions there are two sections of answers. The answers to Sect
solutions and additional commentary that indicates where you where you
indication on how the problem should have been approached. This will a
mistakes and develop strategies on how to tackle future questions. The ar
provide any worked solutions.

How to use this pack:

- You should first complete th s ns in Section 1.
- After you have com th questions you can then proceed by self-
against th w answers and commentary given in the answers se
throu solutions to Section 1, taking note of your mistakes and e
where you went wrong, before continuing with Section 2.
- After completing Section 2 you can proceed by self-marking your solu
section. Additionally you can compare your answers to those obtaine
whether you have improved your skills and identify areas that still ne

Section One: Multiple-Choice Questio

Topic 1: Use of SI Units and their Pre

1. Which of the following forms represents the quantity $5360\ \Omega$?

A $5.36\ \text{M}\Omega$

B $53.6\ \text{n}\Omega$

C $5.36\ \text{k}\Omega$

D $53.$

2. What are the SI base units for temperature?

A K

B °F

C °C

D °R

3. Which of the following are the derived SI units for density (ρ), given

A g m^{-3}

B kg cm^{-3}

C g

D kg m^{-3}

4. What are the SI base units for time?

A Minutes

B Seconds

C Hours

D Milliseconds

5. Which of the following represents 0 A in standard form?

A 0.2×10^{3} A

B 0.2×10^{-6} A

C 0.2 A

D 0.2×10^{6} A

6. Which of the following statements is true?

A Systematic errors cause repeated measurements to alter from their t
varying amounts.

B A source of systematic error can be temperature changes in the exp
surroundings.

C Systematic errors can be more easily identified and eliminated fro
random errors.

D A source of random error can be uncalibrated apparatus.

7. Which of the following statements is true?

A Precision is a term used to describe the relationship between a mea
its true value.

B Precision and accuracy are both terms that indicate how close a me
to its true value.

C Accuracy is a term used to discuss the relationship between a set o
measurements.

D It is possible for a measurement to have both low accuracy and hig

8. A student obtains the values $I = 0.2 \pm 0.1$ A and $R = 2.3 \pm 0.2\ \Omega$ in an

The voltage is found using $V = IR$. What is the voltage?

A 0.46 ± 58.7 V

B 0.46 ... l ...

C 0.4 ... 27 V

D 0.46 ± 0.19 V

9. Which of the following is a valid estimate for the mass of an average m

A 120–130 kg

B 40–60 kg

C 70–80 kg

D 140–150 kg

10. A measurement is repeatable if:

A The experiment is redone by the original experimenter using the sa
apparatus and the same result is achieved.

B The experiment method can be replicated by the same or another e

C The experiment can be carried out using a different method and ap
same result is achieved.

D The experiment can be redone using the same method but differen
the same results are achieved.

11. A student obtains the value $F = 460 \pm 1\ \text{N}$ for the force.

What is the percentage uncertainty of the value for force?

A 0.002%

B 460%

C 0.2%

D 1%

12. What is the derived SI units for velocity, given $v = \frac{d}{t}$?

A km s^{-1}

B m h^{-1}

C km h^{-1}

D m s^{-1}

13. What is the value E = 45 eV converted into joules?

A $7.2 \times 10^{-18}\ \text{J}$

B $2.8 \times 10^{20}\ \text{J}$

C $7.2 \times 10^{20}\ \text{J}$

D $2.8 \times 10^{-18}\ \text{J}$

14. What is the value for energy $E = 0.55\ \text{kWh}$ converted into J?

A 550 J

B 200 000 J

C 33 000 J

D 2 000 000 J

15. Which of the following is an accurate estimate of the order of magnitude of the volume of a human head?

A $\times 10^{-5}\ \text{m}^3$

B $\times 10^{-2}\ \text{m}^3$

C $\times 10^{-3}\ \text{m}^3$

D $\times 10^{-1}\ \text{m}^3$

16. A student obtains the values $Q = 5.2 \pm 0.1\,C$ and $E = 50 \pm 5\,J$ in a circ

The emf of the cell used is the experiment is found using $\varepsilon = \frac{E}{Q}$.

What is the emf?

A $9.6 \pm 11.9\,V$

B $9.6 \pm 1.1\,V$

C $9.6 \pm 0.8\,V$

D 9 V

17. Which of the following units are **not** equivalent to 1 joule (J)?

A $kg\,m^2\,s^{-2}$

B Nm

C Ws

D CV^{-1}

18. Which of the following is the SI base unit for current?

A A

B mA

C kA

D G

19. A space shuttle can travel 700 metres in 0.09 seconds when at maximu

What is the maximum speed of a space shuttle in kms^{-1}?

A $780\ kms^{-1}$

B $78\ kms^{-1}$

C $7.8\ kms^{-1}$

D $7800\ kms^{-1}$

20. Which of the following is not equivalent to J?

A eV

B kW

C W

D CV

Topic 2: Particles and Radiation

1. Which of the following statements is true?

A The mass of an electron is greater than the mass of a proton and th

B The charge of an electron and a proton are e[illegible]nd opposite.

C The charge of a neutron is equ[illegible]he charge of a proton.

D The mass of an [illegible] less than the mass of a proton but greate

2. How m[illegible]eutrons are there in lithium-7 ($^{7}_{3}\mathrm{Li}$)?

A 7

B 10

C 3

D 4

3. β^- decay can be represented by the following equation:

$$^{14}_{6}C \rightarrow {}^{14}_{X}N + {}^{0}_{-1}e + Y$$

Which of the following are the correct missing val[illegible] for **X** and **Y?**

A **X** = 7; **Y** = ν_e

B **X** = 7; **Y** = $\overline{\nu_e}$

C **X** = [illegible] ν_e

D **X** = 8; **Y** = $\overline{\nu_e}$

4. The antiparticles of the proton and electron and their charges are prov[illegible]

	Proton	
Antiparticle	antiproton	
Charge of Antiparticle	**Y**	

Which of the following are the correct missing values for **X** and **Y**?

A **X** = antielectron; **Y** = $-e$

B **X** = positron; **Y** = $+e$

C **X** = antielectron; **Y** = [illegible]

D **X** = [illegible]ron; **Y** = $-e$

5. Which of the following values represents the energy of a photon with f

A 1.4×10^{-19} J

B 3.2×10^{47} J

C 3.2×10^{-48} J

D 3.4×10^{-5} J

6. Which of the following is **n** the four fundamental interactions?

A Weak

B Str

C Radioactive

D Electromagnetic

7. Which of the following statements is **not** true?

A *Down* and *up* are both names of quarks.

B Mesons and baryons are both hadrons.

C Baryons are made up of three quarks and mesons are made up of t

D Strange particles are quarks and are produce ough strong inte

8. Light with frequency 2.8× is incident on the surface of zinc, w
4.3 eV. The pho effect causes photoelectrons to be emitted fro

Calcula maximum kinetic energy of the photoelectrons emitted fr

A 1.2×10^{-18} J

B -4.3 J

C 2.5×10^{-18} J

D 4.3 J

9. An electron de-excites from an excited energy state $E = -0.90$ eV to a lowe

What is the frequency of the photon emitted electron transitions

A 9.10×10^{32} Hz

B 1.45×10^{14} Hz

C 5.7 14

D 2.8 18 Hz

10. Which of the following statements is **not** true?

A All quarks have a charge of $+\frac{2}{3}$ and all antiquarks have a charge

B All quarks have a baryon number of $+\frac{1}{3}$.

C Baryon number is a conserved quantity.

D All antiquarks have a baryon number of $-\frac{1}{3}$.

11. Which of the following statements is true?

A Isotopes are nuclei of the same element with the same nucleon nu atomic number.

B Isotopes are nuclei of the same element with the same number of number of neutrons.

C ^{4}Li and ^{4}He are examples of isotopes of each other.

D For nuclei of the same element to be referred to as isotopes they n nucleon number and atomic number.

12. A high-energy gamma ray has energy 100 G

What is the wavelength of a gamma ray of 100 GeV?

A 1.99×10^{-36} m

B 1.24×10^{-8} m

C 1.24×10^{-17} m

D 7.24×10^{33} m

13. Which of the following statements is true?

A The threshold frequency is the maximum frequency of light incid cause electron emission from the surface.

B The rate of emission of electrons from the surface of a metal can b the metal to incident light for a longer time period.

C Light of frequency below the threshold frequency can increase the emitted per second if the intensity of the light is increased.

D The stopping potential causes the maximum kinetic energy of an e reduced to zero.

14. The muon decay can be represented by the following decay equation:

$$\mu^- \rightarrow X + \overline{\nu_e} + Y$$

What are the missing values for **X** and **Y**?

A X = e^+ ; Y = ν_μ

B X = e^- ; Y = $\overline{\nu_\mu}$

C X = e^- ; Y = ν_μ

D X = [illegible] ; Y = ν_μ

15. An electron and positron meet and annihilation occurs.

What is the minimum energy of each photon produced during annihi[illegible]

Note: E_0 is the rest energy of the electron.

A E_0

B $2E_0$

C $\frac{1}{2}E_0$

D $4E_0$

16. A table of th[illegible]nental forces and their force carriers is given be[illegible]

Fundamental force	Force carri[illegible]
Electromagnetic force	**X**
Y	W boson
Z	pion

What are the missing values for X, Y and Z?

A **X** = kaon; **Y** = Strong nuclear force; **Z** = Weak nuclear force

B **X** = photon; **Y** = Weak nuclear force; **Z** = Strong nuclear force

C **X** = kaon; **Y** = Weak nuclear force; **Z** = G[illegible]

D **X** = photon; **Y** = Gravity; **Z** = [illegible]g nuclear force

17. The decay of the neutron is represented by the decay equation:

$$n \rightarrow X + Y + \overline{\nu_e}$$

What are the missing values for **X** and **Y**?

A **X** = p; **Y** = e^+

B **X** = $\overline{\nu_\mu}$; **Y** = e^-

C **X** = p; **Y** = e^-

D **X** = n; **Y** = e^+

18. Which of the following statements is **not** true?

A Electrons can cause ionisation when they collide with gas in a fluo

B Alpha, beta and gamma radiation cause ionisation when they coll

C An ion is produced from adding or removing an electron from an

D An ion is a charged atom with the same number of electrons and p

19. Which of the following statements is **not** true?

A Strong nuclear force is the force that holds n together in stable

B Strong nuclear force compensates for the electromagnetic repulsio in the nucleus.

C Strong nuclear force has a different effect between a proton and a n between two protons.

D The range of the strong nuclear force is 3–4 fm.

20. A photon has energy 1.8×10^{-19} J.

What will the wavelength of the photon be with this energy?

A 2.5×10^{60} m

B 8.2×10^{22} m

C 1.1×10^{-6} m

D 1.2×10^{-23} m

Topic 3: Waves

1. Which of the following statements **is** true?

A Phase difference can be measured in radians but not in degrees.

B Amplitude of a wave is the distance from a crest to its correspondi

C If the frequency of a wave is increased the period of the wave will

D The wavelength of a wave is the distance of one complete cycle.

2. Which one of the following is **not** an example of a transverse wave?

A Sound

B Electromagnetic

C Wave on a string

D Light

3. A transverse wave is travelling with a frequency of $f = 5.6$ Hz and has

What is the wave speed of the wave?

A $4.5\ \text{ms}^{-1}$

B $0.04\ \text{ms}^{-1}$

C $7\ \text{ms}^{-1}$

D $0.($

4. Which of the following statements is **not** true?

A If a wave is plane-polarised then it is only oscillating in one directi

B Plane of polarisation for an electromagnetic wave is the plane in w oscillates.

C To plane-polarise light you need two polarising filters at right angl

D The intensity of light passing through polarising filters can be alter relative to one another.

5. A string fixed at both ends forms a stationary wave.

The length of the string is 1.2 m.

What is the wavelength of the first harmonic?

A 0.6 m

B 2.4 m

C 1.2 m

D 4.8 m

6. A stati[illegible]wave is created with a string of length 53 cm which has m[illegible] $\mu = 0.0$[illegible] $kg\,m^{-1}$.

The string is fixed between two points creating tension of 0.2 N in the s[illegible]

What is the harmonic frequency?

A 18.8 Hz

B 4.2 Hz

C 0.04 Hz

D 0.2 Hz

7. Which of the following statements is **not** true?
(i is the angle of incidence and r is th[illegible] refraction.)

A The refractive index of a sub[illegible]ce is the ratio of the speed of light i[illegible] the speed of li[illegible] substance.

B Th[illegible]ctive index of a substance is the ratio of $\sin i$ to $\sin r$.

C If the angle of incidence was increased it would increase the refrac[illegible] substance.

D The refractive index ratio can also be referred to as Snell's law.

8. The refractive index of air is approximately 1 and the refractive index o[illegible]

Light travels from air into a diamond at an angle of incidence of 37.0°.

What is the angle of refraction of the light ray in the diamond?

A 53.0°

B 37.0°

C 14.5°

D 75.5°

9. Which of the following statements is **not** true?

A If $i >$ critical angle, then total internal reflection will always occur.

B If $i =$ critical angle and the incident substance has a larger refractiv
$r = 90°$.

C If $i <$ critical angle and the incident substance ha a larger refractiv
there will be partial reflection.

D If $i =$ critical angle and the inci sub tance has a larger refractiv
there will be partial f ech

10. Whic following statements **is** true?

A Core cladding surrounding the core of an optical fibre is made of
greater refractive index than the core.

B A narrow core in an optical fibre prevents modal dispersion.

C Modal dispersion refers to pulse dispersion caused by using whit
monochromatic light.

D Material dispersion refers to lengthening of a light pulse due to th
different speeds down the optical fibre.

11. A monochromatic light source is diffracted through a diffraction grat
$d = 3.07\ \mu\text{m}$.

The 4th order beam is observed at ar g from the zero order b

What is the wavelength o ig. t sed in this experiment?

A 6.6 0

B 1.5 0 m

C 0.66 m

D 1.50 m

12. Young's double slit experiment is used to create an interference patte

The experiment uses light with wavelength $\lambda = 720\ \text{nm}$.

The separation between the fringes on the screen is 20 cm and the slit

What is the slit spacing s?

A 7.9×10^{-6} m

B 7.9×10^{-8} m

C 1 0 5

D 1.26×10^{7} m

13. Which of the following statements is **not** true?

A Bright fringes are formed due to interference of light rays that arr another.

B Dark fringes are formed due to interference of light rays that arriv other.

C If the slit spacing decreased, the fringe separation of the interfere increase.

D The two slits in Young's double-slit experiment act as coherent so

14. Which of the following statements **is** true?

A Reflection refers to the change in a wave's speed and wavelength boundary.

B Refraction is the effect of the angle of incidence being equal to ang surface of the boundary.

C Diffraction arises when waves spread round an obstacle or throug

D The shorter the wavelength of a wave, the more the waves will di

15. The distance between two points A and B on a transverse wave is 42 c

The wavelength of the transverse wave is 6.0 cm.

What is the phase difference in rad between A and B?

A 0.44

B 0.

C 27

D 2.7

16. Which of the following statements is **not** true?

A The frequency of a wave is the number of cycles of oscillation per

B The displacement is half the distance from a crest to the corresponding trough.

C The frequency of a wave can be defined as the number of complete per second.

D The period is the time for one complete wave to pass a fixed point.

17. A stationary wave is created in a string fixed at either end.

The frequency of the first harmonic is $f_1 = \frac{c}{2L}$.

What is the frequency of the second harmonic?

A $2f_1$

B f_1

C $\frac{1}{2}f_1$

D $4f_1$

18. A light ray enters a block at an angle of 37° and is refracted inside the block at an angle of 24°.

What is the refractive index of the block?

A 0.65

B 1.5

C 1.3

D 0.76

19. Which of the following statements is **not** true?

A Light from a filament lamp is comprised of a range of wavelengths.

B Vapour lamps produce light with one predominant colour.

C Laser light has light that is highly monochromatic.

D Laser beam light can permanently damage your retina if looked at when the light has first been reflected.

20. The period of a wave on a string is 1 minute.

What is the frequency of the wave?

A 1 Hz

B 0.02 Hz

C 60 Hz

D 0.01 Hz

Topic 4: Mechanics and Materials

1. Which of the following quantities is **not** a scalar?

A Mass

B Energy

C Displacement

D Speed

2. Which following statements is **not** true?

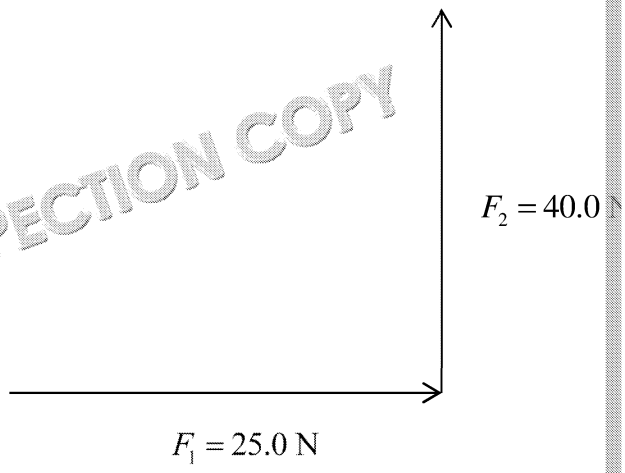
A A scalar is defined by both magnitude and direction.

B Force and weight are both vectors.

C A vector is defined by both magnitude and direction.

D Acceleration is a vector and time is a scalar.

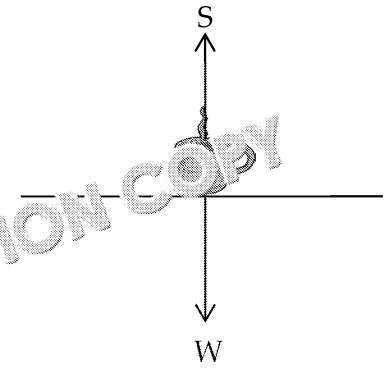
3. Two forces act at right angles to each other:



Which of the following rows gives the correct magnitude and direction

A	↙
B	↗
C	
D	↙

4. A coffee mug is at rest on the surface of a table.



Which of the following statements is true for the forces S and W?

A $S \leq W$

B $S > W$

C $S < W$

D $S = W$

5. An engineer turns a spanner with a force of 140 N.

The engineer's hand is 390 mm from the pivot.

What is the moment of the force about the pivot?

A 0.00546 Nm

B 54.6 Nm

C 359.0 Nm

D 3.59 Nm

6. Which of the following statements is true?

The principle of moments states that for a body in equilibrium:

A The sum of the clockwise moments is equal to half the sum of the a
moments.

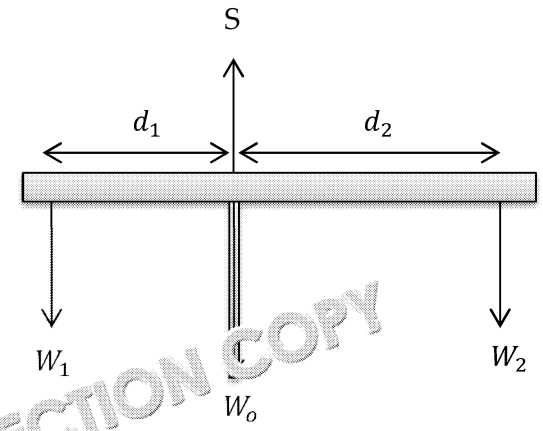
B The sum of the clockwise moments is equal t ce the sum of the
moments.

C The sum of the clockw ts is equal to the sum of the antic

D The o ckwise moments is equal to four times the sum o
mo

7. Supports are being built during the construction of a house.

The supports are in equilibrium:



Which f g statements is true for the supports to be in equ

A $S = W_2 - W_O$

B $W_1 d_1 = -W_2 d_2$

C $W_1 = \dfrac{W_2 d_1}{d_2}$

D $d_1 = \dfrac{W_2 d_2}{W_1}$

8. Which of the following statements is **not** true?

A The displacement of an object can be d te m ed by the area unde

B The acceleration of an ject t be determined using the gradient
graph.

C Th ity of an object can be determined using the gradient of a
grap

D The acceleration of an object can be determined by the area under t

9. A cyclist sets off at $2.1\,ms^{-1}$.

The cyclist travels for 5 minutes and reaches $4.9\,ms^{-1}$.

What is the acceleration of the cyclist?

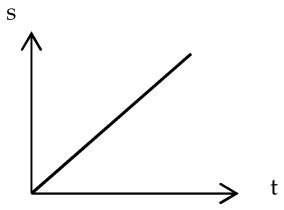
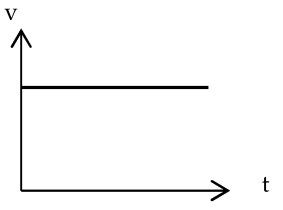
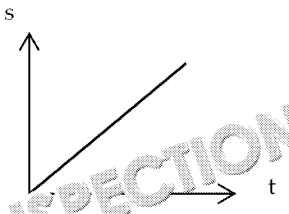
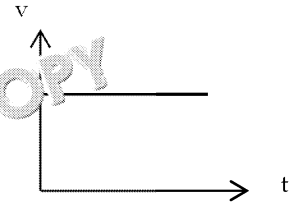
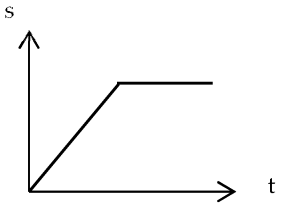
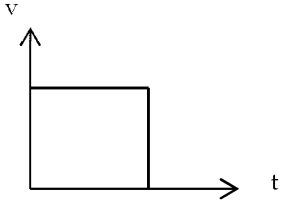
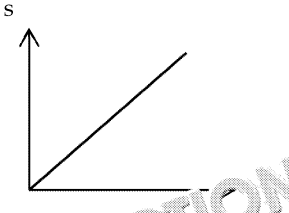
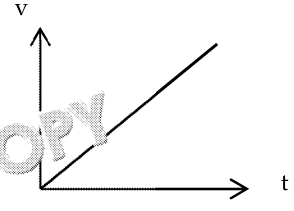
A $0.02\,ms^{-1}$

B $0.56\,ms^{-1}$

C $0.01\,ms^{-1}$

D $1.4\,ms^{-1}$

10. Which of the following rows identifies three graphs related to the same

A		
B		
C		
D		

11. A ball is projected horizontally off a cliff.

What will the height of the ball be after 2.20 seconds? Assume air res

A 10.8 m

B –23.7 m

C –10.8 m

D 23.7 m

12. Whic following statements is **not** true?

A The acceleration of a projectile is always equal to g if air resistan

B The horizontal motion and vertical motion of a projectile are depe

C The horizontal velocity of a projectile is constant if air resistance i

D A ball projected horizontally and a ball dropped vertically will re same time if air resistance is negligible.

13. Which of the following statements is **not** true?

A Newton's first law states that if no external force is applied to an o rest or continue travelling at a constant velocity.

B An object will experience acceleratio if speed remains constan changes.

C If a student pu with a force of 150 N, the wall will push N the opposite direction.

D An applied force is proportional to the velocity of the object.

14. A skydiver opens her parachute in the last stage of her jump and crea

The skydiver has mass $m = 65$ kg and accelerates towards the ground

What is the value for the drag force created by the parachute?

A 39 N

B 640 N

C 600 N

D –600 N

15. A footballer kicks a 430 g football.

The football was travelling at 21 m s^{-1} before being kicked. After bein
footballer's foot at 29 m s^{-1}.

What is the value for the impulse of the force on the football?

A 3.4 Ns

B 3.4×10^{3} Ns

C -3.4×10^{3} N

D -3

16. A 0.50 kg ball is dropped from a 10.0 m building.

What will the kinetic energy of the ball be 2.00 m above the ground?

A 39.2 J

B 9.80 J

C 58.8 J

D 49.0 J

17. An object has a density $\rho = m / V$

What is the volume of the object with a mass of $2m$ and with the s

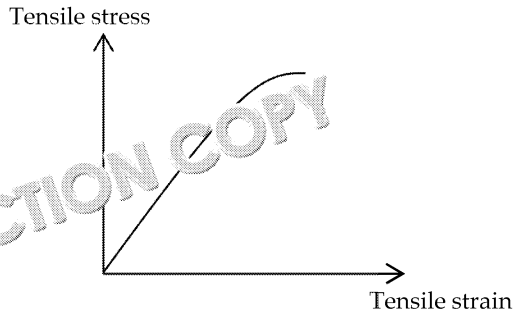
A $2V$

B $\frac{1}{2}V$

C V

D $\frac{1}{V}$

18. The graph below shows how the tensile stress of a material varies wit



How can you determine the Young modulus from the graph?

A The y-intercept of the graph

B The area under the graph

C The gradient of the straight line section of the graph

D Any x-coordinate on the curve

19. A force of 56.0 N is applied to an elastic band in order to stretch it by 0

What is the value of the energy stored in the elastic band?

A 0.001 J

B 0.18 J

C 18

D 11.8 J

20. The period of a wave on a string is 3 minutes.

What is the frequency of the wave?

A 0.3 Hz

B 0.003 Hz

C 180 Hz

D 0.006 Hz

Topic 5: Electricity

1. Which of the following statements **is** true?

A Electric current is the rate of flow of charge.

B Potential difference is the work done per unit time.

C The resistance of an electrical component is the ratio of voltage to charge.

D Charge is the ratio of resistance to voltage.

2. A student measures 5.0 A of current flowing through an electrical circuit.

What is the charge flow in the circuit?

A 100 C

B 2500 C

C 0.01 C

D 5.0 C

3. The charge flow through a cell is measured to be 24 C.

How many electrons have passed through the cell?

A 1.5×10^{20}

B 6.7×10^{-21}

C 2.6×10^{31}

D 1.5

4. A filament bulb is connected in series with a cell. The bulb does 40.0 J of work as 3.0 C of charge flows through it.

What is the potential difference across the bulb?

A 12 V

B 120 V

C 0.01 V

D 13.3 V

5. Which of the following statements is/are true?

A A filament bulb is an example of an ohmic conductor.

B Ohm's law states that the resistance of a component is equal to the potential difference across the component and the current flowing through it.

C Ohm's law states that the potential difference across a conductor is proportional to the current through it, if the temperature of the conductor remains constant.

D Ohmic conductors are components that obey Ohm's law.

6. A wire of cross-sectional area A and length L and resistance R.

A second wire with a cross-sectional area of $4A$ and length $2L$ is found i
same resistance.

What is the resistivity of the second wire?

A 2ρ

B $\frac{1}{2}\rho$

C ρ

D 4ρ

7. Which of the following statements is **not** true?

A When a device is displaying superconductivity it has no resistance.

B Superconductors can be used to make high-power electromagnets t
strong magnetic fields.

C A superconductor is a device made of a material that has zero resis

D Superconductivity is the property of a material indicating that any
above its critical temperature will result in the terial having zero

8. Three 16.5 Ω resistors are co ed in parallel.

What is the total r ce of the parallel circuit?

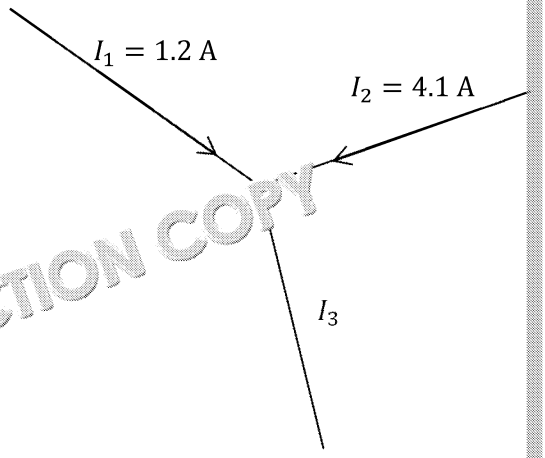
A 49.5

B 5.5 Ω

C 0.18 Ω

D 16.5 Ω

9. A junction in an electrical circuit is demonstrated below:



Which of the following rows correctly identifies the direction and valu

A	↘	
B	↘	
C	↖	
D	↖	

10. A kettle is fitted with a heating element to heat the water inside it.

The heating element has a resistance of 150 Ω. When the kettle is connected to the mains, a current of 1.50 A flows through it.

What is the rate of heat transfer to the water in the kettle?

A 2.00 mW

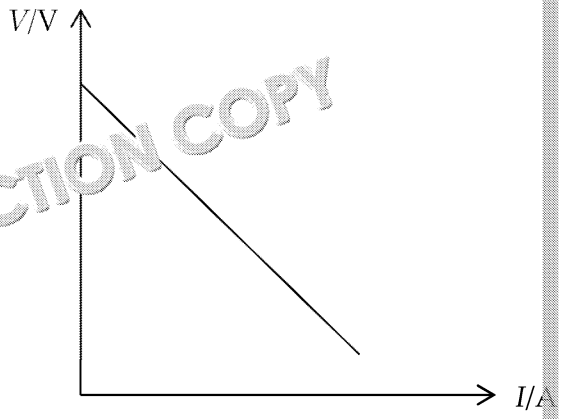
B 225 W

C 338 W

D 67.0 W

11. A student completes an experiment to determine the internal resistanc

The student plots a graph of potential difference across the cell agains
the cell:



Which of the following rows correctly identifies how to determine the
of the cell from the graph?

	Internal resistance	
A	gradient	
B	y-intercept	
C	$\frac{1}{\text{gradient}}$	
D	y-intercept	

12. An 8.0 Ω resistor is connected in series with a cell. The e.m.f. of the c
resista 110 mΩ.

What is the terminal potential difference of the cell?

A 5.44 V

B 12.0 V

C 0.800 V

D 11.8 V

13. Which of the following statements is **not** true?

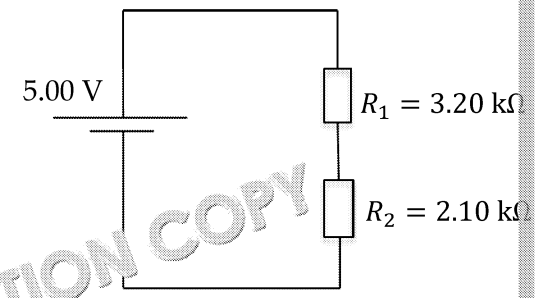
A When the temperature of a thermisto increases, the resistance of

B When the intensity of light incident on an LDR increases, the
decreases.

C When the intensity of the light incident on an LDR decreases, the
acr the LDR decreases.

D When the temperature of a thermistor increases, the potential diff
thermistor decreases.

14. A potential divider is set up as below:



What is the potential difference across R_1?

A 2.4

B 2.50 V

C 2.12 V

D 3.01 V

15. Which of the following statements is **not** true?

A The potential difference across each component connected in series terminal potential difference across the cell of the circuit.

B The total resistance in a series circuit is the sum of all the resistance connected in series.

C The current in a series circuit is the same at all points in the circuit

D The total resistance of two resistors in a parallel circuit is equal to

16. A 2.2 kΩ resistor is connected in series with a cell. The potential differen

What is the rate of energy transfer through the resistor?

A 14 W

B 0.01 W

C 2.50 W

D 2.50×10^{3} W

17. Which of the following statements is **not** true?

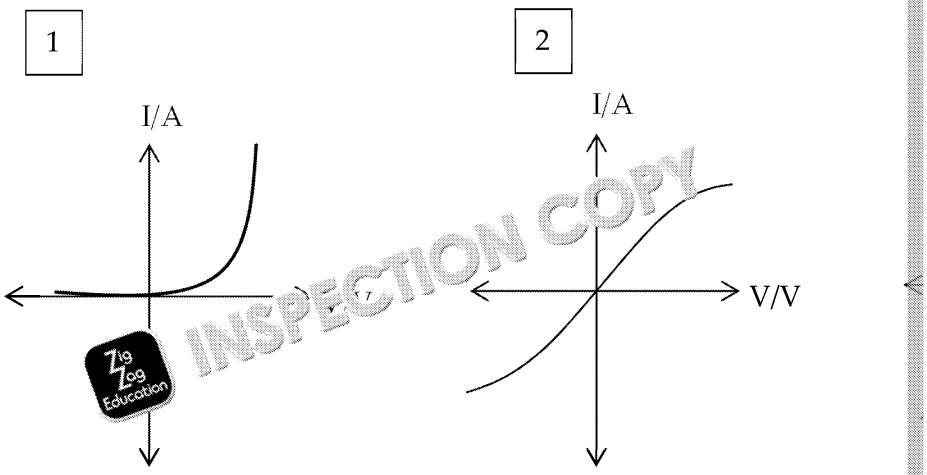
A In an insulator each electron is connected to an atom and fixed to th

B Electrons that are connected to atoms in a metallic conductor are the con

C In a semiconductor the number of charge carriers increases with an temperature.

D Most electrons within a metallic conductor are connected to atoms a delocalised.

18. A student plots graphs of current against potential difference for three



Which of the following rows correctly identifies the electrical compone
above?

	1	2
A	Thermistor	Diode
B	Lamp	Thermistor
C	Diode	Lamp
D	Thermistor	Lamp

19. Which of the following statements i ot ?

A A metal has a posi ter perature coefficient as its resistance inc
increase.

B Ti stance of a thermistor decreases non-linearly with increas

C Semiconductors have a negative temperature coefficient.

D The charge carriers in a conductor travel through the conductor w
potential difference is applied across the conductor.

20. The power output of a filament lamp is 0.15 kW. The current flowing

What is the potential difference across the lamp when there is current

A 38 V

B 0.04 V

C 600 V

D 0.6 V

Answers to Multiple-Choice Questio

Topic 1: Use of SI Units and their Pre

Question 1

A	✗	**M = 'mega' = ×10^{6}** 5.36×10^{6} Ω = 5 360 000 Ω	**Mistake:** You have used ×10^{3} as the or instead of its true order of magnitude ×
B	✗	**n = 'nano' = ×10^{-9}** 5.36×10^{-9} Ω = 0.000 000 005 36 Ω	**Mistake:** You have used ×10^{3} as the or instead of its true order of magnitude ×
C	✓	**k = 'kilo' = ×10^{3}** 5.36×10^{3} Ω = 5 360 Ω	
D	✗	**c = 'centi' = ×10^{-2}** 5.36×10^{-2} Ω = 0.0536 Ω	**Mistake:** You have used ×10^{3} as the or instead of its true order of magnitude ×

Question 2

A	✓	Kelvin is the SI base unit for temperature.
B	✗	Fahrenheit can be used as a unit for temperature but it is not the SI ba
C	✗	Celsius can be used as a unit for temperature but it is not the SI base
D	✗	Rankine can be used as a unit for temperature but it is not the SI base

Question 3

A	✗	$\rho = \frac{m}{V}$ Units: m = **g** and V = m^{3} $\rho = \frac{\mathbf{g}}{\mathrm{m}^3}$ $\rho = \mathbf{g}\,\mathrm{m}^{-3}$	You have correctly determined the uni **Mistake:** You have not determined the You have not converted mass into its **S** Both **mass** and **volume** quantities need determine the **derived base units** for d
B	✗	$\rho = \frac{m}{V}$ Units: m = kg and V = **cm**^{3} $\rho = \frac{\mathrm{kg}}{\mathbf{cm}^3}$ $\rho = \mathrm{kg}\,\mathbf{cm}^{-3}$	You have correctly determined the uni **Mistake:** You have not determined the You have not converted volume into its Both **mass** and **volume** quantities need determine the **derived base units** for d

C	✗	$\rho = \frac{m}{V}$ Units: $m = \mathbf{g}$ and $V = \mathbf{cm^3}$ $\rho = \frac{\mathbf{g}}{\mathbf{cm^3}}$ $\rho = \mathbf{g\,cm^{-3}}$	You have correctly determined the units for density. **Mistake:** You have not determined the You have converted neither mass nor v **cm^3 into m^3 and g into kg.** Both **mass** and **volume** quantities need determine the **derived base units** for d
D	✓	$\rho = \frac{m}{V}$ Units: $m = \text{kg}$ and V $\rho = \text{kg m}^{-3}$	

Question 4

A	✗	**Minutes** are units that can be used for time, but they are **not the SI b**
B	✓	**Seconds** are the **SI base unit** for time.
C	✗	**Hours** are units that can be used for time, but they are **not the SI bas**
D	✗	**Milliseconds** are units that can be used for time, **but are not the SI b**

Question 5

A	✗	**k = 'kilo' = $\times 10^3$** 0.2×10^3 A= 0.2 kA	**Mistake:** You have used $\times 10^{-3}$ as the o instead of its true order of magnitude $\times$
B	✗	**μ = 'micro' = $\times 10^{-6}$** 0.2×10^{-6} A= 0.2 μA	**Mistake:** You have used $\times 10^{-3}$ as the o instead of its true order of magnitude $\times$
C	✓	m = 'milli' = $\times 10^{-3}$ 0.2×10^{-3} A= 0.2 mA	
D	✗	M= 'Mega' = $\times 10^6$ 0.2×10^6 A= 0.2 MA	**Mistake:** You have used $\times 10^{-3}$ as the o instead of its true order of magnitude $\times$

Question 6

A	✗	Systematic errors do cause **repeated measurements** to **alter from the** the **same** amount.
B	✗	Temperature changes in the experiment's surroundings are a source o **that cannot be foreseen**.
C	✓	True. Systematic errors can be foresee and usually to do with inaccura uncalibrated apparatu is of experimental equipment where external factor not be foreseen.
D	✗	lib apparatus will cause **repeated measurements** to **deviat same amount** and is therefore a source of **systematic error**.

Question 7

A	✗	**Accuracy** is a term used to describe the **relationship** between a **meas**
B	✗	Only **accuracy** is a term used to describe **how close** a **measured valu**
C	✗	**Precision** is a term used to discuss the **relationship** between a **set of**
D	✓	A measurement can be described as being **[illegible]ut from its true value** **proximity to the rest of the repeated measurements** (high precision)

Question 8

A	✗	$V = IR$ $V = 0.2 \times 2.3 = 0.46$ $\%$ uncertainty in $I = \frac{0.1}{0.2} \times 100 = 50\%$ $\%$ uncertainty in $R = \frac{0.2}{2.3} \times 100 = 8.7\%$ $\%$ uncertainty in $V = (50 + 8.7) = 58.7\%$ $V = 0.46 \pm \mathbf{58.7}$ V	**Mistake:** Y **percentage** **uncertainty** The equatio $\%$ uncerta Therefore t percentage uncertainty $\Delta a = \frac{\%}{}$
B	✗	$V = IR$ $V = 0.2 \times 2.3 = 0.46$ $\%$ uncertainty in $I = \frac{0.1}{0.2} \times 100 = 50\%$ $\%$ uncertainty in $R = \frac{0.2}{2.3} \times 100 = 8.7\%$ $\%$ uncertainty in $V = (50 - 8.7) = \mathbf{41.3\%}$ $0.46 \pm \mathbf{41.3}$ V	**Mistake:** Y **uncertainti** should hav another. The rule fo quantities a *If* $C = AB$ $C = (A \pm a)$ $C = (A \times B)$ Additionall from **perce** **absolute u** The equatio $\%$ uncerta Therefore t percentage uncertainty $\Delta a = \frac{\%}{}$

C	✓	$V = IR$ $V = 0.2 \times 2.3 = 0.46$ $\%$ uncertainty in $I = \frac{0.1}{0.2} \times 100 = 50\%$ $\%$ uncertainty in $R = \frac{0.2}{2.3} \times 100 = 8.7\%$ $\%$ uncertainty in $V = (50 + 8.7) = 58.7\%$ absolute uncertainty in $V = \left(\frac{\%\ \text{uncertainty}}{100} \times V \right)$ absolute uncertainty in $V = \left(\frac{58.7}{100} \times 0.46 \right) = 0.27$ $V = 0.46 \pm 0.27$ V	
D	✗	$V = IR$ $V = 0.2 \times 2.3 = 0.46$ $\%$ uncertainty in $I = \frac{0.1}{0.2} \times 100 = 50\%$ $\%$ uncertainty in $R = \frac{0.2}{2.3} \times 100 = 8.7\%$ $\%$ uncertainty in $V = (50 - 8.7) = \mathbf{41.3\%}$ absolute uncertainty in $V = \left(\frac{\%\ \text{uncertainty}}{100} \times V \right)$ absolute uncertainty in $V = \left(\frac{\mathbf{41.3}}{100} \times 0.46 \right) = 0.19$ $V = 0.46 \pm \mathbf{0.19}$ V	**Mistake:** Yo **uncertainti** should have another. The rule fo quantities a If $C = AB$ $C = (A \pm a)$ $C = (A \times B)$

Question 9

A	✗	**Too heavy** for an average man
B	✗	**Too light** for an averag[illegible] suited to an average boy
C	✓	Correct
D	✗	[illegible] **heavy** for an average man

Question 10

A	✓	
B	✗	**Reproducibility** refers to property of an experiment whereby its **meth** **same or another experimenter** working independently.
C	✗	The experiment has to be carried out using the **same method and app** achieved for the measurement to be said to be **repeatable**.
D	✗	The experiment has to be carried out using the **same method and app** achieved for the measurement to be said to be **repeatable**.

Question 11

A	✗	$F = 460 \pm 1$ N $\text{percentage uncertainty} = \frac{1}{460}$ $\text{percentage uncertainty} = 0.002\ \%$	**Mistake:** You have calcu instead of the percentag You should have **multip** $\frac{1}{460}$ **by 100** to obtain th
B	✗	$F = 460 \pm 1$ N $\text{rce} \ldots \text{certainty} = \frac{\mathbf{460}}{\mathbf{1}}$ $\ldots\text{centage uncertainty} = 460\ \%$	**Mistake:** You have inco uncertainty. You have **d** by its **absolute uncertai** **divided** the **absolute un** **value (460).** Additionally you should uncertainty **by 100** to ob
C	✓	$F = 460 \pm 1$ N $\text{percentage uncertainty} = \frac{1}{460} \times 100$ $\text{percentage uncertainty} = 0.2\ \%$	
D	✗	$F = 460 \pm \mathbf{1}$ **N** uncertainty = **1** percentage uncertainty = 1 %	**Mistake:** You have mist (± 1) to be the percentag

Question 12

A	✗	$v = \frac{d}{t}$ …ts: $d = \mathbf{km}$; $t =$ s $v = \frac{\mathbf{km}}{\text{s}}$ $v = \mathbf{km}\ \text{s}^{-1}$	…u have determined the units for velocity. **Mistake:** You have not determined the **deri** have not converted displacement into its **SI** Both **distance** and **time** quantities need to b determine the **derived base units** for velocit
B	✗	$v = \frac{d}{t}$ Units: $d =$ m; $t = \mathbf{h}$ $v = \frac{\text{m}}{\mathbf{h}}$ $v = \text{m}\ \mathbf{h}^{-1}$	You have determined the units for velocity. **Mistake:** You have not determined the **deri** have not converted time into its **SI base uni** Both **distance** and **time** …uantities need to b determine the **d… …b…se units** for velocit

C	✗	$v = \frac{d}{t}$ Units: $d = \mathbf{km}; t = \mathbf{h}$ $v = \frac{\mathbf{km}}{\mathbf{h}}$ $v = \mathbf{km\,h^{-1}}$	You have determined the units for velocity. **Mistake:** You have not determined the **deri** have not converted time into its **SI base uni** You have not converted displacement into i Both **distance** and **time** quantities need to b determine the **derived base units** for veloci
D	✓	$v = \frac{d}{t}$ Units: $d = \text{m}; t = \text{s}$ $\frac{\text{m}}{\text{s}}$ $v = \text{m s}^{-1}$	

Question 13

A	✓	$E = 45\text{ eV}$ $1\text{ eV} = 1.6\times10^{-19}\text{ J}$ $45\times(1.6\times10^{-19})$ $= 7.2\times10^{-18}\text{ J}$	
B	✗	$E = 45\text{ eV}$ $\frac{45}{1.6\times10^{-19}}$ $= 2.8\times10^{20}\text{ J}$	**Mistake:** You have not correctly conve You have **divided** by the value **e = 1.6 multiplied**.
C	✗	$E = 45\text{ eV}$ $45\times\mathbf{1.6\times}$ $2.$ J	**Mistake:** You have used the wrong co converting between electron volts and $\mathbf{1.6\times10^{19}}$ instead of $\mathbf{1.6\times10^{-19}}$.
D	✗	$E = 45\text{ eV}$ $\frac{45}{\mathbf{1.6\times10^{19}}}$ $= 2.8\times10^{-18}\text{ J}$	**Mistake**: You have not correctly conve You have **divided** by the value **e = 1.6 multiplied.** Additionally, you have used the wrong converting between electron volts and $\mathbf{1.6\times10^{19}}$ instead of $\mathbf{1.6\times10^{-19}}$.

Question 14

A	✗	$E = 0.55\text{ kWh}$ $1\text{ W} = 1\text{Js}^{-1}$ $\text{k} = \times10^{3}$ 0.55×1000 $= 550\text{ J}$	You have correctly multiplied by 1000 **Mistake:** You have not converted from have multi value for energy by

B	✗	$E = 0.55$ **kWh** $1\text{ W} = 1\text{ Js}^{-1}$ **k = ×10²** **1kWs = 100 J** 1 hour = 60×60 seconds 1 kWh = **100**×60×60 J 0.55×**100**×60×60 = 200 000 J	You have correctly multiplied by 3600 to convert from hours to seconds. **Mistake:** You have incorrectly **multiplied by 100** to convert from **kW to W**, when you should have **multiplied b**
C	✗	$E = 0.55$ kW**h** $1\text{ W} = 1\text{ Js}^{-1}$ $k = \times 10^3$ **kWs = 1000 J** **1 hour = 60 minutes** 0.55×1000×**60** = 33 000 J	You hav[illegible] multiplied by 1000 t[illegible] **M[illegible]** you have incorrectly **multipli[illegible]** **minutes**, when you need to **multiply minutes to seconds.**
D	✓	$E = 0.55$ kWh $1\text{ W} = 1\text{ Js}^{-1}$ k = ×10³ 1 kWs = 1000 J 1 hour = 60×60 seconds 1 kWh = 1000×60×60 J 0.55×3 600 000 = 2000 000 J	

Question 15

A	✗	
B	✗	
C	✓	The radius of a human head is around 0.1 m (10 cm). The volume of a human head can be estimated as the volume of a sp[illegible] $\frac{4}{3}\pi r^3$ Therefore, $\frac{4}{3}\pi \times (0.1)^3 \approx \times 10^{-3}\text{ m}^3$
D	✗	

Question 16

A	✗	$\varepsilon = \frac{E}{Q}$ $\varepsilon = \frac{50}{5.2} = 9.6\ \text{V}$ % uncertainty in $Q = \frac{0.1}{5.2} \times 100\% = 1.9\%$ % uncertainty in $E = \frac{5}{50} \times 100\% = 10\%$ uncertainty in $\varepsilon = (10\% + 1.9\%) = \mathbf{11.9\%}$ $\varepsilon = 9.6 \pm \mathbf{11.9}\text{V}$	**Mistake:** You ha **percentage unc** **uncertainty** form The equation fo % uncertainty Therefore to co percentage unce uncertainty form $\Delta a = \frac{\%\ \text{uncert}}{100\%}$
B	✓	$\varepsilon = \frac{E}{Q}$ $\varepsilon = \frac{50}{5.2} = 9.6\ \text{V}$ % uncertainty in $Q = \frac{0.1}{5.2} \times 100\% = 1.9\%$ % uncertainty in $E = \frac{5}{50} \times 100\% = 10\%$ % uncertainty in $\varepsilon = (10\% + 1.9\%) = 11.9\%$ absolute uncertainty in $\varepsilon = \frac{11.9}{100} \times 9.6 = 1.1$ $\varepsilon = 9.6 \pm 1.1\ \text{V}$	
C	✗	$\varepsilon = \frac{E}{Q}$ $\frac{50}{5.2} = 9.6\ \text{V}$ % uncertainty in $Q = \frac{0.1}{5.2} \times 100\% = 1.9\%$ % uncertainty in $E = \frac{5}{50} \times 100\% = 10\%$ % uncertainty in $\varepsilon = (10\% - 1.9\%) = \mathbf{8.1\%}$ absolute uncertainty in $\varepsilon = \frac{\mathbf{8.1}}{100} \times 9.6 = 0.8$ $\varepsilon = 9.6 \pm \mathbf{0.8}\ \text{V}$	**Mistake:** You ha from one anothe **the uncertainti** The rule for com quantities are d If $C = \frac{A}{B}$ $A \pm \mathbf{a}$ and $B \pm$ $C = \frac{(A \pm a)}{(B \pm b)}$ $C = \frac{A}{B} \pm (\mathbf{a} + \mathbf{b})$

D	✗	$\varepsilon = \frac{E}{Q}$ $\varepsilon = \frac{50}{5.2} = 9.6\ \text{V}$ $\%\ \text{uncertainty in}\ Q = \frac{0.1}{5.2} \times 100\% = 1.9\%$ $\%\ \text{uncertainty in}\ E = \frac{5}{50} \times 100\% = 10\%$ $\%\ \text{uncertainty in}\ \varepsilon = (10\% + 1.9\%) = \mathbf{8.1\%}$ $\varepsilon = 9.6 \pm \mathbf{8.1}\ \text{V}$	**Mistake:** You have **subtracted the uncertainties** from one another when you should have **added the uncertainties** together. The rule for combining uncertainties when quantities are divided by one another is: If $C = \frac{A}{B}$ $A \pm \mathbf{a}$ and $B \pm \mathbf{b}$ $C = \frac{(A \pm a)}{(B \pm b)}$ $C = \frac{A}{B} \pm (\mathbf{a} + \mathbf{b})$ Additionally, yo… **percentage unce… uncertainty** form… The equation fo… $\%\ \text{uncertainty}$ … Therefore to con… percentage unce… uncertainty form… $\Delta a = \frac{\%\ \text{uncert…}}{100\%}$

Question 17

A	✗	$E = F \times d$ $\text{J} = \text{kg m s}^{-2}\text{.m}$ $\text{J} = \text{kg m}^2\ \text{s}^{-2}$	
B	✗	$E = F \times d$ $\text{J} = \text{Nm}$	
C	✗	$E = P \times t$ $\text{J} = \text{Ws}$	
D	✓	$E = \frac{\mathbf{Q}}{\mathbf{V}}$ $\text{J} = \text{CV}^{-1}$	The relationship… $E = QV$ which … joules as CV. **Mistake:** You ha… V when you sho…

Question 18

A	✓	
B	✗	These units can be used for current but are various orders of magnitu… amperes (A).
C	✗	
D	✗	

Question 19

A	✗	$v = \frac{d}{t}$ $v = \frac{700}{0.09}$ $v = 7777.8 \text{ m s}^{-1}$ $v = \frac{7777.8}{\times \mathbf{10}} \text{ km s}^{-1}$ $7\ldots \text{ km s}^{-1} = 780 \text{ km s}^{-1}$ (2 *s.f.*)	The correct num… carried out. **Mistake:** You h… $\mathbf{m\,s^{-1}}$ to $\mathbf{km\,s^{-1}}$, … instead of $\times\mathbf{10^3}$
B	✗	$v = \frac{d}{t}$ $v = \frac{700}{0.09}$ $v = 7777.8 \text{ m s}^{-1}$ $v = \frac{7777.8}{\times \mathbf{10^2}} \text{ km s}^{-1}$ $v = 77.8 \text{ km s}^{-1} = 78 \text{ km s}^{-1}$ (2 *s.f.*)	The correct num… carried out. **Mistake:** You h… $\mathbf{m\,s^{-1}}$ to $\mathbf{km\,s^{-1}}$, … instead of $\times\mathbf{10^3}$
C	✓	$v = \frac{d}{t}$ $v = \frac{700}{0.09}$ $v = 7777.8 \text{ m s}^{-1}$ $v = \frac{7777.8}{\ldots}$ $\ldots .8 \text{ km s}^{-1}$	
D	✗	$v = \frac{d}{t}$ $v = \frac{700}{0.09}$ $v = 7777.8 \text{ km s}^{-1} = 7800 \text{ km s}^{-1}$ (2 *s.f.*)	The correct num… carried out. **Mistake:** You h… $\mathbf{km\,s^{-1}}$. You ne… to km s^{-1}.

Question 20

A	✗	These are equivalent to J.
B	✗	These units are equivalent to J.
C	✓	These units are **not** equival… …s as these are the units for po…
D	✗	These units ar… …val… …t to J.

Question 1			
A	✗	False	**Mistake:** You have identified the **mass** the **mass of a prot and neutron.** $m_n = 1.67 \times 10$ kg $m_p = 1.67 \times 10^{-27}$ kg $m_e = 9.11 \times 10^{-31}$ kg Therefore $m_e < m_p$ *and* $m_e < m_n$ The mass of the electron is therefore **sn** and the neutron.
B	✓	True	$q_e = -e$ $q_p = +e$ $e = 1.6 \times 10^{-19}$ C *Therefore* $q_e = -q_p$
C	✗	False	**Mistake:** You have identified that the **c charge of a proton.** $q_n = 0$ $q_p = 1.6 \times 10^{-19}$ C Therefore q_n q_p Th ha of a neutron is therefore **no**
D	✗	False	You have correctly identified that the **n** the **mass of a proton**. **Mistake:** You have incorrectly identifie **greater than** the **mass of a neutron.** $m_n = 1.67 \times 10^{-27}$ kg $m_p = 1.67 \times 10^{-27}$ kg $m_e = 9.11 \times 10^{-31}$ kg *Therefore* $m_e < m_p$ *and* $m_e < m_n$ The mass of the electron is therefore **sn** and the neutron.
Question 2			
A	✗	$^{A}_{Z}\mathrm{Li}$ A	**Mistake:** Yo e ncorrectly identifie **num be of trons**. The **number of neutrons** should be fou Z). A = nucleon number = number of neutr Z = proton number = number of proton

B	✗	$^{A}_{Z}\text{Li}$ **A + Z** = 7 + 3 = 10	**Mistake:** You have **added** the nucleon n (A + Z). You should have **subtracted Z** A = nucleon number = number of neutr Z = proton number = number of proton
C	✗	$^{A}_{Z}\text{Li}$ =	**Mistake:** You ha ncorrectly identifie **numbe ie ons.** The **number of neutrons** should be fou Z). A = nucleon number = number of neutr Z = proton number = number of proton
D	✓	$^{A}_{Z}\text{Li}$ A = number of neutrons and protons Z = number of protons Number of neutrons = A – Z = 7 – 3 = 4	
		Question 3	
A	✗	$^{14}_{6}\text{C} \rightarrow {}^{14}_{X}\text{N} + {}^{0}_{-1}e + Y$ $^{14}_{6}\text{C} \rightarrow {}^{14}_{7}\text{N} + {}^{0}_{-1}e + \mathbf{v_e}$ **X = 7** **Y = $\mathbf{v_e}$**	You have correctly identified **X** by und **numbers** (Z) and **nucleon numbers** (A) **Mistake:** You have identified **Y** as the **antineutrino**. An antineutrino is neede **lepton num e conserved**; the neu quantities.
B	✓	$^{14}_{6}\text{C} \rightarrow {}^{14}_{X}\text{N} + {}^{0}_{-1}e +$ $^{14}_{6}\text{C} \rightarrow {}^{14}_{7}\text{N} + {}^{0}_{-1}e + \overline{v_e}$ **X = 7** **Y = $\overline{v_e}$**	
C	✗	$^{14}_{6}\text{C} \rightarrow {}^{14}_{X}\text{N} + {}^{0}_{-1}e + Y$ $^{14}_{6}\text{C} \rightarrow {}^{14}_{8}\text{N} + {}^{0}_{-1}e + \mathbf{v_e}$ **X = 8** **Y = v_e**	**Mistake:** You have **not equated the pro numbers (Z)** on either side of the equat **conserved.** Additionally, you have identified **Y** as t the **antineutrino.** An antineutrino is ne **lepton number** are **conserved;** the neu quantities.
D	✗	$^{14}_{6}\text{C} \rightarrow {}^{14}_{X}\text{N} + {}^{0}_{-1}e + Y$ $^{14}_{6}\text{C} \rightarrow {}^{14}_{8}\text{N} + {}^{0}_{-1}e + \overline{v_e}$ **X = 8** **Y = $\overline{v_e}$**	You have c y identified **Y** as the a **Mistake:** You have incorrectly identifie t **proton numbers** (Z) and **nucleon n**

Question 4

A	✗	X = Incorrect Y = Correct	You have correctly identified **Y**. **Mistake:** You have incorrectly identified **X** as the a **the electron** is the **positron**.
B	✗	X = Correct Y = Incorrect	You have correctly identified **Y**. **Mistake:** You have incorrectly identified **Y** as $+e$. The charge of a proton is $+e$ therefore its **antiparti** **opposite** charge of $-e$.
C	✗	X = Incorrect Y = Incorrect	**Mistake:** You have incorrectly identified **X** as the a **the electron** is the **positron**. Additionally, you have incorrectly identified **Y** as The charge of a proton is $+e$ therefore its **antiparti** **opposite** charge of $-e$.
D	✓	X = Correct Y = Correct	

Question 5

A	✓	$E = (6.63\times10^{-34})\times(2.1\times10^{14})$ $E = 1.4\times10^{-19}$ J	
B	✗	$E = \dfrac{2.1\times10^{14}}{\mathbf{6.63\times10^{-34}}}$ $E = 3.2\times10^{47}$ J	**Mistake:** You have **divided** by have **multiplied** by h. The correct relationship betwe
C	✗	$E = \dfrac{\mathbf{6.63\times10^{-34}}}{2.1\times10^{14}}$ J	**Mistake:** You have **divided** by **multiplied** by f. The correct relationship betwe
D	✗	$E = \mathbf{1.6\times10^{-19}} \times 2.1\times10^{14}$ $E = 3.4\times10^{-5}$J	**Mistake:** You have incorrectly value for the constant **h**. The v $\mathbf{6.63\times10^{-34}}$.

Question 6

A	✗	Weak interaction is a fundamental interaction.
B	✗	Strong interaction is a fundamental interaction.
C	✓	Radioactive is **not** a fundamental interaction.
D	✗	Electromagnetic interaction is a fundamental interaction.

Question 7

A	✗	True	
B	✗	True	
C	✓	False	**Baryons** are made up of **three quarks** but **mesons** **antiquark**. Therefore the statement is false.
D	✗	True	

Question 8

A	✓	$E_{k\max} = hf - \phi$ $1\text{ eV} = 1.6\times10^{-19}$ J $E_{k\max} = (6.63\times10^{-34})\times(2.8\times10^{15})$ $-(4.3\times1.6\times10^{-19})$ $E_{k\max} = 1.2\times10^{-18}$ J	
B	✗	$E_{k\max} = hf -$ $= (6.63\times10^{-34})\times(2.8\times10^{15}) - \mathbf{4.3}$ $E_{k\max} = -4.3$ J	You have correctly $E_{k\max}$. **Mistake**: You have function (ϕ) from **multiplied** the wo
C	✗	$\mathbf{E_{kmax} = hf + \phi}$ $1\text{ eV} = 1.6\times10^{-19}$ J $E_{k\max} = (6.63\times10^{-34})\times(2.8\times10^{15})$ $+(4.3\times1.6\times10^{-19})$ $E_{k\max} = 2.5\times10^{-18}$ J	**Mistake:** You have to the **energy of th** have **subtracted**. The maximum po in fact be the ener photon (hf) minu the surface of the ($E_{k\max} = hf - \phi$)
D	✗	**hf +** ϕ $E_{k\max} = (6.63\times10^{-34})\times(2.8\times10^{15}) + \mathbf{4.3}$ $E_{k\max} = 4.3$ J	**Mistake:** You have function (ϕ) from **multiplied** the wo Additionally, you (ϕ) to the **energy** should have **subtr** The maximum po in fact be the ener photon (hf) minu the surface of the ($E_{k\max} = hf - \phi$)

Question 9

A	✗	$hf = E_1 - E_2$ $f = \dfrac{E_1 - E_2}{h}$ $f = \dfrac{\mathbf{(-0.9) - (-1.5)}}{6.63\times}$ $f = \dfrac{0.6}{6.63\times10^{-34}}$ $f = 9.05\times10^{32}$ Hz	**Mistake:** You have values from **eV in** be **multiplied by** This needs to be c joules.

B	✓	$hf = E_1 - E_2$ $f = \frac{E_1 - E_2}{h}$ $1\text{ eV} = (1.6\times10^{-19})$ $f = \frac{(-0.9\times1.6\times10^{-19}) - (-1.5\times1.6\times10^{-19})}{6.63\times10^{-34}}$ $f = \frac{(-0.9\times1.6\times10^{-19}) + (1.5\times1.6\times10^{-19})}{6.63\times10^{-34}}$ $f = 1.45\times10^{14}\text{ Hz}$	
C	✗	$hf = E_1 - E_2$ $f = \frac{E_1 - E_2}{h}$ J[illegible] $f = \frac{(-0.9\times1.6\times10^{-19}) - (-1.5\times1.6\times10^{-19})}{6.63\times10^{-34}}$ $f = \frac{(-0.9\times1.6\times10^{-19}) - (1.5\times1.6\times10^{-19})}{6.63\times10^{-34}}$ $= -5.79\times10^{14}$ $f = \mathbf{5.79\times10^{14}\text{ Hz}}$	**Mistake:** You hav **equate to a positi**
D	✗	$E = 45\text{ eV}$ $\frac{45}{\mathbf{1.6\times10^{19}}}$ $= 2.8\times10^{-18}\text{ J}$	**Mistake:** You hav **eV and J**. You ha $\mathbf{e = 1.6\times10^{-19}}$ w by the constant. Additionally have **value $\mathbf{1.6\times10^{19}}$** value is $\mathbf{1.6\times10^{-1}}$

Question 10

A	✓		**Up** and **Charm** both have charge $+\frac{2}{3}$ and **Down** and **Stran** Since **all four are quarks**, then **all quarks cannot** have the **s** The charge of their antiparticles will be equal in magnitude t Anti-up, Anti-charm, Anti-down and Anti-strange will have respectively. Therefore all antiquarks also **cannot have** the **same value** fo
B	✗	True	
C	✗	True	
D	✗	True	

Question 11

A	✗	Not true	Isotopes are two o element with the s protons) but **diffe**
B	✓	True	
C	✗	Not true	**Mistake:** You hav and ^4He are isot Isotopes are two o **element** with the s different number o
D	✗	Not true	You have correctl **same atomic num Mistake:** You hav isotopes also have Isotopes have a **di** therefore they mu **number**.

Question 12

A	✗	$E = hf$ $f = \frac{c}{\lambda}$ $E = \frac{hc}{\lambda}$ GeV=$\times 10^9$ eV **1 eV = 1.6×10^{-19} J** $\lambda = \frac{(6.63\times10^{-34})\times(3\times10^8)}{\mathbf{100\times10^9}}$ $\lambda = 1.99\times10^{-36}$ m	You have correctl **Mistake:** You hav **to J**. You need to energy by **e = 1.6**
B	✗	$E = hf$ $f = \frac{c}{\lambda}$ $E = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E}$ (×1 eV 1 1.6×10^{-19} J $\lambda = \frac{(6.63\times10^{-34})\times(3\times10^8)}{\mathbf{100}\times1.6\times10^{-19}}$ $\lambda = 1.24\times10^{-8}$ m	You have correctl **Mistake:** You hav You need to **mult** = $\times 10^9$).

C	✓	$E = hf$ $f = \frac{c}{\lambda}$ $E = \frac{hc}{\lambda}$ $\lambda = \frac{hc}{E}$ GeV=$\times 10^{9}$ eV 1 eV=1.6×10^{-19} J $\lambda = \frac{(6.63\times10^{-34})\times(3\times10^{8})}{(100\times10^{9})\times(1.6\times10^{-19})}$ $\lambda = 1.24\times10^{-17}$ m	
D	✗	$E = hf$ $f = \frac{\lambda}{c}$ $E = \frac{c}{\lambda}$ $\lambda = \frac{Ec}{h}$ GeV =$\times 10^{9}$ eV 1 eV =1.6×10^{-19} J $\lambda = \frac{(100\times10^{9})\times(1.6\times10^{-19})\times(3\times10^{8})}{(6.63\times10^{-34})}$ $\lambda = 7.24\times10^{33}$ m	You have correctly from eV to J. **Mistake:** You have **speed of light** c w speed of light c by The relationship be

Question 13

A	✗	False	**Mistake:** You have identified the **threshold fr** **frequency** required to **induce electron emissi** **minimum frequency** to **induce electron e**
B	✗	False	**Mistake:** You have identified time as a factor emission. **Only intensity of the radiation** affects the **rat**
C	✗	False	**Mistake:** You have indicated that **light of freq** **frequency** can **increase the number of emitte** Any frequency below the threshold frequency emit any electrons.
D	✓	True	

Question 14

A	✗	$\mu^- \rightarrow X + \overline{\nu_e} + Y$ $\mu^- \rightarrow e^+ + \overline{\nu_e} + \nu_\mu$ **X = e^+** Y = ν_μ	You have correctly identified Y. **Mistake:** You have **incorrectly identified X** a **charge is conserved** during the decay: $-1 \rightarrow +1\ +0\ +0$ Th… …s –1 before and +1 after which **br**
B	✗	$\mu^- \rightarrow X + \overline{\nu}$ A… …$\overline{\nu_e} + \nu_\mu$ X … **Y = $\overline{\nu_\mu}$**	…ou have correctly identified **X.** **Mistake**: You have **incorrectly identified Y** a **ensured** that the **lepton number is conserved** $+1 \rightarrow -1\ -1\ -1$ The lepton number is +1 before and –3 after w
C	✓	$\mu^- \rightarrow X + \overline{\nu_e} + Y$ $\mu^- \rightarrow e^- + \overline{\nu_e} + \nu_\mu$ X = e^- Y = ν_μ	
D	✗	$\mu^- \rightarrow X + \overline{\nu_e} + Y$ $\mu^- \rightarrow e^+ + \overline{\nu_e} + \nu_\mu$ **X = e^+** **Y = $\overline{\nu_\mu}$**	**Mistake:** You have **incorrectly identified X** a **charge is conserved** duri…g the decay: $-1 \rightarrow +1\ +…\ +($ T…e charge is –1 before and +1 after which **br** Additionally, you have **incorrectly identifie** **ensured** that the **lepton number is conserved** $+1 \rightarrow -1\ -1\ -1$ The lepton number is +1 before and –3 after w

Question 15

A	✓	total energy before = total energy after total energy of electron + positron = total energy of 2 photons $2E_o = 2hf_{\min}$ Energy of one photon: $hf_{\min} = E_o$	

B	✗	total energy before = total energy after total energy of electron + positron = = total energy of 2 photons $2E_o = 2hf_{min}$ **Energy of photons :** **$2hf_{min} = 2E_o$**	**Mistake:** You have determined the **energy of both of the photons** created in t**only asks for** the **energ**therefore you need to d The total energy before between each photon p The energy of one pho
C	✗	total energy before = total energy after total energy of electron + positron = total energy of 2 photons **$E_o = hf_{min}$** Energy of one photon: $\frac{1}{2}hf_{min} = \frac{1}{2}E_o$	**Mistake:** You have **inc****combined energy** of a The **energy** of an **electr**of its antiparticle, the p**combined energy** w Additionally, you have **combined energy** of **tw****photon** has **energy hf****energy** will be **$2hf_{min}$**
D	✗	total energy before = total energy after total energy of electron + positron = total energy of photon **$2E_o = hf_{min}$** Energy of 2 photons: **$2hf_{min} = 4E_o$**	**Mistake:** You have **inc****energy before** the anni**photon** created during **energy** before **is split** created. Additionally, you have **f the photons** created **question only asks for photons** and therefore for energy by **2**.

Question 16

A	✗	
B	✓	
C	✗	
D	✗	

Question 17

A	✗	You have correctly identified **X**. **Mistake:** You have **incorrectly identified Y** as **e^+** and in turn **charge is conserved** during the decay: $0 \rightarrow +1 +1 +0$ The charge before is 0 while the charge after is +2, which **breaks**

B	✗	**Mistake:** You have **incorrectly identified X** as $\overline{\nu_\mu}$ and in turn **baryon number is conserved**: $+1 \longrightarrow 0 + 0 + 0$ The baryon number before is +1 but after is 0 which **breaks co**
C	✓	
D	✗	**Mistake:** You have **incorrectly identified Y** as e^+ and in turn **conserved** during the decay: $0 \longrightarrow 0 + 1 + 0$ You have also **incorrectly identified X** as ν_u not ensuring con B). The charge before is 0 and after is +1, which **breaks conservati**

Question 18

A	✗	True	
B	✗	True	
C	✗	True	
D	✓	Not true	An **ion** by definiti Therefore it must h electrons and prot

Question 19

A	✗	True	
B	✗	True	
C	✓	N	**Strong nuclear for two neutrons, two neutron.**
D	✗	True	

Question 20

A	✗	$\mathbf{E = \frac{f}{h}}$ $\mathbf{E = \frac{c}{h\lambda}}$ $\mathbf{\lambda = \frac{c}{hE}}$ $\lambda = \frac{3 \times 10^{8}}{(6.6[illegible]) \times (1.8 \times 10^{-19})}$ $\lambda = [illegible] \times 10^{60}$ m	**Mistake:** You have **divided** freq[illegible] you should have **multiplied f** by The correct relationship betwee[illegible] $E = [illegible]$
B	✗	$E = hf$ $E = h\frac{\mathbf{\lambda}}{\mathbf{c}}$ $\lambda = \frac{Ec}{h}$ $\lambda = \frac{1.8 \times 10^{-19} \times 3 \times 10^{8}}{(6.63 \times 10^{-34})}$ $\lambda = 8.2 \times 10^{22}$ m	**Mistake:** You have **divided** wav[illegible] when you should have **divided** [illegible] The correct relationship betwee[illegible]
C	✓	$\lambda = \frac{(6.63 \times 10^{-34}) \times (3 \times 10^{8})}{(1.8 \times 10^{-19})}$ $\lambda = 1.1 \times 10^{-6}$ m	
D	✗	$\mathbf{E = \frac{h}{\lambda c}}$ $\lambda = \frac{h}{Ec}$ $\lambda = \frac{(6.63 \times 10^{-34})}{(1.8 \times 10^{-19}) \times (3 \times 10^{8})}$ $\lambda = 1.2 \times 10^{-23}$ m	**Mistake:** You have **divided** the [illegible] you should have **multiplied f** by The correct relationship betwee[illegible] $E = hf$. Additionally, you have **multipli**[illegible] wavelength $\mathbf{\lambda}$ when you should[illegible] **c** by $\mathbf{\lambda}$. The correct relationship betwee[illegible]

Question 1

A	✗	False	**Phase difference** is a **measured in angles**, and therefore can degrees.
B	✗	False	**Amplitude** is **half** the **distance** between a crest and a corresponding
C	✗	False	The equation relating frequency and the period: $f = \frac{1}{T}$ The wave if **frequency is increased** the **period** of the wave d
D	✓		

Question 2

A	✓	Sound is a **longitudinal** wave.
B	✗	
C	✗	
D	✗	

Question 3

A	✗	$v = f\lambda$ $v = 5.6 \times \mathbf{0.8}$ $v = 4.48\ \text{m s}^{-1}$	**Mistake:** You have **not converted** the value fo You should have **multiplied** the value for wa Your answer is in fact in m s^{-1}.
B	✓	$v = f\lambda$ $v = 5.6 \times 0.8 \times 10^{-2}$ $v = 0.04$	
C	✗	$v = \frac{\mathbf{f}}{\boldsymbol{\lambda}}$ $v = \frac{5.6}{0.8}$ $v = 7.0\ \text{m s}^{-1}$	**Mistake:** You have **divided** frequency $\mathbf{f}$ by w have **multiplied** the two values together. The correct relationship is $v = f\lambda$. Additionally, you have **not converted** the valu You should have **multiplied** the value for wa Your answer is in fact in cm s^{-1}.
D	✗	$\boldsymbol{v = \frac{\lambda}{f}}$ $v = \frac{0.8 \times 10^{-2}}{5.6}$ $v = 0.0010\ \text{m s}^{-1}$	You have correctly converted from cm to m. **Mistake:** You have divided wavelength $\boldsymbol{\lambda}$ by have **multiplied** the two values together. The correct relationship is $v = f\lambda$.

Question 4

A	✗		
B	✗	True	
C	✓	False	Two polarising filters at **right angles** to each other would p **both planes** and therefore let through **no light** at all.
D	✗	True	

Question 5

A	✗	$\lambda = \frac{1}{2}L$ $\lambda = \frac{1}{2}\times 1.2$ $\lambda = 0.6$ m	**Mistake:** You h **harmonic** of a s ends will repres have then deter wave will there the string, $\frac{1}{2}L$. The first harmo fixed at both en therefore the w twice the length
B	✓	$\lambda = 2L$ $\lambda = 2\times 1.2$ $\lambda = 2.4$ m	
C	✗	$\lambda = L$ $\lambda = 1.2$ m	**Mistake:** You h **harmonic** of a s ends will repres have then deter wave will there string L. The first harmo fixed at both en therefore the w twice the length
D	✗	$\lambda = 4$ $\lambda = 4\times 1.2$ $\lambda = 4.8$ m	**Mistake:** You h **harmonic** of a s ends will repres **wave.** You have **wavelength** of to four times th The first harmo at both ends wi therefore the w twice the length

Question 6

A	✗	$f = \frac{1}{2l}\sqrt{\frac{\mathbf{T}}{\boldsymbol{\mu}}}$ $f = \frac{1}{2\times 0.}\sqrt{\frac{0.}{0.01}}$ 18.8 Hz	You have used frequency. **Mistake:** You h the $\frac{T}{\mu}$ term in

B	✓	$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ $f = \frac{1}{2\times 53\times 10^{-2}}\times\sqrt{\frac{0.2}{0.01}}$ $f = 4.2\ \text{Hz}$	
C	✗	$f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ $f = \frac{1}{2\times 53}\times\sqrt{\frac{0.2}{0.01}}$ $f = 0.04\ \text{Hz}$	You have used t frequency. **Mistake:** You ha length **from cm** value for length You need to do frequency to ha
D	✗	$\mathbf{f = \frac{1}{2l}\sqrt{\frac{\mu}{T}}}$ $f = \frac{1}{2\times 53\times 10^{-2}}\times\sqrt{\frac{0.01}{0.2}}$ $f = 0.2\ \text{Hz}$	**Mistake:** You ha length **μ** by per **divided** the per length **μ**. The correct equ $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

Question 7

A	✗	True	
B	✗	True	
C	✓		The **refractive index** of a su material. Therefore the **angle of inci** any **effect** on the **refractive**
D	✗	True	

Question 8

A	✗	$\mathbf{i + r = 90°}$ $r = 90° - 37°$ $r = 53°$	**Mistake:** You have identifi i and r is that they add to You should have used the r $n_1 \sin i = n_2 \sin r$ to determine the angle of re
B	✗	$i = r$ $r = 37°$	**Mistake:** You have identifi **equal** to the **angle of incid** You should have used the r $n_1 \sin i = n_2 \sin r$ to determine the angle of re

C	✓	$n_1 \sin i = n_2 \sin r$ $\sin r = \frac{n_1 \sin i}{n_2}$ $\sin r = \frac{1 \times \sin 37}{2.41}$ $\sin r = 0.249$ $r = 14.5°$	
D	✗	$n_1 \sin i = n_2 \sin$ $\sin r = \frac{1 \times \sin 37}{2.41}$ $\sin r = 0.249$ $r = 14.5°$ **90° - 14.5°** **= 75.5°**	You have used the correct r incidence and the angle of r **Mistake:** You have obtained refraction, 14.5°, but then h from 90° when you didn't r
		Question 9	
A	✓	False	If $i >$ critical angle **and the incident substance has a lar** **other,** then total internal reflection will occur. Both conditions need to hold i r for total internal refl than the critical angle a or is enough.
B	✗	True	
C	✗	True	
D	✗		
		Question 10	
A	✗	False	Core cladding needs to be of a **lower** refractive index than reflection
B	✓	True	Narrow cores ensure light can enter at a smaller range of a the same velocity
C	✗	False	Modal dispersion is the pulse dispersion caused by mono through the core at **different angles and directions**.
D	✗	False	Light always travels at the **same speed** within a medium.
		Question 11	
A	✓	$n\lambda = d \sin \theta$ $\lambda = \frac{d \sin \theta}{n}$ $\lambda = \frac{(3.\times 10^{-6}) \times \sin 60}{4}$ $\lambda = 6.65 \times 10^{-7}$ m	

B	✗	$\lambda = \dfrac{\mathbf{n}}{\mathbf{d\sin\theta}}$ $\lambda = \dfrac{4}{(3.07\times10^{-6})\times\sin 60}$ $\lambda = 1.50\times10^{6}$ m	**Mistake:** You have **divided** have **divided** $\mathbf{d\sin\theta}$ by **n.**
C	✗	$n\lambda = d\sin\theta$ $\lambda = \dfrac{d\sin\theta}{n}$ $\lambda = \dfrac{(3.\ldots)\times\sin 60}{4}$ $\lambda = 0.66$ m	**Mistake:** You have **not con** separation from **µm** to **m** 3.07 µm by $\mathbf{10^{-6}}$ to conve
D	✗	$\lambda = \dfrac{\mathbf{n}}{\mathbf{d\sin\theta}}$ $\lambda = \dfrac{4}{(\mathbf{3.07})\times\sin 60}$ $\lambda = 1.50$ m	**Mistake:** You have **divided** have **divided** $\mathbf{d\sin\theta}$ by **n.** Additionally, you have **n** diffraction separation from **multiplied** 3.07 µm by **1**
		Question 12	
A	✓	$s = \dfrac{\lambda D}{w}$ $s = \dfrac{(720\times10^{-9})\times 2.2}{(20\times10^{-2})}$ $s = 7.9\times10^{-6}$ m	
B	✗	$s = \dfrac{\lambda D}{w}$ $s = \dfrac{(720\times10^{-9})\times 2.2}{(\mathbf{20})}$ $s = 7.9\times10^{-8}$ m	**Mistake:** You have **not con** spacing w **from cm to m.** value for fringe spacing, 20
C	✗	$\mathbf{s = \dfrac{w}{\lambda D}}$ $s = \dfrac{20\times10^{-2}}{(720\times10^{-9})\times 2.2}$ $s = 1.26\times10^{5}$ m	**Mistake:** You have **divided** have divided $\mathbf{\lambda D}$ by **w** . The correct relationship for
D	✗	$s = \dfrac{\mathbf{w}}{\mathbf{\lambda D}}$ $s = \dfrac{\mathbf{20}}{(720\times\ldots)}$ 20×10^{7} m	**Mistake:** You have **divided** have divided $\mathbf{\lambda D}$ by **w** . The correct relationship for Additionally, you have **n** spacing w **from cm to m.** value for fringe spacing, 20

Question 13

A	✗	True	
B	✓	False	**Dark fringes** are **formed** from the **interference of light rays** one another.
C	✗	True	
D	✗	True	

Question 14

A	✗		**Refraction** refers to the change in a wave's speed and wave[length] boundary.
B	✗	False	**Reflection** is the effect of the angle of incidence being equal [to] surface of the boundary.
C	✓	True	
D	✗	False	The **longer** the wavelength of the wave the more it will diff[ract]

Question 15

A	✗	$\text{phase difference} = \frac{\mathbf{d}}{\boldsymbol{\lambda}}$ $\text{phase difference} = \frac{(42\times10^{-2})}{0.96}$ $\text{phase difference} = 0.44 \text{ radians}$	**Mistake:** You have **not inc[luded]** equation to ensure the answ[er] The correct equation is $\frac{2\pi}{\lambda}$
B	✗	$\text{phase difference} = \frac{\boldsymbol{\lambda}}{\mathbf{2\pi d}}$ phase diff[erence] $= \frac{0.96}{2\pi\times\left(42\times10^{-2}\right)}$ [phase] difference $= 0.36$ radians	**Mistake:** You have **divided** [by] have **divided 2πd** by **λ**. The correct equation for ph[ase]
C	✗	$\text{phase difference} = \frac{2\pi d}{\lambda}$ $\text{phase difference} = \frac{2\pi\times(\mathbf{42})}{0.96}$ $\text{phase difference} = 270 \text{ radians}$	**Mistake:** You have **not con[verted]** **from cm to m**. You should [have] order to obtain the answer[s]
D	✓	$\text{phase difference} = \frac{2\pi d}{\lambda}$ $\text{phase difference} = \frac{2\pi\times(42\times10^{-2})}{0.96}$ $\text{phase difference} = 2.7 \text{ radians}$	

Question 16

A	✗		
B	✓		The **amplitude** is half the distance from a crest to the [trough] wave.
C	✗	True	
D	✗	True	

Question 17

A	✓	$f_2 = \frac{c}{\lambda_2}$ $f_2 = \frac{c}{L}$ $f_1 = \frac{c}{2L}$ $f_2 = 2f_1$	
B	✗	$f_2 = \frac{c}{\lambda_2}$ $f_2 = \frac{c}{\mathbf{2L}}$ $f_1 = \frac{c}{2L}$ $f_2 = f_1$	**Mistake:** You have identified that the relationship b wavelength of the second harmonic is $\lambda_2 = 2L$. The correct wavelength for the second harmonic is λ
C	✗	$f_2 = \frac{c}{\lambda_2}$ $f_2 = \frac{c}{\mathbf{4L}}$ $f_1 = \frac{c}{2L}$ $f_2 = \frac{1}{2} f_1$	**Mistake:** You have identified that the relationship b wavelength of the second harmonic is $\lambda_2 = 4L$. The correct wavelength for the second harmonic is λ
D	✗	$f_2 = \frac{c}{\lambda}$ $\mathbf{2}$ $\mathbf{L}$ $f_1 = \frac{c}{2L}$ $f_2 = 4f_1$	**Mistake:** You have identified that the relationship b wavelength of the second harmonic is $\lambda_2 = \frac{L}{2}$. The correct wavelength for the second harmonic is λ

Question 18

A	✗	$n = \frac{\sin i}{\sin r}$ $n = \frac{\sin 23}{\sin 37}$ $n = 0.65$	**Mistake:** You have **substituted** the **numerical values** f **refraction** the **wrong way round**: $i = 23°$ instead of $i = 37°$ and $r = 37°$ instead of $r =$
B	✓	$n = \frac{\sin i}{\sin r}$ $\sin$ $\mathbf{n\ 23}$ $n = 1.5$	

C	✗	$n = \frac{\sin i}{\sin r}$ $n = \frac{\sin 23}{\sin 37}$ $n = 1.3$	**Mistake:** You have **substituted** the **numerical values** for angle of **refraction** the **wrong way round**: $i = 23°$ instead of $i = 37°$ and $r = 37°$ instead of $r = 23$ Additionally, you have completed the calculation on your calculator in **radians** instead of the **degrees setting**.
D	✗	$\sin i$ $\sin r$ $n = \frac{\sin 37}{\sin 23}$ $n = 0.76$	**Mistake:** You have completed the calculation on your calculator in **radians** instead of the **degrees setting**.
			Question 19
A	✗	True	
B	✗	True	
C	✗	True	
D	✓	False	Laser beam light can permanently damage your retina if **light has first been reflected**.
			Question 20
A	✗	$f = \frac{1}{T} = \frac{1}{\mathbf{1}}$ $f = 1\,\text{Hz}$	**Mistake:** You have **not converted** the value of time **to seconds**. You need **multiply** the value of time by 60.
B	✓	$f = \frac{1}{T}$ $1\,\text{minute} = 60\,\text{seconds}$ $f = \frac{1}{1 \times 60}$ $f = 0.02\,\text{Hz}$	
C	✗	$\mathbf{f = 1 \times T}$ $1\,\text{minute} = 60\,\text{seconds}$ $f = 1 \times (1 \times 60)$ $f = 60\,\text{Hz}$	**Mistake:** You have **multiplied** 1 by the period instead of **divided** 1 by the period. The correct relationship is $f = \frac{1}{T}$.
D	✗	$f = \frac{1}{T}$ $1\,\text{minute} = 100\,\text{seconds}$ $f = \frac{1}{1} \times 100$ $f = 0.01\,\text{Hz}$	**Mistake:** You have **multiplied by 100** to convert minutes to seconds when you should have **multiplied by 60**.

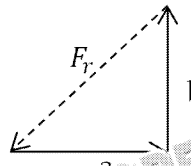
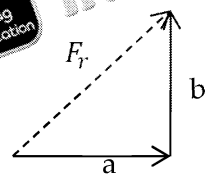
Question 1

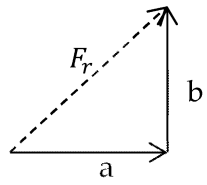
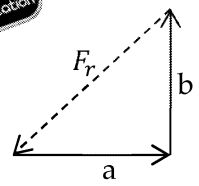
A	✗	Scalar
B	✗	Scalar
C	✓	Vector
D	✗	Scalar

Question 2

A	✓	
B	✗	True
C	✗	True
D	✗	True

Question 3

A	✗	$a^2 + b^2 = c^2$ $F_r = \sqrt{(40)^2 + (25)^2}$ $F_r = 47.2$ N  	You used have determined the the resultant ve **Mistake:** You h **from finish to s should always**
B	✗	 $a^2 + c^2 = b^2$ $\mathbf{F_r = \sqrt{b^2 - a^2}}$ $F_r = \sqrt{(40)^2 - (25)^2}$ $F_r = 31.2$ N	**Mistake:** You h **Pythagoras's th** vector F_r. You have stated **one of the smal of the hypoten the other small** $a^2 + c^2 = b^2$ **The correct rela** $a^2 + b^2 = c^2$ The **sum** of th **lengths** $(a^2 +$ **the hypotenus** Therefore: $F_r = \sqrt{a^2 + b^2}$

C	✓	 $a^2 + b^2 = c^2$ $F_r = \sqrt{(40)^2 + (\quad)^2}$ $= \quad$	
D	✗	 $\mathbf{a^2 + c^2 = b^2}$ $\mathbf{F_r = \sqrt{(40)^2 - (25)^2}}$ $F_r = 31.2$ N	**Mistake:** You h **Pythagoras's th** vector F_r. You have stated **one of the smal** **of the hypotenu** **the other small** $a^2 + c^2 = b^2$ **The correct rela** $a^2 + b^2 = c^2$ where the **sum** **lengths** $(a^2 +$ **the hypotenus** Therefore: $F_r = \sqrt{a^2 + b^2}$ Additionally, y directed **from f** it **should alway**

Question 4

A	✗	False	**Mistake:** You have **not identified** that if an object **external forces acting** on the object. Therefore the directions must be **equal to each other** $(\mathbf{S = W})$. If $S \leq W$ then the coffee mug would **either** be at **downwards direction** as the forces are **either equal** or the **force upwards.** The question states the **mug is at rest** therefore S
B	✗	False	**Mistake:** You have **not identified** that if an object **external forces acting** on the object. Therefore the directions must be **equal to each other** $(\mathbf{S = W})$. If $S > W$ then the coffee mug would be accelerating the **force upwards** is **greater than** the **force downwards** The question states the **mug is at rest** therefore S
C	✗	False	**Mistake:** You have **not identified** that if an object **external forces acting** on the object. Therefore the must be **equal to each other** $(\mathbf{S = W})$. If $S < W$ then the coffee mug would be accelerating as the **force downwards** is **greater than** the **force** The question states the **mug is at rest** therefore S
D	✓		

Question 5

A	✗	$\text{moment} = F \times d$ $\text{moment} = 140 \times \mathbf{39}$ $\text{moment} = 5.46 \times 10^{3}\ \text{Nm}$	**Mis** the You val
B	✓	$\text{moment} = F \times d$ $1\ \text{mm} = 1 \times 10^{-3}\ \text{m}$ $\text{moment} = 140 \times (390 \times 10^{-3})$ $\text{moment} = 54.6\ \text{Nm}$	
C	✗	$\text{moment} = \mathbf{\frac{F}{d}}$ $1\ \text{mm} = \times 10^{-3}\ \text{m}$ $\text{me} \quad \frac{140}{(390 \times 10^{-3})}$ $\text{ment} = 359.0\ \text{Nm}$	**Mis** by hav dis

D	✗	$moment = \dfrac{\mathbf{F}}{\mathbf{d}}$ $moment = \dfrac{140}{\mathbf{39}}$ $moment = 3.59\,\text{Nm}$	**Mistake:** You have **divided** force **F** by distance **d** when you should have **multiplied** the force **F** by dista**d** The mo Ad **cor** fro **mu** 390

Question 6

A	✗	F	The principle of moments states that **the sum of** t **to** the **sum of the anticlockwise moments**.
B	✗	False	The principle of moments states that the **sum of** t **to** the **sum of the anticlockwise moments**.
C	✓	True	
D	✗	False	The principle of moments states that the **sum of** t **to** the **sum of the anticlockwise moments**.

Question 7

A	✗	F	**Mistake:** Yo av **correctly identified** the cor dition for equilibrium: Upwards Force = Downwards Force $S = W_1 + W_2 + W_0$
B	✗	False	**Mistake:** You have **incorrectly identified** the rela **moments** to be '**Sum of clockwise moments = –** S The principle should be '**Sum of clockwise mom moments**'. Therefore the correct relationship is: $W_1 d_1 = W_2 d_2$

C	✗	False	**Mistake:** You have used an **incorrect equation** for the **principle of moments**. You have used $W_1 d_2 = W_2 d_1$ when you should have The correct relationship is therefore: $W_1 = \frac{W_2 d_2}{d_1}$
D	✓	True	

Question 8

A	✗	True	
B	✗	True	
C	✗	True	
D	✓	False	The **displacement** can be determined by the area

Question 9

A	✗	$a = \frac{v+u}{t}$ 1 minute = 60 seconds $a = \frac{\mathbf{4.9+2.1}}{(5\times60)}$ $a = 0.02\ \mathrm{m\,s^{-1}}$	**Mistake:** You have **added** the velocity **u** when you should h **u from** the final velocity **v**.
B	✗	$a = \frac{v-u}{t}$ $a = \frac{4.9-2.1}{\mathbf{(5)}}$ $a = 0.56$ m	**Mistake:** You have **not conver minutes to seconds**. You shou time, minutes, **by 60.**
C	✓	$a = \frac{v-u}{t}$ $a = \frac{4.9-2.1}{(5\times60)}$ $a = 0.01\ \mathrm{m\,s^{-1}}$	
D	✗	$a = \frac{v+u}{t}$ $a = \frac{\mathbf{4.9+2.1}}{\mathbf{(5)}}$ $a = 1.4\ \mathrm{m\,s^{-1}}$	**Mistake:** You have **added** the velocity **u** when you should h **u from** the final velocity **v**. Additionally you have **not cor minutes to seconds**. You shou time minutes, **by 60.**

Question 10

A	✗	False	**Mistake:** You have identified that **velocity** and **acceleration** c If an object has **constant velocity** then by Newton's second la **accelerating** as there is **no net external force** acting on the ob Therefore the velocity–time, a cel ra ion–time and displacem the same motion.
B	✓	True	
C	✗	False	**Mistake:** You have identified that an object can be **gaining di** **accelerates at a linear rate**. If the acceleration of the object is increasing at a constant rate at an **exponential** rate. Therefore the velocity–time, acceleration–time and displacem the same motion.
D	✗	False	**Mistake:** You have identified that an object can be **gaining di** **velocity is increasing at a linear rate.** If an object is **increasing its velocity at a linear rate** then it w **exponential rate.** Therefore the velocity–time, acceleration–time and displacem the same motion.

Question 11

A	✗	$y = \frac{1}{2}gt^2$ $y = \frac{1}{2} \times \mathbf{9.8} \times \mathbf{(2.2)}$ $y = 10.8 \text{ m}$	**Mistake:** You have **not squared** the term **t** Additionally, you have not included the **n** **negative value** to account for the fact it is **direction**. You should have used the valu
B	✓	$y = \frac{1}{2}gt^2$ $y = \frac{1}{2} \times -9.8 \times (2.2)^2$ $y = -23.7 \text{ m}$	
C	✗	$y = \frac{1}{2}gt^2$ $y = \frac{1}{2} \times -9.8 \times \mathbf{(2.2)}$ $y = -10.8 \text{ m}$	**Mistake:** You have **not squared** the term **t**
D	✗	y [illegible]^2 $y = \frac{1}{2} \times \mathbf{9.8} \times (2.2)^2$ $y = 23.7 \text{ m}$	**Mistake:** You have not included the **nume** **value** to account for the fact it is acting in should have used the value **–9.8**.

Question 12

A	✗	True	
B	✓	False	The horizontal motion and vertical motion of a projectile **are**
C	✗	True	
D	✗	True	

Question 13

A	✗	True	
B	✗		
C	✗		
D	✓	False	An applied force is proportional to the **acceleration** of the obj

Question 14

A	✗	$\mathbf{F_d = F_{net}}$ $F_d = ma$ $F_d = 65 \times 0.6$ $F_d = 39\,\text{N}$	**Mistake:** You have identified that the force $\mathbf{F_{net}}$ acting on the skydiver. The **net force** is the **contribution of a** force therefore will contribute to the The correct relationship for net force $F_{net} = W - F$ A minus sign has been included to in opposite directions.
B	✗	$\mathbf{F}$ = W $\mathbf{F}$ $F_d = 65 \times 9.8$ $F_d = 640\,\text{N}$	**Mistake**: You have identified that the drag force $\mathbf{F_d}$. If the object is **accelerating** then the e **cannot be equal to one another** as N object **accelerates** as a result of a **net**
C	✓	$F_{net} = W - F_d$ $F_d = W - F_{net}$ $F_d = (mg) - (ma)$ $F_d = (65 \times 9.8) - (65 \times 0.6)$ $F_d = 600\,\text{N}$	
D	✗	$\mathbf{F_{net} = W + F_d}$ $F_d = F_{net} - W$ $F_d = (ma) -$ F $\times 0.6) - (65 \times 9.8)$ $F_d = -600\,\text{N}$	You have correctly identified that bo rce contribute to the net force. **Mistake:** You have **not included** a m account for the **forces acting in oppo** The correct equation for net force is : $F_{net} = W - F_d$

Question 15

A	✓	impulse $= mv - mu$ $1\text{ g} = 10^{-3}$ kg impulse $= (430\times10^{-3})\times29 - (430\times10^{-3})\times21$ impulse $= 3.4$ Ns	
B	✗	impulse $= mv - mu$ impulse $= \mathbf{(430)}\times$ [illegible] $\times21$ im[illegible] Ns	**Mistake:** You ha[illegible] mass **from g to k**[illegible] the value for mas[illegible]
C	✗	in[illegible] $= mv - mu$ impulse $= \mathbf{(430)\times21 - (430)\times29}$ impulse $= -3.4\times10^{3}$ Ns	**Mistake:** You ha[illegible] the mass **from g** [illegible] **multiplied** the v[illegible] $\mathbf{10^{-3}}$. Additionally, yo[illegible] **values** for the fi[illegible] **u** the **wrong wa**[illegible] The correct num[illegible] should be : $v = 29$ ms^{-1} an[illegible]
D	✗	impulse $= mv - mu$ $1\text{ g} = \times10^{-3}$ kg impulse $= (430\times10^{-3})$[illegible] $\times\mathbf{29}$ impulse = [illegible]	**Mistake:** You ha[illegible] **values** for the fi[illegible] **u** the **wrong wa**[illegible] The correct num[illegible] should be : $v = 29$ m s^{-1} an[illegible]

Question 16

A	✓	$E_p(\text{at } 10\text{ m}) = E_{Total} = mgh$ $E_p = 0.5\times9.8\times10$ $E_p = 49$ J $\text{E}_k(at\ 2\text{m}) = E_{Total} - E_p(\text{at } 2\text{ m})$ $\text{E}_k = 49 - 0.5\times9.8\times2$ $E_k = 39.2$ J	

B	✗	$\mathbf{E_k\,(at\ 2\,m) = E_p\,(at\ 2\,m)}$ $E_k = mgh$ $E_k = 0.5\times 9.8\times 2$ $E_k = 9.80\ \text{J}$	**Mistake:** You have incorrectly used the **conservation of energy principle**. You have identified that $\mathbf{E_k}$ is **equal** to $\mathbf{E_p}$ at all stages of motion. The **conservation of energy** stat… **conserved** and is the same at all … The correct relationship for cons… $E_{Total} = E_k + E_p$ Therefore the relationship of the … $E_{Total} = E_k(\text{at } 2\,\text{m}) + E_p(\text{at } 2\,\text{m})$ $E_k(\text{at } 2\,\text{m}) = E_{Total} - E_p(\text{at } 2\,\text{m})$
C	✗	$E_p(\text{at } 10\,\text{m}) = E_…$ $E_… = 5\times …\times 10$ $E_p = …\ \text{J}$ $\mathbf{E_k\,(at\ 2\,m) = E_{Total} + E_p\,(at\ 2\,m)}$ $E_k = 49 + 0.5\times 9.8\times 2$ $E_k = 58.8\ \text{J}$	**Mistake:** You have incorrectly u… **principle**. You have identified t… $\mathbf{E_{total}}$ and $\mathbf{E_p}$. The correct principle of **conserva… total energy is conserved** and is … The correct relationship for cons… $E_{Total} = E_k + E_p$ Therefore the relationship of the … $E_{Total} = E_k(\text{at } 2\,\text{m}) + E_p(\text{at } 2\,\text{m})$ $E_k(\text{at } 2\,\text{m}) = E_{Total} - E_p(\text{at } 2\,\text{m})$
D	✗	$\mathbf{E_k\,(at\ 2\,m) = E_p\,(at\ 10\,m)}$ $E_k = mgh$ $E_k = 0.5\times 9.8\times 1…$ $E_… = 9.0…$	**Mist…** …ou have incorrectly u… **p…ciple**. You have identified t… metres) is **equal to** $\mathbf{E_k}$ at any sta… The correct principle of **conserva… total energy is conserved** and is … The correct relationship for cons… $E_{Total} = E_k + E_p$ Therefore the relationship of the … $E_{Total} = E_k(\text{at } 2\,\text{m}) + E_p(\text{at } 2\,\text{m})$ $E_k(\text{at } 2\,\text{m}) = E_{Total} - E_p(\text{at } 2\,\text{m})$

Question 17

A	✓	$\rho = \frac{m}{V}$ $\rho = \frac{(2m)}{V_2}$ $V' = \frac{(2m)}{\rho}$ $V' = \frac{(2m)V}{m}$ $V' = 2V$	
B	✗	$\rho = \frac{m}{V}$ $V' = \frac{\mathbf{(m)}}{\rho}$ $V' = \frac{\mathbf{(m)}V}{2m}$ $V' = \frac{1}{2}V$	**Mistake:** You have incorrectly substituted stated in the question.
C	✗	$\rho = \frac{m}{V}$ $\rho = \frac{(2m)}{V}$ $V' = \frac{(2m)}{\mathbf{\rho}}$ $V' = \frac{(2m)V}{\mathbf{2m}}$ $V' = V$	**Mistake:** You have used an **incorrect sub** equation for volume V' in the fourth lin You have substituted $\rho = \frac{2m}{V}$. You should have substituted $\rho = \frac{m}{V}$
D	✗	$\rho = \frac{m}{V}$ $\rho = \frac{(2m)}{V'}$ $V' = \frac{(2m)}{\rho}$ $V' = \frac{(2m)}{\mathbf{2mV}}$ $V' = \frac{1}{V}$	**Mistake:** You have used an **incorrect sub** equation for volume V in the fourth line You have substituted $\rho = 2mV$. You should have substituted $\rho = \frac{m}{V}$

Question 18

A	✗	F
B	✗	False
C	✓	True
D	✗	False

Question 19

A	✗	$\mathbf{E = \frac{1}{2}F\Delta L^2}$ $E = \frac{1}{2} \times 56 \times (0.65 \times 10^{-2})^2$ $E = 1.18 \times 10^{-3}$ J	**Mistake:** You have included the length L equation for energy when it **should not** The correct equation for energy stored i
B	✓	$E = \frac{1}{2}F\Delta L$ $E = \frac{1}{2} \times 56 \times (0.65 \times 10^{-2})$ $E = 0.18$ J	
C	✗	$E = \frac{1}{2}F\Delta L$ $E = \frac{1}{2} \times 56 \times (0.65)$ $E = 18.2$ J	**Mistake:** You have **not converted** the va **to m**. You should have **multiplied** the centimetres, **by 10^{-2}**.
D	✗	$E = \frac{1}{2}F\Delta L^2$ $E = \frac{1}{2} \times 56 \times (0.65)^2$ $E = 11.8$ J	**Mistake:** You have **not converted** the va **to m**. You should have **multiplied** the centimetres, **by 10^{-2}**. Additionally you have included the leng equation for ene y when it **should not** Th rre equation for energy stored i

Question 20

A	✗	$f = \frac{1}{T}$ $f = \frac{1}{3}$ $f = 0.3$ Hz	**Mistake**: You have **not converted** the va **minutes to seconds**. You should have m **by 60**.
B	✗	$f = \frac{1}{T}$ **1 minute = 100 seconds** $f = \frac{1}{3 \times 100} = 0.003$ Hz	**Mistake:** You have **multiplied** the perio **from minutes to seconds**. You should h from minutes to seconds.
C	✗	$\mathbf{f = 1 \times T}$ $f = 1 \times 3 \times 60$ $f = 180$ Hz	**Mistake**: Y e **multiplied** 1 by the **divided** by the period T. The correct equation is $f = \frac{1}{T}$.
D	✓	$f = \frac{1}{T}$ $f = \frac{1}{3 \times 60}$ $f = 0.006$ Hz	

Question 1

A	✓	True	
B	✗	False	Potential difference is the **work done**
C	✗	False	The resist[illegible] of an electrical device is
D	✗	False	[illegible]rge is the **product of current and**

Question 2

A	✗	$\Delta Q = \frac{\mathbf{t}}{\mathbf{I}}$ $\Delta Q = \frac{500}{5}$ $\Delta Q = 100\ \text{C}$	**Mistake:** You have **divided** time **t** by … have **multiplied** **t** by **I**. The correct equation is $\Delta Q = It$.
B	✓	$\Delta Q = It$ $\Delta Q = 500 \times 5$ $\Delta Q = 2500\ \text{C}$	
C	✗	$\mathbf{\Delta Q = \frac{I}{t}}$ $\Delta Q = \frac{5}{500}$ $\Delta Q = 0.01\ \text{C}$	**Mistake:** You have **divided** the curre… have **multiplied** **t** by **I**. The correct equation is $\Delta Q = It$.
D	✗	$\mathbf{\Delta Q = I}$ $\Delta Q = 5\ \text{C}$	**Mistake:** You have identified that the … The correct relationship is $\Delta Q = It$.

Question 3

A	✓	$n = \frac{\text{total } Q}{\text{charge of electron}}$ $n = \frac{24}{1.6 \times 10^{-19}}$ $n = 1.5 \times 10^{20}$	
B	✗	$\mathbf{n = \frac{charge\ of\ electron}{total\ charge\ Q}}$ $n = \frac{1.6 \times 10^{-19}}{24}$ $n = 6.7 \times 10^{-21}$	**Mistake:** You have divided **charge of** … you should have divided **total charge** The correct relationship is: $\frac{\text{total } Q}{\text{charge of electron}}$
C	✗	$\mathbf{\frac{[illegible]arge\ Q}{mass\ of\ electron}}$ $n = \frac{24}{9.11 \times 10^{-31}}$ $n = 2.6 \times 10^{31}$	**Mistake:** You have divided total char… should have divided total charge **by** … The correct relationship is : $n = \frac{\text{total charge } Q}{\text{charge of electron}}$

D	✗	$n = \dfrac{\text{total } Q}{\text{charge of electron}}$ $n = \dfrac{24}{\mathbf{1.6\times10^{19}}}$ $n = 1.5\times10^{-18}$	**Mistake:** You have used an **incorrect** e. You should have used $\mathbf{1.6\times10^{-19}}$
		Question 4	
A	✗	$V = W \times Q$ $V = 4 \times 3$ $V = 12$ V	**Mistake:** You have **multiplied** W and Q when you The correct equation is $V = \dfrac{W}{Q}$. Additionally, you have used an **incorrect** nume You have used **4 J** when **40 J** was the value give
B	✗	$V = W \times Q$ $V = 40 \times 3$ $V = 120$ V	**Mistake:** You have **multiplied** W and Q when you The correct equation is $V = \dfrac{W}{Q}$.
C	✗	$V = \dfrac{Q}{W}$ $V = \dfrac{3}{40}$ $V = 0.01$ V	**Mistake:** You have divided Q by W when you sho The correct equation is $V = \dfrac{W}{Q}$.
D	✓	$V = \dfrac{40}{3}$ $V = 13.3$ V	
		Question 5	
A	✓	False	A filament bulb is an example of a **non-ohmic cond** A filament bulb **does not** maintain **constant temper** difference and current are **not directly proportional**
B	✗	True	
C	✗	True	
D	✗	True	

Question 6

A	✓	$\rho = \frac{RA}{L}$ $= \frac{R4A}{2L}$ $= 2\left(\frac{RA}{L}\right)$ $= 2\rho$	
B	✗	$\rho = \frac{\mathbf{RA}}{\mathbf{L}}$ $= \frac{R2L}{4A}$ $= \frac{1}{2}\left(\frac{\mathbf{RL}}{\mathbf{A}}\right)$ $= \frac{1}{2}\rho$	**Mistake:** You have **multiplied by length** L and **di** have **divided by length** L and **multiplied by area** A The correct equation is $\rho = \frac{RL}{A}$.
C	✗	$\rho = \frac{RA}{L}$	You have used the correct equation for resistivity. **Mistake:** You have not included any of the inform question in the correct equation.
D	✗	$\rho = \frac{RA}{L}$ $= \frac{R4A}{\mathbf{L}}$ $= \frac{1}{2}\left(\frac{R4A}{\mathbf{2L}}\right)$ $= 2\rho$	You have used the correct equation for resistivity. **Mistake:** You have incorrectly substituted the **leng** substituted **2L** the value of length given in the qu

Question 7

A	✗	True	
B	✗	True	
C	✗	True	
D	✓	False	Superconductivity is the property of a material inc **below its critical temperature** will result in the ma

Question 8

A	✗	$\mathbf{R_T = R_1 + R_2 + R_3}$ $R_T = 16.5 + 16.5 + 16.5$ $R_T = 49.5\ \Omega$	**Mist** have used the equatio **cu** $\left(R_T = R_1 + R_2 + R_3 + ...\right)$ as $\left(\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...\right)$.

B	✓	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R_T} = \frac{1}{16.5} + \frac{1}{16.5} + \frac{1}{16.5}$ $\frac{1}{R_T} = \frac{3}{16.5}$ $R_T = \frac{16.5}{3}$ $R_T = 5.5\ \Omega$	
C	✗	$\mathbf{R_T = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$ $R_T = \frac{1}{16.5} + \frac{1}{16.5} + \frac{1}{16.5}$ $R_T = \frac{3}{16.5}$ $R_T = 0.18\ \Omega$	**Mistake:** You have incorrectly iden is **equal** to the **sum of the inverse r** identified that the **inverse of the tot** **sum of the inverse resistances** of th The correct equation is: $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
D	✗	$\mathbf{R_T = R_1 = R_2 = R_3}$ $R_T = 16.5\ \Omega$	**Mistake:** You have indicated that th R_T is **equal** to the value of **all of the** parallel circ e correct equation is $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Question 9

A	✓	True	
B	✗	False	You have identified the correct direction for I_3. **Mistake:** You have **subtracted** I_1 and I_2 to obtain the taken into consideration the **conservation of current la** The **conservation of current law** states that the **total cu** **equal** to the total current flowing **out** of a junction. I_3 will therefore be the sum of I and I_2.

C	✗	False	You have identified the correct value for I_3 . **Mistake:** You have identified the current I_3 as **entering** the case as it **breaks the conservation of current law.** The **conservation of current law** states that the **total cu** **equal** to the **total current** flowi[illegible]t of a junction. Since I_1 and I_2 [illegible]ring the junction then by deducti[illegible] junc[illegible] in order for the conservation of current law to h[illegible]
D	✗	False	**Mistake:** You have **subtracted** I_1 and I_2 to obtain the v[illegible] taken into consideration the **conservation of current law** Additionally, you have identified the current I_3 as **ente**[illegible] be the case as it **breaks the conservation of current law**. The **conservation of current law** that states that the **tota**[illegible] is **equal** to the **total current** flowing **out** of a junction. Since I_1 and I_2 are entering the junction then by deducti[illegible] junction in order for the conservation of current law to h[illegible] Therefore the value of I_3 will be the sum of I_1 and I_2.

Question 10

A	✗	$\mathbf{P = \frac{I^2}{R}}$ $P = \frac{(1.[illegible])}{150}$ $P = 2.00$ mW	**Mistake:** You have **divided** the square of the [illegible] should have **multiplied** the two values. The correct equation is $P = I^2R$.
B	✗	**P = IR** $P = 1.5 \times 150$ $P = 225$ W	**Mistake:** You have **multiplied** the current I [illegible] should have **multiplied** the **square of the cur**[illegible] The correct equation is $P = I^2R$.
C	✓	$P = I^2R$ $P = (1.5)^2 \times 150$ $P = 338$ W	
D	✗	$\mathbf{P = \frac{R}{I^2}}$ $P = \frac{150}{(1.[illegible])^2}$ [illegible]7.0 W	**Mistake:** You [illegible]av[illegible]ded the **resistance** R [illegible] wh[illegible]y [illegible]ould have **multiplied** the two va[illegible] The correct equation is $P = I^2R$.

Question 11

A	✓	True	
B	✗	False	**Mistake:** You have identified the value for the **internal** r… **e.m.f.** the **wrong way round**. The equation for e.m.f. of so…: $V = \varepsilon - Ir$ C…ring to straight line equation: $y = mx + c$ Therefore $m = -r$ and $c = \varepsilon$.
C	✗	False	You have correctly identified the value for the e.m.f. **Mistake:** You have identified the **internal resistance** as t… should have identified it as the **gradient**. The equation for e.m.f. of source is: $V = \varepsilon - Ir$ Comparing to straight line equation: $y = mx + c$ Therefore $m = -r$ and $c = \varepsilon$.
D	✗	False	**Mistake**: You have **incorrectly i…fied** the value for e… The equation fo… of source is: $V = \varepsilon - Ir$ Comparing to straight line equation: $y = mx + c$ Therefore $m = -r$ and $c = \varepsilon$.

Question 12

A	✗	$\mathbf{I = \frac{(R + r)}{\varepsilon}}$ $I = \frac{8 + 110 \times 10^{-3}}{12}$ $I = 0.68$ $V = IR$ $V = 0.68 \times 8 = 5.44$ V	**Mistake:** You have divided the ter… have divided ε by $(R + r)$. The relationship for e.m.f. of a sou… $\varepsilon = IR + Ir$ $\varepsilon = I(R + r)$ $I = \frac{\varepsilon}{R + r}$ Therefore the correct equation for c…

B	✗	$V = \varepsilon$ $V = 12.0\ \text{V}$	**Mistake:** You have identified that the **terminal potential difference** is **equal to** the **e.m.f.** of the source. Due to the presence of internal resis voltage develops across the interna therefore the full e.m.f. is not availa some voltage is 'lost' across the inte remaining voltage supplied to the r potential difference.
C	✗	$I = \frac{\varepsilon}{(R+r)}$ $I = \frac{12}{(8+110)}$ $I = 0.1$ $V = IR$ $V = 0.1 \times 8 = 0.80\ \text{V}$	You have used the correct equation **Mistake:** You have **not converted** th from **mΩ to Ω**. You should have m resistance, 110 mΩ, **by 10^{-3}.**
D	✓	$I = \frac{\varepsilon}{(R+r)}$ $I = \frac{12}{(8+110\times10^{-3})}$ $I = 1.48$ $V = IR$ $V = 1.48 \times 8 = 11.8\ \text{V}$	

Question 13

A	✗	True	
B	✗	True	
C	✓	False	When the **intensity of the light** incident on an LDR **decr** the resistance of the LDR **increases**.
D	✗	[illegible]	

Question 14

A	✗	$I = \frac{V_T}{(R_1 + R_2)}$ $I = \frac{5}{(3.2\times10^3 + 2.1\times10^3)}$ $I = 0.0009$ $V_1 = IR_1$ $V_1 = 0.0009 \times 3.2 \times 10^3$ $V_1 = 2.88\ \text{V}$	**Mistake:** You have rounded too m only writing *I* to 1 significant figure
B	✗	$\mathbf{V_1 = \frac{V_T}{2}}$ $V_1 = 2.5\ \text{V}$	**Mistake:** You have identified that t the **p.d.** is **divided equally** across the This would only be the case if the same, as voltage is proportional resistance values are different proportionally different.

C	✗	$I = \frac{V}{(R_1 + R_2)}$ $I = \frac{5}{(3.2\times10^3 + 2.1\times10^3)}$ $I = 0.0009$ $V_1 = V_T - IR_1$ $V_1 = 5 - 2.88 = 2.12$ V	**Mistake:** You have calculated the voltage across R_2. You should have calculated the voltage across R
D	✓	$I = \frac{V}{(R_1 + R_2)}$ $I = \frac{5}{(3.2 + 2.1)\times10^3}$ $I = 9.4\times10^{-4}$ $V_1 = 9.4\times10^{-4}\times3.2\times10^3 = 3.01$ V	
Question 15			
A	✓	False	The **sum of the potential difference** connected in series is **equal to the** **across the cell**.
B	✗	True	
C	✗	True	
D	✗	True	
Question 16			
A	✗	$P = \frac{V^2}{R}$ $P = \frac{5.6\times5.6}{2.2}$ $P = 14$	**Mistake:** You have **not converted** t Ω. You should have **multiplied** t **by 10^3**.
B	✓	+	
C	✗	$P = \frac{V}{R}$ $P = \frac{5.6}{2.2}$ $P = 2.5$ W	**Mistake:** You have **divided** the **volt** you should have **divided** the **square** **resistance R**. The correct equation is $P = \frac{V^2}{R}$. Additionally, you have **not convert** **kΩ to Ω**. You should have **multipli** 2.2 kΩ, **by 10^3**.
D	✗	$P = \frac{V}{R}$ $P = \frac{5.6}{2.2\times10^3}$ $P = 2.5$ W	**Mistake:** You have **divided** the **volt** you should have **divided** the **square** **resistance R**.

Question 17

A	✗	True	
B	✓	False	Electrons that are **not connected** to atoms in a metallic c of the conductor.
C	✗	True	
D	✗	True	

Question 18

A	✗	ls	
B	✗	se	
C	✓	True	*Diodes only allow current to flow above a threshold voltage. A lamp and it heats up its resistance (V/I) increases. The resista same temperature.*
D	✗	False	

Question 19

A	✗	True	A positive temperature coefficient implies a positive ra and resistance increase.
B	✗	True	Thermistors have a non-linear negative temperature co
C	✗	True	As a semiconductor heats up, it can conduct more easil
D	✓	False	The charge carriers in a conduc travel through the co potential difference is a pli across the conductor.

Question 20

A	✓	$V = \frac{P}{I}$ $V = \frac{0.15\times10^3}{4} = 38$ V	
B	✗	$V = \frac{P}{I}$ $V = \frac{\mathbf{0.15}}{4}$ $V = 0.04$ V	**Mistake:** You have **not converted** the v You should have **multiplied** the value
C	✗	$\mathbf{V = P \times I}$ $V = 0.15\times10^3 \times 4$ $V = 600$ V	**Mistake:** You have **multiplied** the pow have **divided** the power P by I. The co ect uation is $V = \frac{P}{I}$.
D	✗	$\mathbf{V = P \times I}$ $V = \mathbf{0.}$ 1 .6 V	**Mistake:** You have **not converted** the v You should have **multiplied** the value Additionally, you have **multiplied** the should have **divided** the power P by The correct equation is $V = \frac{P}{I}$.

Section Two: Multiple-Choice Questio

Topic 1: Use of SI Units and their Pre

1. Which of the following forms represents the quantity $4\,250\,000\ \Omega$?

A $4.25\ \text{m}\Omega$

B $4.25\ \text{M}\Omega$

C $4.25\ \text{p}\Omega$

D 4.2

2. Which of the following are the SI base units for mass?

A g

B lb

C kg

D Tonnes

3. Which of the following are the derived SI units for current density (J)

A Am^{-2}

B mAm^{-2}

C Am

D mA

4. Which of the following are the SI base units for the amount of substanc

A mol

B kg

C m^3

D g

5. Which of the following represents $9.6\ \text{TJ}$ in standard form?

A $9.6\times10^{6}\ \text{J}$

B $96\times10^{11}\ \text{J}$

C 9.6

D $96\times10^{10}\ \text{J}$

6. Which of the following statements is true?

A A source of random errors can be zero error.

B A source of systematic error can be inaccurate experimental metho

C Random errors and systematic errors can both easily be identified.

D Random errors cause repeated measurements to vary from the true amount.

7. Which of the following statements is true?

A It is possible for a measurement to have low precision and high

B Precision and accuracy are both terms that indicate how close repea measurements are in relation to one another.

C Precision is a term to describe how many repeated measurements a proximity to the true value.

D Accuracy is a term used to describe the relationship between a mea its true value.

8. A student obtains the values $F = 45 \pm 1$ N and $m = 12.3 \pm 0.1$ kg in an e mass of an object.
The acceleration is found using $a = \frac{F}{m}$. What is the acceleration?

A 3.7 ± 1.4 m s^{-2}

B 3.7 ± 3.0 m s^{-2}

C 3.7 m s^{-2}

D 3.7 ± 0.05 m s^{-2}

9. Which of the following values is a valid estimate for the weight of an a

A 690–780 N

B 40–60 N

C 330–550 N

D 70–80 N

10. An experiment has the property of reproducibility:

A The results obtained during the experiment are the same when the method is repeated and the same equipment is used.

B The experiment's method can be replicated by the same experimen by another independent experimenter.

C The experiment's method can be replicated by the same experimen experimenter working independently.

D The experiment can be redone using the same method but differen the same results are achieved.

11. A student obtains the value $f = 12.9 \pm 0.5$ Hz for frequency of a simp

What is the percentage uncertainty of the value for frequency?

A 0.04%

B 0.5%

C 3.9%

D 25.8%

12. Which [illegible] following are the derived SI units for acceleration, given

A km s^{-1}

B m s^{-2}

C km s^{-1}

D m s^{-1}

13. Which of the following represents 630 eV in joules?

A 1.01×10^{-16} J

B 3.94×10^{-17} J

C 3.94×10^{21} J

D 1.01×10^{22} J

14. What is the value for energy E = 2.4 kWh converted into J?

A 2.4×10^{3} J

B 1.44×10^{5} J

C 8.64×10^{5} J

D 8.64×10^{6} J

15. Which of the following is an accurate estimate of the order of magnitu
man?

A $\times 10^{2}$ cm

B $\times 10^{-2}$ cm

C [illegible]

D $\times 10$ cm

16. A student obtains the values $Q = 4.3 \pm 0.05$ V and $E = 30 \pm 1$ J in a c

The e.m.f. is found using $\varepsilon = \frac{E}{Q}$. What is the e.m.f.?

A 7.0 ± 2.17 V

B 7.0 ± 4.5 V

C 7.0 ± 0.31 V

D 7.0 ± 0.15 V

17. Which of the following units are **not** equivalent to 1 joule (J)?

A CV

B Ws

C eV

D $\text{kg m}^2\text{ s}^2$

18. Which of the following are the SI base units for temperature?

A K

B °C

C mK

D m°C

19 A space shuttle travels 600 metres in 0.07 seconds.

What is the speed of a space shuttle in km/s?

A 8571.4 km/s

B 857.1 km/s

C 85.71 km/s

D 8.57 km/s

20. Which of the following is the value of 1 eV?

A 1.67×10^{27} J

B 1.6×10^{-19} J

C 1 [illegible] J

D 1.6×10^{19} J

Topic 2: Particles and Radiation

1. Which statement is true?

A The charge of a neutron is greater than the charge of an electron.

B The proton and the neutron have approximately equal masses.

C The charge of the proton is smaller than the charge of an electron.

D The mass of an electron is less than the mass of a neutron but greater

2. How many neutrons are there in carbon-14 ($^{14}_{6}\mathrm{C}$)?

A 8

B 6

C 14

D 20

3. β^- decay can be represented by the following equation:

$$^{65}_{X}\mathrm{Ni} \rightarrow {}^{65}_{29}\mathrm{Cu} + {}^{0}_{-1}e + Y$$

Which of the following are the correct missing values for **X** and **Y?**

A **X** = 30; **Y** = ν_e

B **X** = 30; **Y** = $\overline{\nu_e}$

C **X** = 28; **Y** = ν_e

D **X** = 30; **Y** = $\overline{\nu_e}$

4. The antiparticles of the neutron and electron and their charges are provi

	Neutron	
Antiparticle	**X**	
Charge of Antiparticle	0	

Which of the following are the correct missing values for **X** and **Y**?

A **X** = antineutron; **Y** = $+e$

B **X** = antineutrino; **Y** = $+e$

C **X** = antineutron; **Y** = $+e$

D **X** = antineutrino; **Y** = e

5. The energy of a photon can be determined from $E = hf$.

What is the energy of a photon with frequency 8.9×10^{15} Hz?

A 7.4×10^{-50} J

B 1.3×10^{16} J

C 5.9×10^{-18} J

D 1.4×10^{-3} J

6. Which following is **not** one of the four fundamental interactions?

A Gravitational

B Strong

C Heavy

D Electromagnetic

7. Which of the following statements is **not** true?

A Mesons are a classification of leptons and baryons are a classificati

B Electrons, muons and neutrinos all have lepton number +1.

C Baryons are made up of three quarks and mesons are made up of t

D Pions and kaons are bosons.

8. Light with frequency 1.7×10^{15} Hz is incident of the surface of berylliu
5.0 eV.

The photoelectric effect causes photoelectrons to be emitted from its su
What is the maximum kinetic energy of the photoelectrons emitted fro

A –5 J

B 3.3×10^{-19} J

C 1.9×10^{-18} J

D 1.1×10^{-18} J

9. An electron de-excites from an excited energy state $E = -4.9$ eV to a l
$E = -7.65$ eV.

What is the frequency of the photon emitted as the electron transitions

A 1.9 Hz

B 1.2×10^{34} Hz

C 3.0×10^{15} Hz

D 6.6×10^{14} Hz

10. Which of the following statements is **not** true?

A All antiquarks have a baryon number of $-\frac{1}{3}$.

B Baryon number is conserved quantity.

C All quarks have a baryon number of 1.

D A Baryon is composed of three quarks.

11. Which of the following statements is true?

A ${}^{3}_{1}\mathrm{H}$ and ${}^{3}_{2}\mathrm{He}$ are an example of isotopes.

B Isotopes are two or more nuclei of different elements with the same different nucleon numbers.

C ${}^{3}_{1}\mathrm{H}$ and ${}^{2}_{1}\mathrm{H}$ are examples of hydrogen isotopes.

D Isotopes are two or more nuclei of the same element with the same a different number of protons.

12. An ultra-high energy gamma ray can reach energies of 1 TeV.

What is the wavelength of a gamma ray at 1 TeV?

A $1.2\times10^{-6}\,\mathrm{m}$

B $1.99\times10^{-25}\,\mathrm{m}$

C $7.24\times10^{34}\,\mathrm{m}$

D $1.24\times10^{-18}\,\mathrm{m}$

13. When electrons are emitted from the surface of a metal due to incident statements is true?

A $\phi > hf$; where ϕ is the work function, h is Planck's constant and incident light.

B An electron at the surface of a metal absorbs two photons of light

C The rate of emission of electrons is proportional to the intensity of

D The stopping potential applied to a metal plate can increase the number emitted per second.

14. The muon decay can be represented by the following decay equation

$$\mu^{-1} \rightarrow X + Y + v_{\mu}$$

What are the missing values for **X** and **Y**?

A $X = e^{+}$; $Y = v_e$

B $X = e^{-}$; $Y = \overline{v_e}$

C $X = e^{-}$; $Y = v_e$

D X [illegible]; Y [illegible]

15. In pair production, a photon forms a particle and its corresponding a[illegible]

What is the minimum energy of the photon required to form this part[illegible]

Note: E_0 is the rest energy of the electron.

A $\frac{1}{2}E_o$

B $2E_0$

C E_o

D $4E_O$

16. A table of the fundamental [illegible] and their force carriers is given be[illegible]

[illegible]ndamental force	Force carri[illegible]
X	pion
Weak nuclear force	**Y**
Z	photon

What the missing values for X, Y and Z?

A **X** = Gravitational; **Y** = kaon; **Z** = Strong nuclear force

B **X** = Gravitational; **Y** = W boson; **Z** = Strong nuclear force

C **X** = Strong nuclear force; **Y** = kaon; **Z** = E[illegible]m[illegible]gnetic force

D **X** = Strong nuclear force; **Y** = W [illegible]on; **Z** = Electromagnetic force

17. The decay of the neutron is represented by the decay equation:

$$n \rightarrow X + e^{-} + Y$$

What are the missing values for **X** and **Y**?

A **X** = p; **Y** = ν_e

B **X** = $\overline{\nu_\mu}$; **Y** = ν_e

C **X** = p; **Y** = $\overline{\nu_e}$

D **X** = [illegible]; **Y** = [illegible]

18. Which of the following statements is **not** true?

A An ion is only produced when an electron is removed from an ato

B Alpha, beta and gamma radiation cause ionisation when they coll

C If an electron does not have sufficient energy to cause ionisation, it atom.

D An ion is positively charged when an electron is removed from th

19. Which of the following statements is **not** true?

A The exchange particle of weak nuclear force is the W boson.

B Weak nuclear force causes changes in neutrons and protons.

C Weak nuclear force exchange particle has a non-zero rest mass.

D The exchange particle of weak nuclear force has an extremely long

20. A photon has energy 2.7×10^{-17} J.

What will the wavelength of the photon be with this energy?

A 1.38×10^{8} m

B 1.68×10^{58} m

C 8.19×10^{-26} m

D 7.37×10^{-9} m

Topic 3: Waves

1. Which of the following statements **is** true?

A The frequency of a wave is dependent upon the amplitude of the w

B One complete cycle is the maximum displace[illegible]t to the next min

C Amplitude of a wave is the maxi[illegible]m displacement of an oscillati

D Phase difference [illegible] measured in degrees and in radians.

2. Which [illegible] following is an example of a transverse wave?

A Sound wave

B Electromagnetic wave

C Stretched and compressed slinky toy

D Pressure wave

3. A transverse wave is travelling with a frequency of $f = 17.9$ Hz and h

What is the wave speed of the wave?

A 3.4×10^{-4} m s^{-1}

B 2.98×10^{3} m s^{-1}

C 10.74 m s^{-1}

D 0.11 m s^{-1}

4. Which [illegible] following statements is true?

A Plane of polarisation for an electromagnetic wave is the plane in w
oscillates.

B If a wave is plane-polarised then it is said to only be oscillating in t

C The intensity of light passing through polarising filters can be alter
relative to one another.

D To plane-polarise light you need two polarising filters at right ang

5. A string fixed at both ends forms a stationary wave.

The length of the string is 2.3 m.

What is the wavelength of the [illegible] monic?

A 4.6 m

B 1.6 [illegible]

C 9.2 m

D 0.6 m

6. A stationary wave is created with a string of length 132 cm which has
$\mu = 0.03\ \text{kg m}^{-1}$.

The string is fixed between two points, creating a tension of 0.7 N in t

What is the harmonic frequency?

A 0.06 Hz

B 13.3 Hz

C 1.83 Hz

D 0.

7. Which of the following statements is **not** true?

(i is the angle of incidence and r is the angle of refraction.)

A The refractive index of air is approximately 1.

B The refractive index of a substance when light goes from air into th
the ratio of $\sin i$ and $\sin r$.

C The refractive index of a substance is the ratio of the speed of soun
substance to the speed of sound in a vacuum.

D The ratio of $\sin i$ and $\sin r$ as a light ray crosses a boundary betwee
is equal to the ratio between the speed of li[illegible] each substance.

8. The refractive index of ai[illegible]ately 1 and the refractive index o

Light tra[illegible] into a glass block at an angle of incidence of 42°.

What is [illegible]ngle of refraction of the light ray in the glass block?

A 30.2°

B 0.5°

C 62.8°

D 0.89°

9. Which of the following statements is **not** true?

A If i = critical angle and the incident substance has a larger refractiv
$r > 90°$.

B If $i >$ critical angle and the incide[illegible] substance has a larger refractive
then total internal refle[illegible] occur.

C If i = critical a[illegible] the incident substance has a larger refractive
the[illegible] b[illegible]ome partial reflection.

D If i [illegible]ical angle and the incident substance has a larger refractiv
then the light ray will refract.

10. Which of the following statements is **not** true?

A There are no methods of preventing modal dispersion in optical f

B Core cladding surrounding the core of the optical fibre is of lowe than the optical fibre.

C Modal dispersion is the lengthening of a l p lse due to the lig undergoing total internal reflecti .

D Material dispersion ers t pulse dispersion from the use of whi monochroma ight.

11. A monochromatic light source is diffracted through a diffraction grati

The light has a wavelength of 715 nm and it is observed at an angle o

What is the order of the light beam?

A 4

B 3

C 1

D 2

12. Young's double slit experiment is used to cr te n terference patte

The experiment uses light with w ngth $\lambda = 650$ nm.

The fringe separati n and the slit–screen distance is 4.1 m.

What sli pacing s?

A 2.1×10^{-7} m

B 4.9×10^{5} m

C 4.9×10^{6} m

D 2.1×10^{-5} m

13. Which of the following statements is **not** true?

A Dark fringes are formed due to interference, when light waves ar with each other.

B Bright fringes are formed due to i te fe ence when light waves ar other.

C The fringe d by Young's double slit experiment are evenly

D If spacing increased, the fringe separation of the interferen increase.

14. Which of the following statements is **not** true?

A The shorter the wavelength of a wave, the less the waves will diff

B Reflection refers to when the angle of incidence is equal to the an

C Diffraction is the process of combining two w s to create a resu

D Refraction refers to the change in wave speed and wavelength boundary.

15. The d e between two points A and B on a transverse wave is 85 c

The wavelength of the transverse wave is 1.46 m.

What is the phase difference in radians between A and B?

A 366

B 3.66

C 0.58

D 0.27

16. Which of the following statements is **not** true?

A The frequency of a wave can be defined as the number of comple per second.

B The period is the time for a complete wave to pass a fixed poin

C The frequency of a wave is the number of cycles of oscillation per

D The displacement is the distance and direction from a particle's re

17. A stationary wave is created in a string fixed at both ends.

The frequency of the first harmonic is f_1.

What is the frequency of the second harmonic?

A f_1

B $4f_1$

C $\frac{1}{2}f_1$

D $2f_1$

18. A light ray enters a block at an angle of 35° and is refracted inside the

What is the refractive index of the block?

A 1.17

B 0.85

C 0.47

D 0.43

19. Which of the following statements is **not** true?

A Light from a filament lamp is comprised of a range of wavelengths

B Vapour lamps produce light with one predominant colour.

C Laser light has light that is highly monochromatic.

D Laser beam light can permanently damage your retina if looked at the light has first been reflected.

20. The period of a wave on a string is 2 minutes.

What is the frequency of the wave?

A 0.005 Hz

B 2 Hz

C 0.5 Hz

D 0.

Topic 4: Mechanics and Materials

1. Which of the following quantities is **not** a scalar?

A Time

B Distance

C Temperature

D Acceleration

2. Which one of the following statements is **not** true?

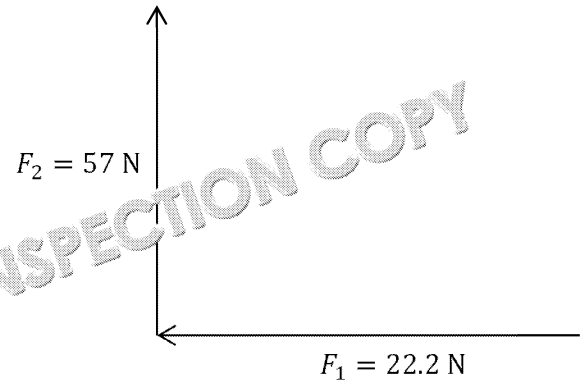
A Acceleration is a vector and energy is a scalar.

B A scalar can be defined by magnitude.

C Energy and mass are both scalar quantities.

D A vector can be defined by only magnitude.

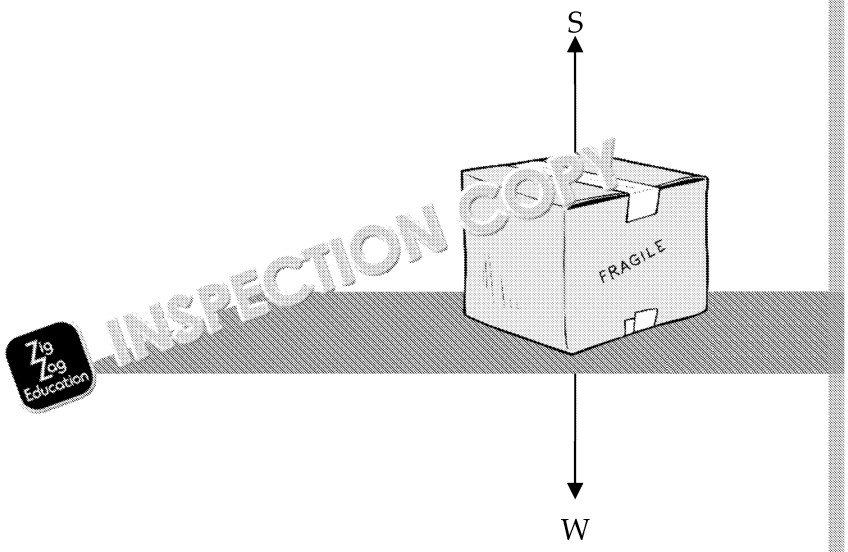
3. Two forces acting at right-angles to each other are demonstrated below.



Which of the following rows gives the correct magnitude and direction

A	
B	
C	
D	

4. A box is sitting at rest on a conveyor belt at a factory.



Which of the following statements is true?

A $S > W$

B $S = W$

C $S < W$

D $S \leq W$

5. An engineer turns a spanner with a force of 500 N.

The engineer's hand is 0.217 m from the pivot.

What is the moment of the force about the pivot?

A 21.7 Nm

B 21.7×10^2 Nm

C 115×10^2 Nm

D 115 Nm

6. Which of the following statements is true?

The principle of moments states that:

A The sum of the clockwise moments is equal to the sum of the anticlockwise moments.

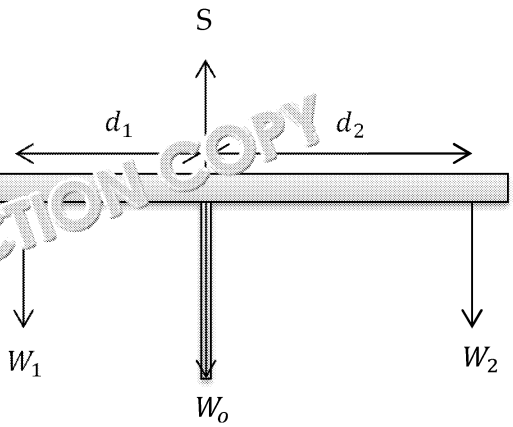
B The sum of the clockwise moments is equal but opposite to the sum of the anticlockwise moments.

C The sum of the clockwise moments is equal to a quarter of the sum of the anticlockwise moments.

D The sum of the clockwise moments is equal to twice the sum of the anticlockwise moments.

7. Supports are being built during the construction of a house.

The supports are in equilibrium:



Which of the following statements is true for the supports to be in equ

A $d_1 = \dfrac{W_1 d_2}{W_2}$

B $-W_1 d_1 = W_2 d_2$

C $S = W_1 + W_2 - W_O$

D $W_2 = \dfrac{W_1 d_1}{d_2}$

8. Which of the following statements is **not** true?

A The velocity of an object can be determined using the gradient of a

B The acceleration of an object can be determined using the gradient graph.

C The distance travelled by an object can be determined by the area u graph.

D The displacement of an object can be determined by the area under

9. A cyclist sets off at $1.9\ ms^{-1}$.

The cyclist travels for 3 minutes and reaches $3.8\ ms^{-1}$.

What is the acceleration of the cyclist?

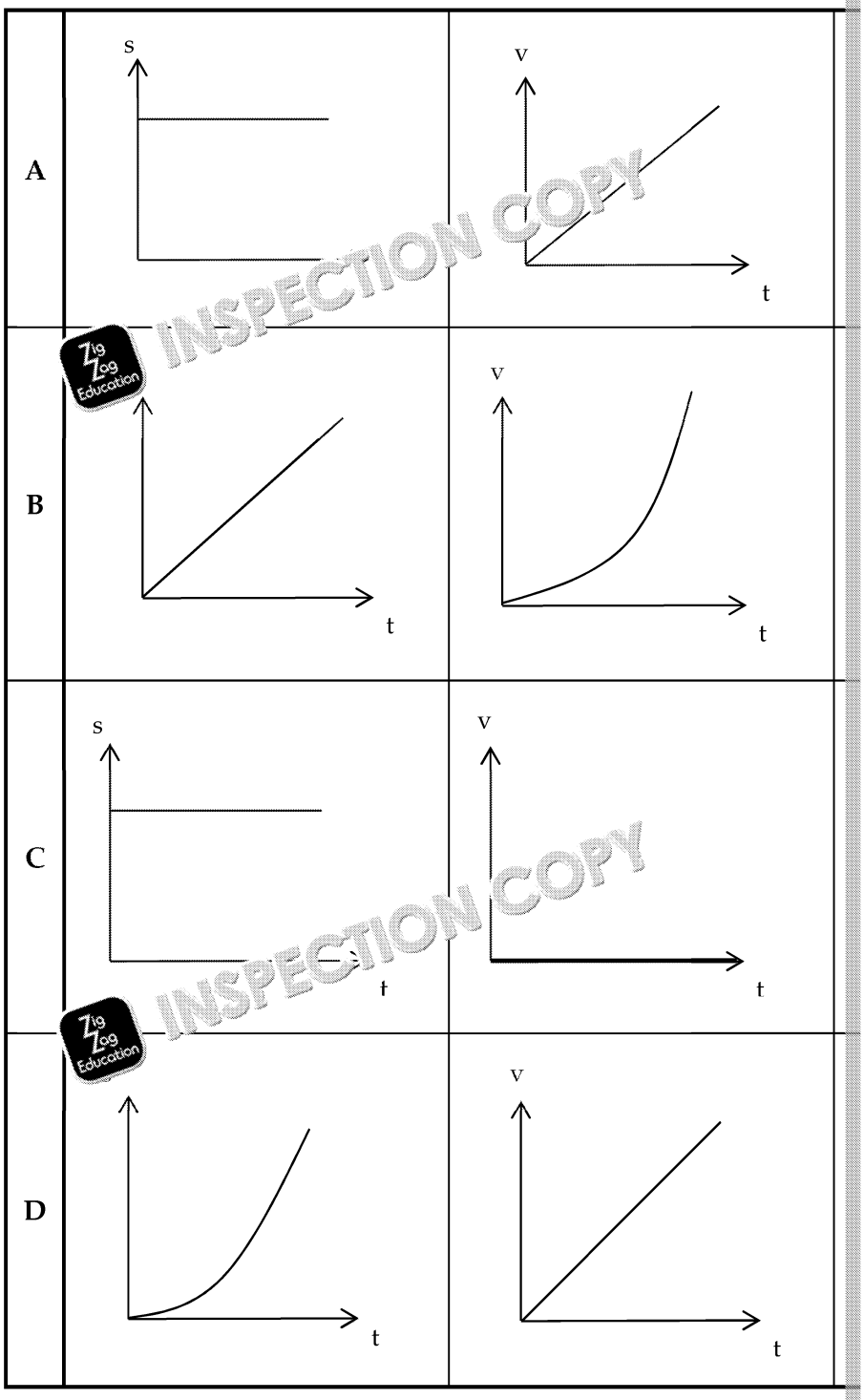
A $0.03\ ms^{-2}$

B $1.9\ ms^{-2}$

C 0.0

D $0.63\ ms^{-2}$

10. Which of the following rows correctly identifies three graphs related



11. A ball is projected horizontally off a cliff. Wh[illegible] the height of the b[illegible]
Assume air resistance is negligib[illegible]

A –12.5 m

B –[illegible]

C 12.5 m

D 23.7 m

12. Which of the following statements is **not** true?

A The horizontal velocity of a projectile changes with time if air resis

B A ball projected horizontally and a ball dropped vertically will re same time.

C The acceleration of a projectile is always t g if air resistan

D The horizontal motion and v motion of a projectile are inde

13. Which of the fo g tatements is **not** true?

A A ed force is proportional to the acceleration of the object.

B If a student pushed a wall with a force of 100 N, the wall will push b

C An object will experience acceleration if its speed remains constant b

D Newton's first law states that if no external force is applied to an o rest or continue travelling at a constant velocity.

14. A skydiver opens her parachute in the last stage of her jump and crea

The skydiver has mass $m = 57$ kg and accelerates towards the groun

What is the value for the drag force created by the parachute?

A 1095 N

B 559 N

C 536 N

D 22

15. A footballer kicks a 430 g football.

The football was travelling at 18 ms^{-1} before being kicked. It leaves th opposite direction at 22 ms^{-1}.

What is the value for the impulse of the force?

A -9.3×10^{3} Ns

B 9.3×10^{3} Ns

C -17.2 Ns

D 17.2 Ns

16. A 0.8 kg ball is dropped from a building.

What will the kin gy of the ball be 3 m above the ground?

A 6

B 23.5 J

C 86.3 J

D 39.2 J

17. An object has a density $\rho = M / V$.

What is the volume of another object with a mass of $4M$ and with the

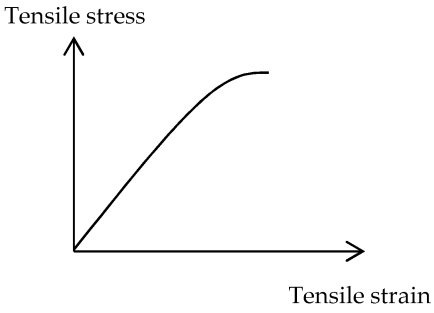
A $2V$

B $\frac{1}{2}V$

C V

D $\frac{1}{V}$

18. The graph below shows how the tensile stress of a material varies wit



How can you determine the Young modulus from the graph?

A The y-intercept of the graph

B The area under the grap

C The gradient ... aight-line section of the graph

D A ... ordinate on the line

19. A force of 77 N is applied to stretch an elastic band by 0.55 cm.

What is the value of the energy stored in the elastic band?

A 42.4 J

B 21.2 J

C 0.42 J

D 0.2 J

20. The period of a wave on a str... is ... nutes.

What is the frequ... wave?

A 3

B 0.3 Hz

C 0.006 Hz

D 0.017 Hz

Topic 5: Electricity

1. Which of the following statements is true?

A Charge is the ratio of resistance to current.

B The resistance of an electrical device is the ratio of voltage to power

C Potential difference is the work done per unit charge.

D Electric current is a rate of flow of electrical energy.

2. A student measures 6.7 mA of current flowing through an electrical circ

What is the charge flow in the circuit?

A 2.3 C

B 2.3×10^{3} C

C 0.02 C

D 1.9×10^{-5} C

3. There are 5.8×10^{20} electrons flowing in a series circuit.

What is the value of charge flowing in the circuit when this number of

A 3.63×10^{39} C

B 2.76×10^{-40} C

C 92.8

D 32.5

4. A filament bulb is connected in a series circuit. The bulb does 0.6 J of w flows through it.

What is the potential difference across the bulb?

A 200 V

B 0.2 V

C 5 V

D 5×10^{-3} V

5. Which of the following statements is **not** true?

A Ohmic conductors are components that obey Ohm's law.

B Ohm's law states that the potential difference across a conductor is current through it, if the temperature of the conductor remains co

C Ohm's law states that the resistance of a co[illegible]ent is equal to the difference across the component and the charge flowing through it

D A metal wire is an exa[illegible] ohmic conductor.

6. A wire [illegible] resistivity of ρ, length L, cross-sectional area A and a r

A second wire has a resistivity of 8ρ, length $2L$ and cross-sectional a series with a cell to determine its resistance.

What is the resistance of the second wire?

A $16R$

B $\frac{1}{4}R$

C R

D $4R$

7. Which of the following statements is [illegible]?

A Aluminium is an ex[illegible]le of a superconductor.

B Su[illegible]nd[illegible]y is the property of a material whereby at any tem its [illegible] temperature the material will have zero resistivity.

C Superconductivity is a phenomenon which occurs when metals ar temperatures close to their melting points.

D Superconductors are used in MRI and particle accelerator machine

8. Four 1.2 kΩ resistors are connected in parallel.

What is the total resistance of the parallel circuit?

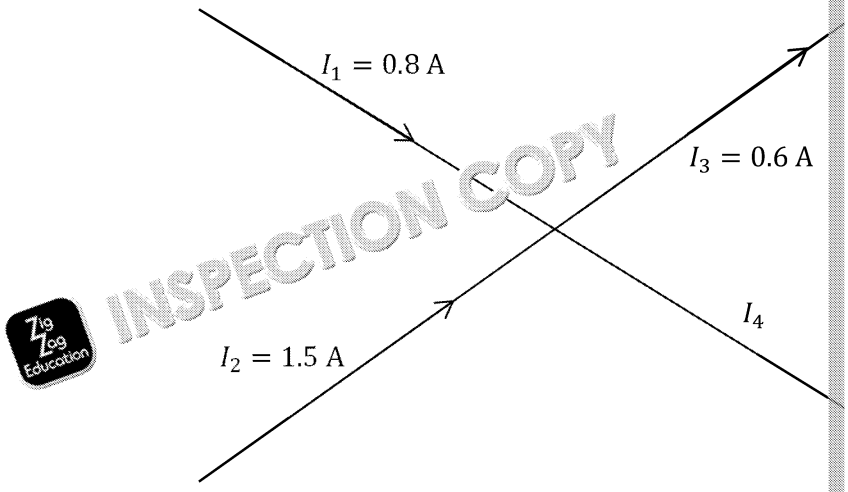
A 0.3 Ω

B 4.8 kΩ

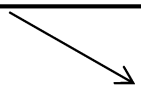
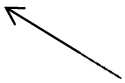
C 300 Ω

D 4.8 Ω

9. A junction in an electrical circuit is demonstrated below:



Which of the following rows correctly identifies the direction and valu

A		
B		
C		
D		

10. An ir tted with a heating element to take out creases in clothin

The heating element has a rate of heat transfer of 260 W. When the i supply it has 1.2 A of current flowing through it.

What is the resistance of the heating element of the iron?

A 374 Ω

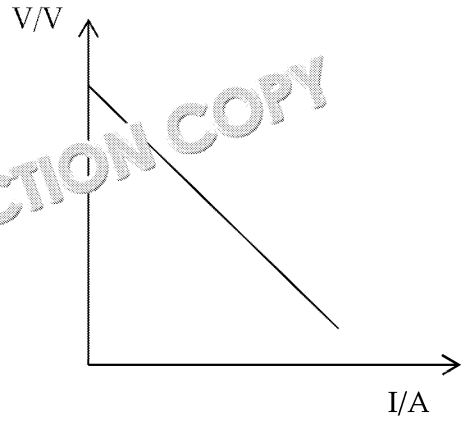
B 181 Ω

C 217 Ω

D 312 Ω

11. A student completes an experiment to determine the internal resistan

The student plots a graph of potential difference across the cell agains the cell:



Which of the following rows correctly identifies how to determine the of the cell from the graph?

	Internal resistance	
A	$\frac{1}{\text{gradient}}$	
B	gradient	
C	y-intercept	
D	-intercept	

12. A 15 Ω resisto connected in series with a cell. The e.m.f. of the cell resista 250 mΩ.

What is the terminal potential difference of the cell?

A 24 V

B 15.2 V

C 9.5 V

D 23.6 V

13. Which of the following statements is **not** true?

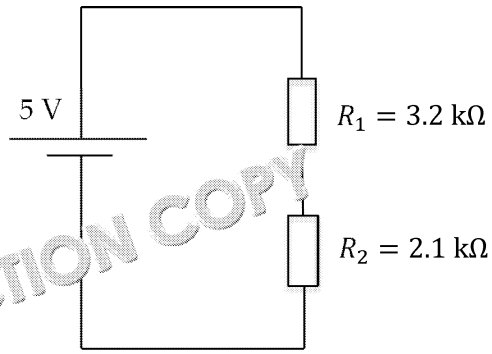
A When the temperature of a thermistor in creases, the potential diff thermistor increases.

B When the intensity of the light incident on an LDR decreases, the the LDR in

C When the intensity of the light incident on an LDR increases, the decreases.

D When the temperature of a thermistor increases, the resistance of

14. A potential divider is set up as below:



What is the potential difference across R_2?

A 2.0 V

B 3.9 V

C 2.5 V

D 0.9 V

15. Which of the following statements is **not** true?

A The current in a series circuit is the same at all points in the circuit.

B The total voltage of two bulbs in series is equal to $V_1 + V_2$.

C The potential difference across each component connected in parallel is the terminal potential difference across the cell.

D The total resistance of three resistors in a parallel circuit is equal to

16. A $5.3\ \text{k}\Omega$ resistor is connected in series to a cell. The potential difference is 16.4 V.

What is the rate of energy transfer through the resistor?

A 19.7 W

B 50.7 W

C 0.05 W

D 3.1×10^{-3} W

17. Which of the following statements is **not** true?

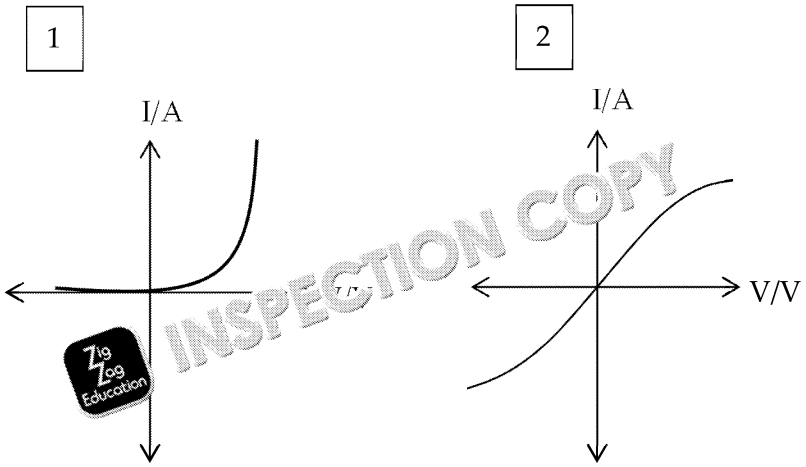
A The resistance of a semiconductor decreases as its temperature increases.

B In a metal, when a voltage is applied across it, conduction electrons move to the positive terminal.

C In an insulator most electrons are connected to atoms but others are free.

D When a voltage is applied across an insulator no current passes through it.

18. A student plots graphs of current against potential difference for thr



Which of the following rows correctly identifies the electrical compo
above?

	1	2
A	Diode	Lamp
B	Metal wire	Lamp
C	Diode	Metal wire
D	Lamp	Thermistor

19. Which of the following statements i ot tr e?

A A metal has a positi ten erature coefficient as its resistance inc
increase.

B Th tance of a thermistor decreases non-linearly with increas

C Semiconductors have a negative temperature coefficient.

D The charge carriers in a conductor travel through the conductor w
potential difference is applied across the conductor.

20. A bulb is connected in series with a cell with terminal potential differ
flowing through the lamp is 1.2 A.

What is power output of the bulb?

A 29 W

B 20 W

C 0.05 W

D 24 W

Answers to Multiple-Choice Questio

Topic 1		Topic 2		Topic 3		Topi	
1	B	1	B	1	D	1	
2	C	2	A	2	B	2	
3	A	3	C	3	D	3	
4	A	4	C	4	C	4	
5	B	5	C	5	A	5	
6		6	C	6	C	6	
7		7	A	7	C	7	
8	C	8	B	8	A	8	
9	A	9	D	9	A	9	
10	C	10	C	10	A	10	
11	C	11	C	11	B	11	
12	B	12	D	12	D	12	
13	A	13	C	13	D	13	
14	D	14	B	14	C	14	
15	A	15	B	15	B	15	
16	C	16	D	16	C	16	
17	D	17	C	17	D	17	
18	A	18	A	18	B	18	
19	D	19	[illegible]	19	D	19	
20	[illegible]	20	D	20	D	20	