Y11 to Y12 Physics Transition Booklet 2022

Aim

The aim of this booklet is to set you 7 tasks to complete over the summer so that you are well prepared for starting A-level physics in September. In completing these tasks, we specifically aim to

1) Develop good learning habits.
2) Provide your teachers will information about your current level of knowledge and understanding.
3) Indicate to you the amount of effort necessary for success in you're a-level studies.
4) Suggest physics super-curricular opportunities which will be essential to your UCAS or job application process.

Due date

The due date for all of this work is at the start of your second lesson of physics in September.

Tasks

Task A	Create a folder
Aims	1 and 3
Essential or desirable	Essential
To do and hand in	We want you to get a folder (try the prep room, or buy one) and organise it ready for A-level physics. You will need dividers for • Practical and maths skills • Forces and motion • Electrons, waves and photons • Definitions You will need to populate your folder with some useful parts of the specification document • Pages 5 and 6 which show a breakdown of all topics and shows details of the examinations. • Pages 8 -30 which shows you exactly what the chief examiner expects you to learn during Y12. • Pages 60 -66 which are the formula and data book for the entire A-level (You will refer to this on a daily basis throughout the course).
Extra documents	http://www.ocr.org.uk/Images/171726-specification-accredited-a-level-gce-physics-a-h556.pdf

Task B	20 multiple choice questions (MCQs)
Aims	1, 2 and 3
Essential or desirable	Essential
To do and hand in	Attempt the 20 MCQs to the best of your ability. There is an answer sheet to hand in provided. A good technique is to try and rule out some wrong answers if you have to guess any.
Extra documents	Appendix A contains the questions and answer sheet

Task C	6 maths skills
Aims	1
Essential or desirable	Essential
To do and hand in	You need to print sections of the OCR A-level physics maths guide, store them in the folder you created in task A and 'read' them. What exactly we mean by 'read' at A-level is explained in depth in appendix B How to 'read' like an expert. You may also like to use the website www.mathswatch.co.uk/vle to improve your skills on the following maths topics that will crop up repeatedly in A-level physics. This website was recommended to us by the maths department. 1) Standard form 2) Significant figures 3) Changing the subject of an equation 4) Calculating gradients 5) SI units and prefixes 6) Trigonometry (SOHCAHTOA)
Extra documents	http://www.ocr.org.uk/Images/295471-mathematical-skills-handbook.pdf Appendix B How to 'read' like an expert

Task D	'Read' a PAG
Aims	1 and 3
Essential or desirable	Essential
To do and hand in	During your GCSE science or physics course you did RPs (required practicals) and at A-level there are similar things called PAGs (practical activity groups). You must read the GCSE RP Hooke's Law found in appendix C and then read the A-level PAG 2.1 Young's Modulus found in appendix D which builds on it. Appendix B contains a very clear description of how to 'read' technical information like a physicist ought to. You will hand in your three bullet points worth of annotation of the PAG provided in appendix D.
Extra documents	Appendix B How to 'read' like an expert Appendix C GCSE RP Hooke's Law Appendix D PAG 2.1 Young's modulus

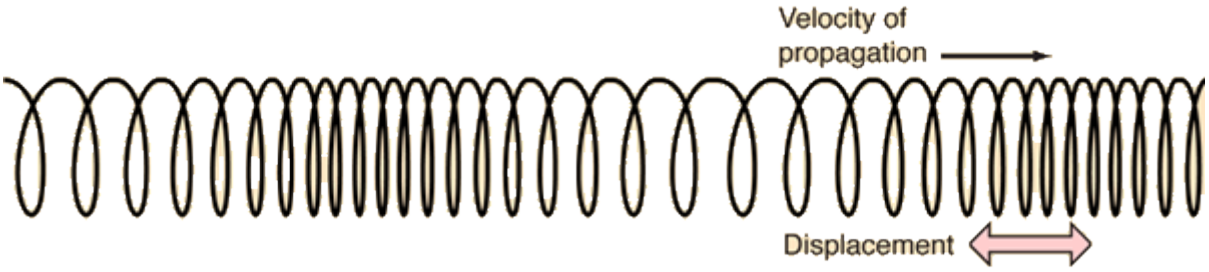
Task E	Mastery sheet
Aims	1 and 3
Essential or desirable	Essential
To do and hand in	Use the mastery sheet according to the instructions written on the top of it. This is one example of a mastery sheet and with repeated use it will enable you to memorise lots of key facts. Mastery sheets can also be easily turned into flashcards, if you want to really get ahead.
Extra documents	Appendix E Mastery sheet

Task F	Initial review
Aims	1, 2 and 3
Essential or desirable	Essential
To do and hand in	We have created you a short exam to do. These questions are A-level exam questions that we think you should be just about able to answer. In some cases you will need to look up key terms in bold or definitions. In some cases you will need to use equations given in the formula and data book that you printed as part of task A. This exam does not have to be done to a strict time limit or without a textbook, but it does have to be your own work. This exam paper will allow us to get a good idea of what you can and can't do from your GCSE studies.
Extra documents	Appendix F Initial review

Task G	Super-curricular activity
Aims	4
Essential or desirable	Desirable
To do and hand in	There is nothing to hand in. In appendix G there is a wide range of choice of super-curricular activites. Soon you will be thinking about your post-18 plans and doing one super-curricular activity will give you a brilliant early advantage when it comes to writing UCAS or job applications.
Extra documents	Appendix G List of super-curricular suggestions

Appendix A – 20 Multiple choice questions and answer sheet

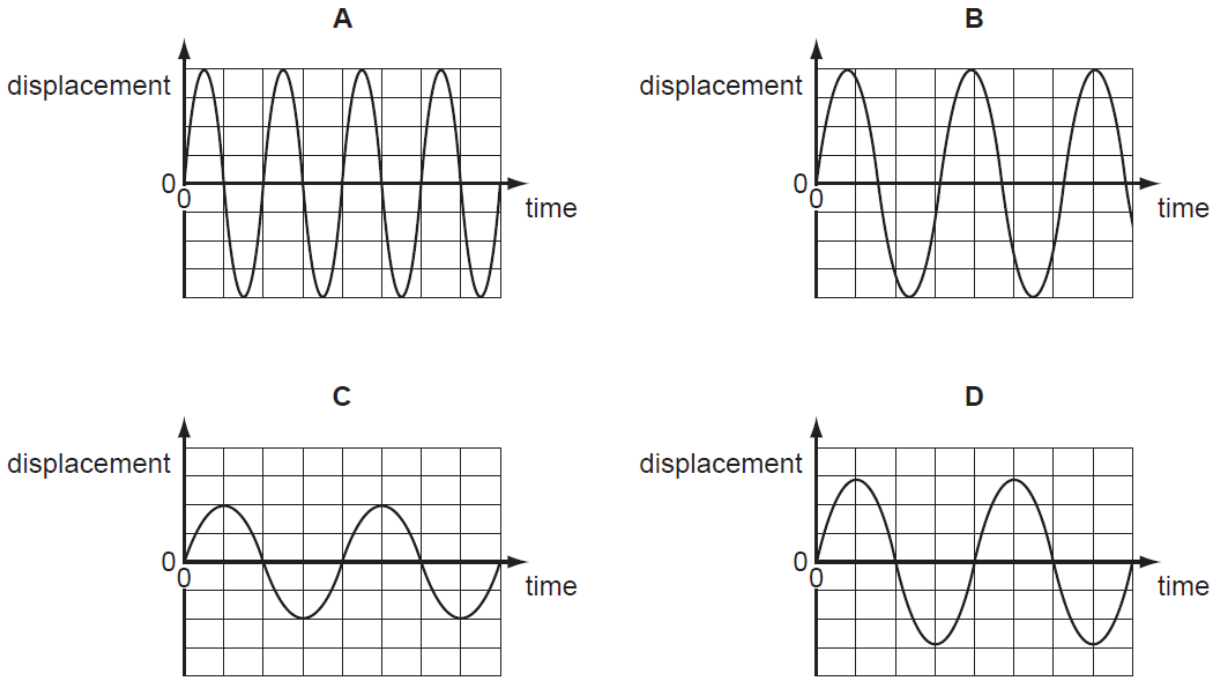
Question 1 – Select the letter which shows the correct examples of longitudinal and transverse waves.



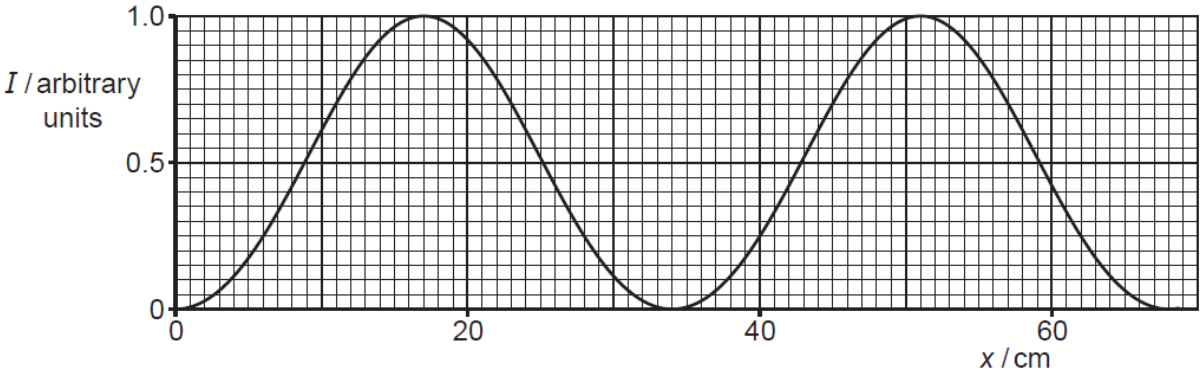
This is a longitudinal wave

Answer letter	Longitudinal waves	Transverse waves
A	Light and x-rays	Sound and ultrasound
B	Sound and light	Ultrasound and x-rays
C	Sound and ultrasound	Light and x-rays
D	Ultrasound and x-rays	Sound and light

Question 2 – These graphs are all drawn to an identical scale, showing the number of waves in one second. Which wave has frequency 4Hz?

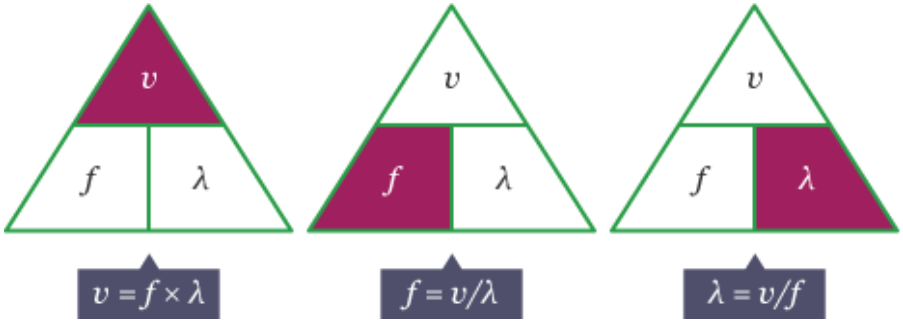


Question 3 – Select the letter which shows the correct wavelength of this wave.



Answer letter	Wavelength / cm
A	0.5
B	2
C	34
D	68

Question 4 – Select the letter which shows the correct speed of a wave of wavelength 12 cm and frequency 2.45×10^9 Hz.

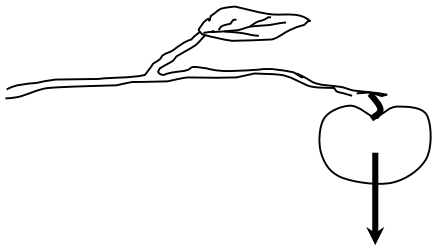


Answer letter	Speed / ms^{-1}
A	12
B	2.9×10^8
C	2.9×10^9
D	2.9×10^{10}

Question 5 – Select the letter which shows the correct order of the electromagnetic waves.

Answer letter	Order from highest frequency to lowest frequency
A	Radio waves Microwaves Infra-red Light Ultra-violet X-rays Gamma rays
B	Gamma rays X-rays Infra-red Light Ultra-violet Microwaves Radio waves
C	Gamma rays X-rays Ultra-violet Light Infra-red Microwaves Radio waves
D	Gamma rays X-rays Ultra-violet Light Microwaves Infra-red Radio waves

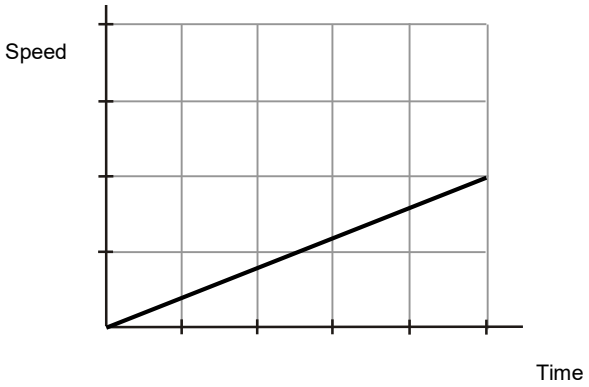
Question 6 – Select the letter which shows the correct statement about the force shown.



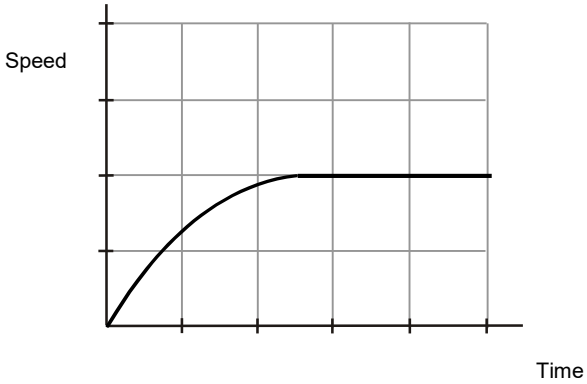
Answer letter	Statement
A	This force is exerted by the branch and acts on the apple.
B	This force is exerted by the apple and acts on the apple.
C	This force is exerted by the Earth and acts on the apple.
D	This force is exerted by the apple and acts on the branch.

Question 7 – Five cars A, B, C, D travel along a straight road for 60 seconds. The graphs are all drawn to the same scale. Select the letter of the car that travelled furthest.

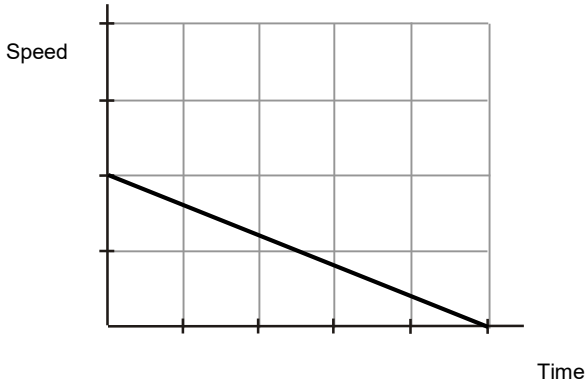
A



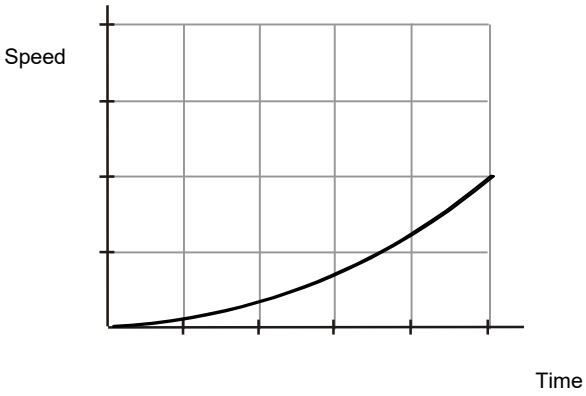
B



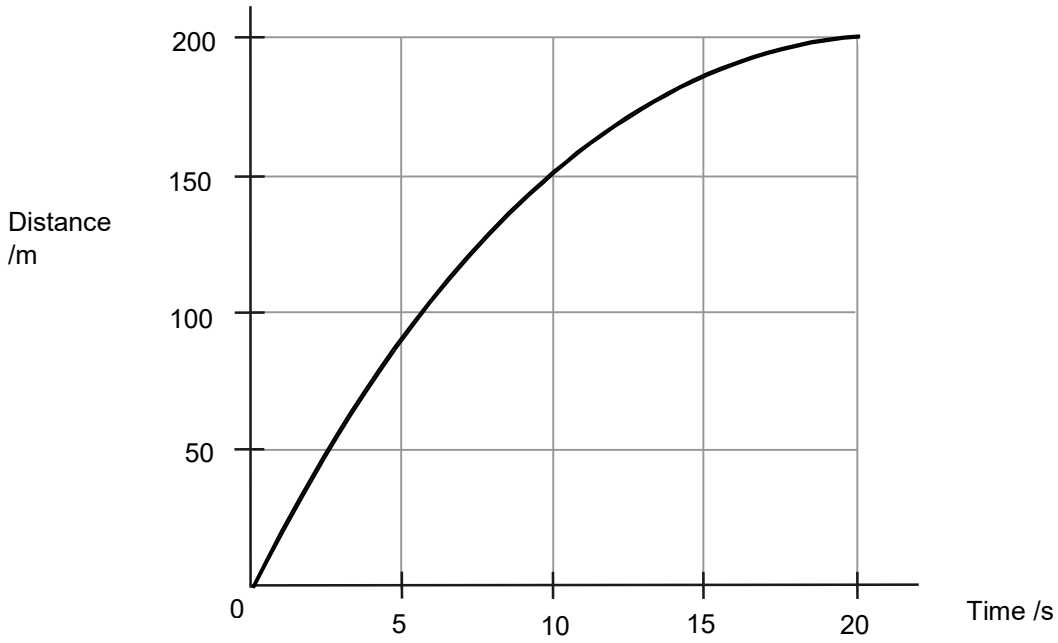
C



D

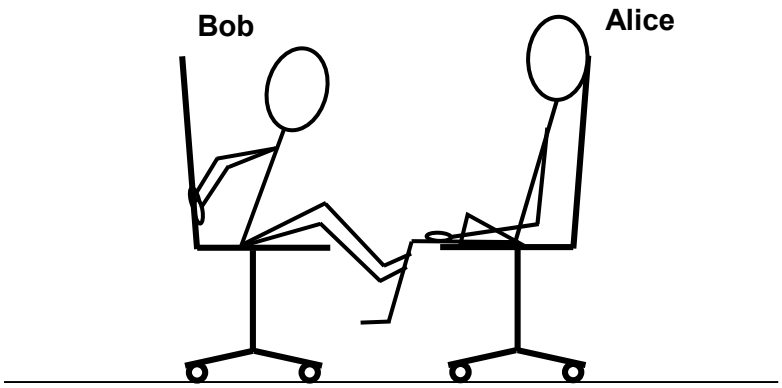


Question 8 – Select the letter which shows the correct statement about the journey represented in the graph.



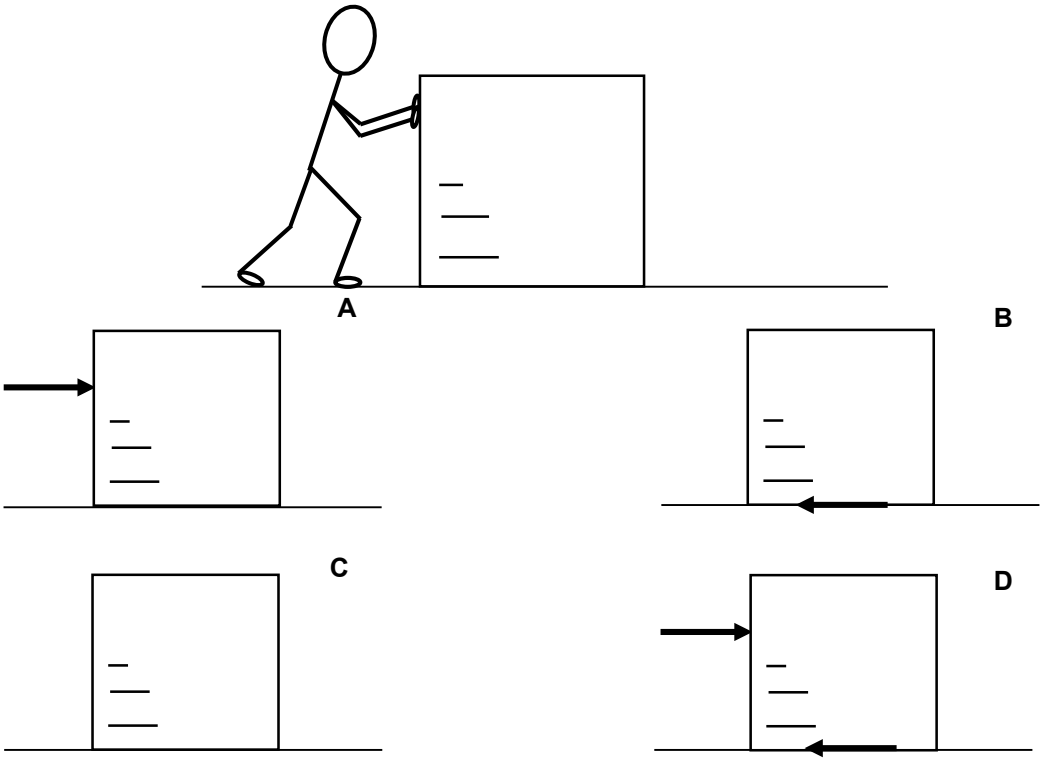
Answer letter	Statement
A	The speed increases during the journey
B	The speed remains constant during the journey
C	The speed decreases during the journey

Question 9 – Bob has a greater mass than Alice. Bob and Alice are messing about on wheelie chairs and Bob pushes at Alice with his feet. Select the letter which shows the correct statement about the motion of Bob and Alice.

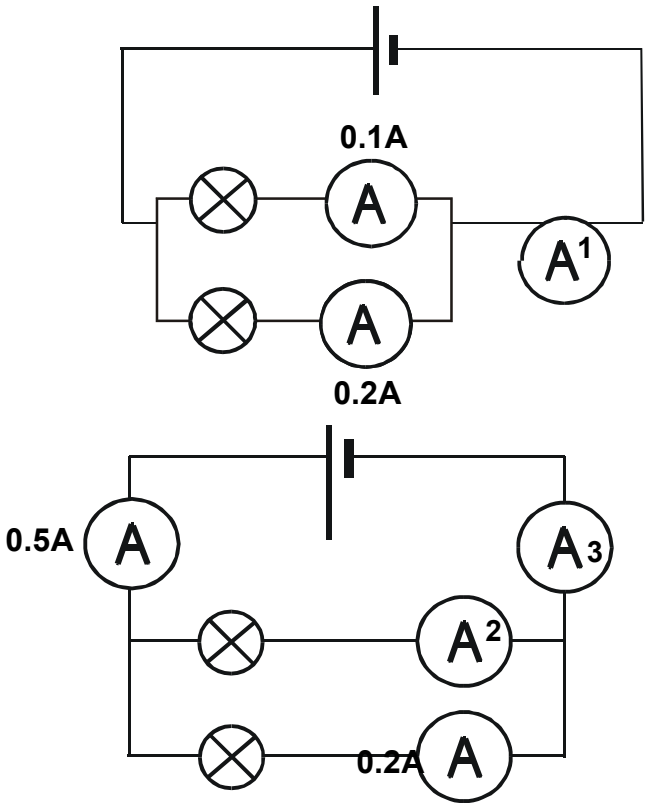


Answer letter	Statement
A	Bob will move, but Alice won't
B	Alice will move, but Bob won't
C	Alice and Bob will both move

Question 10 – Bob is pushing a box across the floor at a steady speed. In this question we will only picture horizontal forces. Select the letter that correctly shows all horizontal forces acting on the box.

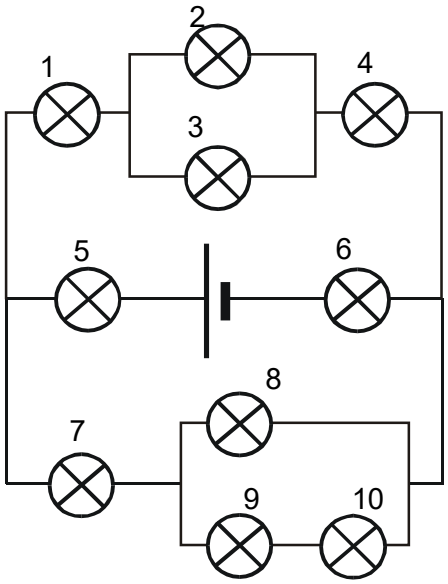


Question 11 – These circuits contain bulbs which **are not identical** to one another. Select the letter which shows the correct reading on the ammeters.



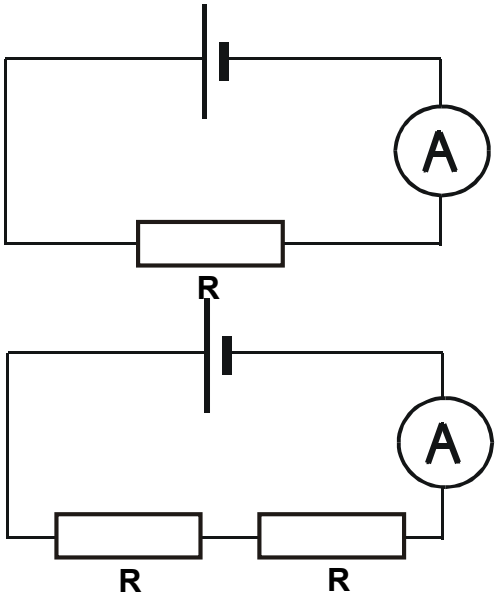
Answer letter	A_1	A_2	A_3
A	0.2	0.2	0.3
B	0.3	0.7	0.2
C	0.3	0.2	0.7
D	0.3	0.3	0.5

Question 12 – The bulbs in this circuit are all identical to one another. Select the letter which shows the correct answers.



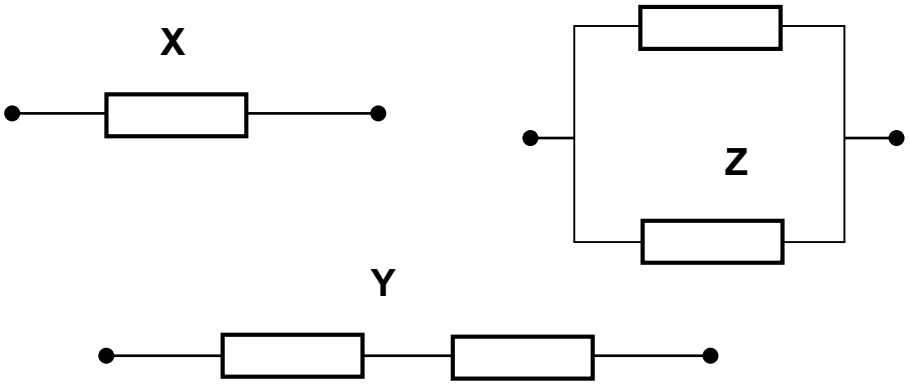
Answer letter	The bulb that is the same brightness as bulb 1 is …	The bulb that is the same brightness as bulb 6 is …	The bulb that is the same brightness as bulb 9 is …
A	5	4	8
B	4	5	10
C	5	1	10
D	7	5	2

Question 13 – Alice makes two circuits which have identical cells and resistors. Select the letter that gives the correct statement about the ammeter readings.



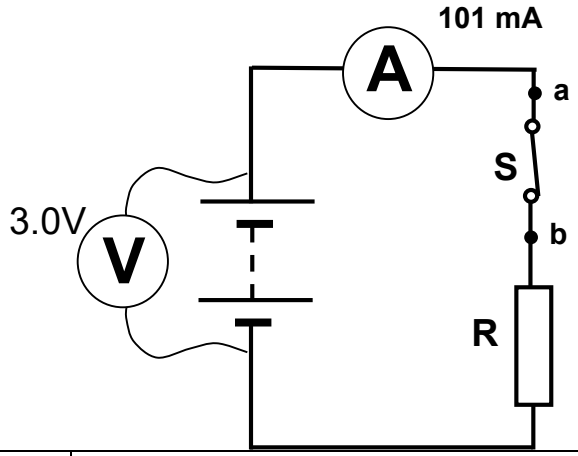
Answer letter	The reading on the ammeter in the top circuit is…
A	Less than the reading on the ammeter in the lower circuit
B	Equal to the reading on the ammeter in the lower circuit
C	More than the reading on the ammeter in the lower circuit
D	Zero

Question 14 – These networks of resistors are made of resistors with equal resistance. Select the letter that correctly describes the resistances in the different networks.



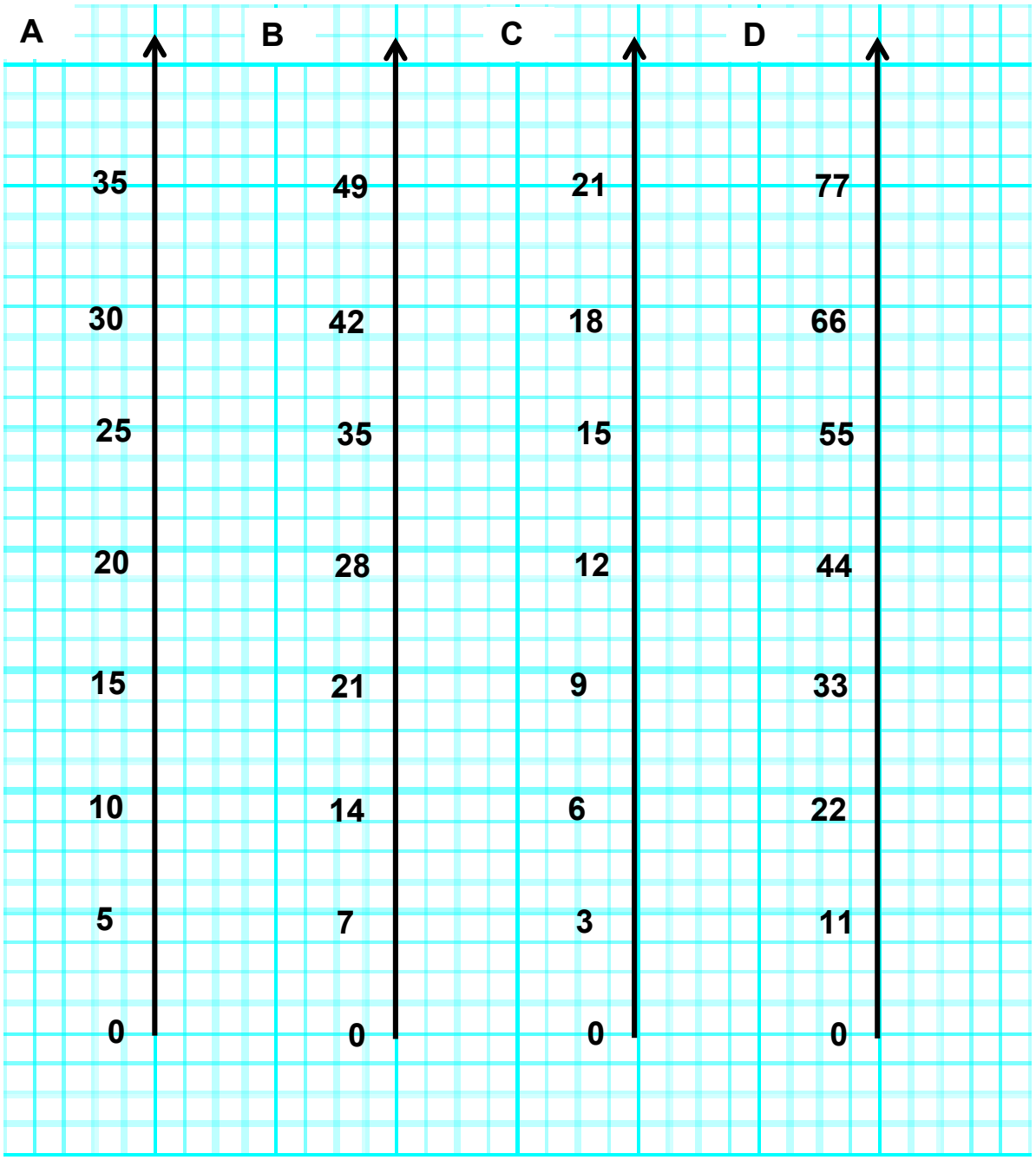
Answer letter	The resistance of X is greater than the resistance of Y	The resistance of X is greater than the resistance of Z
A	True	True
B	True	False
C	False	True
D	False	False

Question 15 – Select the letter that correctly gives the resistance of the resistor R.

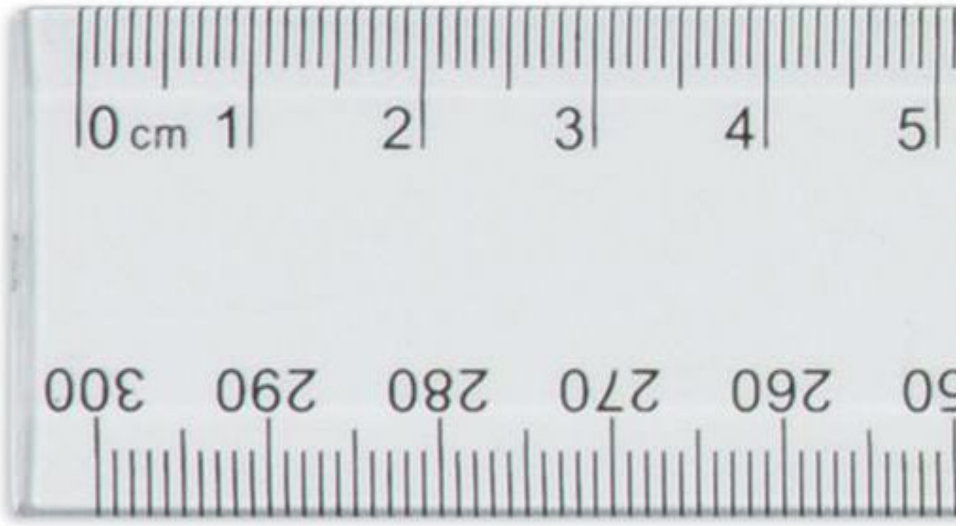


Answer letter	The resistance of the resistor R is
A	0 Ω
B	0.030 Ω
C	30 Ω
D	34 Ω

Question 16 – Which axis is properly scaled?



Question 17 – Select the letter that correctly represents the length being measured.



Answer letter	The length of the paperclip is…
A	3.2 mm
B	0.32 m
C	320 mm
D	0.032 m

Question 18 – Select the letter that represents that correct rearrangement of this equation.

$$\frac{1}{2}mv^2 = hf - \phi$$

Answer letter	***V*** **=**
A	$\sqrt{\frac{m}{2(hf-\phi)}}$
B	$\sqrt{\frac{2}{m}(hf-\phi)}$
C	$\frac{2}{m}\sqrt{hf-\phi}$
D	$\sqrt{hf}+\frac{2\phi}{m}$

Question 19 – Select the letter that represents the correct units for the quantities given.

Answer letter	Unit for current	Unit for mass
A	Ampere	Kilogram
B	Volt	Newton
C	Ampere	Pound
D	Coulomb	Kilogram

Question 20 – Select the letter that represents the correct order of the columns in a results table.

Answer letter	From left to right the columns should go
A	Dependent variable, Derived quantities, Independent variable
B	Derived quantities, Dependent variable, Independent variable
C	Independent variable, Dependent variable, Derived quantities
D	Independent variable, Derived quantities, Dependent variable

Answer Grid to the 2021 A-Level Physics transition MCQs.

Forename _____

Surname _____

Question	A	B	C	D	No idea
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Part guesses are encouraged, but if it is going to be a total punt then use the “no idea” box. Thanks.

Appendix B - How to read a textbook like an expert

First things first

Set aside 15 minutes and lift out a pencil (highlighter, post-its optional)

Preview

Read the aims and section headings (you are just trying to get the gist of it in a few seconds).

Look up any words in bold that you don't know the exact meaning of (in a glossary).

Think "what do I already know about this?" and "where do I want to be at the end of these 15 minutes?" and "which bit of this am I curious about?"

Active reading

Read the entire section (aloud if you are alone – it slows you down and makes you really take it in).

Now, and only now, pick up a pencil.

Underline, circle, post-it, or write marginalia next to the important bits (you want to be able to read just the bits you chose in the future and it represents a meaningful summary. Also, when you are forced to choose what is and what is not important you are thinking hard – good for you).

Write marginalia questions for clarification, which you can later ask an expert about e.g. "but what about…? or "What circumstances is this true under?" or "Does that mean *all* leptons?" or "But the other day I swear you said…" etc.

Review

Now write down three bullet points at the end of the section to record what you were thinking about. These could be key points, definitions, times when you changed your mind, or realised something important, or 'got it' all of a sudden, or mistakes you made.

Appendix C – Hooke's Law RP

Does a stretched spring obey Hooke's law?

Aims

When a weight is suspended from a spring it stretches (this change in length is called extension). You are going to investigate whether the extension of the spring is directly proportional to the weight added.

Safety

* Wear eye protection – if the spring snaps sharp metal can recoil quickly.

* Secure your equipment to prevent it from toppling over.

* Stand up – if you are sat down then it's harder to move out of the way of falling weights.

Equipment and materials

* Spring

* Set of 1 N weights (100 g)

* 1 m ruler

* Clamp stand, clamp and boss

Method

1 Attach the spring to the clamp stand and allow the spring to hang freely over the side of the bench.

2 Suspend the weight holder on the spring and record the length of the spring.

3 Add a 1 N (100 g) weight and measure the length of the spring.

4 Now add another 1N weight and again measure the length of the spring.

5 Continue adding weights until 8N is suspended.

6 Remove the weights 1N at a time, measuring the length of the spring as each weight is removed.

7 Record all your results in a table.

8 Plot a graph of extension (y-axis) against weight (x-axis).

Questions

1 What happens to the spring as the weight is increased?

2 What are the independent and dependent variables?

3 Did your line of best fit through the origin?

4 Describe the relationship between the weight applied (force) and the extension of the spring.

5 Did your spring obey Hooke's law? You will need to use your results to explain your answer.

Appendix D – PAG 2.1 Young' modulus

PAG 2.1 Determining Young Modulus for a Metal

Aim

Determine a value for the Young's modulus of copper

Equipment

- Test wire (28 swg copper)
- Travelling microscope (to measure extension)
- Metre rules
- 50g slotted masses
- Bench pulley
- G clamp
- Carpet square
- Screwgauge micrometer
- Top-pan balance
- Safety spectacles to EN166F

Health and Safety

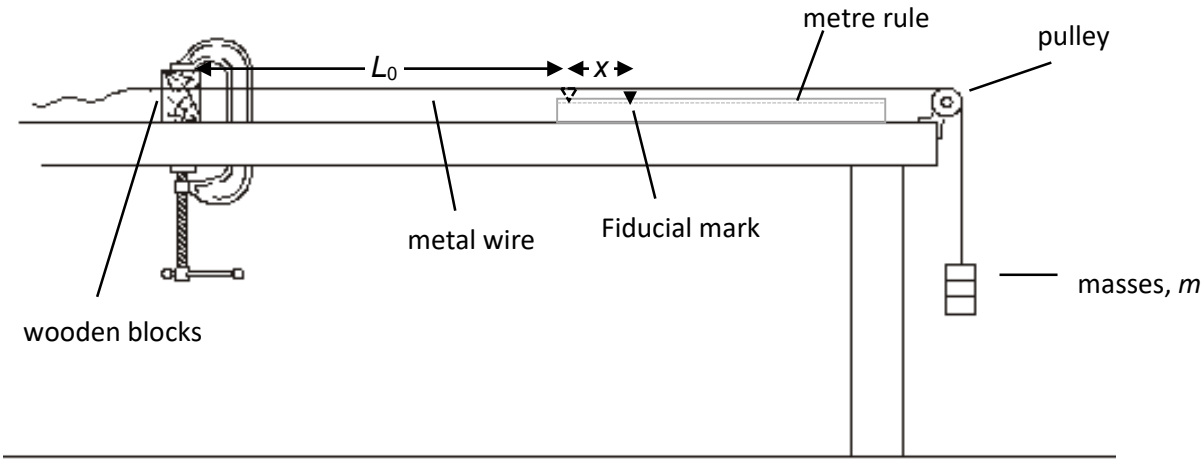
Safety spectacles must be worn at all times due to the risk of the tensioned wire snapping and causing damage to the eyes.

Do not exceed a mass of 600g to reduce the risk of breaking the wire.

Avoid standing next to the masses use a carpet square beneath the masses and wear closed-toe footwear.

Procedure

The apparatus is set up as shown below. Note that L_0 should be at least a metre long to minimise uncertainties.



Although it is not immediately obvious, choosing any length as L_0 and then measuring extension from that starting length will result in correct measurements for the strain of your material.

1. Measure the diameter of the test wire using a screwgauge micrometer (measure at different places along the length of the wire and in different orientations to minimise uncertainties).

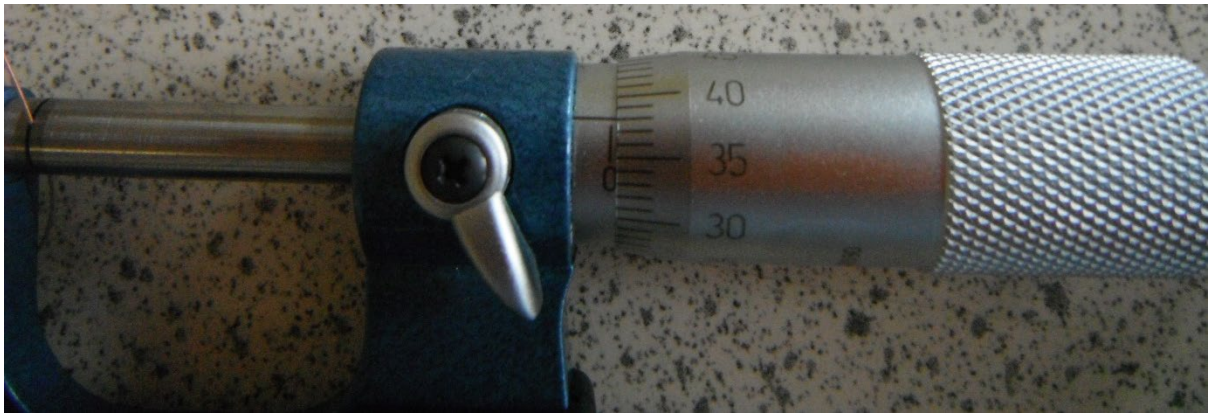


Figure 1 - Screwgauge micrometer reading 0.38 mm

2. Use this measurement to calculate the cross sectional area of the wire. Record the result clearly with the appropriate units.

3. The original length L_0 of the test wire is measured so that any extension can be established. This may require a 50g mass to tighten the wire.

4. The load is increased in stages by adding 50g at a time up to a maximum of 600g. At each point the extension will be measured using a fiducial mark affixed to the wire viewed under the travelling microscope.

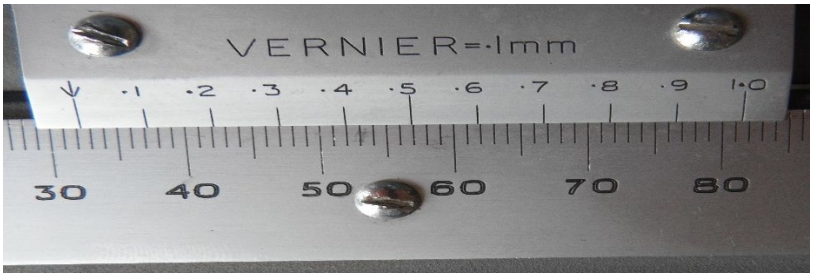


Figure 2 - Vernier scale reading 32.4 mm

5. Record your results of mass using the top-pan balance, force applied (calculated from the mass), extension, stress and strain in a table complete with all units appropriately detailed.

6. Plot a graph of stress (on the y axis) against strain (on the x axis).

7. Calculate the value of the gradient with appropriate units. This is the Young's modulus of copper.

You are encouraged to access the additional help sheets regarding

* Screwgauge micrometers

* Vernier scales

* Travelling microscopes

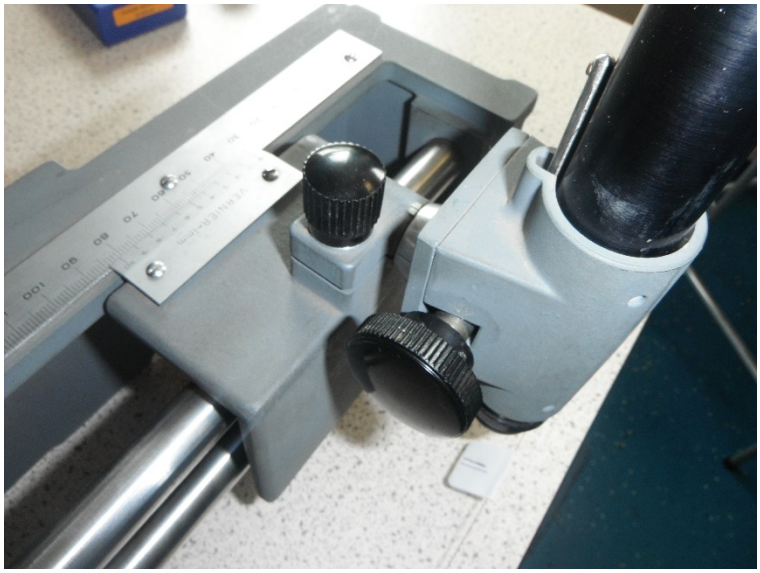


Figure 3 - travelling microscope with (from top left to bottom right) vernier scale, travelling wheel, Focussing knob, fiducial mark

Evaluation

Calculate the percentage uncertainty in F, A, x and L_0.

Combine these uncertainties to calculate a percentage uncertainty for the Young's Modulus.

Compare your value to an accepted value.

Comment on the comparison between your result and the accepted value, taking your estimated uncertainty into account.

PAG 2.1 Determining the Young's modulus of copper

Submission checklist (for student use)

1) Data table ☐

2) Graph ☐

3) Calculation of Young's modulus ☐

4) Calculation of the percentage uncertainty in your value of Young's modulus ☐

5) Comparison of your value of Young's modulus to the accepted value. ☐

CPAC references (for teacher use)

CPAC 1) Follows written procedures ☐

CPAC 3) Safely uses a range of practical equipment and materials ☐

CPAC 4) Makes and records observations ☐

CPAC 5) Researches, references and reports ☐

Detailed checklist (for teacher use)

1.2.1(c) Follows written procedures ☐

1.2.1(d) Makes and records observations ☐

1.2.1(e) Keep appropriate records of experimental activities ☐

1.2.1(f) Present information and data in a scientific way ☐

1.2.1(g) Use appropriate software and tools to carry out research and report findings ☐

1.2.1(h) Researches ☐

1.2.1(i) Correctly cite sources of information ☐

1.2.2(a) Using appropriate analogue apparatus to record length and distance and to interpolate between scale marks ☐

1.2.2(b) Use of appropriate digital instruments to measure mass ☐

1.2.2(c) Use methods to improve accuracy of measurements ☐

1.2.2(e) Use callipers and micrometers for small distances, use digital or Vernier scales ☐

Appendix E – Mastery sheet

Module 4 Electrons, Waves and Photons 4.1.1 Charge and 4.1.2 Mean Drift Velocity Mastery Sheet

1. Cover up the right hand side of each column and write down all you can from memory in black ink.
2. Uncover the information and complete anything you missed in green ink.

4.1.1 a and b	
Electric current is defined as the...	rate of flow of charge
The symbol for charge is...	Q
The symbol for electric current is...	I
The units for charge are...	Coulombs (C)
The units for electric current are...	Amperes or Amps (A)
The delta symbol Δ means...	"small change in..."
4.1.1 c and d	
The charge on an electron is...	$e = -1.6 \times 10^{-19}$ C
That means that the charge on a proton is...	1.6×10^{-19} C
All objects made up of protons and electrons have a	that is an exact multiple of e.
4.1.1 e	
Electric current is the flow of...	electrons through metals.
Electric current is the flow of...	ions through electrolytes.

4.1.1 f	
Electrons are negative so they flow from...	the negative terminal of a cell to the positive terminal of a
Conventional current is always indicated...	in the opposite direction to the direction the electrons
The negative terminal on the symbol for a cell...	is the shorter fatter line.
4.1.1 g	
The total amount of charge is...	always the same.
Quantities with this property are called...	conserved quantities.
Kirchoff's first law of circuits says that the sum of the...	electric currents entering and leaving any given point is
4.1.2 a, b and c	
The number density n is...	the number of free charge carriers per unit volume.
For conductors n is approximately...	10^{28} m^{-3}
For semiconductors n is approximately...	10^{17} m^{-3}
For insulators n is...	zero.
Drift velocity is the...	mean flow speed of a charge carrier around a circuit.
Drift velocity is...	inversely proprotional to the cross-sectional area of the

Appendix F – Initial review

1(a). Fig. 5.1 shows a graph of drag *D* against speed *v* for a lorry.

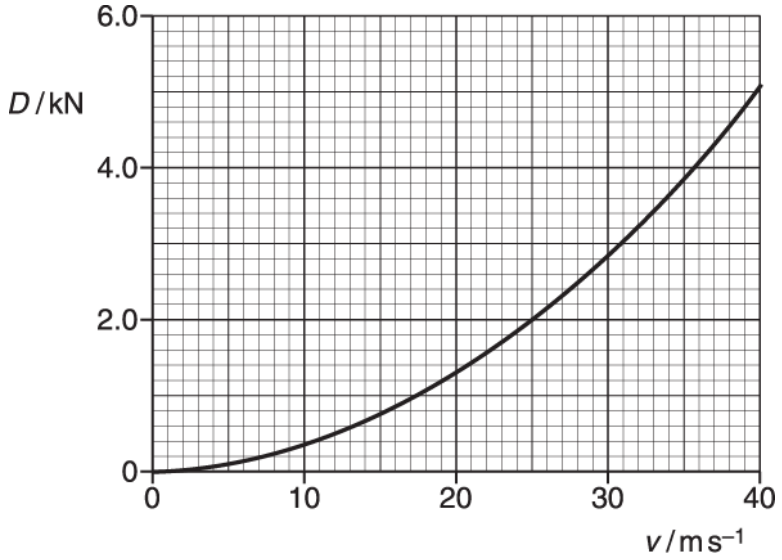


Fig. 5.1

The lorry has a mass of 8000 kg. Its engine provides a **constant** forward force of 3200 N.

i. Calculate the instantaneous acceleration of the lorry when travelling on a level road at aspeed of 25 m s^{-1}.

acceleration = ... m s^{-2} **[3]**

ii. Explain why this lorry cannot travel at a speed of 40 m s^{-1} on a level road.

[1]

(b). The lorry driver wears a seat belt. Describe and explain how a seat belt reduces the force on a driver during the impact in an accident.

[3

2(a). A sports manufacturer is testing the quality of one of their footballs.

Fig. 3.1 shows how the force *F* applied to a football varies with time *t* whilst it is being kicked horizontally. The ball is initially at rest.

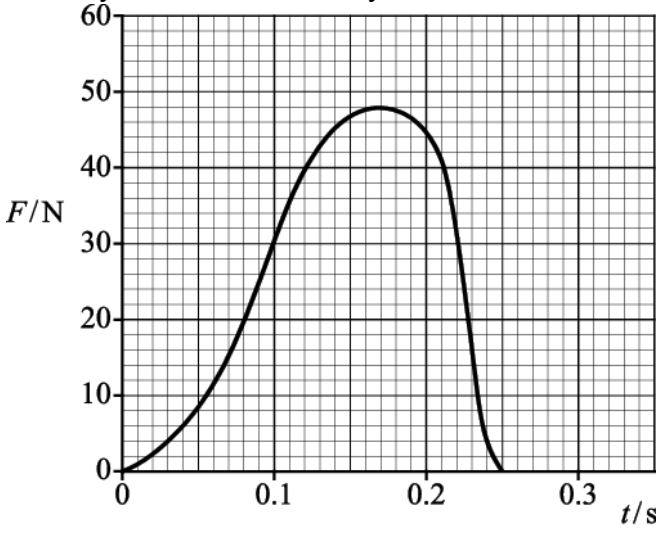


Fig. 3.1

i. Use the graph to find:

1. the maximum force applied to the ball ..... N

2. the time the boot is in contact with the ball ..... s.

[1]

ii. The mean force multiplied by the time of contact is called the impulse delivered to the ball. The impulse delivered to the ball is about 6.5 N s.

Explain how you would use the graph to show that the impulse has this value.

[2]

(b). The mass of the ball is 0.60 kg. Use your answers in **(a)** to calculate

i. the maximum acceleration of the ball

acceleration = ... m s^{-2} **[2]**

ii. the final speed of the ball.

speed = ... m s^{-1} **[2]**

(c). A The ball hits a wall with a speed of 11 m s^{-1}. It rebounds from the wall along its initial path with a speed of 6.0 m s^{-1}. The impact lasts for 0.18 s.

Calculate the mean force exerted by the ball on the wall.

mean force = ... N **[3**

3. Fig. 6.2 shows a thin strip of aluminium which is secured by a clamp stand.

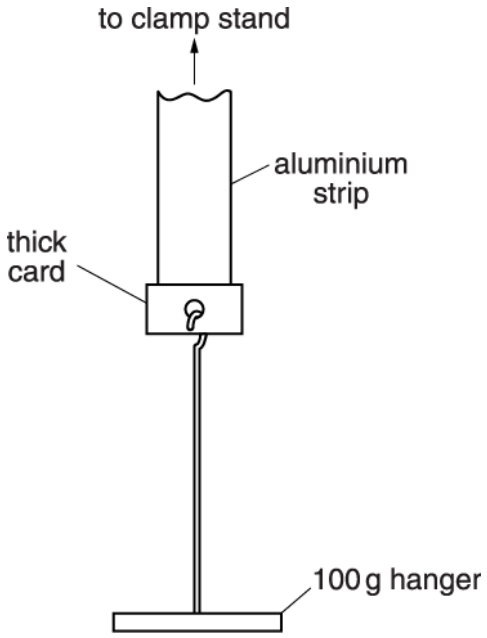


Fig. 6.2

The width of the strip has been measured to be 1.0 cm. A piece of thick card is taped to the lower end of the strip. A 100 g mass hanger is hooked through the card as shown in Fig. 6.2. A number of 100 g slotted masses and a micrometer are also available.

Describe how you would use the equipment to determine the **breaking stress** of aluminium.

[3]

4. A copper rod of cross-sectional area $3.0 \times 10^{-4}\ \text{m}^2$ is used to transmit large currents.
A charge of 650 C passes along the rod every 5.0 s. Calculate

i. the current *I* in the rod

I = ... A **[1]**

ii. the total number of electrons passing any point in the rod per second

number per second = ... **[1]**

iii. the mean drift velocity of the electrons in the rod given that the number density of free electrons is $1.0 \times 10^{29}\ \text{m}^{-3}$.

mean drift velocity = ... m s^{-1} **[2]**

5. A battery of negligible internal resistance is connected across two resistors of resistance values *R* and *2R* as shown in **Fig. 24.1.**

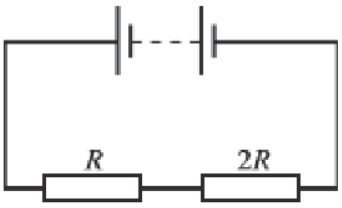


Fig. 24.1

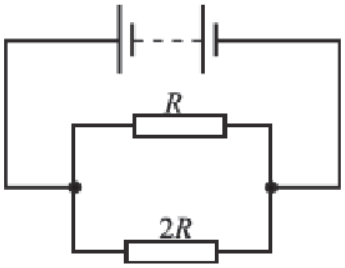


Fig. 24.2

The same battery is now connected to the same resistors as shown in **Fig. 24.2.**

Calculate the ratio

$$\frac{\text{current from battery in circuit of Fig. 24.1}}{\text{current from battery in circuit of Fig. 24.2}}.$$

ratio = ... **[3]**

6. The circuit in **Fig. 5.1** consists of a d.c. supply of e.m.f. 45 V and negligible internal resistance and three resistors.

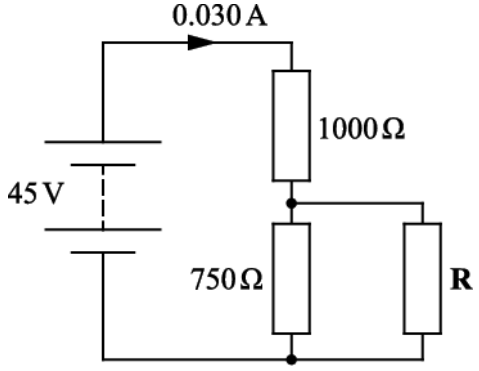


Fig. 5.1

Two of the resistors have resistances 1000 Ω and 750 Ω as shown.

The current drawn from the supply is 0.030 A. Calculate the resistance of **R**.

resistance = ... Ω **[4]**

7. State **two** properties which distinguish electromagnetic waves from other transverse waves.

[2]

8. i. Define the terms *wavelength*, *frequency* and *period* used to describe wave motion.

wavelength, λ
.....

frequency, *f*
.....

period, *T*
.....

[3]

ii. Starting from the definition of speed *v*, derive the wave equation which relates λ, *f* and *v*. Explain your reasoning clearly.

[3]

END OF QUESTION PAPER

Appendix G - Super-curricular items

Things to show an admissions office you are serious about physics

Books (read it and be ready to offer a view on it)

1. The first three minutes – Steven Weinberg
2. A brief history of time/ the Universe in a nutshell – Stephen Hawking
3. 6 easy pieces/ 6 not so easy pieces/ QED – The strange theory of light and matter/ The Feynman lectures – Richard Feynman
4. The elegant Universe – Brian Greene
5. Just 6 numbers – Martin Rees

Podcasts (listen to it and be ready to offer a view on it)

1. The infinite monkey cage – BBC Radio 4 program with Brian Cox
2. Star Talk – Neil DeGrasse Tyson's podcast
3. Physics at Oxford – The Oxford University physics department podcast
4. Inside Science – BBC Radio 4 program with Adam Rutherford

TV/ Boxsets (watch it and be ready to offer a view on it)

1. The Sky at Night – BBC4
2. Stargazing Live – BBC
3. Wonders of the Solar System/ Wonders of the Universe/ Forces of Nature – Brian Cox
4. Fun to Imagine – Richard Feynman

Openware (complete a course)

1. https://ocw.mit.edu/courses/physics/
2. http://oyc.yale.edu/physics
3. http://www.physics.org/explore.asp
4. http://www.open.edu/openlearn/science-maths-technology/science/physics-and-astronomy/comparing-stars/content-section-0

Magazines (read an issue and be ready to offer a view on it)

1. Physics World
2. Physics Today
3. Scientific American

4. Astronomy

Trip (visit it and be ready to offer a view on it)

1. Visit the National Space Centre in Leicester
2. Visit Jodrell Bank observatory
3. Go to a meeting of the Sheffield Astronomical Society

Work experience

1. Take a CV to Ms Evans about a placement at AMP