CCEA GCSE PHYSICS (2003 SPECIFICATION)

PHYSICS



EXAM QUESTION PACK

PAPER 1 HIGHER TIER G7604 PAPERS

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Physics

Paper 1
Higher Tier

[G7604]

G7604

FRIDAy 15 JUNE, AFTERNOON

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 125.
Quality of written communication will be assessed in Question **1(a)(iv)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with numerical answers where appropriate.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The diagram shows one solar panel consisting of a number of sections.
The solar panel is made up of a number of photocells.
The photocells produce electricity directly from sunlight.
Solar panels are placed on the roof of a house.



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On a cloudless summer day the solar energy shining on the panel **every second** is 6000 J. Of this amount 4800 J are reflected, the rest is converted to electricity.

(i) Calculate the output electrical energy every second from the solar panel.

Output electrical energy = _____ J [1]

(ii) Calculate the efficiency of the solar panel.
You are advised to show clearly how you get your answer.

Efficiency = _____ [2]

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(iii) On a certain summer day the panel generated electricity for 10 hours. Using your answer to part **(a)(i)** calculate the number of kilowatt-hours (kWh) generated by the solar panel.
You are advised to show clearly how you get your answer.

Number of kWh = _____ [2]

A family of four would use on average 15 kWh per day.
The electricity generated is d.c. and is used to charge a battery.
Most electrical appliances in the home are powered by a.c.

(iv) Using your answer to part **(a)(iii)** and the information given above, write a paragraph to discuss whether the use of this solar panel is a practical solution to the energy needs of a family of four.
Suggest how they might improve the situation from the point of view of their energy needs. In your answer mention one advantage and one disadvantage of the use of the solar panel.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

Quality of written communication [2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(b) The diagram shows weightlifting equipment found in most gyms.



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(i) When using the equipment, John wants to do 300 J of work in each lift.
He can vary the weight from 100 N to 500 N in steps of 50 N.
He can also vary the distance he lifts the weights from 1.0 m to 2.0 m in steps of 0.5 m.
State **three** weights and the corresponding distances that John can use to achieve this.

1 weight = _____ N distance = _____ m

2 weight = _____ N distance = _____ m

3 weight = _____ N distance = _____ m

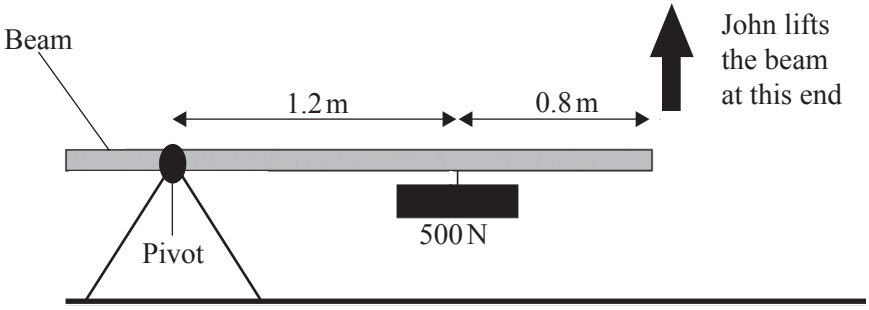
[3]

(ii) John repeats the exercise. He does 10 complete lifts in a time of 30 seconds.
Calculate the power John produces during this time.
Remember to include the unit for power.
You are advised to show clearly how you get your answer.

Power = _____ [4]

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(c) John builds a simple weightlifting device as shown below.



(i) For the arrangement of weight and distances shown above, calculate the force John needs to exert to raise the weight.
You are advised to show clearly how you get your answer.

Force = _____ N [4]

(ii) To reduce the force he needs to exert, John moves the 500 N weight. In what direction should he move it?
Explain your answer.

_____

_____

_____

_____ [3]

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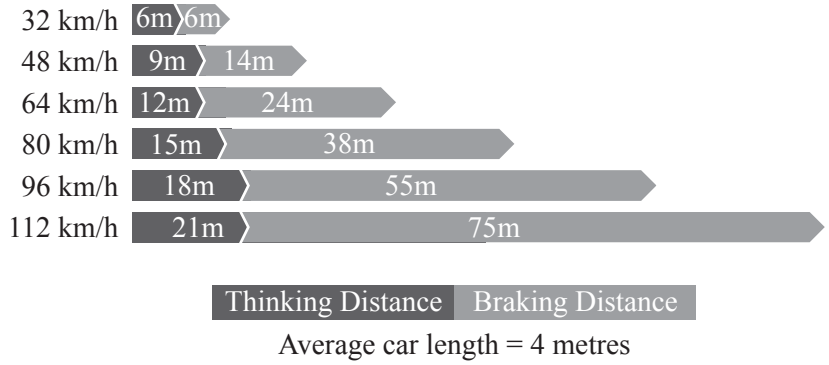
Marks	Remark

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Examiner Only	
Marks	Remark

2 The **stopping distance** of a car is the **thinking distance** added to **the braking distance**.
The thinking distance is the distance the car travels at constant speed before the driver reacts (reaction time) to a hazard on the road and applies the brakes.
The braking distance is the distance the car travels from where the brakes were first applied to where the car stops.

The chart below shows the results of a study of stopping distance by an alert driver, on a dry day, using a car with good tyres and good brakes.



(i) Show clearly that a speed of 80 km/h is equal to a speed of 22.2 m/s.

[3]

(ii) Using the data from the chart that applies to a speed of 80 km/h calculate the thinking time (reaction time) of the driver.
You are advised to show clearly how you get your answer.

Reaction time = _____ s [4]

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(iii) The speed of two cars following each other on a motorway is 112 km/h. Should the car in front suddenly brake it is advisable for the following car to leave a gap. The average length of a car is 4 m. Use the data from the chart to calculate the size of the required gap. Give your answer in complete car lengths.
You are advised to show clearly how you get your answer.

Required gap = _____ complete car lengths [3]

(iv) A car is travelling at 112 km/h. This is equivalent to a speed of 31.1 m/s. Using the braking distance given in the chart, calculate the deceleration of the car.
You are advised to show clearly how you get your answer.

Deceleration = _____ m/s^2 [6]

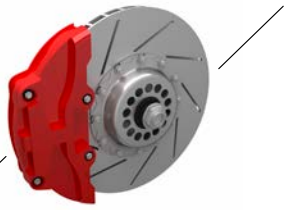
(v) The car has a mass of 1500 kg.
Calculate the required braking force to produce this deceleration.
Remember to give the unit for force.
You are advised to show clearly how you get your answer.

Braking force = _____ [4]

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Marks	Remark

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(vi) This braking force is produced by the friction of brake pads rubbing against a metal disc. A car has **eight** such brake pads, 2 per wheel.



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Using the information given in the diagram above and your answer to part **(v)** calculate the pressure that each brake pad exerts on the metal disc as the car comes to rest.
You are advised to show clearly how you get your answer.

Pressure = _____ N/cm² [5]

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Marks	Remark

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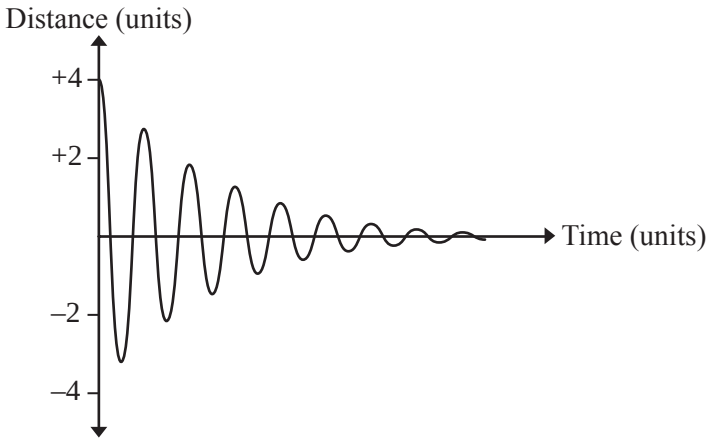
Marks	Remark

3 **(a)** Waves can be classified according to the direction of the vibrations they create. Complete the table below to illustrate this method of classification. Some entries in the table have already been completed for you.

Wave	Direction of vibrations	Type of wave
Light wave	Perpendicular to the direction of energy transfer	
Sound wave		
Water wave		Transverse

[4]

(b) The graph below shows an earthquake's shock wave.



(i) Write down the **maximum** amplitude of the wave.

Amplitude = _____ units [1]

(ii) How many **complete** waves are shown above?

_____ [1]

(iii) How can you tell **from the graph** that the frequency of the wave is constant?

_____ [1]

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The frequency of the shock wave was 50 Hz and it travelled with a speed of 4500 m/s.

(iv) Explain what a frequency of 50 Hz means.

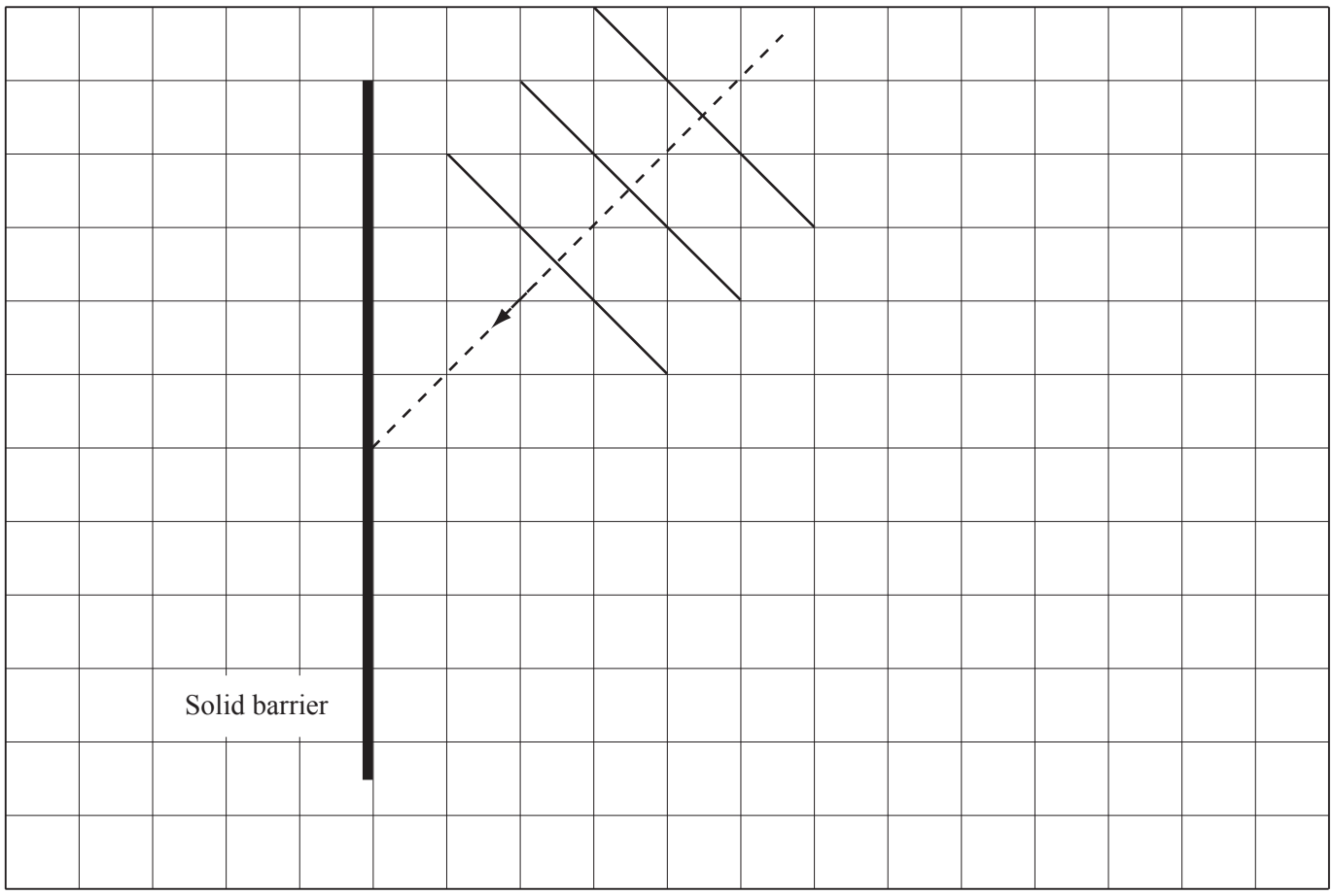
_____ [1]

(v) Calculate the wavelength of this shock wave.

Wavelength = _____ m [3]

Examiner Only	
Marks	Remark

(c) Water waves can be studied in a laboratory using a ripple tank. Below is a **full-scale** diagram showing the movement of water waves in a ripple tank towards a solid barrier.



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(i) Use a ruler to measure accurately the wavelength of the water waves.

Wavelength = _____ mm [1]

(ii) What is being transferred by the waves?

_____ [1]

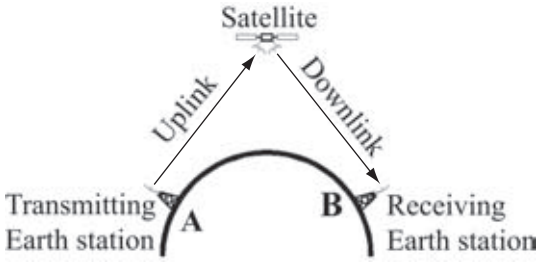
(iii) Using a ruler, carefully complete the diagram opposite to show the reflection of the water waves from the solid barrier.
Your diagram should show:

- an arrow showing the direction of the reflected waves and
- three reflected waves [5]

(iv) Is the frequency of the reflected waves greater than, smaller than or equal to the frequency of the incident waves? Ring the correct answer.

Greater than **Smaller than** **Equal to** [1]

(d) Long-distance communications between two points on the Earth's surface can be done using a satellite. Information is passed from **A** to **B** using a satellite above the Earth's surface.



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(i) What property of microwaves allows them to travel from **A** to the satellite?

_____ [1]

Examiner Only

Marks	Remark

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Microwaves carry the information at a speed of 300 000 km/s from **A** to **B** via the satellite.

(ii) The points **A** and **B** are both 36 000 km from the satellite. Calculate the time taken for the information to travel from **A** to **B** by microwaves.

Time = _____ s [4]

(iii) The same information could also be sent from **A** to **B** along the surface of the Earth using infra-red waves. What type of connection between **A** and **B** would permit this type of communication link?

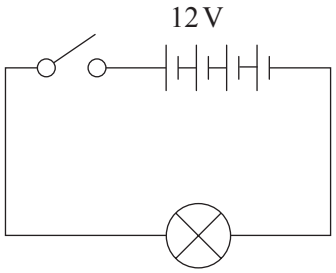
_____ [1]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

4 **(a)** The diagram below represents a lamp which can be connected to the 12 V battery.



(i) Using the correct symbol show, on your diagram, how a voltmeter should be connected to measure the voltage across the lamp. [1]

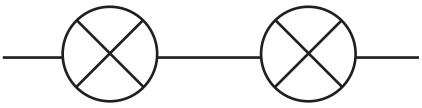
(ii) Mark, on the diagram, the positive terminal of the voltmeter. [1]

(iii) When the switch is closed a current of 2 A flows in the circuit.
Calculate the resistance of the lamp.
Remember to give the unit for resistance.
You are advised to show clearly how you get your answer.

Resistance = _____ [4]

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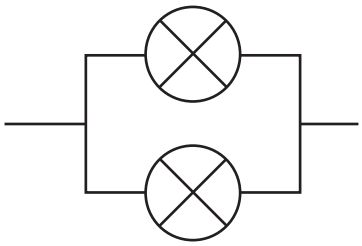
(iv) Calculate the combined resistance of two such lamps connected in **series**.



You are advised to show clearly how you get your answer.

Combined resistance = _____ [2]

(v) Calculate the combined resistance when the two lamps are connected in **parallel**.



You are advised to show clearly how you get your answer.

Combined resistance = _____ [2]

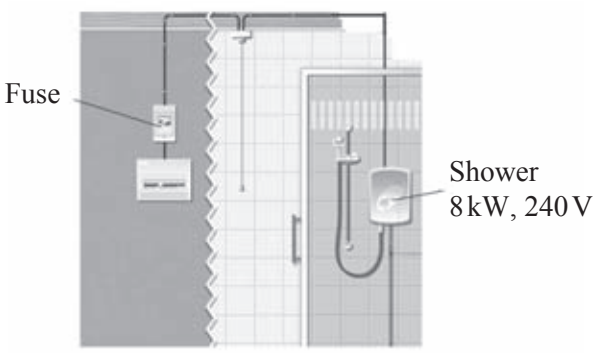
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Marks	Remark

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Examiner Only	
Marks	Remark

(b) An electric shower is rated at 8 kW when used on a 240 volt power supply.



(i) Calculate the size of the current flowing in the shower circuit when it is operating.
You are advised to show clearly how you get your answer.

Current = _____ A [4]

(ii) Calculate the cost of using this shower for 15 minutes.
The cost of a kWh is 13.5 pence.
You are advised to show clearly how you get your answer.

Cost = _____ pence [3]

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Marks	Remark

(c) During a lightning strike the average current flowing is 40 000 A and the amount of electric charge delivered is 5 C.



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(i) Name the unit of electric charge. _____ [1]

(ii) Calculate the duration of the average strike.
You are advised to show clearly how you get your answer.

Duration = _____ s [4]

(iii) If the energy discharged is 700×10^6 J what is the voltage of the strike?

Voltage = _____ volts [3]

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Examiner Only	
Marks	Remark

5 **(a)** The full symbol for a nucleus of carbon-14 is ${}^{14}_{6}\mathrm{C}$

Complete the table below by naming the particles in a nucleus of carbon-14 and give the number of each in the nucleus of carbon-14.

Particle	Number in the nucleus

[4]

(b) Four unknown nuclei are labelled *W*, *X*, *Y* and *Z*.
Their full symbols are given below.

${}^{30}_{15}W$ ${}^{30}_{16}X$ ${}^{32}_{17}Y$ ${}^{33}_{16}Z$

(i) Which, if any, of these nuclei are isotopes of the same element?

_____ [1]

(ii) Explain your answer.

_____

_____ [1]

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(c) A radioactive substance has a half-life of **12 years**.
Which of the following statements is/are true?
Write your answer in the space provided.

For a sample of this substance **after 12 years**:

Statement	True or False
Its activity will be half of what it was at the start.	
Its activity will be double what it was at the start.	
Its activity will be zero.	

For a sample of this substance **after 24 years**:

Statement	True or False
All of the radioactive nuclei will have decayed.	
Its activity will be zero.	
Its activity will be $\frac{1}{4}$ of what it was at the start.	

[3]

Examiner Only	
Marks	Remark

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(d) Fission and fusion are nuclear reactions which release large amounts of energy. The table below is intended to show a number of significant differences between the two reactions. Complete the table using the list of phrases/words below.

1. building of larger nuclei from small nuclei
2. the splitting up of large nuclei
3. nuclear power station
4. requires very high temperatures to start
5. the sun
6. hydrogen
7. uranium
8. will start at normal temperatures

Write the number corresponding to the statement in the appropriate box in the table below.

Nuclear Reaction	Fusion	Fission
Where the process can be found happening		
Fuel used		
Description of the reaction		
Conditions required to start		

[4]

(e) Cobalt-60 is a beta emitter, which decays to nickel.
The nickel produced decays by gamma (γ) emission.

(i) Complete the decay equations below.

$$^{60}_{27}\mathrm{Co} \rightarrow {}^{60}_{28}\mathrm{Ni}^{*} + {}^{\square}_{\square}\beta$$

$$\downarrow$$

$${}^{\square}_{\square}\mathrm{Ni} + \gamma$$

[4]

Examiner Only

Marks	Remark

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After 15 years the measured activity of a cobalt-60 source is found to have fallen from 120 counts per minute to 15 counts per minute.

Examiner Only	
Marks	Remark

(ii) What is the half-life of cobalt-60?
You are advised to show clearly how you get your answer.

Half-life = _____ years [3]

(iii) State **two** possible uses of gamma radiation.

1. _____

2. _____ [2]

Uranium is an alpha emitter.

(iv) Explain why wearing heavy gloves to handle uranium rods could be sufficient protection.

_____ [1]

(v) State **two** alternatives to shielding as ways of protecting people from the radiation from radioactive sources.

1. _____

2. _____ [2]

THIS IS THE END OF THE QUESTION PAPER

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112062

Rewarding Learning

General Certificate of Secondary Education
2012

Science: Physics

Paper 1
Higher Tier

[G7604]

FRIDAY 15 JUNE, AFTERNOON

MARK SCHEME

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Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

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					AVAILABLE MARKS
1	**(a)**	**(i)**	Output electrical energy = 1200 (J) [1]		
		(ii)	Efficiency = useful output energy/total input energy [1] = 1200/6000 = 0.2 (20%) ecf from **(i)** [1]	[2]	
		(iii)	Conversion of 1200 W to 1.2 kW ecf from **(i)** [1] 1.2 kW × 10 hrs = 12 (kWh) [1]	[2]	
		(iv)	The solar panel is a little short of their energy demands they would supplement this with other resources If the calculation in **(iii)** gives 15 kWh or greater then allow an answer consistent with this. Accept, that if the energy provided is more than enough/use smaller solar panel [1] The use of another/larger solar panel would solve the problem [1] Advantages – free after the initial cost/non polluting [1] Disadvantages – produces d.c. but appliances require a.c. or less sunlight in the winter when most energy is needed Expensive to install [1]	[4]	
			Quality of written communication	[2]	

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar all of the main points shown above. The form and style is of a high standard and specialist terms are used appropriately at all times	**2**
Candidates make some reference to the same main points shown above using satisfactory spelling, punctuation and grammar. The form and style is of a satisfactory standard and they have made some reference to specialist terms.	**1**
Response not worthy of credit	**0**

	(b)	**(i)**	Work = force × distance moved Give [1] if no further credit possible Possible combinations 200 N 1.5 m 150 N 2.0 m 300 N 1.0 m	[3]	
		(ii)	Total work in 30 seconds = 300 × 10 = 3000 [1] Power = work/time worth [1] on its own = 3000/30 **or** = 300/3 [1] = 100 = 100 [1] W **or** J/s W **or** J/s [1]	[4]	
	(c)	**(i)**	ACM = CM [1] [1] F × 2.0 = 500 × 1.2 [1] [2] F = 300 (N) [1]	[4]	
		(ii)	To the left or away from him/towards the pivot 500 N has a smaller moment because its distance from pivot is less	[3]	25

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2 **(i)** 80 km = 80 000 m — Give [1] if no further credit possible
1 hr = 60 × 60 = 3600 s — Give [1] if no further credit possible

80 km/h = 80 000/3600 = (22.2 m/s) — This line is worth [3] [3]

(ii) (Thinking) distance = speed × time — Give [1] if no further credit possible
15 = 22.2 × time — Give [2] if no further credit possible
Time = 15/22.2 — Give [3] if this line present
= 0.675 (s) — Method is not required for full marks
Accept 0.67 to 0.68
No ecf for the speed or the distance [4]

(iii) 75/4 or 96/4 [1] no further marks
21/4 or 5.25 [2]
round up to 6 car lengths [1] [3]

(iv) $v^2 = u^2 + 2as$ [2] giving $0 = 31.1^2 + 2a \times 75$ [3] ([1] per substitution)
giving $a = 6.4$ (m/s^2) [1]
or [1] [1]
$s = \frac{1}{2}(u + v) \times t$ [1] giving $75 = \frac{1}{2} \times 31.1 \times t$ [2] giving $t = 4.82$ [1]
then $v = u + at$ [1] giving $0 = 31.1 \times 4.8\ a$ $a = 6.4$ (m/s^2) [1]
Accept $a = 6.4$ to 6.5
Ignore any minus sign [6]

(v) $F = ma$ give [1] if no further credit
or $F = 1500 \times 6.4 = 9600$ N [3] Allow ecf for deceleration
Unit mark [1] [4]

(vi) $P = F/A$ [1]
$= 9600/(8 \times 40)$ **or** $\frac{2400}{2 \times 40}$ allow ecf for force from **(v)** [3]
$= 30$ (N/cm^2) [1] [5]

AVAILABLE MARKS

25

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3 **(a)**

Wave	Direction of vibrations	Type of wave
Light wave	Perpendicular to the direction of energy transfer	Transverse
Sound wave	Parallel to the direction of energy transfer	Longitudinal
Water wave	Perpendicular to the direction of energy transfer	Transverse

[4]

(b) **(i)** 4 [1]

(ii) 8 [1]

(iii) The time between one wave and the next (**or** the period) is constant [1]

(iv) 50 waves/wavelengths/vibrations pass in 1 second [1]

(v) $\lambda = v/f \quad v = f\lambda$ [1]
$= 4500/50$ [1]
$= 90$ (m) [1] [3]

(c) **(i)** 14 (mm) (Allow 13–15 mm) [1]

(ii) Energy [1]

(iii) **Arrow** at 45° to horizontal/barrier [1]
With 3 wavefronts crossing the arrow [1]
Perpendicular to arrow [1]
Wavefronts parallel and equally spaced [1]
Reflected wavefront spacing = wavelength of incident waves [1] [5]

(iv) Equal to [1]

(d) **(i)** They can travel through a vacuum/space [1]

(ii) Time = distance/speed (**or** equivalent) [1]
Distance to satellite and back = 72 000 km [1]
Time for microwaves to travel from A to B via satellite
$= 72000/300000$ [1]
$= 0.24$ (s) [1] [4]

(iii) Fibre optic link/optical fibre [1]

AVAILABLE MARKS

25

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						AVAILABLE MARKS
4	(a)	(i)	Voltmeter in parallel with the lamp		[1]	
		(ii)	Correct location of + sign		[1]	
		(iii)	R = V/I	[1]		
			R = 12/2	[1]		
			R = 6	[1]		
			ohms or Ω	[1]	[4]	
		(iv)	R = 6 + 6 [1] = 12 ohms [1] ecf from **(iii)** R = R_1 + R_2 [1] if no further no unit mark		[2]	
		(v)	R_{comb} = R/2 [1] = 3 ohms [1] ecf from **(iii)** no unit mark		[2]	
	(b)	(i)	P = IV	[1]		
			[1] 8000 = I × 240 [1]	[2]		
			I = 33.3 (A)	[1]	[4]	
			[1] [1]			
		(ii)	Number of kWh = 8 × 0.25 = 2	[2]		
			Cost = 2 × 13.5 = 27 (pence)	[1]	[3]	
	(c)	(i)	The coulomb		[1]	
		(ii)	Q = It **or** t = Q/I	[1]		
			5 = 40 000 t **or** t = 5/40 000	[2]		
			t = 0.000125 s **or** t = 1.25 × 10^{-4} s	[1]	[4]	
		(iii)	E = QV **or** E = VIt **or** V = E/Q **or** V = E/It	[1]		
			700 × 10^6 = 5 V **or** 700 × 10^6 = 40 000 × 0.000125 V **or** V = 700 × 10^6/5	[1]		
			V = 140 × 10^6 (volts) Allow ecf from **(ii)** for time	[1]	[3]	25

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			AVAILABLE MARKS
5	**(a)**	Protons 6 [1] Neutrons 8 [1] Name of particle [1] Numbers correct [1] each [4]	
	(b)	**(i)** X and Z both needed [1]	
		(ii) Both have same number of protons/atomic number [1]	
	(c)	True accept T or ✓ False accept F or ✗ False False False True [$\frac{1}{2}$] each, round up Maximum [3] [3]	
	(d)	Fusion Fission 5 3 6 7 1 2 4 8 [$\frac{1}{2}$] each, round down [4]	
	(e)	**(i)** $^{0}_{-1}\beta$ and $^{60}_{28}\mathrm{Ni}$ [1] each [4]	
		(ii) 120/15 = 8 [1]; $8 = 2^3$ **or** 3 half lives **or** $t_{\frac{1}{2}} = 15/3$ [1] $t_{\frac{1}{2}} = 5$ years[1] [3]	
		(iii) sterilisation of medical supplies, radiotherapy, radiography, food irradiation Any **two** [1] each [2]	
		(iv) Alpha radiation is stopped by paper (so gloves stop it) [1]	
		(v) Keep a large distance away/Keep exposure time very short/ Use a weak source Any acceptable alternative(s), e.g. as small a source as possible Any **two** [1] each [2]	25
		Total	**125**

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Rewarding Learning

General Certificate of Secondary Education
2011

Science: Physics

Paper 1
Higher Tier

[G7604]

WEDNESDAY 25 MAY, MORNING

MARK SCHEME

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1	**(i)**	Average speed = distance/time		[1]
		= 36/3		[1]
		= 12 (cm/s)		[1]
	(ii)	Initial speed = 2 × ave speed	or ave speed = ½ (u + v)	[1]
		= 24 (cm/s) 12	= ½ × (u + 0)	[1]
		ecf for Av speed		
	(iii)	Straight line of negative slope		[1]
		From (0,24) to (3,0)	1 each point	[2]
		Allow ecf for velocity from (ii)		
	(iv)	a = (v − u)/t or equivalent		[1]
		= (0 − 24)/3 ecf from (ii) for u		[1]
		= − 8 ignore − sign.		[1]
	(v)	F = ma or F = md e.c.f. for a		[1]
		= 0.075 × 0.08 [failure to convert g to kg *and* cm/s^2 to m/s^2		[4]
		= 0.006 (N) give a max of 4 marks]		[1]
	(vi)	Gravity/weight/component of weight		[1]
	(vii)	They are equal/same		[1]
	(viii)	Average speed = 12 (cm/s)	ecf from (i)	[1]
		Average velocity = 0		[1]
	(ix)	Momentum = mass × velocity (speed)	ecf for velocity	[1]
		= 0.075 × 0.2		[1]
		= 0.015 failure to convert to kg give 3 marks		[1]
		kg m/s		[1]

AVAILABLE MARKS

25

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AVAILABLE MARKS

2 **(a)** Renewable – wind/wave/tidal/geothermal/biomass/hydro(electric)/solar or Sun
Non-renewable – any fossil fuel/nuclear/uranium/peat [3]
½ each round down

(b) **(i)** 14580 J [1]

(ii) PE = mgh [1]
14580 = 90 × 10 × h ecf from (i) [2]
H = 16.2 (m) [1]

(iii) KE = ½ mv^2 no ecf [1]
= ½ × 90 × 15^2 [1]
= 10125 (J) [1]

(iv) Energy wasted = 14580 − 10125 [1]
= 4455 (J) Allow ecf from (iii) for KE and from (i) for P.E. [1]

(c) **(i)** Black [1]

(ii) Infra-red or IR [1]

(iii) B and A receives heat by convection *and* **radiation** [1] [2]
B and C receives heat by radiation only [1]

(d) Shiny outside Poor emitter of radiation [1]
Shiny inside Good reflector/poor absorber of radiation [1]

(e) In metals(copper) electrons [1]
and collide with ions (atoms) either [1] [4] 25
In glass atoms [1] vibrate more/faster [1]
QWC [2]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar the main points shown above. The form and style is of a high standard and specialist terms are used appropriately at all times.	2
Candidates make some reference to the main points shown above using satisfactory spelling, punctuation and grammar. The form and style is of a satisfactory standard and they have made some reference to specialist terms.	1
Candidates make little reference to the main points shown above using limited spelling, punctuation and grammar. The form and style is of a limited standard and they have made no use of specialist terms.	0

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					AVAILABLE MARKS
3	(a)	(i)	I same distance behind mirror as O in front (± 1 div) (2 mm) accept a dot unlabelled	[1]	
		(ii)	Ray from O to mirror Reflected ray comes from I no ecf for position of I	[1] [1]	
	(b)	(i)	Parallel rays converge to a point to the right of lens on p-axis Focal length marked distance from lens to this point	[1] [1]	
		(ii)	Both parallel rays diverge	[1]	
		(iii)	Place lens in front of a screen Move lens toward/away from screen or adjust position Until sharp image is seen/image is in focus Identify or measure distance from lens to screen/lens to image	[1] [1] [1] [1]	
		(iv)	Mark and label both focal points 3 cm from lens (Accept dots for label)	[1]	
		(v)	Ray from top of object through centre of lens undeviated Ray parallel to principal axis refracted through focus Rays produced *back* until they meet Top of image marked at intersection, bottom on principal axis Arrow from object on at least one ray Contradictory arrow no mark – only on real rays	[1] [1] [1] [1] [1]	
		(vi)	Light only appears to come from it/cannot be projected to a screen/Rays do not meet to form it	[1]	
		(vii)	Height consistent with candidate's diagram	[1]	
		(viii)	Image distance consistent with candidate's diagram	[1]	
		(ix)	Eye marked to the right of the lens	[1]	
	(c)	(i)	Straight line from X to hypotenuse of prism REFLECTED RAY at right angles to incident ray	[1] [1]	
		(ii)	Total internal reflection occurs at prism/TIR occurs angle of incidence in the glass is greater than the critical angle	[1] [2]	25

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					AVAILABLE MARKS
4	**(a)**	**(i)**	He lost electrons	[1]	
		(ii)	STATEMENT (2) is correct	[1]	
		(iii)	Q = It or equivalent (wrong equation no marks	[1]	
			$I = 8 \times 10^{-6}/1 \times 10^{-3}$ incorrect physics)	[1]	
			$= 8 \times 10^{-3}$ or 0.008A or 8 mA	[1]	
			or $\frac{1}{125}$ A		
	(b)	**(i)**	Earth to metal case/sole/parts	[1]	
			Live to the fuse	[1]	
			If live touches metal case	[1]	
			Surge of/Large current flows/low resistance path/current goes through earth wire	[1]	
			Blows fuse	[1]	
		(ii)	P = IV or equivalent	[1]	
			I = 2200/240	[1]	
			= 9.17 (9.2) (A) 9 ⅙ (A)	[1]	
	(c)	**(i)**	R = V/I	[1]	
			= 1.5/0.25	[1]	
			= 6 (Ω)	[1]	
		(ii)	Bulbs in parallel	[1]	
			Battery in series with bulbs	[1]	
			Switch in series with battery	[1]	
			All symbols correct	[1]	
	(d)	**(i)**	Ammeter in series with box	[1]	
			Voltmeter in parallel with box	[1]	
			Variable resistor (for a series of values)	[1]	
			Correct symbols providing circuit includes sealed box accept Ⓥ or Ⓐ in series	[1]	
		(ii)	Diode	[1]	25

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								AVAILABLE MARKS
5	**(a)**	**(i)**	Electron	(1/1840)	–1	8	Outside nucleus	
			Neutron	1	0	9	In the nucleus	[6]
			Proton	1	+1	8	In the nucleus	
			½ each round up					
		(ii)	$^{17}_{9}$O ringed					[1]
		(iii)	Has not same number of protons/atomic number					[1]
	(b)	**(i)**	The activity/reading reaches a maximum/increases/starts					[1]
		(ii)	Activity recorded without any source present/activity from surrounding materials					[1]
		(iii)	$^{24}_{11}$Na + γ					[3]
		(iv)	Every half life the activity halves worth [1] 15 hr = 500 30 hour = 250 45 hours = 125					[3]
		(v)	15 hrs long enough *to be detected*					[1]
			1 minute too short *to be detected*					[1]
			1 year *dangerous radiations* for too long					[1]
	(c)	**(i)**	Fission (correct spelling only)					[1]
			Heavy nucleus splitting/breaking (up)					[2]
			if (Heavy / Large) atom splitting only [1]					
		(ii)	Fusion (correct spelling)					
			Light joining					[1]
			nuclei joining					[1]
								[1]
								25
							Total	**125**

Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2010

Science: Physics

Paper 1
Higher Tier

[G7604]

G7604

FRIDAY 28 MAY, MORNING

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

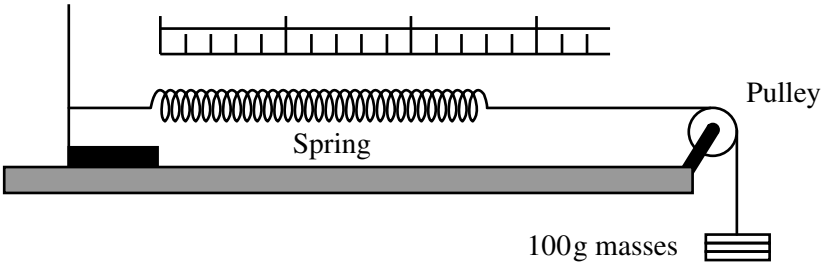
The total mark for this paper is 125.
Quality of written communication will be assessed in question **1(b)(iii)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with numerical answers where appropriate.

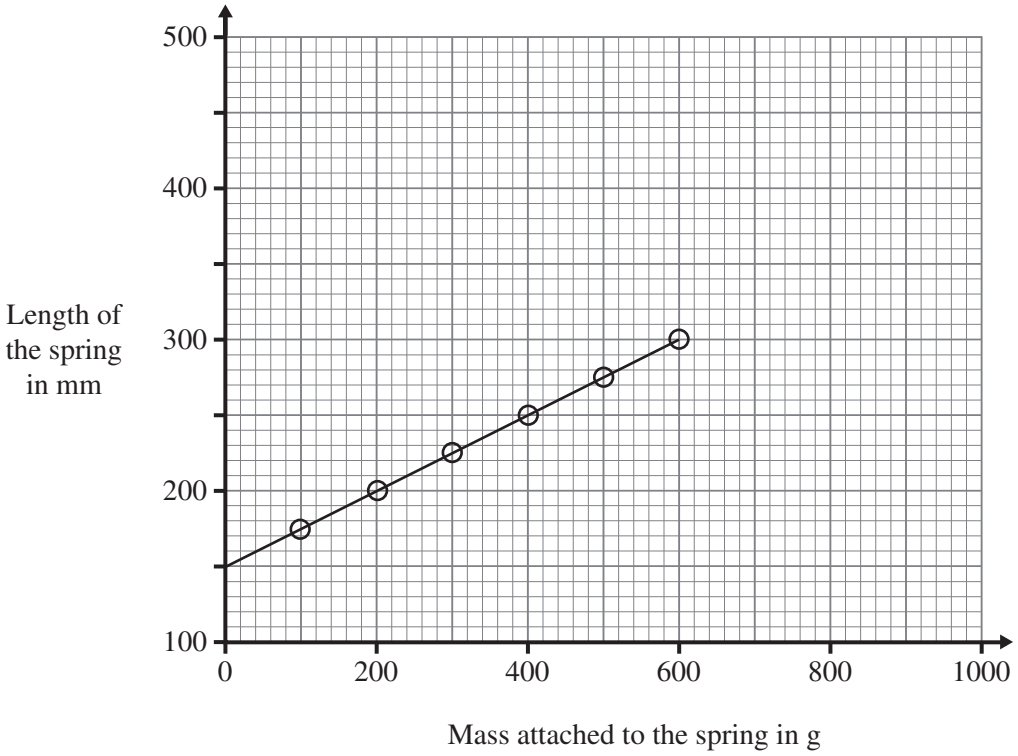
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** John sets up the apparatus shown below.
He uses it to discover how the length of the spring changes as he increases the force stretching it. He changes this force by adding 100 g masses to a length of string attached to the spring.
The graph below shows some of John's results.





(i) With reference to the graph, explain why the **length** of the spring is **not** directly proportional to the mass attached to it.

_____ [1]

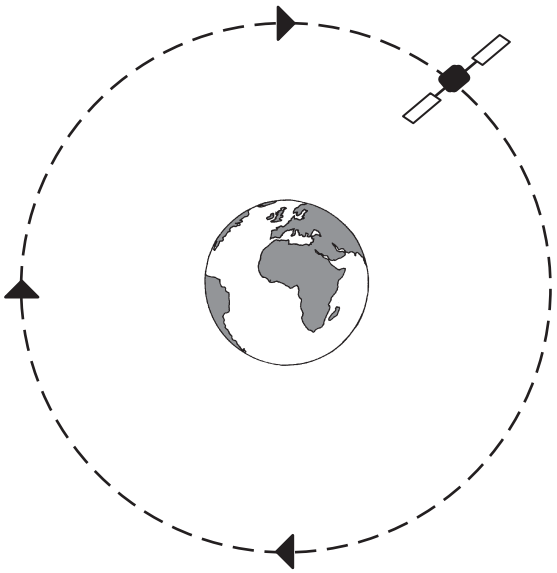
(ii) Use the graph to find the **extension** of the spring for each 100 g mass added.

Extension for each 100 g mass = _____ mm [1]

(iii) John discovers that the spring obeys Hooke's law for masses up to a maximum of 800 g. On the grid, continue the graph to show its shape up to 800 g and from 800 g to 1000 g. [2]

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(b) The diagram shows a satellite in orbit around the Earth.



(i) The satellite takes 1.5 **hours** to complete one orbit. The distance it travels in one orbit is 40 000 km.
Calculate its average speed in kilometres per hour.
You are advised to show clearly how you get your answer.

Speed = _____ km/h [3]

(ii) The satellite has a mass of 150 kg.
Calculate its momentum. Give your answer in kgm/s.
You are advised to show clearly how you get your answer.

Momentum = _____ kgm/s [4]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

(iii) Explain why a satellite's velocity is different from its speed.

_____

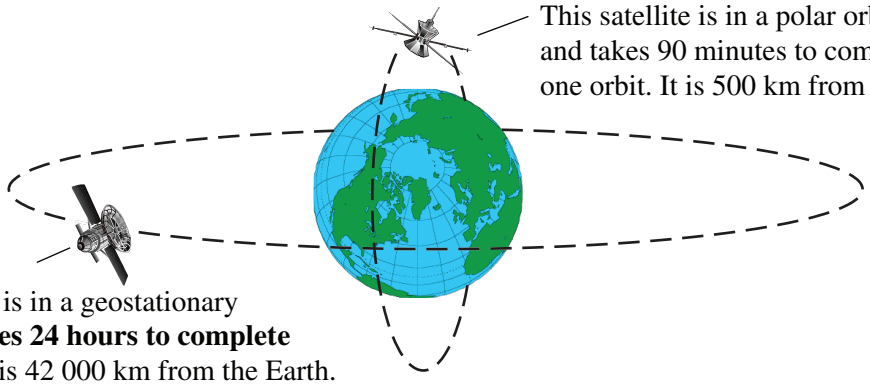
_____[1]

Quality of written communication [1]

(iv) What is the average velocity for one complete orbit?

_____[1]

(c) The diagram below shows two satellites circling the Earth in different orbits. The satellites have the **same mass**. The centripetal force needed to keep each satellite in orbit is provided by the gravitational attraction of the Earth.



This satellite is in a polar orbit and takes 90 minutes to complete one orbit. It is 500 km from the Earth.

This satellite is in a geostationary orbit and **takes 24 hours to complete one orbit**. It is 42 000 km from the Earth.

(i) How does the size of the centripetal force acting on each satellite compare? Explain your answer.

_____

_____

_____[2]

(ii) State a possible use for the satellite that is in a polar orbit.

_____

_____[1]

(iii) State a possible use for the satellite that is in a geostationary orbit.

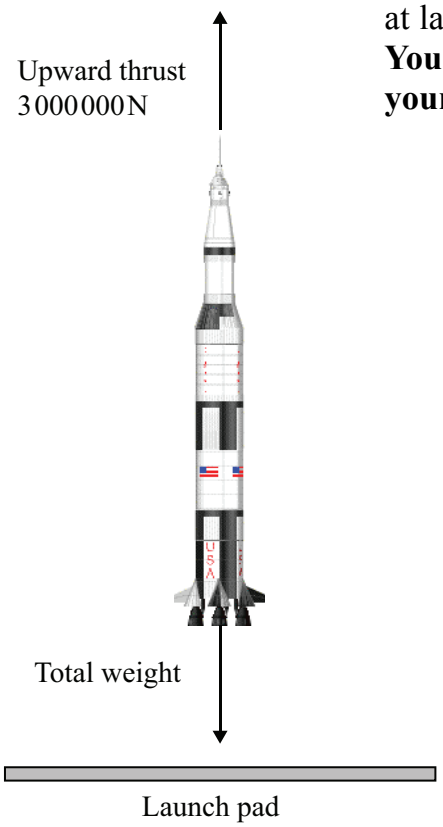
_____

_____[1]

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Examiner Only	
Marks	Remark

(d) The diagram shows a rocket just after its launch.
At launch, the rocket and contents have a total mass of 140 000 kg.
The engine produces a upward thrust of 3 000 000 N.



(i) Calculate the resultant upward force on the rocket at launch.
You are advised to show clearly how you get your answer.

Resultant force = _____ N [3]

(ii) Calculate the acceleration this resultant force produces at launch.
You are advised to show clearly how you get your answer.

Acceleration = _____ m/s^2 [3]

(iii) As the rocket moves upwards, the downward force becomes less, because fuel is being burnt off while the thrust remains the same.
How does the size of the acceleration change?

_____[1]

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Examiner Only	
Marks	Remark

2 **(a)** The use of wind turbines is on the increase. Wind turbines convert some of the kinetic energy of moving air into electricity.



(i) The efficiency of a wind turbine is 0.3 (30%). Explain carefully what this means.

_____

_____

_____ [2]

(ii) The kinetic energy of 1 kg of air moving with a velocity of 6 m/s is 18 J. The efficiency value for this wind turbine is 0.3 (30%). Calculate the electrical energy generated from 1 kg of air moving with a velocity of 6 m/s.
You are advised to shown clearly how you get your answer.

Electrical energy = _____ J [2]

(iii) Every second, 5 000 kg of air moving at 6 m/s passes through the wind turbine.
Calculate the output electrical power of the wind turbine.
Include the unit for power in your answer.
You are advised to show clearly how you get your answer.

Output electrical power = _____ [4]

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(b) Global warming is seen by many as a major threat to many countries and peoples.

Examiner Only

Marks	Remark

(i) Nuclear power is seen by some as a solution to the problem of global warming. Explain briefly why this is.

_____

_____ [1]

(ii) State the main environmental disadvantage of using nuclear power to generate electricity and how it is dealt with.

_____

_____

_____ [2]

(iii) Uranium is used as the fuel in most nuclear power stations.
How does the amount of uranium needed compare with the amount of coal or oil needed to fuel a power station with the same output power?

_____ [1]

(iv) All power stations, when they come to the end of their useful life, have to be de-commissioned.
What does this mean? Describe the problems of decommissioning a nuclear power station compared with a power station that used fossil fuel.

_____

_____

_____

_____

_____ [2]

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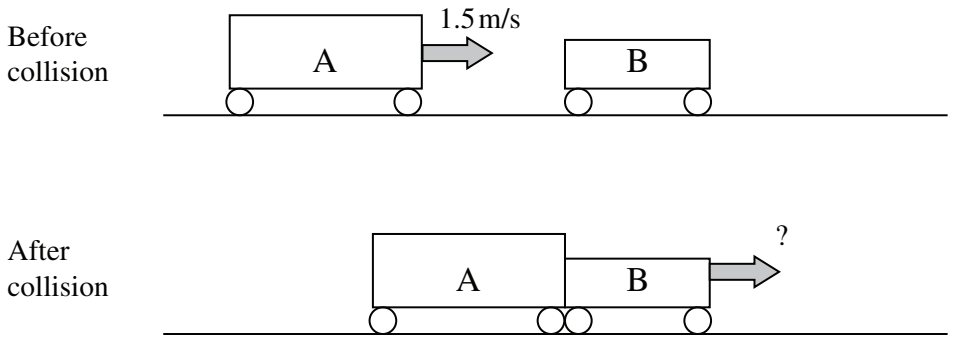
Examiner Only	
Marks	Remark

(c) (i) State the principle of conservation of momentum.

_____

_____ [1]

The principle of conservation of momentum is demonstrated in school laboratories using small trolleys like the ones shown below. When trolley A collides with trolley B they stick together and move together.

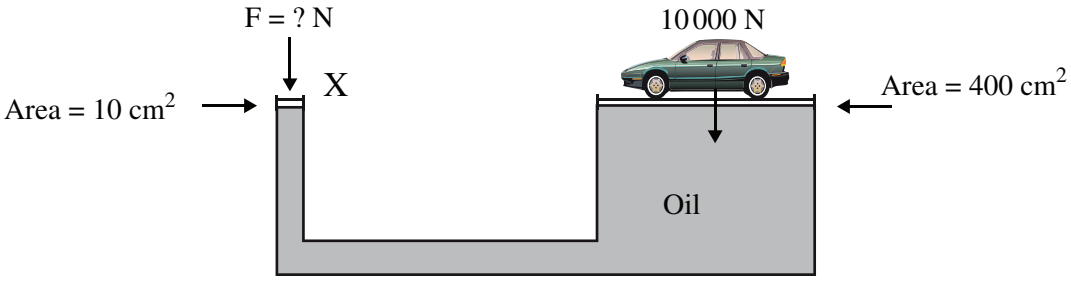


(ii) In one demonstration, trolley A has a mass of 500 g and is moving with a velocity of 1.5 m/s when it collides with trolley B, which is at rest. Trolley B has a mass of 250 g.
Calculate the velocity of the combined trolleys after the collision.
You are advised to show clearly how you get your answer.

Velocity after collision = _____ m/s [3]

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(d) The diagram below shows a hydraulic machine used to raise cars in a garage.



(i) Explain how a force applied at the end marked X is able to raise the car.

_____

_____

_____ [2]

The car weighs 10 000 N. The area of the small platform is 10 cm^2 and the area of the platform, on which the car sits, is 400 cm^2.

(ii) Calculate the force that must be applied to the smaller platform to just raise the car.
You are advised to show clearly how you get your answer.

Force = _____ N [5]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

3 **(a)** **(i)** Explain what a luminous object is.

_____ [1]

(ii) Give an example of a luminous object.

_____ [1]

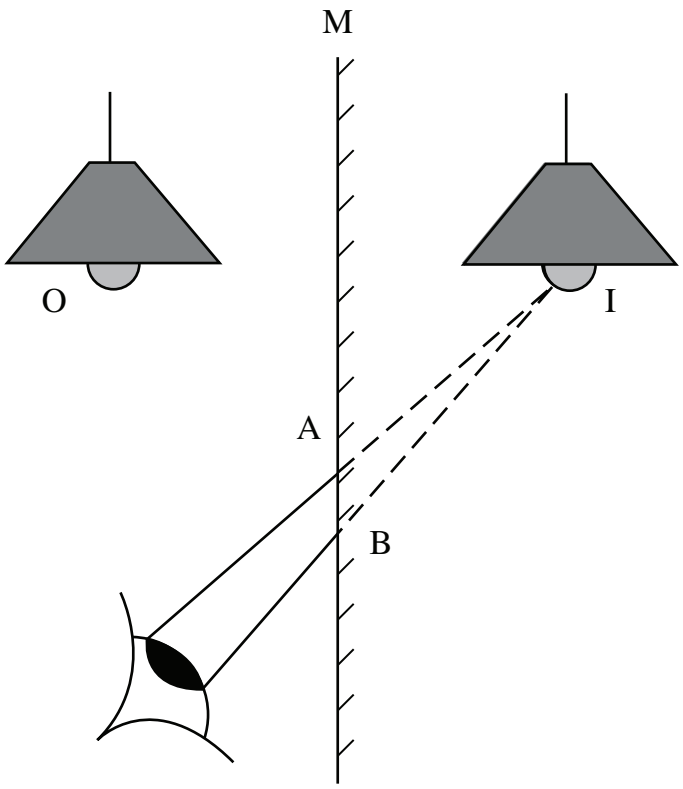
(iii) Explain what a non-luminous object is.

_____ [1]

(iv) Give an example of a non-luminous object.

_____ [1]

(b) The incomplete ray diagram below shows the image I of a lamp O, in a plane mirror M.



Draw on the diagram:

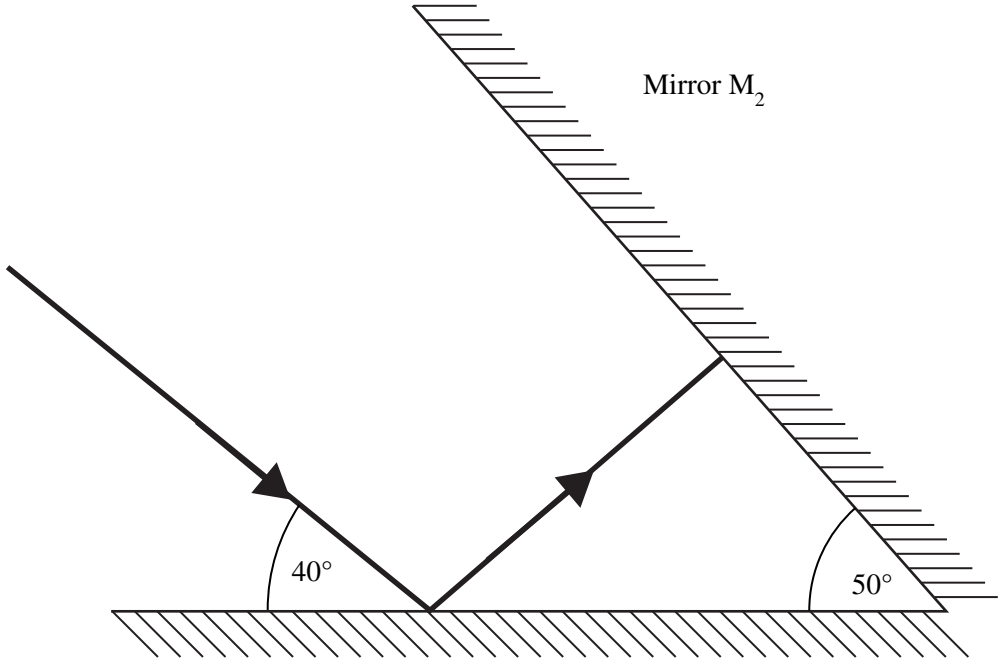
(i) the normals at points A and B. [1]

(ii) the corresponding incident rays. [1]

(iii) arrows to show the direction of the incident rays. [1]

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(c) Two plane mirrors, M_1 and M_2, are inclined at 50° to each other as shown in the diagram below. A ray of light strikes M_1, so that the angle between the mirror and the ray is 40°.



(i) Calculate the angle of incidence at M_1.

Angle of incidence at M_1 = _____ [1]

(ii) State the angle of reflection at M_1.

Angle of reflection at M_1 = _____ [1]

(iii) Calculate the angle of incidence at M_2.

Angle of incidence at M_2 = _____ [2]

(iv) Draw on the diagram an arrow to show the path of the reflected ray from M_2. [1]

Examiner Only	
Marks	Remark

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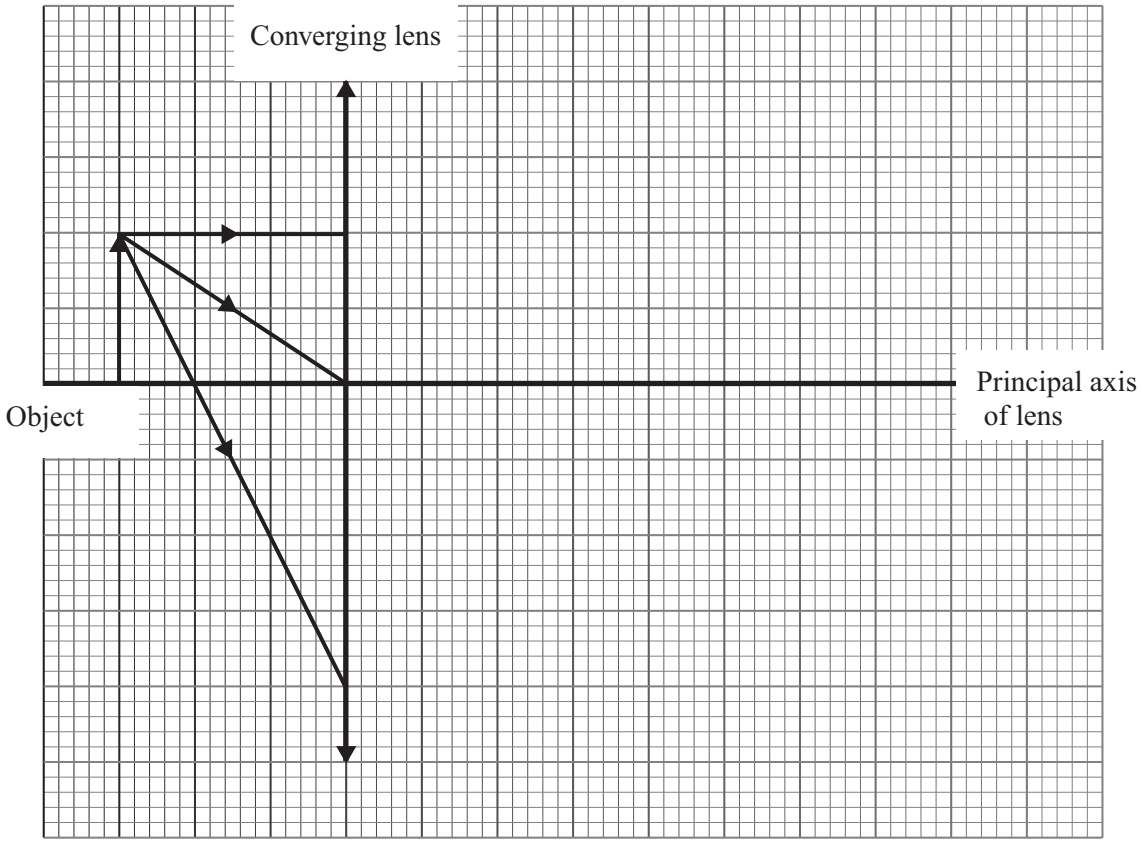
Examiner Only	
Marks	Remark

(d) (i) A converging lens has a focal length of 2 cm. Explain what this means.

_____

_____ [1]

Below is an incomplete full scale ray diagram.
The ray diagram shows how a converging lens can be used in a slide projector. The object is 3 cm from the lens. The lens has a focal length of 2 cm.



(ii) Complete the ray diagram to show how the three rays form an image after refraction by the lens. [3]

(iii) How far is the image from the lens?

_____ [1]

(iv) Underline which **three** of the following words best describe the image.

real : inverted : virtual : magnified : diminished : erect

[3]

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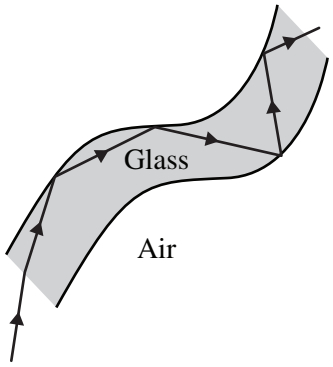
Examiner Only	
Marks	Remark

(e) **(i)** State two conditions that are required before light undergoes total internal reflection at the boundary between two transparent materials.

1. _____

2. _____ [2]

Optical fibres are used in medicine. A typical fibre consists of a strand of glass. Light passes up the glass fibre by repeatedly undergoing total internal reflection as shown in the diagram below.



(ii) The critical angle at the glass–air boundary is 42°. Explain what this means.

_____

_____

_____ [1]

(iii) State one medical and one non-medical application of the use of optical fibres.

Medical application _____

Non-medical application _____ [2]

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Examiner Only	
Marks	Remark

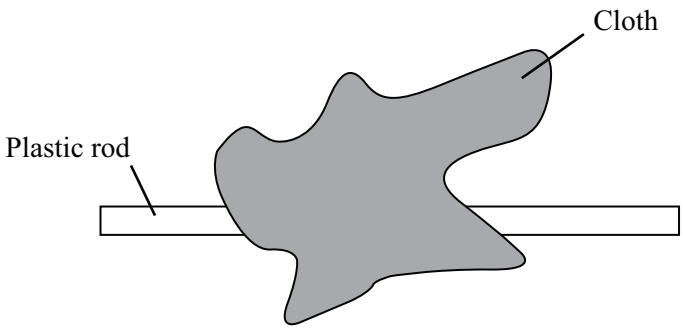
4 **(a)** Atoms contain electric charges.

(i) Explain how an atom is neutral.

_____

_____ [1]

A cloth is rubbed on a plastic rod. This makes electrons move from the cloth to the rod.



(ii) What effect does the movement of the electrons have on the charge of the cloth and the charge of the plastic rod?

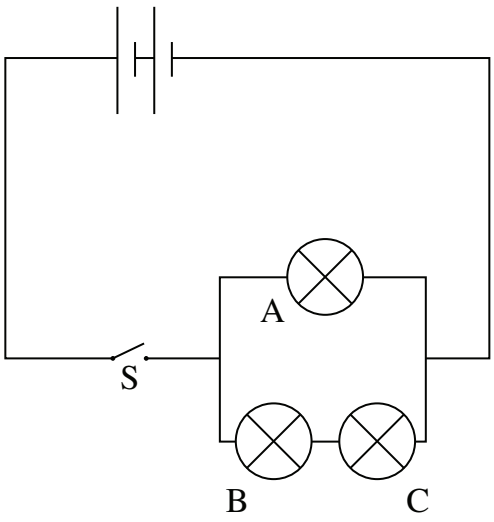
_____

_____

_____

_____ [2]

(b) The circuit shown in the diagram below is set up.



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Examiner Only	
Marks	Remark

(i) On the circuit diagram, show how a voltmeter, using the correct symbol, should be connected to measure the voltage across lamp A. [1]

(ii) Mark, on the diagram, the positive terminal of the voltmeter. [1]

When the switch is closed, it is found that the current flowing in lamp A is 0.2 A and the current flowing in lamp B is 0.15 A.

(iii) What is the current flowing through the switch S?
You are advised to show clearly how you get your answer.

Current = _____ A [1]

Lamps B and C are **identical**. The voltage across lamp B is 1.4 V.

(iv) What is the voltage across lamp C?

Voltage = _____ V [1]

(v) What is the voltage across lamp A?
You are advised to show clearly how you get your answer.

Voltage = _____ V [2]

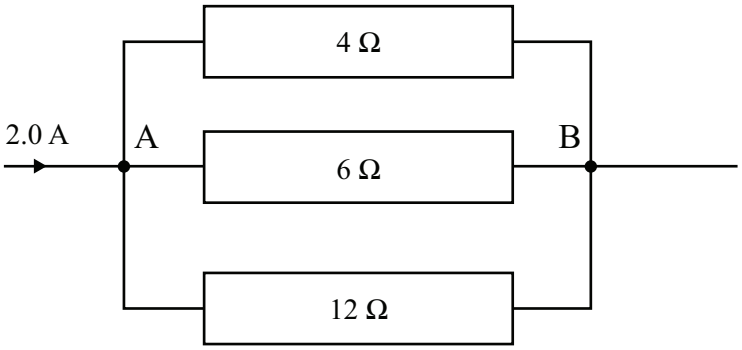
(vi) What is the resistance of lamp A?
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [3]

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Examiner Only	
Marks	Remark

(c) Three resistors, 4 ohm, 6 ohm, and 12 ohm, are connected in parallel.



(i) Calculate their combined resistance.
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [3]

A current of 2 A flows towards the point A.

(ii) Calculate the voltage across AB.
You are advised to show clearly how you get your answer.

Voltage = _____ V [3]

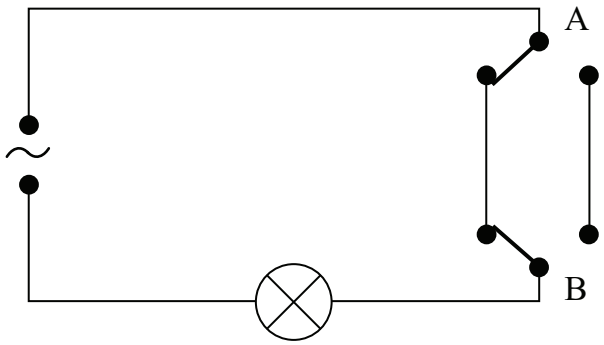
(iii) What is the current flowing in the 4 ohm resistor?
You are advised to show clearly how you get your answer.

Current = _____ A [2]

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(d) The circuit shown below is used in the home in a particular situation.

Examiner Only	
Marks	Remark



(i) Name the type of switch used both at A and B.

_____ [1]

(ii) Where would you use such a circuit in the home?

_____ [1]

(iii) Describe briefly the advantage to the home-owner of such a circuit.

_____

_____ [1]

(iv) On the circuit diagram, mark with the letter L, the live terminal of the power supply. [1]

(v) On the circuit diagram, mark with the letter F, a suitable location for a fuse. [1]

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Examiner Only	
Marks	Remark

5 **(a)** **(i)** Name the particles that are together in the **nucleus** of an atom.

_____

_____ [1]

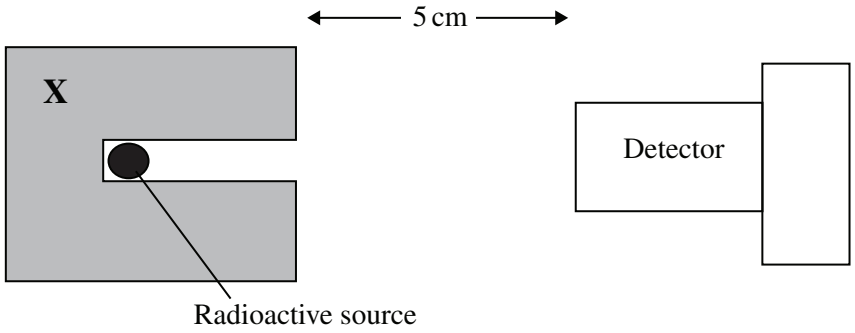
An atom has an atomic number 3 and mass number 7.

(ii) What does this tell you about the particles that make up the nucleus?

_____

_____ [2]

(b) A beta-emitting radioactive source is placed 5 cm from a detector, as shown in the diagram below. The radioactive source is surrounded by a substance **X** on all sides, except for a narrow opening on the right.



(i) Name the substance **X** surrounding the source.

_____ [1]

(ii) Give two reasons why the substance **X** is used in this way.

1. _____

_____

2. _____

_____ [2]

(iii) Give one reason why even a weak radioactive source should be handled using tongs.

_____

_____ [1]

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You are provided with a number of aluminium squares, each 1 mm thick.

(iv) Describe, briefly, how you would use the equipment shown opposite and the aluminium squares, to measure the range of the beta particles in aluminium.

_____

_____

_____

_____

_____

_____

_____

_____ [5]

(c) Yttrium 90 is a beta emitter which decays to zirconium.

(i) Complete the decay equation below for the beta decay of yttrium (Y) to zirconium (Zr).

$$^{90}_{39}Y \rightarrow \square\!\!\square Zr + \square\!\!\square \beta$$ [4]

(ii) Yttrium has a half-life of 64 hours. Explain what this means.

_____

_____

_____ [2]

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Marks	Remark

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(iii) A radioactive source contains 2 micrograms of yttrium 90.
What mass of yttrium 90 remains after 192 hours?
You are advised to show clearly how you get your answer.

Examiner Only

Marks	Remark

Mass = _____ micrograms [3]

(d) Nuclear fission and nuclear fusion are two processes that release large amounts of energy.

(i) Which one of them is the source of energy in stars?

_____ [1]

(ii) What important peaceful use is made of the other process?

_____ [1]

The following statements are inaccurate descriptions of the processes of nuclear fission and nuclear fusion.

Nuclear fission is the splitting of a single atom into two lighter atoms.

Nuclear fusion is the joining of two heavy atoms to make a single atom.

(iii) Correct each statement by writing the correct version in the spaces below.

Nuclear fission is _____

_____

Nuclear fusion is _____

_____ [2]

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THIS IS THE END OF THE QUESTION PAPER

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1847-016-1

GCSE

Science: Physics

Summer 2010

Mark Schemes

Issued: October 2010

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Rewarding Learning

General Certificate of Secondary Education
2010

Science: Physics

Paper 1
Higher Tier

[G7604]

FRIDAY 28 MAY, MORNING

MARK SCHEME

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Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

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					AVAILABLE MARKS
1	(a)	(i)	The straight line does not pass through 0,0 **or** The length does not double when the mass doubles	[1]	
		(ii)	From graph 200 g gives an extension of 200 – 150 = 50 100 g gives an extension of 25 mm	[1]	
		(iii)	Straight line from 600 g to 800 g } independent Upward curve from 800 g to 1000 g }	[1] [1]	[2]
	(b)	(i)	Speed = distance/time = 40 000/1.5 = 26 667 (km/h)	[1] [1] [1]	[3]
		(ii)	Momentum = mass × velocity (speed) 26 667 km/hr = 7407.5 m/s allow ecf for speed from **(b)(i)** momentum = 150 × 7407.5 = 1 111 125 kg m/s	[1] [1] [1] [1]	[4]
		(iii)	Velocity is a vector (speed is not) **or** Velocity depends on direction (speed does not) **or** Direction is changing	[1]	
			Quality of written communication	[1]	[2]
		(iv)	Zero, 0		[1]
	(c)	(i)	The centripetal force on the polar satellite is GREATER Because it is nearer than the geostationary one (and has the same mass)	[1] [1]	[2]
		(ii)	Photographing the Earth		[1]
		(iii)	Communications or TV or weather monitoring		[1]
	(d)	(i)	W = mg or Weight of rocket = $\underline{140\,000 \times 10}$ = 1 400 000 N Resultant force = 3 000 000 – 1 400 000 = 1 600 000	[1] [1] [1]	[3]
		(ii)	F = ma or equivalent 1 600 000 = 140 000 × a A = 1 600 000/140 000 = 11.4 (m/s^2) allow ECF from **(i)** for force only	[1] [1] [1]	[3]
		(iii)	The acceleration <u>increases</u> An increase in speed is **not** acceptable		[1]

25

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						AVAILABLE MARKS
2	**(a)**	**(i)**	30% of input energy appears as electrical energy **or** 30% of input energy appears as useful output energy **or** useful output energy/total input energy = 0.3		[2]	
		(ii)	Electrical energy = 0.3 × 18 = 5.4 J	[1] [1]	[2]	
		(iii)	Output power = 5000 × 5.4 = 27 000 allow ECF from **(ii)** W	[2] [1] [1]	[4]	
	(b)	**(i)**	No release of carbon dioxide/greenhouse gases		[1]	
		(ii)	The waste is radioactive/emits radiation (not just toxic/dangerous) It has to be stored for a long time or buried for a long time	 [1] [1]	 [2]	
		(iii)	Small amount or less of uranium compared with coal/oil		[1]	
		(iv)	Decommissioning means to close down (so that there is no threat to the environment or people) Disposal of the radioactive materials/requires special measures/specialist personnel/special equipment	[1] [1]	 [2]	
	(c)	**(i)**	The momentum before a collision/explosion equals the momentum after a collision/explosion		[1]	
		(ii)	Momentum before = momentum after (no marks for the above already credited in part **(i)** 500 × 1.5 (+ 0) = 750 × V V = 750/750 = 1 (m/s)	 [2] [1]	 [3]	
	(d)	**(i)**	The force creates a pressure or liquids incompressible This pressure is transmitted (through the oil/liquid)	[1] [1]	 [2]	
		(ii)	Pressure at X = pressure at the large platform or P = F/A = 10 000/400 or 25 = F/10 F = 250 (N)	[1] [2] [1] [1]	 [5]	25

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					AVAILABLE MARKS
3	**(a)**	**(i)**	Luminous objects – emit (their own) light	[1]	
		(ii)	Example – sun, stars, flames, torch, bulb, (incandescent) lamps etc.	[1]	
		(iii)	Non-luminous objects do not produce light object/scatter/reflect light (incident upon them)	[1]	
		(iv)	Example – moon, Earth, book, pencil, pen etc	[1]	
	(b)	**(i)**	Normals at A and B (at 90° to mirror by eye)	[1]	
		(ii)	Incident rays from bulb to points of reflection at mirror must both come from same point between bottom of bulb and right side	[1]	
		(iii)	Arrow(s) on incident rays going towards mirror	[1]	
	(c)	**(i)**	50°	[1]	
		(ii)	50° no ECF to **(ii)**	[1]	
		(iii)	Recognition that incident ray strikes M_2 at 90° on diagram [1] Angle of incidence at M_2 is 0° [1]	[2]	
		(iv)	Reflected ray back along path of incidence	[1]	
	(d)	**(i)**	Distance between principal focus/focal point and (centre of) lens is 2 cm	[1]	
		(ii)	Ray parallel to PA refracted through F (to within ± $\frac{1}{2}$ square) [1] Ray through optical centre passes through lens without refraction [1] Ray through F refracts parallel to PA [1]	[3]	
		(iii)	6 cm (±0.3 cm) i.e. 5.7 to 6.3 $1\frac{1}{2}$ divisions	[1]	
		(iv)	real inverted magnified ([1] for each)	[3]	
	(e)	**(i)**	Light is travelling TOWARDS less (optically) dense medium [1] Angle of incidence (at boundary) greater than critical angle [1]	[2]	
		(ii)	When angle <u>of incidence</u> in glass equals critical angle (42°), angle of refraction in air is 90° **or** At angles <u>of incidence</u> in glass less than the critical angle, light is refracted or at angles <u>of incidence</u> greater than the critical angle light is totally internally reflected.	[1]	
		(iii)	Medical: Endoscopy or laparoscopy or key-hole surgery or similar [1] Non-medical: Communications or telephony or cable TV or similar, broadband, interact, Christmas tree lights [1]	[2]	25

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						AVAILABLE MARKS
4	**(a)**	**(i)**	No. of protons = no. of electrons/ Equal amounts of +ve and –ve charge		[1]	
		(ii)	Rod is –ve [1] cloth is +ve [1]		[2]	
	(b)	**(i)**	V in parallel with A using —Ⓥ—		[1]	
		(ii)	+ to left of the voltmeter		[1]	
		(iii)	(0.2 + 0.15 =) 0.35		[1]	
		(iv)	1.4 ← ECF		[1]	
		(v)	V = V1 + V2	[1]		
			V = 2.8 ← 1.4 + answer to **(iv)**	[1]	[2]	
		(vi)	R = V/I			
			$= \frac{2.8}{0.2}$ ← ECF from **(iv)**	[1]		
				[1]	[3]	
	(c)	**(i)**	$1/R = 1/R_1 + 1/R_2 + 1/R_3$	[1]		
			$= \frac{1}{4} + \frac{1}{6} + \frac{1}{12}$	[1]		
			R = 2 → ECF for resistance	[1]	[3]	
		(ii)	V = IR [0] V = 2 × 2 ([1] each sub)	[2]		
			V = 4	[1]	[3]	
		(iii)	I = V/R [0]			
			$I = \frac{4}{4}$ ← ECF from **(ii)**	[1]		
			I = 1.0	[1]	[2]	
	(d)	**(i)**	Two way		[1]	
		(ii)	Landing/hall corridor, across room, kitchen-garage		[1]	
		(iii)	Light can be switched on and/or off at either switch		[1]	
		(iv)	Upper terminal		[1]	
		(v)	Between the correct live and switch A no ECF to **(v)**		[1]	25

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						AVAILABLE MARKS
5	**(a)**	**(i)**	protons and neutrons (both needed)		[1]	
		(ii)	3 protons, 4 neutrons ([1] each)		[2]	
	(b)	**(i)**	Lead		[1]	
		(ii)	To reduce radiation To absorb the radiation/protect from radiation/safe [1] To produce/direct a (narrow) beam of beta particles [1]		[2]	
		(iii)	The user is further from the source To minimise contact/exposure		[1]	
		(iv)	Remove source and read the detector or measure background Put Al sheet between source and detector/in front of detector (or source) Take a reading on detector Add extra sheets of/increase thickness of Al until reading [1] is constant/equals background/zero [1] This thickness of Al is the range		[5]	
	(c)	**(i)**	$^{90}_{40}Zr$ $^{0}_{-1}\beta$ ([1] each number)		[4]	
		(ii)	Time for half of yttrium 90 to decay (is 64 hrs) [1] mention of mass or activity or number of nuclei or radiation [1]		[2]	
		(iii)	192/64 = 3 or 3 half lives [1] $2^3 = 8$ (or other method) or $\frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8}$ [1] 2/8 = 0.25 or 1/4 [1]		[3]	
	(d)	**(i)**	fusion		[1]	
		(ii)	(Generating) <u>electricity</u>		[1]	
		(iii)	fission is the splitting of one (heavy) <u>nucleus</u> [1] (fusion is the uniting) of two light nuclei [1]		[2]	25
				Total		**125**

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Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2009

Science: Physics

Paper 1
Higher Tier

[G7604]

WEDNESDAY 10 JUNE, AFTERNOON

G7604

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 125.
Quality of written communication will be assessed in question **5(d)(ii)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with numerical answers where appropriate.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
Total Marks	

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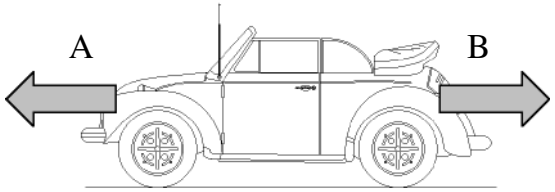
Examiner Only	
Marks	Remark

1 (a) (i) What is friction?

_____

_____ [2]

The diagram shows a car on a level road.
The arrows show the two horizontal forces acting on the car.
The forces are equal.



(ii) What is the resultant of these two forces? _____ [1]

(iii) Describe the **two** possible states of motion of this car.

1. _____

2. _____ [2]

(iv) If the force B does not change, but force A is increased to 1 200 N, this produces an acceleration of 0.5 m/s^2.
Calculate the size of force B. The mass of the car is 750 kg.
You are advised to show clearly how you get your answer.

Force B = _____ N [3]

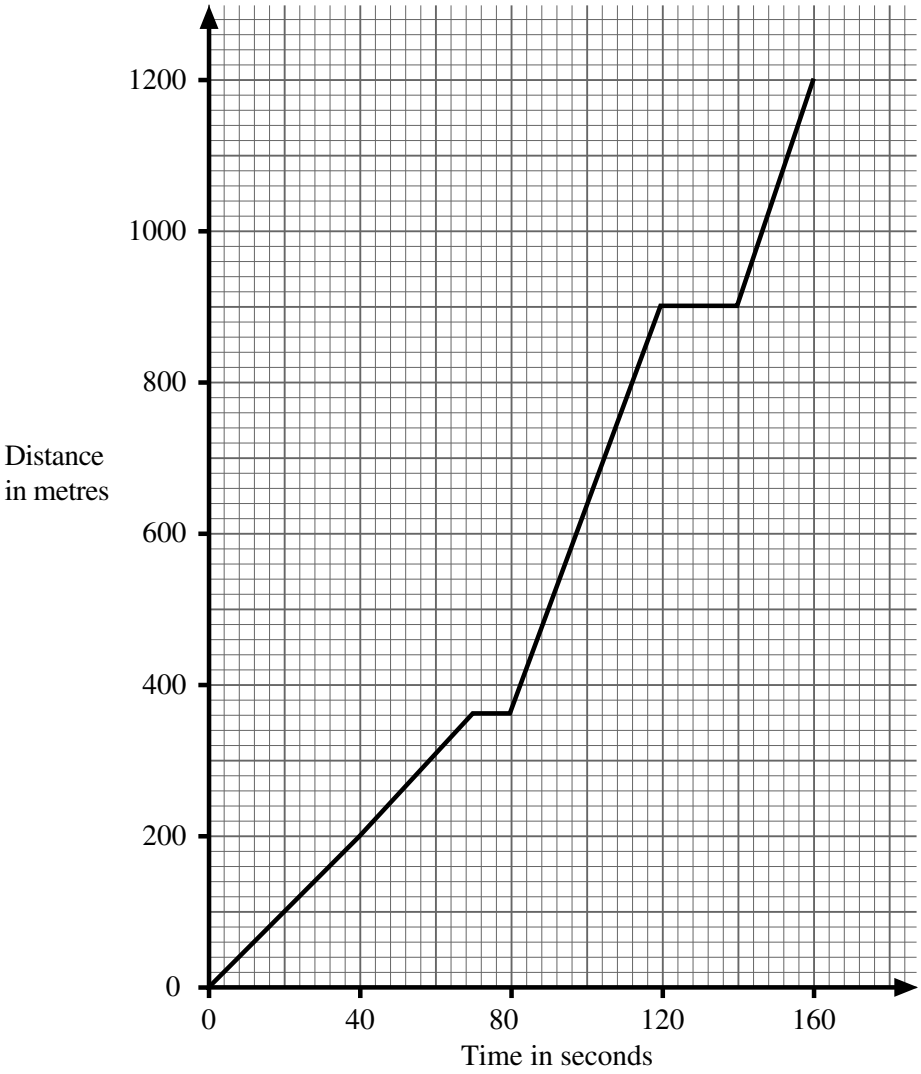
(v) The force A remains constant at 1200 N, but as the velocity of the car increases, the acceleration does not remain the same, but begins to decrease. What does this tell you about force B?

_____ [1]

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Examiner Only	
Marks	Remark

(b) The driver of the car takes it on a journey.
The distance–time graph for this journey is shown below.



(i) Calculate the average speed of the car for the whole journey.
You are advised to show clearly how you get your answer.
Remember to include the correct unit in your answer.

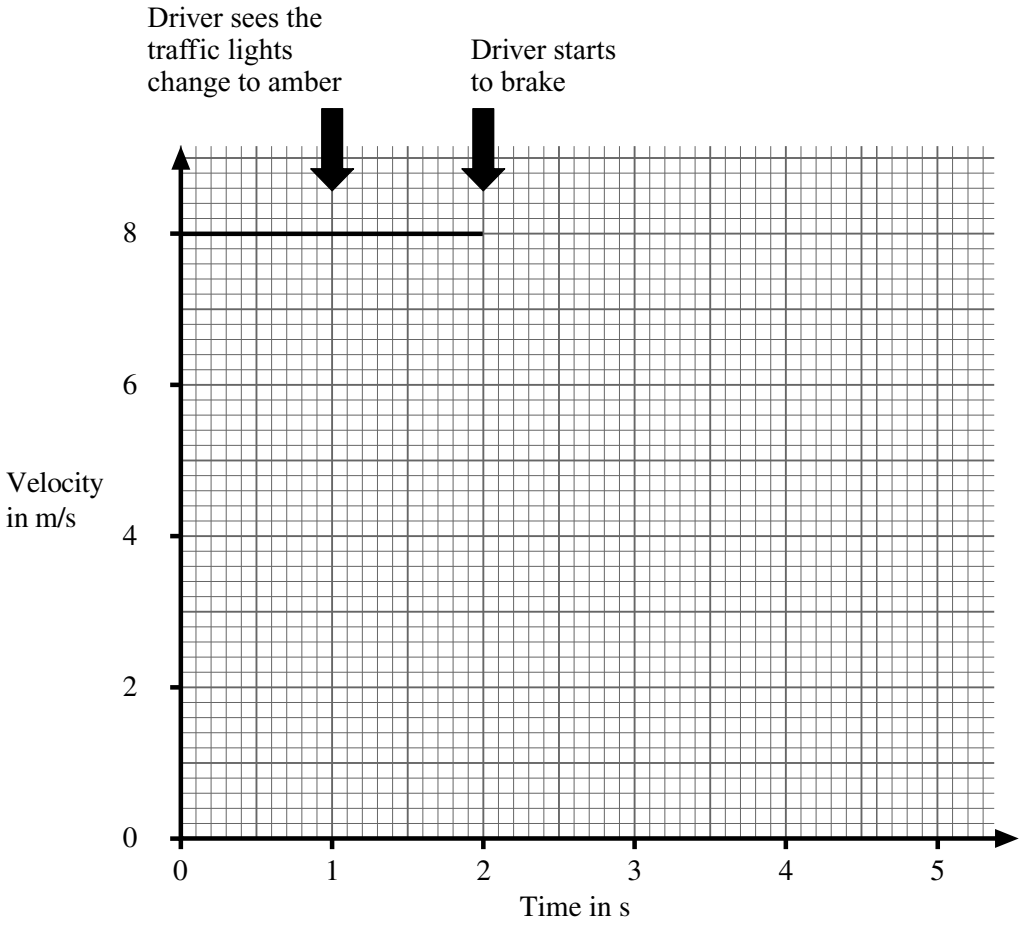
Average speed = _____ [4]

(ii) Draw, on the grid above, what the distance–time graph would look like, if the driver had driven the same journey in the same time, at a **constant speed**. [3]

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Marks	Remark

(c) On another journey, when the car is approaching a road junction, the traffic lights change to amber and the car brakes. The graph below shows part of the velocity–time graph as it brakes.



(i) The driver sees the lights change to amber at a time of 1 s and applies the brakes 1 s later. What distance does the car travel during this time of 1 s?

Distance travelled = _____ m [2]

(ii) The car stops 3 s after the brakes are first applied. Continue the velocity–time graph until the car has stopped. You may assume that the deceleration of the car is constant. [2]

(iii) Calculate the deceleration of the car.
You are advised to show clearly how you get your answer.

Deceleration = _____ m/s^2 [2]

(iv) Calculate the distance travelled by the car from the time when the driver sees the traffic lights change to amber until it comes to rest.
You are advised to show clearly how you get your answer.

Distance travelled = _____ m [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** **(i)** Write down an equation to describe what physicists mean by the word **efficiency**.

Efficiency = [1]

(ii) The **useful output energy** from an electrical generator is 150 kJ and the **wasted output energy** is 450 kJ. Use your knowledge of the principle of conservation of energy to calculate the efficiency of the generator.
You are advised to show clearly how you get your answer.

Efficiency = _____ [3]

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Marks	Remark

(b) (i) Below are seven different energy resources.

biomass coal gas geothermal
hydroelectric nuclear wind

Classify these resources by writing the name of each of them in the appropriate column in the table below.

Renewable and dependent on the energy of the Sun	**Renewable and independent of the energy of the Sun**	**Non-renewable**

[4]

(ii) There is increasing interest in the use of bio-fuels for energy. Bio-fuels are frequently obtained from the oil-bearing seeds of crops like rape and maize. What form of energy is stored in bio-fuels?

_____ [1]

(iii) Explain carefully why bio-fuels can be thought of as renewable sources of energy.

_____

_____

_____ [3]

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Marks	Remark

(c) In a swimming competition, an athlete swims 400 m, at a steady speed of 0.8 m/s against an opposing force of 450 N.

(i) Write down an equation which will enable you to calculate the work done by this athlete.

Work done = [1]

(ii) Use the equation in part **(i)** to calculate the work done by the athlete.
You are advised to show clearly how you get your answer.

Work done = _____ J [2]

(iii) The swim lasts for 500 seconds. Use your answer to part **(ii)** to calculate the power of the athlete.
You are advised to show clearly how you get your answer.

Power = _____ W [3]

(d) From the early 20th century until the present day there was a very significant rise in the amount of carbon dioxide gas in the earth's atmosphere, due to increasing use of fossil fuels. This has caused a rise in the average temperature of the atmosphere. This effect is called global warming.

(i) Explain how a rise in the level of atmospheric carbon dioxide has brought about global warming.

_____

_____

_____

_____

_____ [3]

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There is increasing interest in the use of renewable energy resources such as solar and wind energy for electricity generation. The major advantage of these energy resources is that they reduce carbon dioxide pollution.

(ii) State why it would be unwise for a country to generate electricity using solar and wind energy alone.

_____

_____ [1]

(e) The German government intends to close down all its nuclear power stations and build no more. France produces a high proportion of its electricity using uranium and plans to build more nuclear power stations.

(i) Give **one** reason why a government might want to close down its nuclear power stations and **one** reason why another government might want to build more nuclear power stations.

Reason for closing down _____

_____

_____

Reason for building more _____

_____

_____ [2]

(ii) At the end of their useful lives, all power stations are decommissioned. Why is decommissioning a nuclear power station particularly expensive?

_____

_____ [1]

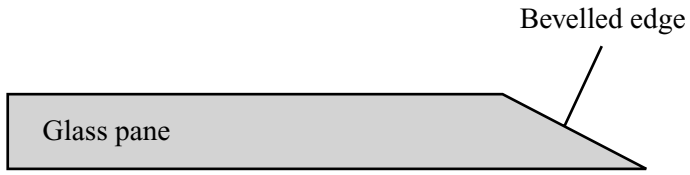
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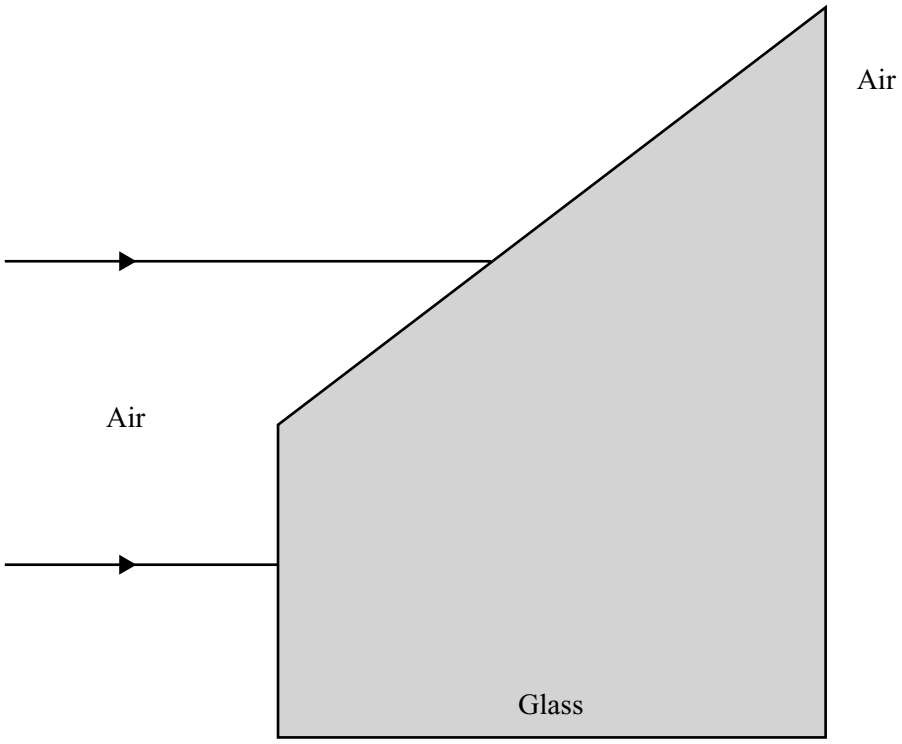
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3 **(a)** A pane of glass is sometimes bevelled at the edges. The diagram below shows what this means.



The next diagram shows an enlarged view of the pane of glass at its bevelled edge. Two rays of white light are shown striking the glass.



Complete the diagram to show how the bevelled edge of the glass can produce a coloured beam of light, while the main pane of glass produces no colours. Label the rays with appropriate colours. [5]

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Marks	Remark

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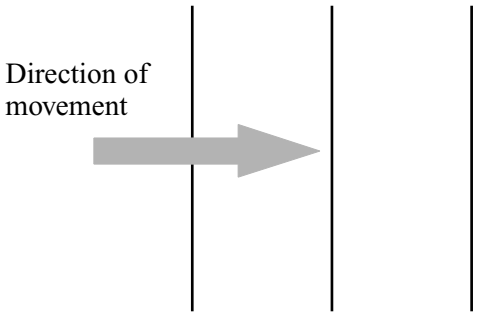
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Marks	Remark

(b) (i) What is meant by the diffraction of a wave?

_____

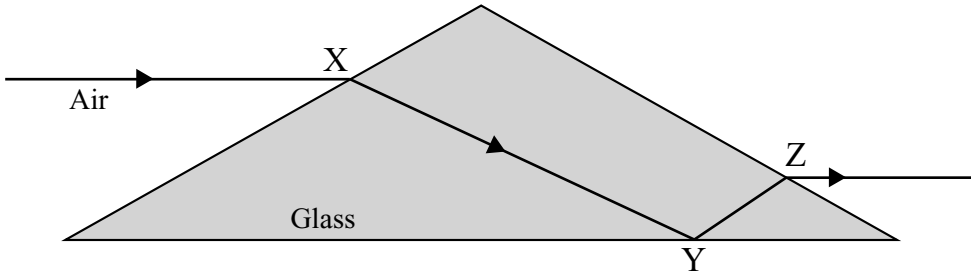
_____ [1]

The diagram below represents wavefronts moving from left to right.



(ii) Complete the diagram by drawing an object in the path of the wavefronts, which would make the wave diffract and show the shape of the wavefronts after they have passed through the object. [2]

(c) The diagram shows the path of a ray of **red** light passing through a glass prism.



(i) Name the process happening to the ray at the point X.

_____ [1]

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Marks	Remark

(ii) There is no light emerging from the prism at Y.
Name the process happening to the light at Y.

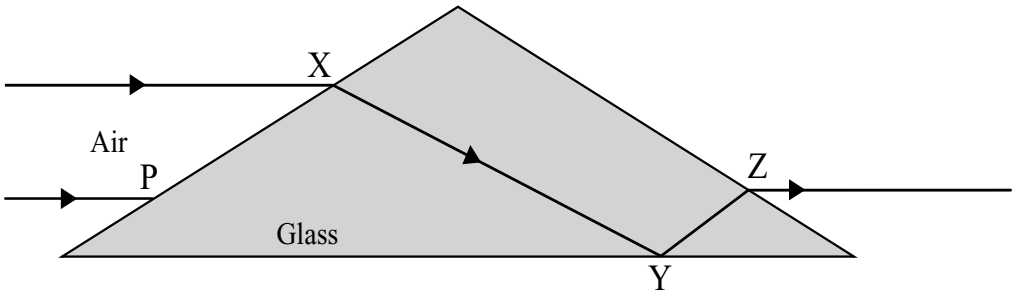
_____ [1]

(iii) How does the speed of light change, if at all, as it passes the point Y and as it passes the point Z?

As it passes Y _____

As it passes Z _____ [2]

A second ray of **red** light strikes the prism at the point P as shown below.



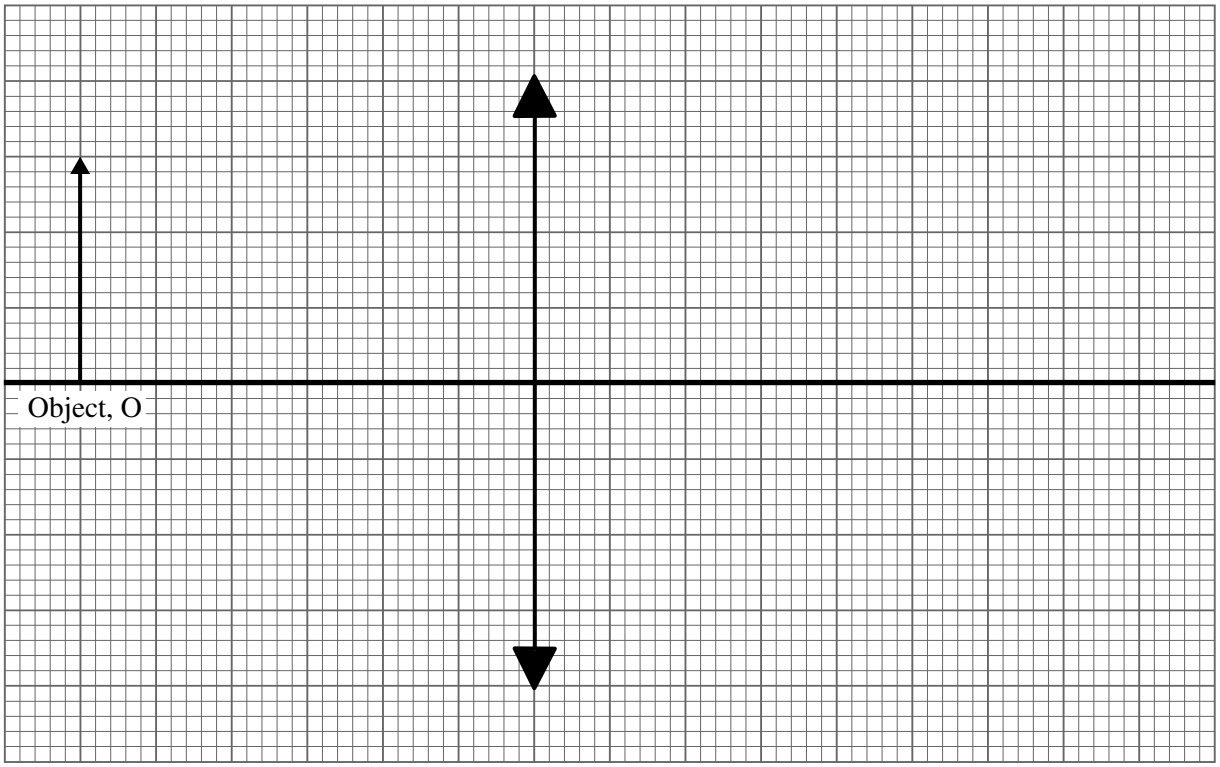
(iv) On the diagram, using a ruler, continue the path of the second ray through and out of the glass prism. [2]

(d) A camera lens has a focal length of 2 cm.

(i) Draw a diagram to illustrate the meaning of this statement. [2]

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This camera is used to photograph an object, O, which is 3.0 cm high and is placed 6.0 cm from the camera lens as shown in the diagram below.



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Marks	Remark

(ii) Mark and label, on the **full scale** diagram, the positions of the two focal points of the lens. [1]

(iii) Using a ruler, draw rays on the diagram to find the position and size of the image. Mark and label the image formed and put arrows on the rays to show their directions. [5]

(iv) What type of image is formed in this case?

_____ [1]

(v) The diagram is full scale. How far from the lens should the film be so as to produce a sharp photograph?

Distance of the lens from the film = _____ cm [1]

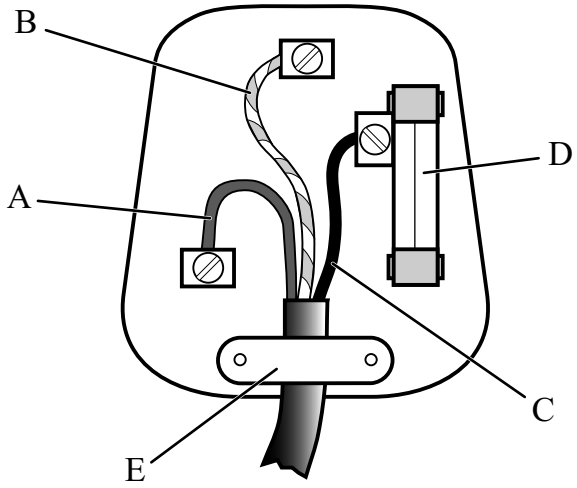
(vi) How tall is the image?

Height of the image = _____ cm [1]

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Marks	Remark

4 **(a)** The diagram below shows a fused 13 A plug.
Five parts are labelled A, B, C, D and E.



(i) Complete the table to identify the wires connected to the three pins of the plug.

Wire connected to:	Live pin	Neutral pin	Earth pin
Letter (A, B or C)			

[1]

(ii) What names are given to the parts labelled D and E?

D _____

E _____ [2]

A washing machine has a metal frame. A fault occurs so that the live wire connected to the motor is detached and makes contact with the metal frame.

(iii) Explain fully how the fuse and the earth wire in the plug above **work together** to prevent a person touching the frame being electrocuted.

_____

_____

_____

_____

_____

_____ [4]

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Examiner Only	
Marks	Remark

(b) Mrs Henderson is investigating the use of electricity in her home.
She reads her electricity meter at the end of the week and records her readings in a table.
The difference between the reading at the end of week 2 and the end of week 1 is the number of units used in week 2 and so on.

Below is an incomplete copy of her table.

Week	1	2	3	4	5	6
Meter reading	12143	12270	12399	12556	12681	
		Units used during week 1	Units used during week 2	Units used during week 3	Units used during week 4	Units used during week 5
		127	129		125	144

(i) Complete the table by entering the numbers in the appropriate boxes. [2]

(ii) What do the units in the above table measure?
Tick (✓) the correct answer below.

Units in the table above measure	**Tick (✓) the correct box**
Electrical power	
Electrical energy	
Electrical current	

[1]

Electricity costs 11 pence per unit.

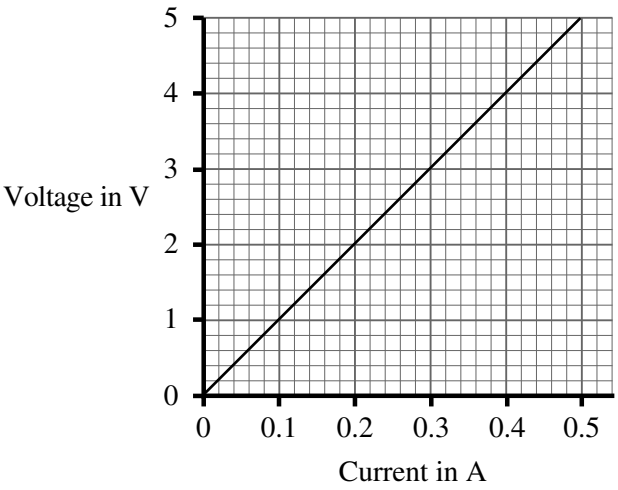
(iii) What is the cost of a kilowatt-hour of electricity? _____ [1]

(iv) Calculate the cost of electricity in Mrs Henderson's home in **week 2**.
You are advised to show clearly how you obtain your answer.

Cost of electricity = £ _____ [2]

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(c) Desmond carries out an investigation into the relationship between the current flowing in a metal wire and the voltage across it.
A graph obtained from Desmond's results is shown below.



(i) What does this graph show about the relationship between current and voltage for this metal wire?

_____

_____ [1]

(ii) During the experiment Desmond switched off the current between one reading and the next. Why was this necessary?

_____

_____ [1]

(iii) On the same grid, carefully draw the straight line which Desmond would have obtained for a wire of **double** the resistance. [2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(d) The resistance of a piece of wire depends on several factors.
Does the resistance of a metal wire:

(i) increase, decrease or remain the same when its length increases?
Tick (✓) the correct answer below.

When the length increases, the resistance of a copper wire	**Tick (✓) the correct box**
increases	
decreases	
remains the same	

[1]

(ii) increase, decrease or remain the same when its cross section area increases? Tick (✓) the correct answer below.

When the cross section area increases, the resistance of a copper wire	**Tick (✓) the correct box**
increases	
decreases	
remains the same	

[1]

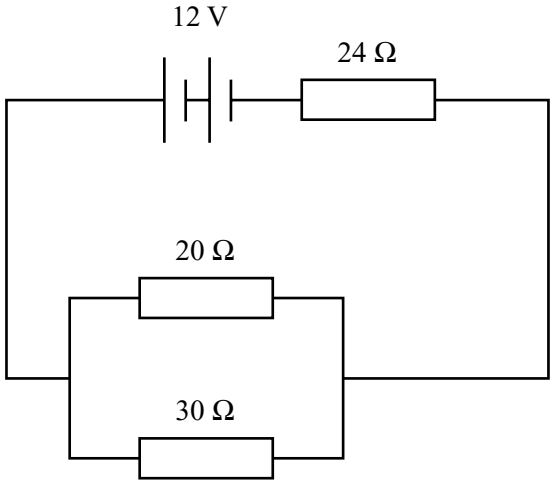
(iii) A piece of cotton thread and a copper wire have the same length and cross section area.
Which one of the following statements about them is true?
Tick (✓) the correct answer below.

The copper wire's resistance is	**Tick (✓) the correct box**
bigger than that of the cotton thread	
smaller than that of the cotton thread	
about the same as that of the cotton thread	

[1]

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(e) Three resistors are connected to a battery as shown in the circuit below.



(i) Calculate the total resistance of this circuit.
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [2]

(ii) Calculate the voltage across the 24 Ω resistor.
You are advised to show clearly how you get your answer.

Voltage = _____ V [3]

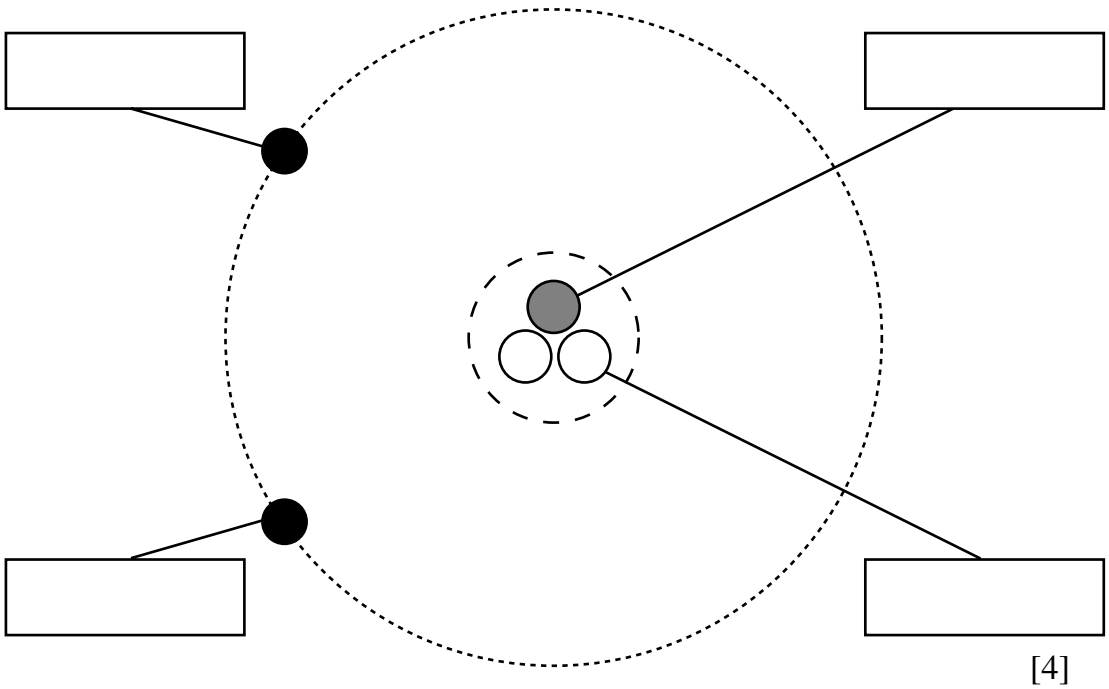
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

5 **(a)** The diagram below represents a neutral atom of a helium isotope. Write the names of the particles indicated, in the boxes.



[4]

(b) The nucleus of an atom of an isotope of sodium (chemical symbol Na) is represented as shown below.

$$^{24}_{11}Na$$

(i) What is the mass number of this nucleus?_____[1]

(ii) What information does the mass number give us?

_____

_____ [1]

(iii) Sodium has several isotopes. In terms of the particles that make up the nucleus, what do they all have in common?

_____ [1]

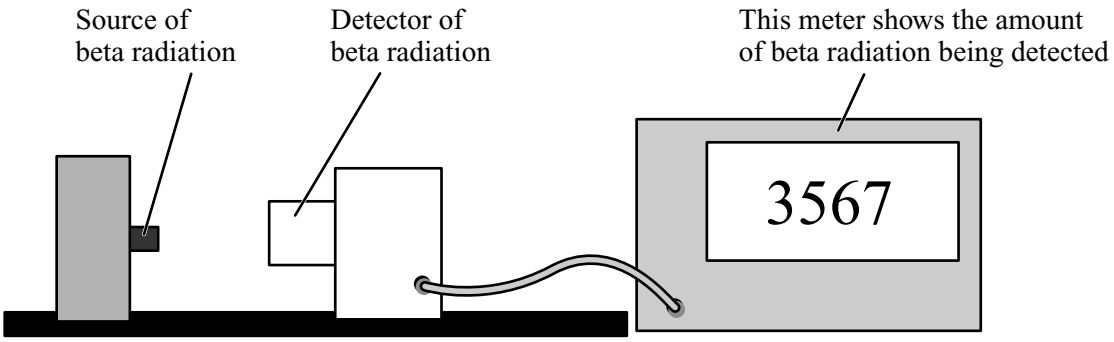
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Examiner Only	
Marks	Remark

(iv) This isotope of sodium is unstable and disintegrates by beta decay. Complete the decay equation for this by writing the appropriate numbers and symbol in the empty boxes.

$$^{24}_{11}Na \rightarrow \square\!\!\square Mg + \square\!\!\square\!\!\square \quad [5]$$

(c) A substance, which emits beta radiation, is placed close to a detector as shown below. You are given a number of aluminium squares, each 1 mm thick. The aim of the investigation is to find out what least thickness of aluminium is needed to prevent the beta radiation reaching the detector. This thickness is known as the **range**.



(i) Describe, briefly, how you would carry out this investigation. How would you know when you have reached the range of beta radiation in aluminium?

_____

_____

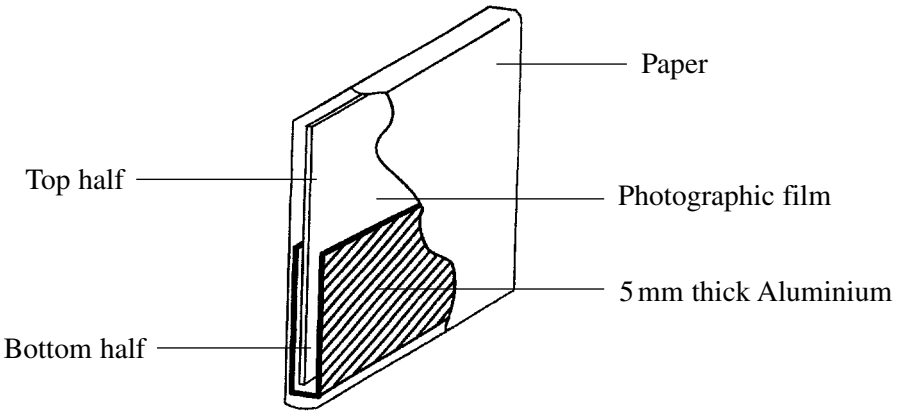
_____

_____

_____ [3]

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People who work with radioactive materials wear a small badge. It allows the amount of radiation, to which they have been exposed to be measured. The diagram below shows the structure of the badge.



The photographic film will be affected by any radiation passing through the paper and the aluminium. In a particular instance it was found that the top half of the photographic film was affected by radiation but the bottom half was not.

(ii) In this instance, was the worker exposed to alpha (α) radiation or beta (β) radiation? Explain your answer.

Type of radiation _____

Explanation _____

_____ [2]

(iii) If the worker had been exposed to gamma (γ) radiation, what effect would this have on the photographic film? Explain your answer.

Effect _____

_____

Explanation _____

_____ [2]

Examiner Only

Marks	Remark

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(d) (i) State the meaning of half-life of a radioactive substance.

Examiner Only

Marks	Remark

_____

_____ [1]

The volume of blood in a person's body can be measured using radioactivity. A small quantity of a radioactive substance is injected into the body. After an hour a small sample of blood is taken and its radioactivity is measured. The volume of blood can then be calculated.

(ii) Three radioactive substances are available. One has a half-life of 5 seconds, one has a half-life of 30 minutes and the third has a half-life of 1 year. Which one is best suited to this technique and why?
Explain, briefly, why the other two are not suitable.

_____

_____

_____

_____

_____

_____ [4]

Quality of written communication [1]

THIS IS THE END OF THE QUESTION PAPER

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GCSE

Science: Physics

Summer 2009

Mark Schemes

Issued: October 2009

Rewarding Learning

General Certificate of Secondary Education
2009

Science: Physics

Paper 1
Higher Tier

[G7604]

WEDNESDAY 10 JUNE, AFTERNOON

MARK SCHEME

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Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote correct units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

					AVAILABLE MARKS
1	**(a)**	**(i)**	A force/resistance [1] force of gravity [0] that opposes/preventing motion [1]	[2]	
		(ii)	Zero	[1]	
		(iii)	At rest [1] Moving with constant velocity or constant speed [1]	[2]	
		(iv)	$F = ma$ [1] $= 750 \times 0.5$ $= 375$ [1] $F = A - B$ or $375 = 1200 - B$ B = 825 N [1]	[3]	
		(v)	Force B is increasing	[1]	
	(b)	**(i)**	Average speed = distance/time [1] = 1200/160 [1] = 7.5 [1] m/s [1] independent mark	[4]	
		(ii)	Straight line [1] from 0, 0 [1] to 160, 1200 [1]	[3]	
	(c)	**(i)**	8×1 [1] = 8 m [1]	[2]	
		(ii)	Straight line [1] from 2, 8 to 5, 0 [1]	[2]	
		(iii)	Deceleration = slope **or** 8/3 [1] **or** $a = \frac{v-u}{t}$ **or** $\frac{8}{3}$ = 2.7 m/s^2 [1] ignore minus sign	[2]	
		(iv)	Area under the graph from [1] **or** $s = \frac{1}{2}(u+v)t$ $= 8 + \frac{1}{2} \times 3 \times 8$ [1] = 20 m [1]	[3]	25

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AVAILABLE MARKS

2 **(a)** **(i)** Efficiency = useful energy or work output/total energy input or equivalent [1]

(ii) [1] [1]
Efficiency = 150/(150 + 450) [2]
= 150/600
= 0.25 [1] **or** 25% [3]

(b) **(i)**

Renewable and dependent on the energy of the Sun	**Renewable and independent of the energy of the Sun**	**Non-renewable**
Biomass Hydroelectric Wind	Geothermal	Coal Gas Nuclear

[$\frac{1}{2}$] each **round up** [4]

(ii) Chemical [1]

(iii) Sun allows plants to grow [1]
Sunlight is converted energy by plants/photosynthesis [2]
Sun is a source of limitless/renewable energy [1] sun's energy never runs out [3]

(c) **(i)** Work = Force × Distance (moved) **or** W = f × d [1]

(ii) Work = 450 × 400 [1]
= 180 000 (J) [1] [2]

(iii) Power = work done/time taken [1] **or** W = P × t
Power = 180 000/500 [1] e.c.f. from **(ii)**
Power = 360 W [1] [3]

(d) **(i)** Heat from Sun is absorbed by land (and sea) or Earth
Heat is radiated back into atmosphere
Radiated heat is absorbed by carbon dioxide which re-radiates it back to earth
More carbon dioxide means more energy absorbed by atmosphere
Any **three** [3]

(ii) Solar and wind energy is unreliable [1]

(e) **(i)** Reason for closing: dangerous radioactive waste/pollution **or** fear of being a terrorist target [1]
Reason for building: secure/reliable source of electricity **or** reduce carbon dioxide emissions **or** conserve fossil fuels [1] [2]

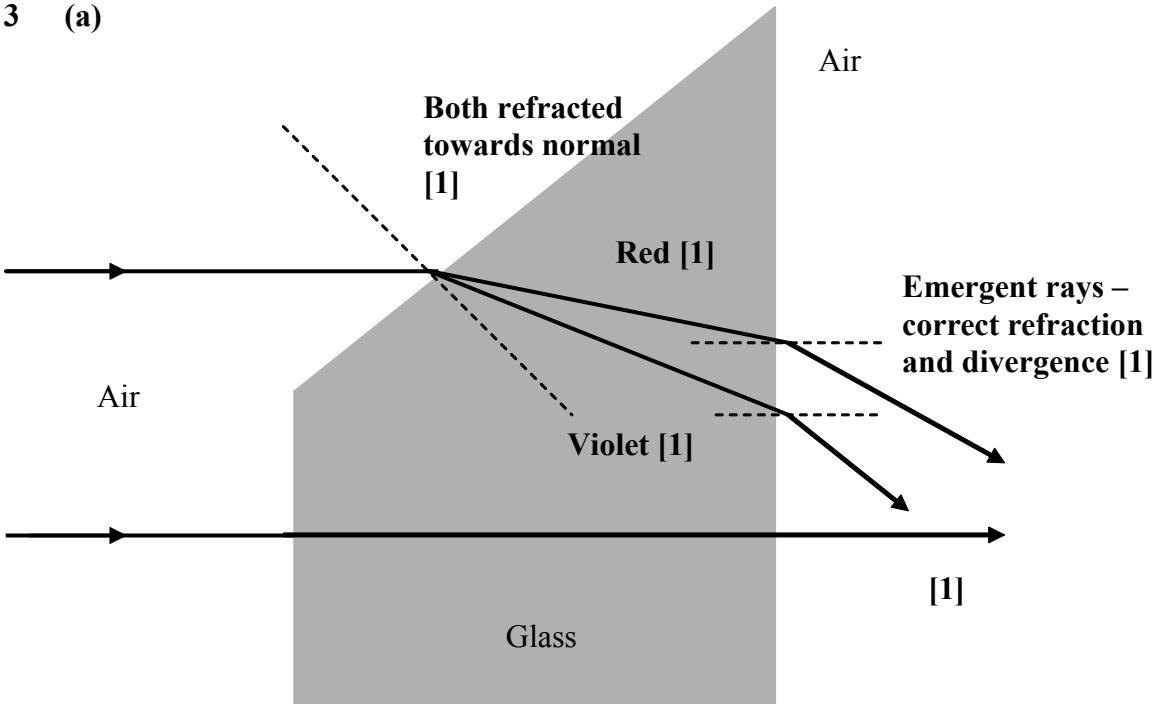
(ii) High costs of: Specialist personnel **or**
Specialist equipment **or**
Takes a very long time to do
Danger to personnel because of radioactivity [1]

25

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AVAILABLE MARKS

3 (a)



Lower ray straight through without dispersion [1]
Top ray – divides with correct refraction for both [1]
Least refracted labelled with appropriate colour [1]
Most refracted labelled with appropriate colour [1]
Emergent rays – correct refraction and divergence [1] [5]

(b) (i) Spreading of a wave after passing through a gap [1]

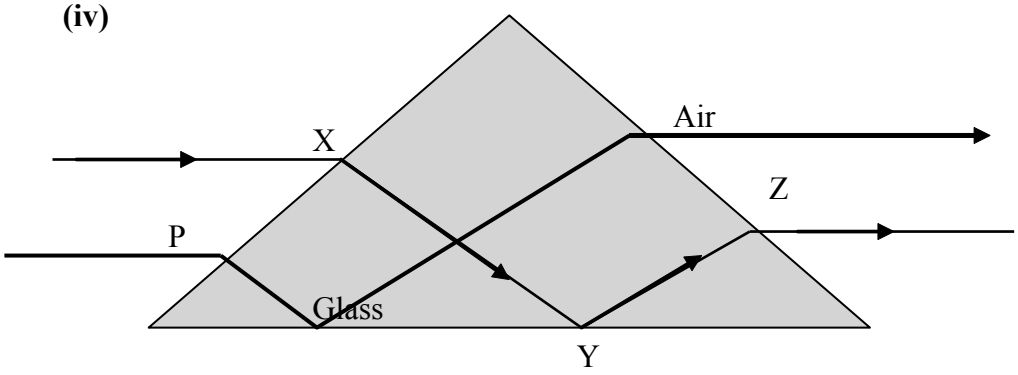
(ii) Obstacle correctly drawn – barrier with gap [1]
Curved wave fronts [1] [2]

(c) (i) Refraction [1]

(ii) Total internal reflection or T.I.R. [1]

(iii) Y no change, Z an increase [1] each [2]

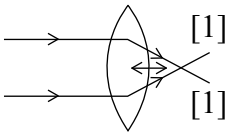
(iv)



New ray parallel to first ray in all parts [2]
(Parallel in only two sections [1]) [2]

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				AVAILABLE MARKS
(d)	**(i)**	Parallel rays converging, etc. [1] Focal length marked [1]	[2]	



	(ii)	**Both** focal points marked and labelled 2 cm from lens	[1]
	(iii)	Ray through centre of lens undeviated [1] Ray parallel to p axis then through F or converse [1] e.c.f. for position of F from **(ii)** Rays produced to meet [1] Full image marked where rays meet [1] accept vertical line labelled I or vertical arrow Arrow from object on at least one ray [1]	[5]
	(iv)	Real Image	[1]
	(v)	Image distance from candidate's diagram ±2 mm	[1]
	(vi)	Height from candidate's diagram ±2 mm	[1]

25

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					AVAILABLE MARKS
4	(a)	(i)	Live – C Neutral – A Earth – B **All** must be correct	[1]	
		(ii)	D: fuse [1] E: cable/cord grip [1] flex, cord, cable clamp	[2]	
		(iii)	Current flows to earth Earth wire has low resistance Current exceeds fuse rating Fuse wire melts/blows/breaks Disconnects/breaks the circuit Any **four**	[4]	
	(b)	(i)	Week 6 meter reading = 12 681 + 144 = 12 825 [1] Units used in week 3 = 12 556 – 12 399 = 157 [1]	[2]	
		(ii)	Electrical energy	[1]	
		(iii)	11 (pence)	[1]	
		(iv)	[1] Cost = 129 × 11 = 1419 p e.c.f. for part **(iii)** = £14.19 [1] **or** 1419 p ignore £ sign if p present	[2]	
	(c)	(i)	Voltage and current are proportional to each other	[1]	
		(ii)	Ensure wire is at room/constant temperature **or** prevent wire heating up	[1]	
		(iii)	Straight line of twice the gradient [2] starting at 0, 0 (if just steeper [1])	[2]	
	(d)	(i)	Increases	[1]	
		(ii)	Decreases	[1]	
		(iii)	Smaller than that of the cotton thread	[1]	
	(e)	(i)	20 and 30 in parallel gives 12 Ω [1] 24 and 12 in series gives 36 Ω [1]	[2]	
		(ii)	[1] [1] $I = V/R = 12/36 = 0.33$ [2] e.c.f. for total resistance at **(i)** $V = IR = 24 \times 0.33 = 8$ V [1]	[3]	25

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			AVAILABLE MARKS
5	**(a)**	Top right – Neutron [1] (N) Bottom right – Proton [1] (P) Top left – Electron [1] (e) Bottom left – Electron [1] (e) [4]	
	(b)	**(i)** 24 [1]	
		(ii) Total of neutrons and protons [1]	
		(iii) Same number of protons [1]	
		(iv) $^{24}_{12}\text{Mg} + {}^{0}_{-1}\text{e}(\beta)$ [5]	
	(c)	**(i)** Measure background reading Place aluminium between source and detector Add more sheets Until count rate falls to zero/background Any **three** [1] each [3]	
		(ii) Beta [1] Only beta can pass through the paper **or** alpha cannot pass through paper [1] [2]	
		(iii) Both parts **or** top and bottom both affected [1] Gamma can pass through paper and the aluminium [1] [2]	
	(d)	**(i)** Time for the activity to fall to half its original value Time for half of the atoms to decay [1]	
		(ii) 30 minutes [1] Long enough to mix with the blood/short enough to avoid damage without causing tissue damage [1] Five seconds too short to mix with blood [1] One year would cause tissue damage [1]/damage to body/cells [4]	
		Quality of written communication [1]	25
		Total	**125**

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