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Wednesday 5 June 2013 – Afternoon

GCSE GATEWAY SCIENCE
PHYSICS B

B751/02 Physics modules P1, P2, P3 (Higher Tier)

B722340613

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 15 minutes

B751102

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **28** pages. Any blank pages are indicated.

EQUATIONS

$$\text{energy} = \text{mass} \times \begin{matrix}\text{specific}\\ \text{heat}\\ \text{capacity}\end{matrix} \times \begin{matrix}\text{temperature}\\ \text{change}\end{matrix}$$

$$\text{energy} = \text{mass} \times \text{specific latent heat}$$

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{energy supplied} = \text{power} \times \text{time}$$

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{distance} = \text{average speed} \times \text{time}$$

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

$$\text{power} = \text{force} \times \text{speed}$$

$$KE = \frac{1}{2}mv^2$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

$$GPE = mgh$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$$I_e = I_b + I_c$$

$$\frac{\begin{matrix}\text{voltage across}\\ \text{primary coil}\end{matrix}}{\begin{matrix}\text{voltage across}\\ \text{secondary coil}\end{matrix}} = \frac{\begin{matrix}\text{number of}\\ \text{primary turns}\end{matrix}}{\begin{matrix}\text{number of}\\ \text{secondary turns}\end{matrix}}$$

$$\text{power loss} = (\text{current})^2 \times \text{resistance}$$

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

SECTION A – Module P1

1 Allan wants to reduce energy losses from his house.

He asks an energy adviser for help.

(a) The adviser uses a camera to produce a thermogram of the house.

Explain how the thermogram can be used to compare how much heat energy is lost from different parts of the house.

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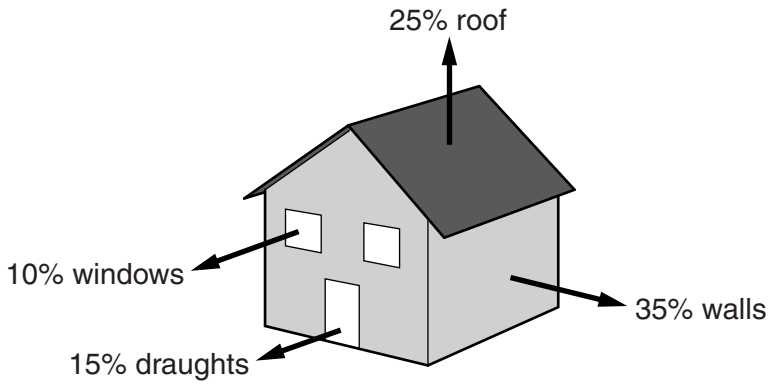
..... **[2]**

(b) The energy adviser draws a diagram of Allan's house.

It shows where some of the energy losses happen.



Energy saving methods are used to reduce energy losses from this house.

The table shows some costs and savings for four of these methods.

	Energy saving method	Cost to fit in £	Annual saving on energy bills in £	Payback time in years
A	double glazed windows	4800	100	
B	loft (roof) insulation	270	45	
C	draught-proofing	90	30	
D	cavity wall insulation	240	120	

The adviser tells Allan that he should install methods C and D in his house.

Complete the table and use the information to explain why C **and** D are the best methods for Allan to install.

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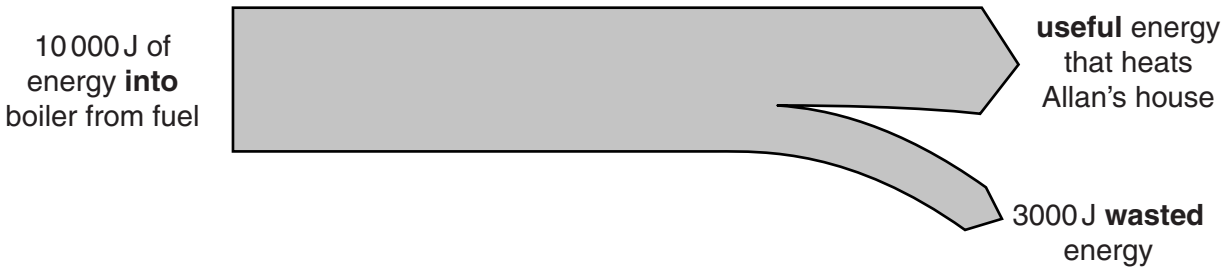
(c) The energy adviser also suggests that Allan replaces his old central heating boiler.

The Sankey diagram shows energy data for Allan's boiler.



(i) Calculate the efficiency of Allan's boiler.

Give your answer as a percentage.

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efficiency ..... % **[3]**

(ii) Allan thinks that some of the energy completely disappears.

How could the adviser use the Sankey diagram to explain that this was **not** scientifically correct?

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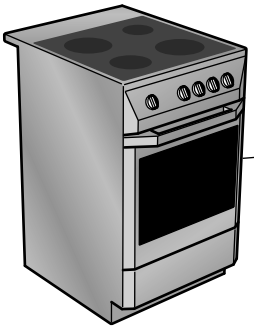
..... **[1]**

[Total: 9]

2 **(a)** Damien wants to cook a curry he bought at the supermarket.

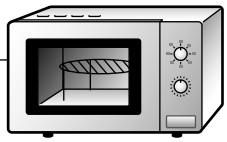
He looks at the label on the packaging of the meal.



Uses infrared radiation to cook the meal. Energy used = 5400 000 J

Place the meal in a glass dish.
Cook in either:
Conventional electric oven;
cook at 190 °C for 36 minutes.

or
Microwave oven;
cook for 6 minutes.



Uses microwave radiation to cook the meal. Energy used = 270 000 J

Explain in detail the mechanisms for both cooking methods and link these to the data for the energy used and cooking times needed.

The quality of written communication will be assessed in your answer to this question.

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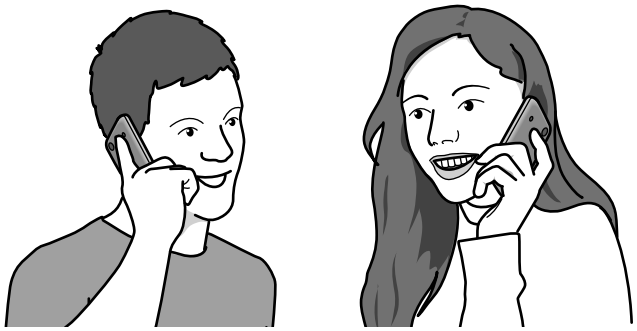
..... **[6]**

(b) Microwaves are also used for mobile phone messages.

Damien is worried about allowing his children to use mobile phones.



He finds evidence in some reports about possible dangers. Look at the notes he makes about the reports from three different years.

A: 2005	**B**: 2007	**C**: 2011
Studied phone use for 4000 people. Concluded that the risk of a cancerous tumour was not increased, at least in the first ten years.	Scientists exposed rat and human cells to microwave radiation and found this caused biological changes to the cells that could lead to tumours developing.	35 800 people aged 30 or over studied for 13 years of phone use. Study concluded that there was no increased risk of brain cancer or any other types of cancer.

Damien decided to allow his children to use mobile phones after considering the evidence from these reports.

Suggest reasons why he did this.

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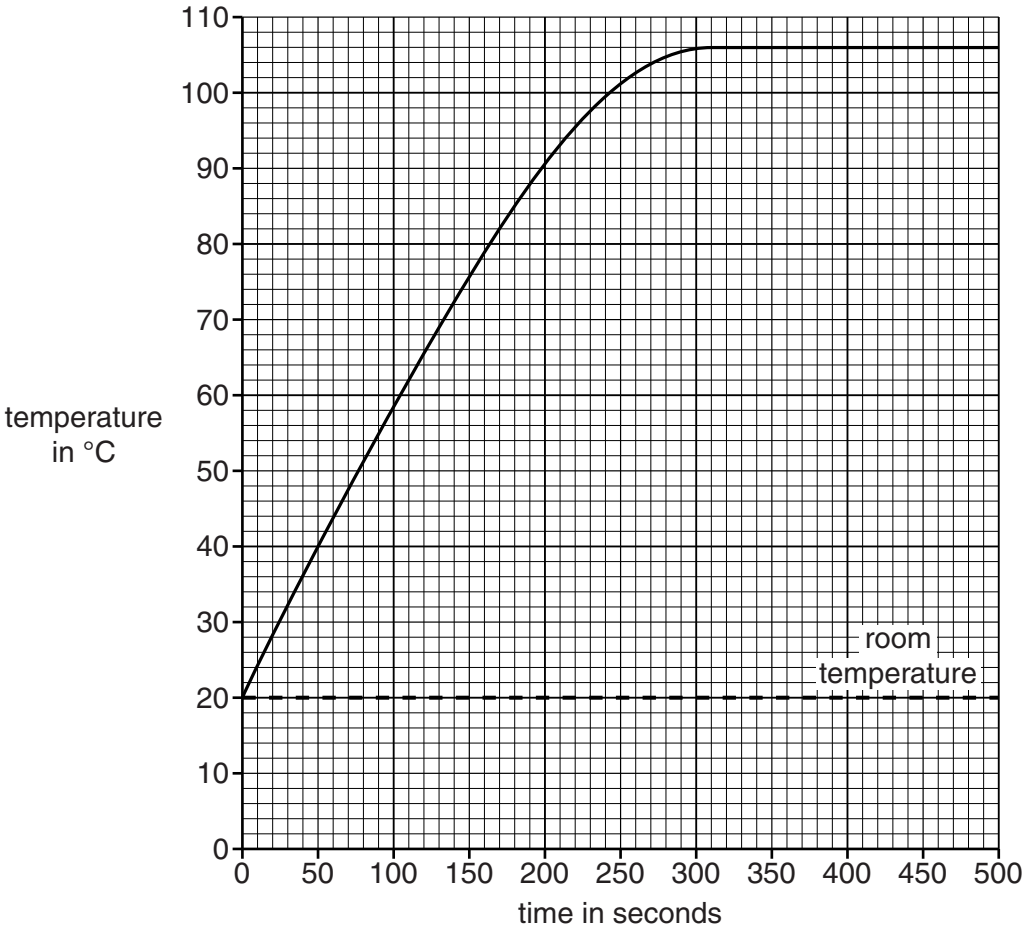
[Total: 8]

3 Layla heats the liquid in a beaker for 500 seconds and records the temperature.

Look at the graph of her results.



Write down the time interval during which **all** of the energy supplied was used to change the state of the liquid, and explain how the energy supplied causes this change of state.

time interval is from ..... seconds to ..... seconds

explanation.....

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..... **[2]**

[Total: 2]

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Question 4 begins on page 10

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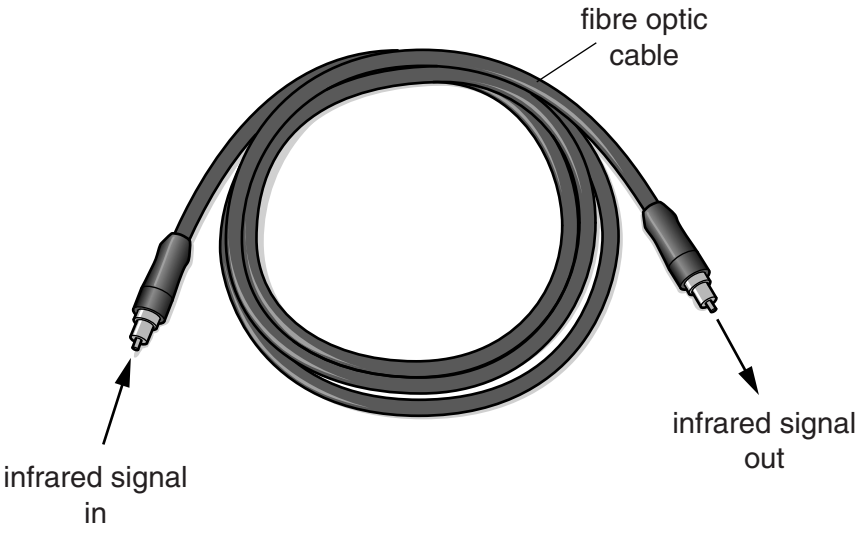
4 Reeta is learning about different types of waves.

Electromagnetic waves are used for communication.

(a) (i) Infrared waves can transmit signals from one end of a fibre optic cable to the other.



Infrared waves of wavelength 1.5×10^{-6} m travel along this optical fibre.

The speed of the infrared waves in the fibre is 2.2×10^{8} m/s.

Calculate the frequency of the infrared waves.

Give your answer in **standard form** and to **2** significant figures.

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answer ..... Hz **[2]**

(ii) When the infrared (IR) radiation leaves the fibre, it is refracted as it enters the air.

Reeta makes a table to compare the speed, wavelength and frequency of the IR signal in the air and in the optical fibre.

Complete the table by putting one tick (✓) in each **row**.

	In air > in fibre	**In air = to that in fibre**	**In air < in fibre**
Speed of IR			
Wavelength of IR			
Frequency of IR			

[2]

(b) Reeta learns that digital signals are used in optical fibres.

Digital signals are used to transmit signals over long distances. As the signal strength falls, it is amplified at points along the cable.

Describe and explain the advantages of using **digital** signals for transmitting information along optical fibres.

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..... **[2]**

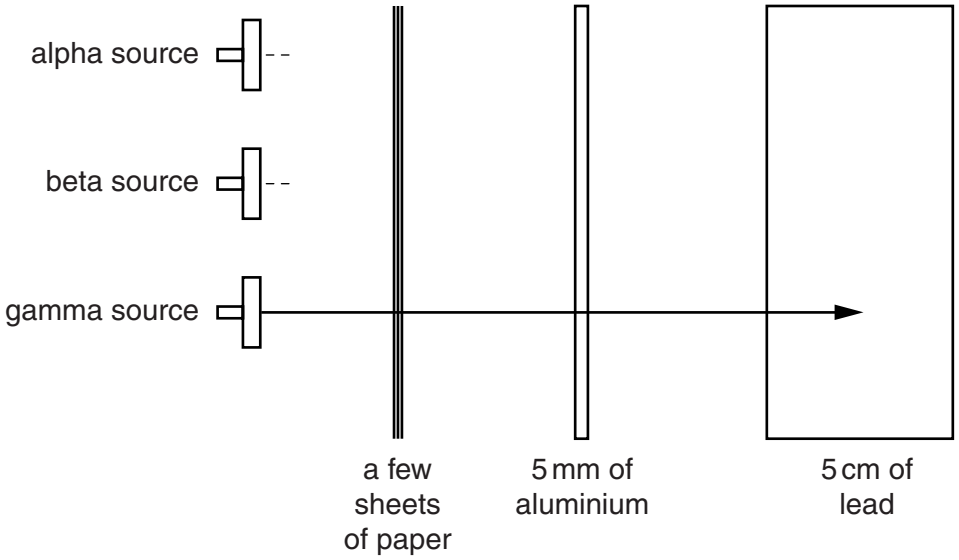
[Total: 6]

SECTION B – Module P2

5 This question is about nuclear radiation.

(a) Complete the diagram to show the penetrating power of alpha **and** beta radiation.

Gamma radiation has been completed for you.



[1]

(b) Write down **two** examples of beneficial uses of gamma radiation.

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(c) Explain the problems of dealing with radioactive waste.

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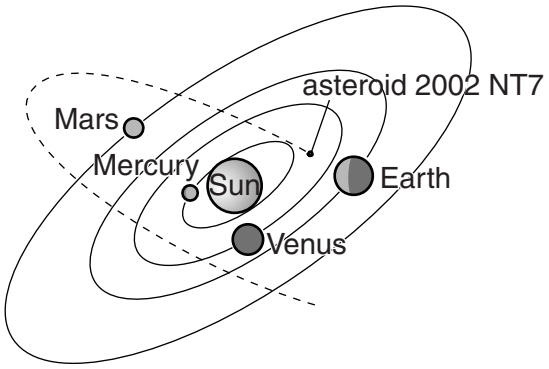
[Total: 5]

6 The asteroid named 2002 NT7 is a Near Earth Object (NEO) with a diameter of 2 km.



Asteroid 2002 NT7 has a low probability of colliding with the Earth in the year 2019.

Explain why most asteroids are not normally a threat, and discuss the possible actions needed to manage the threat of asteroid 2002 NT7.

The quality of written communication will be assessed in your answer to this question.

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[Total: 6]

7 The Sun's energy produces convection currents that cause wind.

Wind is used to drive turbines.

(a) Describe the **advantages** of wind turbines compared to a conventional coal power station.

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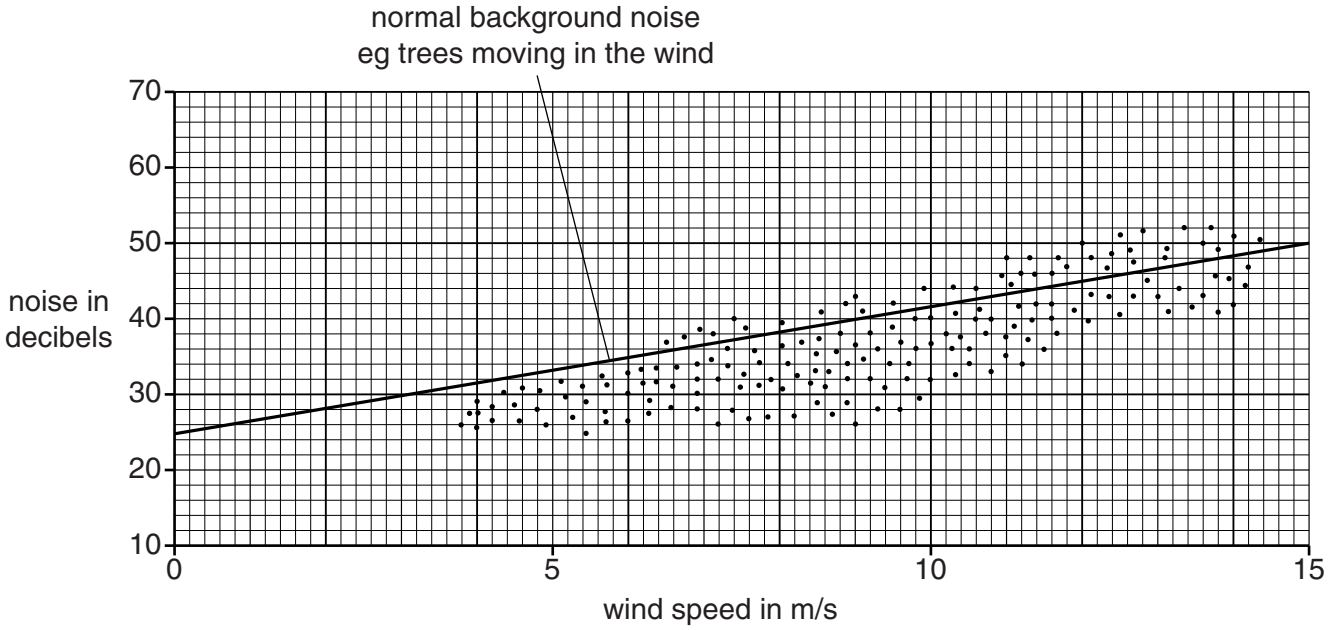
(b) The people in the house are concerned about noise from the turbine.

Look at the graph.

Each dot shows a measurement of the noise from the wind turbine.



(i) Use the graph to describe how the wind turbine noise is affected by wind speed.

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(ii) The mean wind speed in this area is 5 m/s.

The maximum wind speed in this area is usually less than 15 m/s.

Explain, using data from the graph, why the people in the house **do not** normally need to worry about the noise from the turbine.

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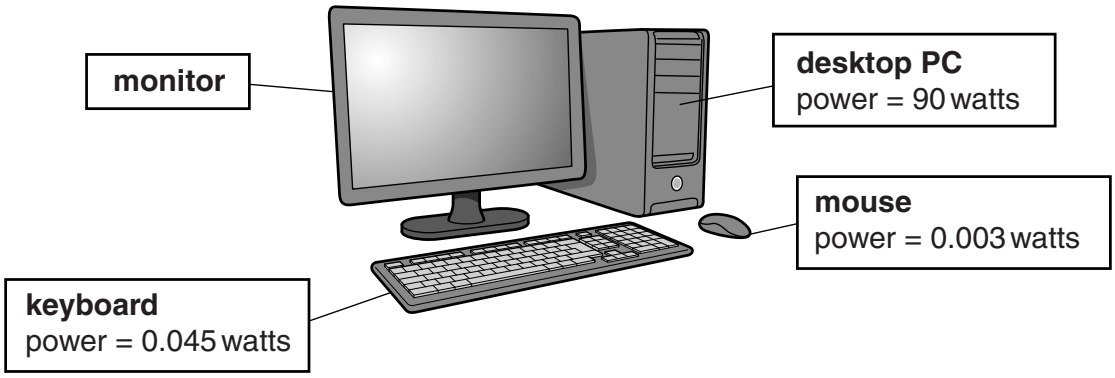
[Total: 5]

8 Kyle has a wireless computing system.

Look at the information in the diagram.



(a) The monitor plugs into a 230 V supply and uses a current of 0.5 A.

Calculate the power of the monitor in kilowatts.

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answer ..... kW **[2]**

(b) The energy supplied to the desktop pc in a day is 0.45 kilowatt hours.

How many hours does Kyle use the desktop PC for that day?

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answer ..... hours **[2]**

(c) The monitor and the desktop pc are connected to a 230V supply.

The mouse and the keyboard use 3V batteries.

Put the four parts of the system in order of the size of current used.

One has been done for you.

highest current .....

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keyboard

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lowest current ..... **[1]**

(d) Increasing the use of technology has increased energy consumption.

This may have contributed to global warming.

People have different views about reducing energy use.

Fatima thinks that it would help if everyone changed to using low energy light bulbs.

Claire thinks we could all reduce energy use by walking instead of driving cars.

Analyse these views and discuss how effective they could be for reducing global warming.

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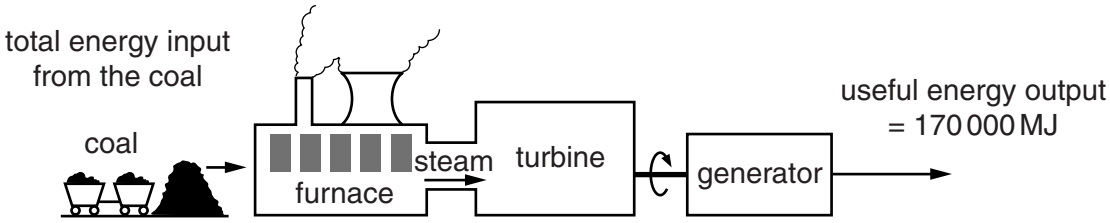
[Total: 7]

9 Electricity is generated in power stations.



(a) The efficiency of this power station is 34%.

Calculate the total energy input from the coal.

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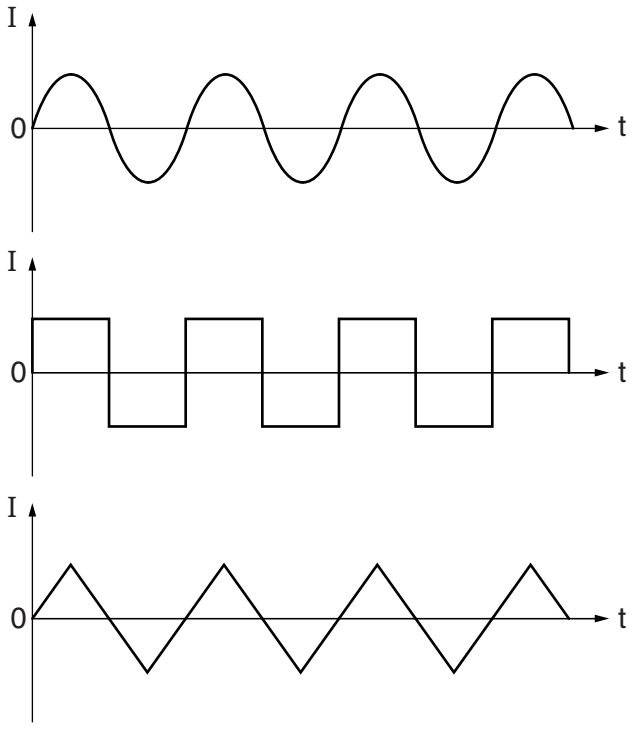
answer ..... MJ **[1]**

(b) The generator in the power station produces alternating current (AC).

Look at the three different current-time graphs.



Describe why all the graphs show alternating currents.

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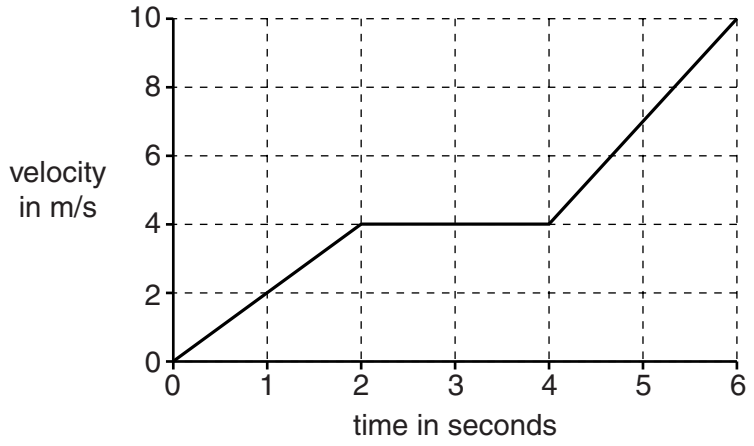
[Total: 2]

SECTION C – Module P3

10 Daisy uses her remote controlled model car.

Look at the simple velocity-time graph for this car.



Describe and compare, in detail, the accelerations, and distances travelled by her car during the three parts of the 6-second journey.

The quality of written communication will be assessed in your answer to this question.

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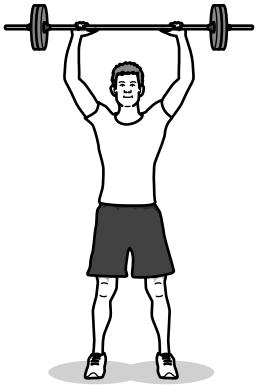
[Total: 6]

11 Hossein is a weightlifter.

His best lift in training is a bar with a mass of 250kg.

He does 5000 J of work on the bar with a mass of 250kg when he lifts it.

The gravitational field strength (g) on Earth is 10 N/kg.



Calculate the weight of this 250kg mass, and how high Hossein lifts the bar.

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weight = ... N

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height lifted = ... m

[3]

[Total: 3]

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Question 12 begins on page 22

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12 Aditi looks at the table of stopping distances for a car.

Speed in m/s	Thinking distance in m	Braking distance in m	Stopping distance in m
4.5	3	1.5	4.5
9	6	6	12
18			
27			

The thinking, braking and stopping distances change with speed.

(a) The thinking time for the driver does **not** change with speed.

Calculate the thinking time for the driver in seconds.

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answer ..... s **[2]**

(b) Aditi says that at 18 m/s the thinking distance is 9 m.

Is she correct? .....

Explain your answer.

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..... **[2]**

(c) Aditi says that at 27 m/s the braking distance is 18 m.

Is she correct? .....

Explain your answer using the data in the table and ideas about energy.

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..... **[3]**

(d) Complete the sentences.

Stopping distances increase with speed and depend on thinking and braking.

The thinking distance is the ..... while the driver is reacting.

Thinking distance increases with speed but also increases if this driver is .....

..... .

Braking distance increases with speed but also increases if the road .....

or the tyres ..... . **[3]**

[Total: 10]

13 Modern cars have many safety features.

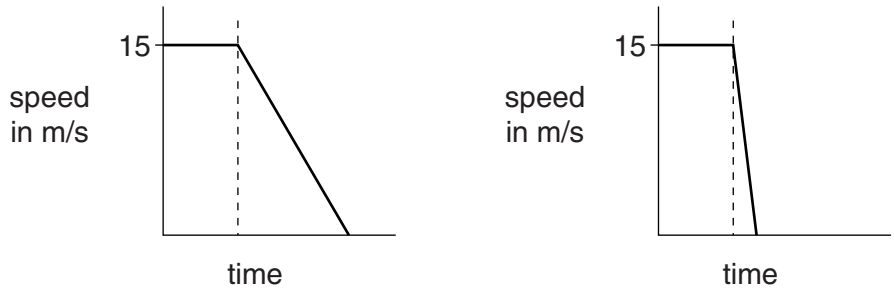
Some features protect people in a crash.

Scientists use crash dummies inside real cars to determine their safety ratings.

(a) Look at the data from two crash tests at 15 m/s.

One is for a **modern** car.

The other is for an **old** car.



modern car **old car**

The forces on the crash dummies in the old car are much higher.

Old cars do not have crumple zones.

Use the information in the graphs to explain why crumple zones in modern cars reduce forces on crash dummies.

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..... **[3]**

(b) More effort is now being made to keep pedestrians safer in car crashes.

(i) Scientists use dummies and cars in tests to improve pedestrian safety.

Describe the steps that scientists take when carrying out these tests.

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..... **[2]**

(ii) These scientists will publish their results.

Why is it important to publish these results?

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[Total: 6]

END OF QUESTION PAPER

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