

Wednesday 30 May 2012 – Afternoon

**GCSE GATEWAY SCIENCE
PHYSICS B**

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

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

Duration: 1 hour 15 minutes

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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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 **24** pages. Any blank pages are indicated.

EQUATIONS

$$\text{energy} = \text{mass} \times \frac{\text{specific heat capacity}}{\text{specific heat capacity}} \times \text{temperature change}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\text{GPE} = mgh$$

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

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

$$V_p I_p = V_s I_s$$

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Question 1 begins on page 4.

PLEASE DO NOT WRITE ON THIS PAGE

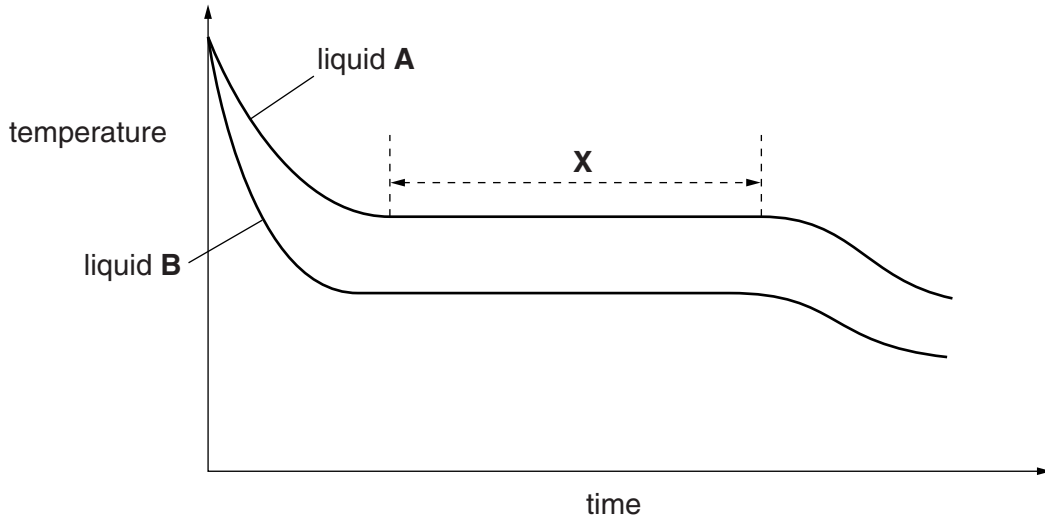
Answer **all** the questions.

Section A – Module P1

1 Amir investigated the cooling of two liquids.

Both liquids had a mass of 350 g.

Look at the graph of his results.



(a) Suggest why liquid **B** cools quicker than liquid **A** at the start of the experiment.

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

(b) What is the direction of the energy flow and what is the effect on the surroundings?

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

(c) (i) Calculate the energy that was transferred for liquid **A** in part **X** of the graph.

The specific latent heat of **A** is 200 000 J/kg.

.....
.....
.....
.....

energy transferred J [2]

(ii) Describe and explain what is happening during part **X** of the graph while this energy is being transferred.

.....

.....

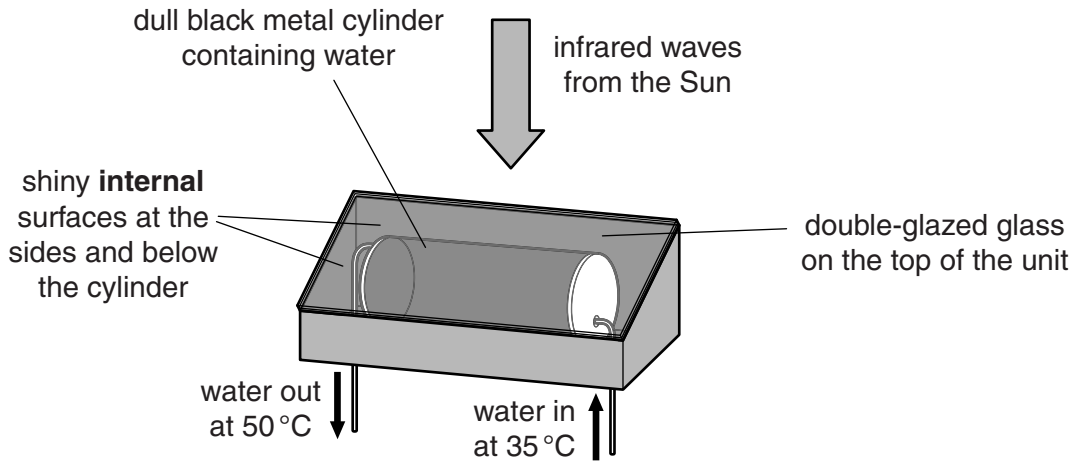
.....

..... [2]

[Total: 6]

2 John installs a solar water-heating unit on the roof of his house.

Look at the diagram of the unit.



(a) Energy is transferred through parts of the unit by different methods.

(i) What is the main method of energy transfer from above the glass to the surface of the cylinder?

..... [1]

(ii) The black cylinder absorbs energy and transfers it to the water inside.

Explain how the water inside then heats up.

.....

 [2]

(b) (i) These solar water-heating units have an efficiency of 85%.

Calculate the useful energy output for every 200 000 J of energy input.

.....

 answer J [2]

(ii) Describe how **one** feature of the solar water-heating unit has helped to produce this high level of energy efficiency.

.....
 [1]

(c) (i) Some infrared waves have a wavelength of 1 mm.

The speed of electromagnetic waves is 3×10^8 m/s.

Show, using a calculation, that the frequency of the infrared waves is 3×10^{11} Hz.

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

(ii) The infrared waves which heat the metal cylinder have much shorter wavelengths.

Explain how the energy of these waves is different to those with a wavelength of 1 mm.

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

[Total: 10]

4 Ricky is interested in radio and TV.

(a) Ricky has a portable analogue radio that he listens to at different places in his house and out in the garden.

His favourite stations are shown in the table.

station	MHz
BBC 2	88.1
Galaxy	106.4
Real Radio	101.8
TFM	96.6
Smooth FM	101.2
Spice FM	98.8

While listening to one of these stations, he often hears another station on his radio.

Which two radio stations can Ricky hear at the same time?

Station and station

Explain your answer.

.....
 [2]

(b) Many radio stations have switched to DAB broadcasting.

If Ricky switches to a radio using a DAB signal he would not hear two stations at once.

Write down one **other** advantage of using a DAB signal.

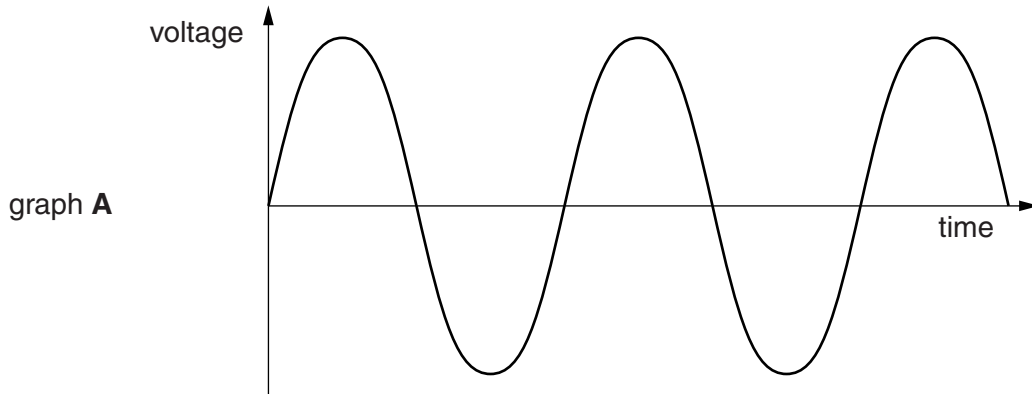
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 [1]

[Total: 3]

Section B – Module P2

5 Electrical generators produce alternating current (AC).

Graph A is the **voltage-time** graph for an electrical generator.



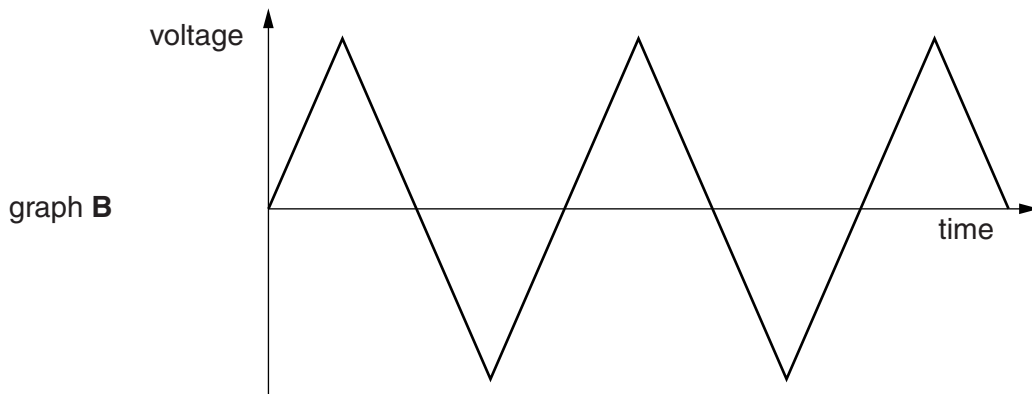
(a) The frequency shown in graph A is 50 Hz.

An alternating voltage produces an alternating current.

On graph A draw another line with a **higher** frequency.

[1]

(b) Look at graph B.



Does graph B also show an alternating voltage?

.....

Explain your answer by **comparing** it with graph A.

.....

..... [1]

[Total: 2]

6 Stars are part of the Universe.

(a) The **end** of the 'life cycle' of a **star** depends on its mass.

Put the life cycle stages from this list into the correct **order** for a large star.

black hole

red supergiant

supernova

order	large star
↓	

[1]

(b) The brightest supergiant stars in our galaxy have very high surface temperatures and appear blue in colour.

Using powerful telescopes these 'super bright' stars can be observed in galaxies other than our own.

Observations of the radiation emitted by these stars can help to accurately calculate the distance to these other galaxies, and provides more evidence for the age of the Universe.

Explain the value of more than one team of scientists investigating these blue supergiants.

.....

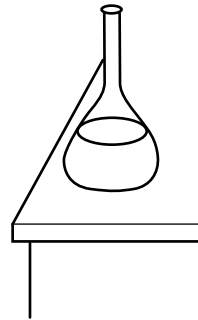
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..... [2]

[Total: 3]

7 Tricia is a scientist investigating the **radioactivity** of a liquid.



(a) Tricia wants to measure the penetrating power of the radiation emitted.

(i) Alpha, beta and gamma radiation can be stopped by different materials.

Which material would be the best material to show that alpha radiation is emitted?

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

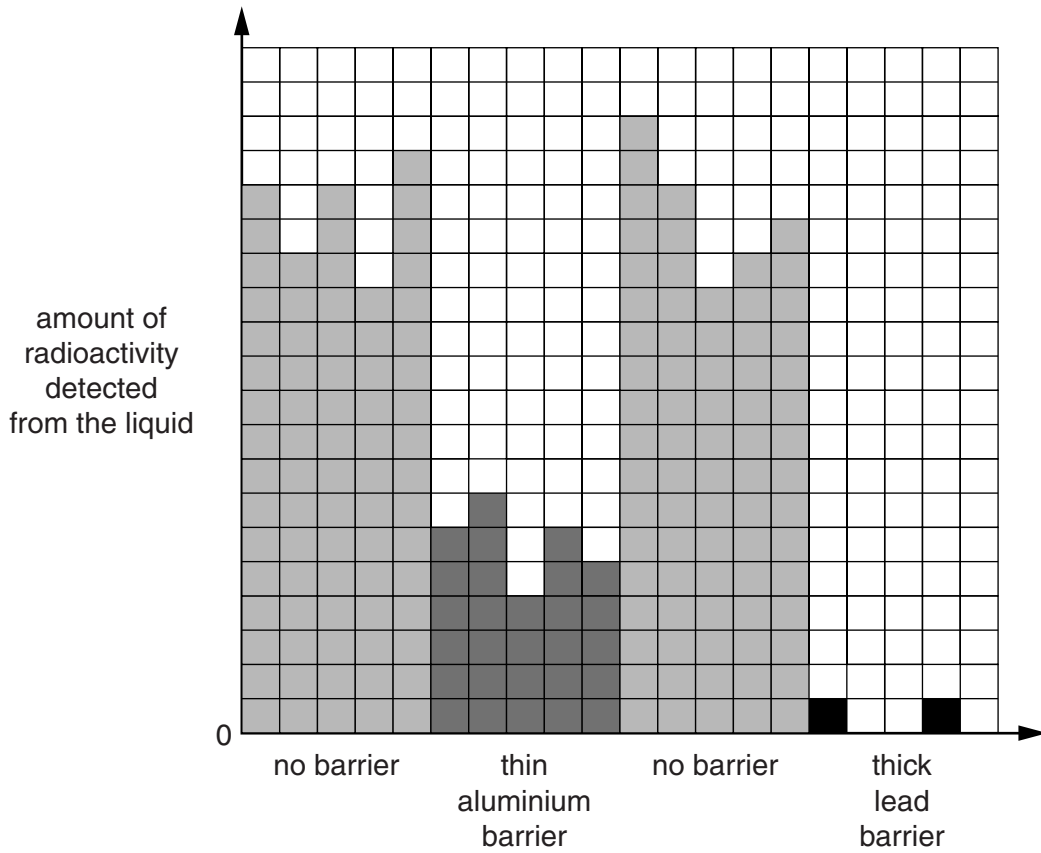
(ii) She may have difficulty measuring the penetrating power of **alpha** radiation **in a liquid**.

Suggest **one** of the problems she may have.

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

(b) Here are her results.

She carried out each investigation five times.



(i) Explain why she carried out each investigation five times.

.....

.....

..... [1]

(ii) Interpret her results to identify the types of radiation emitted.

.....

.....

.....

..... [2]

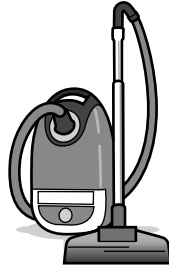
[Total: 5]

8 Zack uses many appliances in his home.

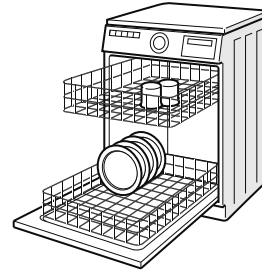
Look at the information about the appliances he uses the **most**.



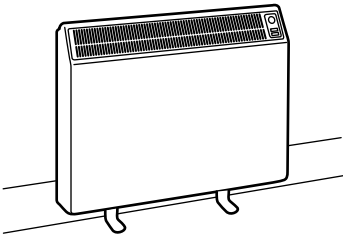
kettle used for 0.5 hours during the day
current of 9 amps



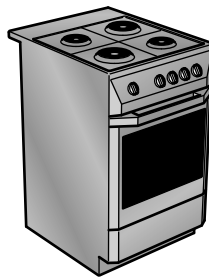
vacuum cleaner used for 0.25 hours during the day
current of 6 amps



dishwasher used for 1.5 hours during the day
current of 9 amps



heater used for 12 hours at night
current of 9 amps



cooker used for 1 hour during the day
current of 14 amps



fridge-freezer on for 12 hours during the day and 12 hours at night
current of 1.8 amps

All the appliances use the 230V mains voltage. The currents shown are average values.

(a) The heater is only used at night.

(i) Calculate the power rating for the heater in **kilowatts**.

.....
.....
.....
.....

power rating kilowatts

[2]

(ii) Calculate the total energy supplied to the heater in one night in **kilowatt hours**.

.....
.....
.....
.....

total energy supplied kilowatt hours [2]

(b) Zack pays **12p** per kilowatt hour for electricity he uses during the **day**.

He pays **6p** per kilowatt hour for electricity he uses during the **night**.

He is considering switching to the same cost for **day and night** of **10p**.

This would not save him money.

Suggest reasons why.

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

[Total: 6]

9 This question is about photocells.

(a) Describe how **light** produces an **electrical current** in a photocell.

.....

.....

.....

.....

.....

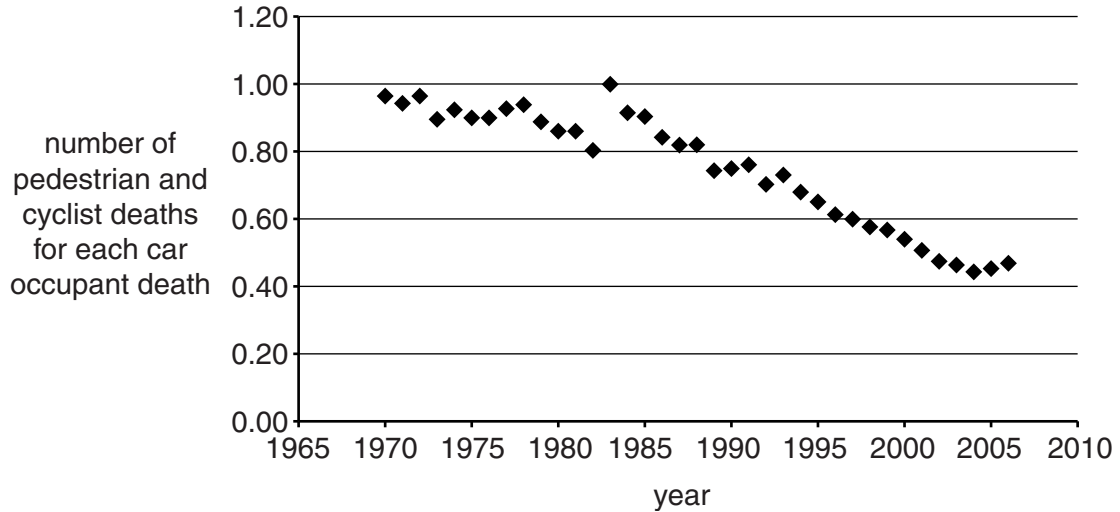
..... [3]

Section C – Module P3

10 Dave and Fred are discussing issues about road safety.

(a) Look at the graph.

It shows data about the risks to road users.



Dave thinks these data show that cycling has become safer since 1970, and that fewer cyclists die in accidents.

(i) Explain how the graph partly supports Dave’s view.

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

(ii) Fred is less confident about what the data shows and feels he needs more information.

Suggest what other information about the data Fred needs to be more convinced.

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

(b) Cars and their occupants have **momentum** when moving.

Seatbelts **stretch** in a crash.

Use these ideas to explain how seatbelts reduce injury in a crash.

.....

.....

.....

.....

..... [2]

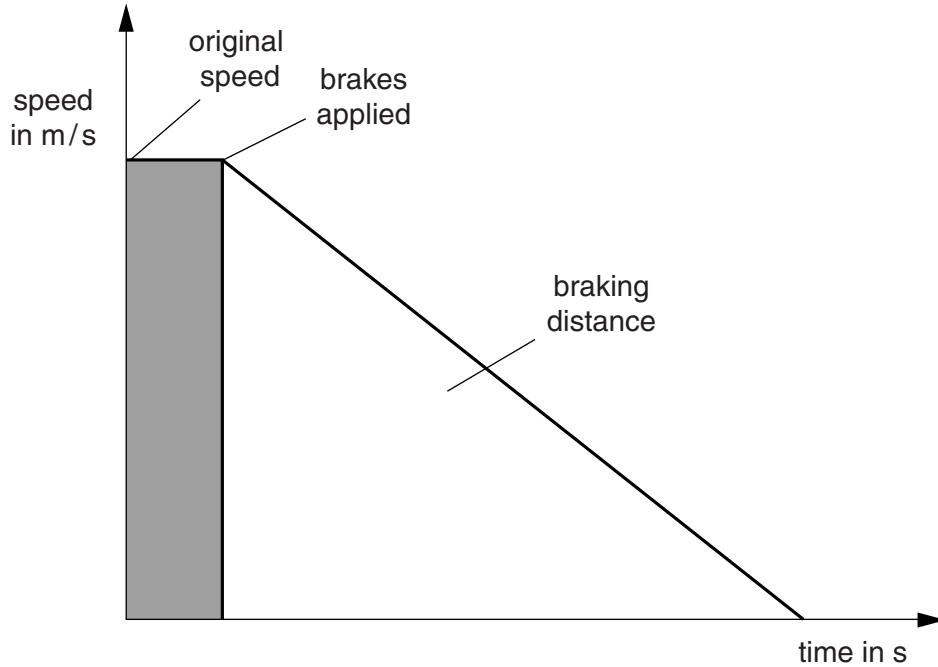
[Total: 5]

11 The police take measurements after some road accidents.

They can measure the braking distance by measuring the length of the skid marks on the road.

This can give them an estimate of the original speed of the vehicles.

Look at the graph of a car stopping.



The car takes 5 s to brake and the skid mark is 75 m long.

(a) Calculate the **original** speed of the vehicle using this distance.

.....

answer m/s [2]

(b) The speed limit is 32 m/s.

The police are not sure if the driver was travelling at a higher speed than the speed limit.

Suggest why the skid mark may **not** give an accurate estimate of the original speed of the driver.

.....

 [2]

(c) Police know that braking distances are related to speed.

This is because kinetic energy is transferred in braking.

Look at the diagram.



(i) Car **A** and car **B** are travelling at the same speed.

Car **A** has double the mass of car **B**.

Compare the amount of kinetic energy of car **A** and car **B**.

..... [1]

(ii) What happens to the kinetic energy of car **A** when its **speed** is doubled?

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

(iii) What happens to the braking distance when the speed is doubled?

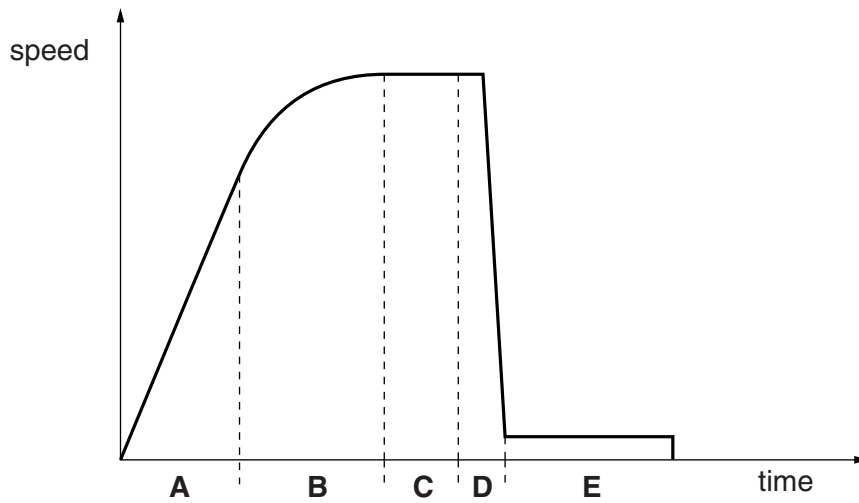
.....
..... [1]

[Total: 7]

12 Alex is a sky-diver.

He jumps out of an aeroplane, and sky-dives before opening his parachute.

Look at the graph of Alex's speed as he falls.



As he falls there are two forces acting on Alex

- weight
- drag.

(a) In part **A** of the graph his speed **increases**.

Explain why.

.....
 [1]

(b) Part **C** of the graph shows Alex travelling at terminal speed **before** his parachute opens.

Explain why terminal speed is reached.

.....
 [1]

(c) In part **D** the parachute opens and the speed reduces very **quickly**.

Explain why.

.....
 [1]

(d) Part **E** of the graph shows the terminal speed **after** the parachute opens.

Explain why the open parachute causes Alex to have a **lower** terminal speed than in part **C** of the graph.

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

(e) The parachute is used again. This time it is used with a much **heavier** person.

His fall is different to Alex's.

Part **E** of the graph has a higher speed.

Explain why.

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

[Total: 7]

Please turn over for question 13.



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