OCR
Oxford Cambridge and RSA

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Tuesday 9 June 2015 – 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.

OCR supplied materials:
None

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

Duration: 1 hour 15 minutes

* B 7 5 1 0 2 *

* 5 0 0 7 6 3 4 8 8 6 *

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 **24** 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 Look at the advert about double glazing.

> *Buy **Evercosy** double glazing.*
>
> *Fitting double glazing to your house will save up to 18% on your energy costs.*
>
> *Spend a little and save a lot. Choose Evercosy.*

Simon has double glazing fitted in his house. He thinks it saves him money.
Look at the data.

Year	Double glazing	Annual energy cost in £
2009	none	1200
2010	none	1040
2011	none	1010
2012	fitted	950
2013	fitted	1020
2014	fitted	790

Before he fitted double glazing, Simon's average annual energy cost was £1083.

With an 18% saving the average annual energy cost should be £888.
How do Simon's actual annual energy costs from 2012 onwards compare to this figure?

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Suggest reasons for this difference.

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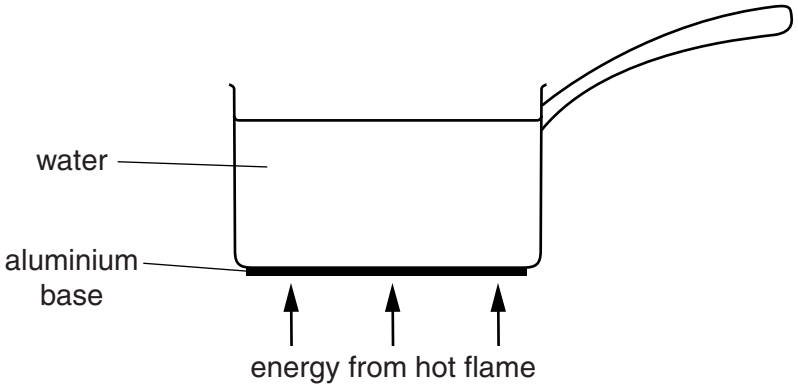
2 This question is about energy transfer and how it is used in cooking.

(a) Steve heats a pan of water on his cooker.
Look at the diagram.



(i) Explain how the particles in the aluminium base conduct energy through the bottom of the pan.

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(ii) There is a convection current in the water in the pan.
Steve starts to describe the convection current.
Look at his description.

The water is heated and it contracts.

This makes the water more dense so it rises.

His description is wrong.
Rewrite his description correctly.

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

(b) Steve has a combination microwave oven.
It can cook food using microwaves or infrared waves.

Microwaves and infrared waves cook food in different ways.

(i) What is **different** about the way microwaves and infrared waves heat food?

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(ii) What is **similar** about the way microwaves and infrared waves heat food?

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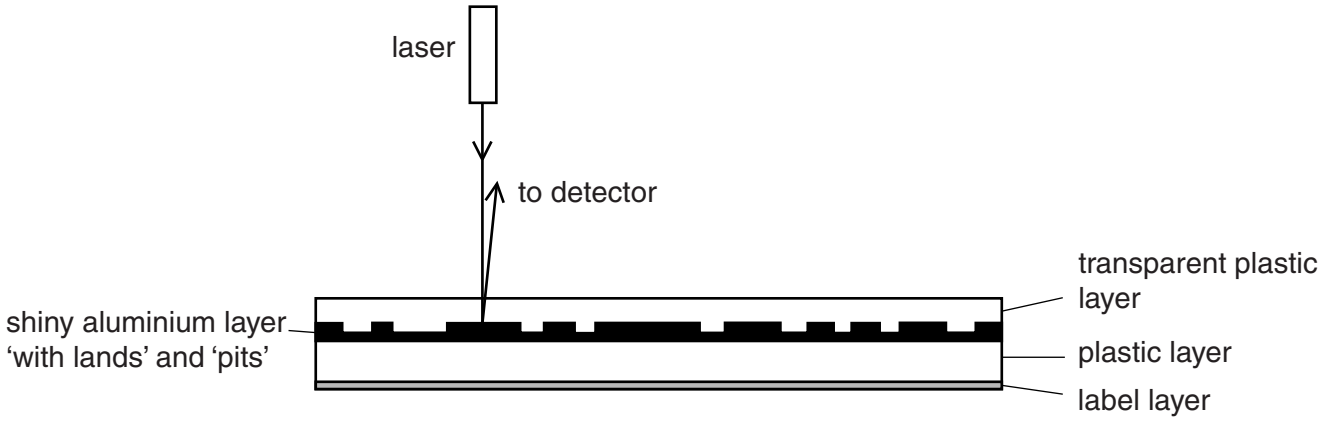
3 CD players use lasers to read information from a disc.

Look at the simplified diagram of the laser and cross-section of part of a disc.



Describe the properties of a laser beam and explain how information is stored and read from the disc.

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

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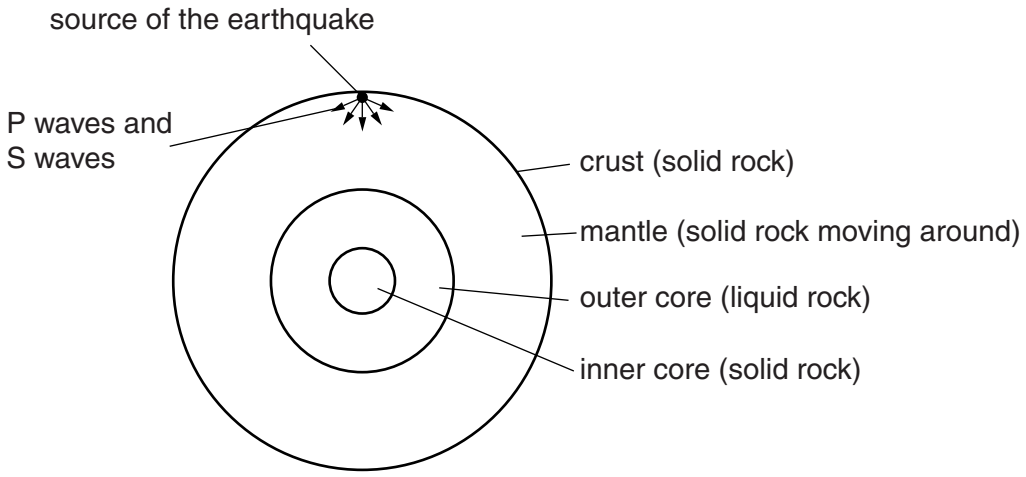
4 Look at the diagram of the Earth.

An earthquake produces P waves and S waves.

Look at the diagram. It shows the initial directions of the P waves and S waves.



(a) P waves and S waves are detected by seismometers on the Earth's surface.
Each type of wave from the earthquake is detected at different times by seismometers.

Which type of wave is received first? .....

Explain your answer.

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(b) Scientists take measurements of P waves and S waves using seismometers.

After an earthquake, scientists can work out the exact position of the earthquake, using these measurements.

Suggest how they do this.

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(c) S waves do not travel through the Earth's inner core.

Explain why.

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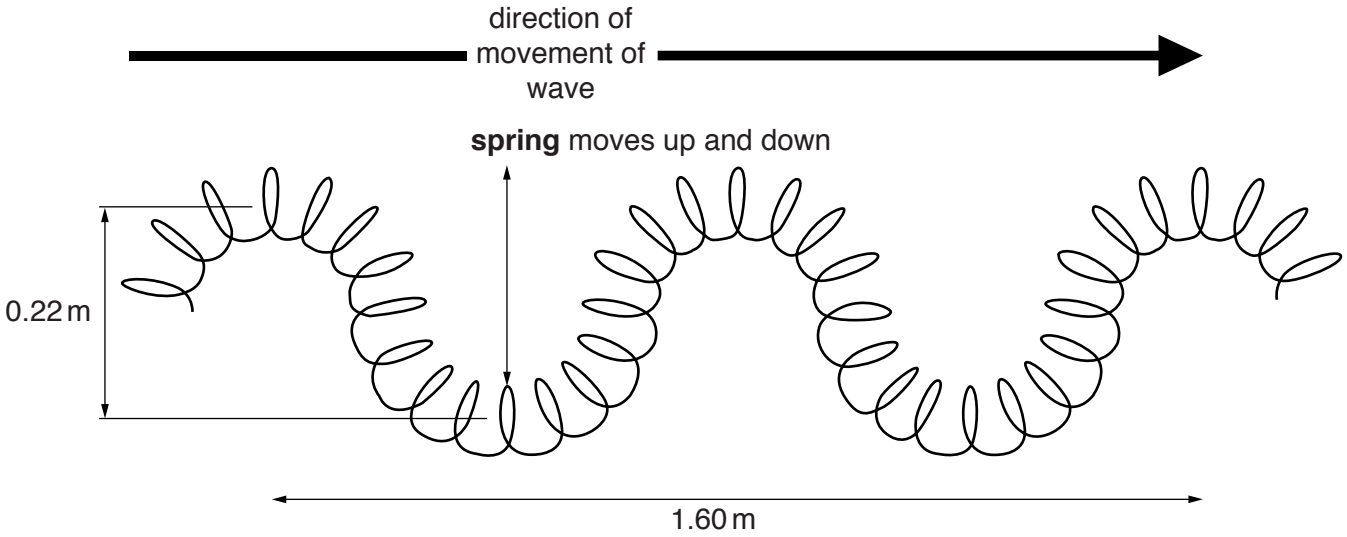
(d) P waves and S waves are different.

P waves are longitudinal and S waves are transverse.

Look at the diagram of a model of an S wave made with a slinky spring.



The wave is made by moving the spring up and down with a frequency of 1.2 Hz.

Look at the diagram.

(i) Calculate the **speed** of the wave.

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answer ..... m/s **[2]**

(ii) What is the **amplitude** of the wave?

Choose from

0.11 m **0.22 m** **0.80 m** **1.60 m** **1.82 m**

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

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Question 5 begins on page 10

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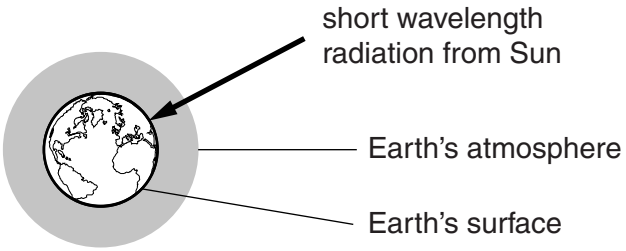
SECTION B – Module P2

5 Scientists are worried about greenhouse gases.

Look at the simple diagram of the Earth and its atmosphere.



(a) The greenhouse effect helps keep the Earth warm.

Explain how the greenhouse effect warms the Earth.

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(b) Three main greenhouse gases are water vapour, carbon dioxide and methane.

These gases can be man-made or produced naturally.

(i) Complete the table showing a possible natural cause for **each** gas.

Greenhouse gas	Man-made cause	Natural cause
water vapour	burning fuels	
carbon dioxide	burning fuels	
methane	producing fuels	

[2]

(ii) A lot of scientists think that global warming is mostly caused by human activities.
A few scientists think that global warming is mostly a natural cycle.

Suggest a reason why some scientists think it is mostly a natural cycle.

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(iii) Each greenhouse gas gives a different contribution to the greenhouse effect.

Look at the information about each gas.

Greenhouse gas	Percentage of gas in atmosphere	How long it lasts	Global warming potential (GWP) over a few years	Contribution to the greenhouse effect
water vapour	0.01% to ~4%	A few days		36% to 66%
carbon dioxide	0.30%	100 years	1	10% to 26%
methane	0.06%	11 to 12 years	21 times more than carbon dioxide	4% to 9%

The global warming potential (GWP) for water vapour has not been calculated.

Use data from the table to suggest why scientists do not calculate the GWP for water vapour.

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(c) Methane has a GWP that is 21 times more than carbon dioxide, but contributes less than carbon dioxide to the greenhouse effect.

Suggest why.

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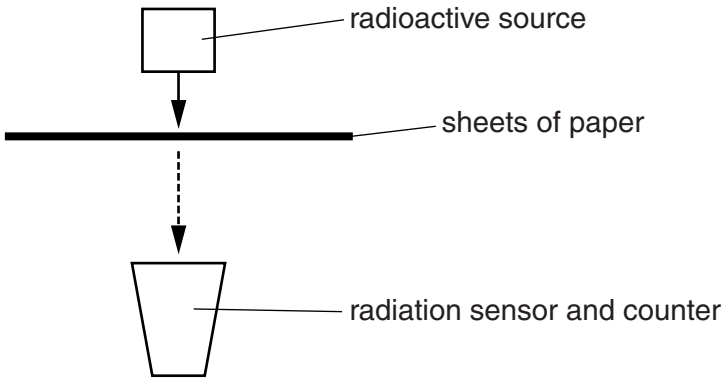
6 Dr Williams shows her class an experiment with radioactivity.

She uses three different radioactive sources

- an alpha emitter
- a beta emitter
- a gamma emitter.

She uses different thicknesses of sheets of paper between the source and the sensor.

Look at the diagram.



Dr Williams measures the nuclear radiation from each source using the sensor.
Each radioactive source emits only one type of radiation.
This can be alpha, beta or gamma.
Look at her results for each source.

Thickness of sheets of paper in mm	Average count rate in counts per second		
	Radioactive source X	Radioactive source Y	Radioactive source Z
0	30	68	65
0.2	32	36	60
0.4	31	21	57
0.6	33	5	52
0.8	34	1	48
1.0	29	0	45
1.2	31	1	41
1.4	30	0	39
1.6	31	0	38
1.8	30	2	35
2.0	31	1	33

Use the data to identify and explain which radiation comes from sources X, Y and Z. Comment on how useful each source is for detecting the thickness of sheets of paper up to 2 mm.

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

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7 Fossil fuel power stations generate electricity.
Nuclear power stations also generate electricity.

(a) Many people think that nuclear power stations are a greater risk to people than fossil fuel power stations. Explain why.

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(b) In 2011 there was an accident at a nuclear power station in Japan.
This was a very serious accident but there were no deaths reported.

The authorities evacuated the general public from the area.
Suggest other things that the authorities might have done to reduce the risks to the workers and rescue staff.

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(c) Explain how the authorities could decide when the public can return to the area.

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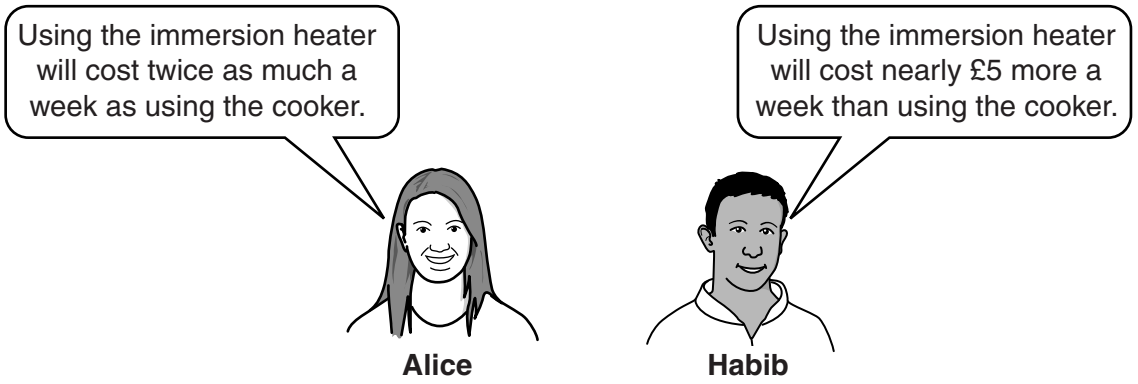
8 This question is about paying for electricity.

(a) Alice checks the information on her electricity bill.
She also looks at information about some of her appliances.

Appliance	Average power in kW	Time used per week in hours
cooker	2.0	6
immersion heater	3.0	12
central heating	6.0	18

Habib also looks at the information.

He sees from the bill that the price of a unit of electricity is 20p.



Complete calculations to show who is correct.

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Who is correct? ..... **[3]**

(b) The electricity that Alice and Habib use comes from the National Grid.

The National Grid has many power lines at high voltage.

The National Grid uses two high voltages.

- 4.00×10^5 V
- 2.75×10^5 V

Both voltages are used to transfer 2.0×10^9 W of electrical power.

Calculate the current in the power lines at each voltage and explain why the higher voltage is better for power transmission through the National Grid.

At a voltage of 4.00×10^5 V .....

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answer ..... A

At a voltage of 2.75×10^5 V .....

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answer ..... A

Explanation .....

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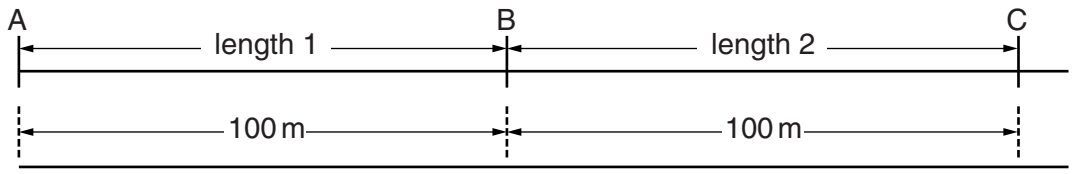
SECTION C – Module P3

9 This question is about speed.

(a) Pupils at a school measure the time cars take to travel two 100 m lengths.

Look at the diagram.



Look at the results that they collect for four cars passing the school.

Type of car	Time taken to travel length 1 in seconds	Time taken to travel length 2 in seconds
Golf	9	8
Fiat	8	8
Jaguar	8	9
Skoda	7	7

(i) Which car's speed is increasing as it travels from **A** to **C**?

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

(ii) The speed limit on the road in front of the school is 13 m/s.

Calculate the time it takes for a car travelling at a speed of 13 m/s to travel 100 m.

Use your answer to explain if any of the cars are travelling faster than the speed limit.

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(b) Look at the information about thinking distance and braking distance for cars travelling at 13 m/s.

Driver	Thinking distance in metres	Braking distance in metres
Sam	9	14
Chris	9	25
Jo	15	14
Ben	7	10

One of the drivers is tired after driving for several hours.

Suggest which driver is tired.

answer .....

Explain fully why you chose this driver .

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One of the drivers was driving on an icy road.

Suggest which driver was driving on an icy road.

answer .....

Explain fully why you chose this driver.

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[2]

(c) Sam's car uses a biofuel.

She says that, over time, this does not increase the amount of carbon dioxide in the atmosphere.

Is she correct?

Explain your answer.

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(d) Some cars are fitted with ABS brakes to reduce injuries and save lives.

Describe how **ABS** works and under what conditions it is used.

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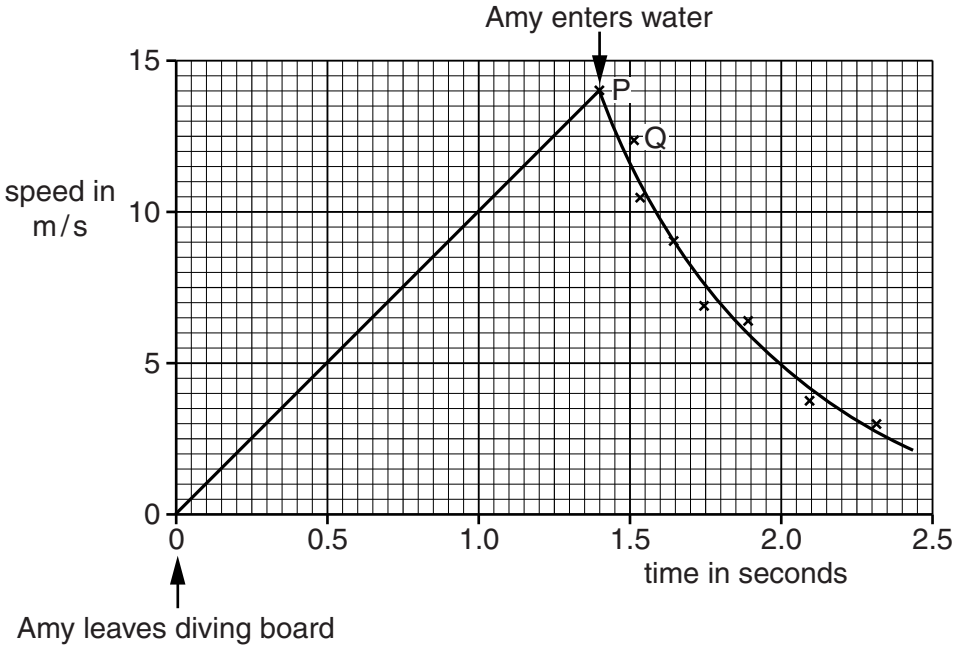
10 Amy dives from the high diving board at a swimming pool.

Look at the graph of her motion.



(a) Calculate the height of the diving board above the water.

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answer ..... m **[2]**

(b) (i) John thinks that he can find Amy's deceleration just after she enters the water by using points **P** and **Q** on the graph.

Elaine thinks it is better to find Amy's deceleration just after she enters the water by using the gradient of the graph at point P.

Explain why Elaine's method is better than John's to find the deceleration.

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(ii) Amy has a mass of 60 kg.
Amy's deceleration as she enters the water is 20 m/s^2.
Calculate the decelerating force on Amy just as she enters the water.

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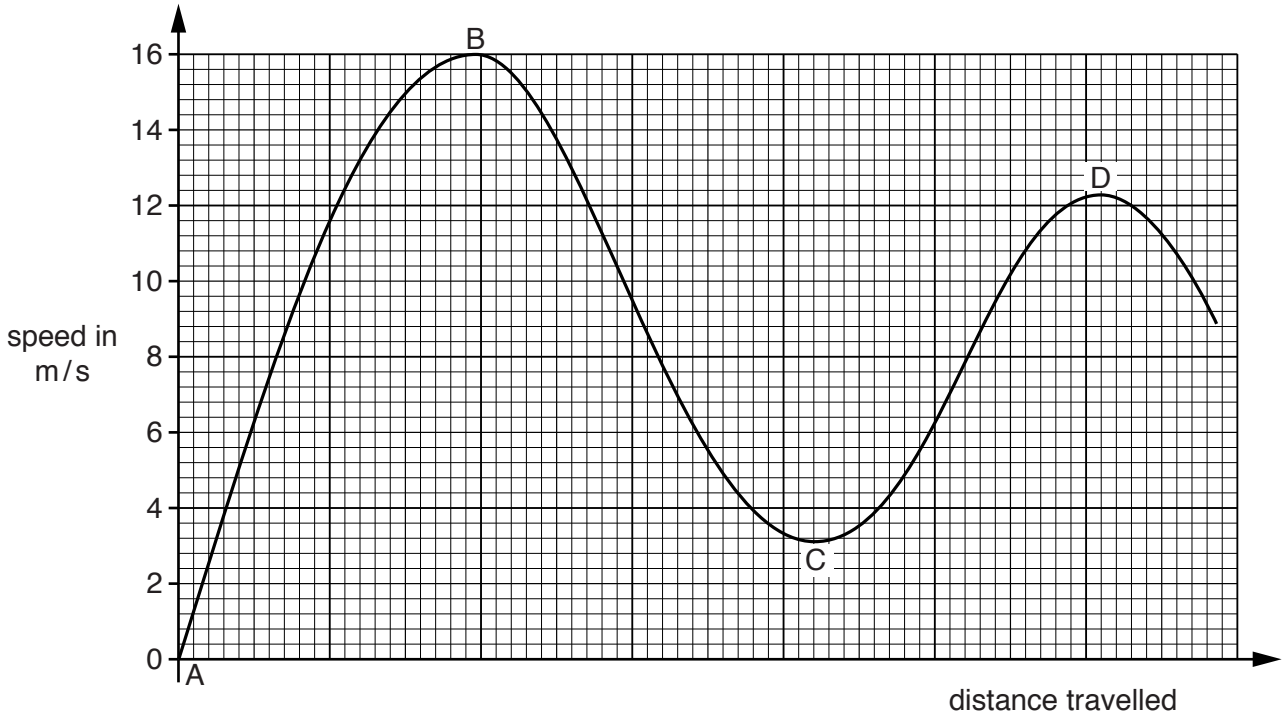
answer ..... N **[1]**

11 This question is about kinetic and gravitational potential energy.

Look at the graph.

It shows how the speed of a roller coaster car changes with the distance travelled along part of the track.
The roller coaster car starts from rest at the top of the track at **A**.
The car and its passengers have a total mass of 400 kg.



Describe how the kinetic energy and the gravitational potential energy of the car change in sections AB and BC of the journey, and calculate the difference in height of the roller coaster between A and B assuming no energy is lost.

The acceleration due to gravity is 10 m/s^2.

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

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12 (a) Ben is considering buying a new car.

He investigates how the cost of a journey changes with the speed of the car and the distance travelled.

He does this for a car with a petrol engine and a car with a diesel engine. Both cars have the same size engine.

Look at the table for a petrol car.

	Speed in km/hr	Cost of fuel per km for different distances in pence		
		5 km	25 km	100 km
Petrol	10	38.2	38.2	38.2
	40	17.8	17.8	17.8
	80	10.0	10.0	10.0
	120	17.4	17.4	17.4

Look at the table for a diesel car.

	Speed in km/hr	Cost of fuel per km for different distances in pence		
		5 km	25 km	100 km
Diesel	10	30.6	30.6	30.6
	40	14.2	14.2	14.2
	80	8.4	8.4	8.4
	120	13.9	13.9	13.9

What conclusions can Ben make about the costs of fuel per km travelled using this data?

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(b) Battery powered cars cost much less to drive per km than petrol or diesel cars but they have some disadvantages.

Write down one disadvantage of using a battery powered car rather than a petrol or diesel car.

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END OF QUESTION PAPER

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