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Tuesday 22 January 2013 – Morning

# GCSE GATEWAY SCIENCE
# PHYSICS B

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

*B72222201133*

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 **24** pages. Any blank pages are indicated.

## EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

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

power = force × speed

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

momentum = mass × velocity

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

GPE = mgh

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

$v = u + at$

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

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

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

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

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

$I_e = I_b + I_c$

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

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

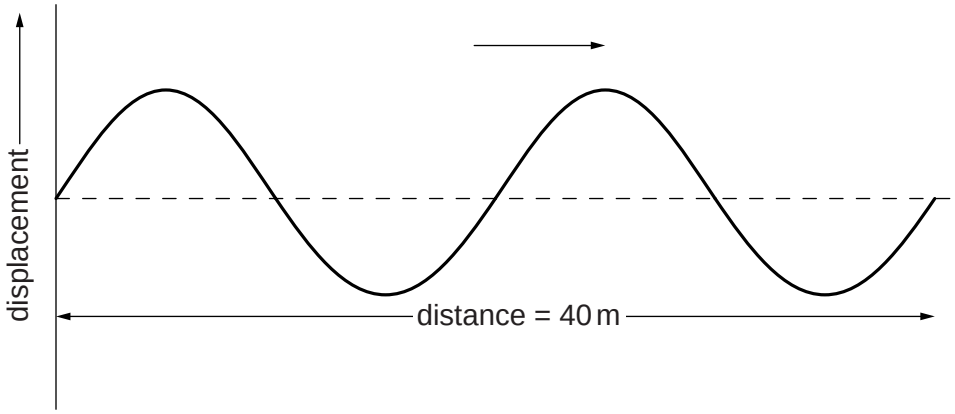
$V_pI_p = V_sI_s$

Answer **all** the questions.

## SECTION A – Module P1

**1** Surfers use water waves on the sea to move fast.

Look at the diagram of the water waves on the sea.




The surfer travels at the same speed as the water waves.

The water waves have a frequency of 0.25 Hz.

Use the information in the diagram to find the wavelength of the waves and calculate the speed of the surfer.

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.....

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

**[Total: 2]**

**2** Dave experiments heating different materials.

**(a)** He needs to choose a heater to warm some water.

The table shows how much energy different heaters supply in 600 seconds.

| Heater | Energy supplied in joules |
|---|---|
| **A** | 5000 |
| **B** | 10 000 |
| **C** | 20 000 |
| **D** | 25 000 |
| **E** | 35 000 |

Dave needs to increase the temperature of 0.6 kg of water by 12 °C in 600 seconds.

Water has a specific heat capacity of 4200 J/kg °C.

Do a calculation to find out which heater Dave needs. Show your working.

.....

.....

..... J

The heater Dave needs for this is ..... **[2]**

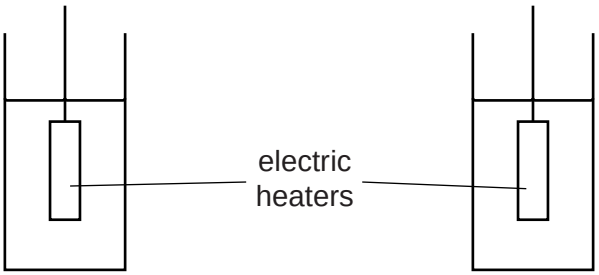
**(b)** Dave's teacher gives him two different liquids to boil.

They have different specific latent heats.

| |
|---|
| Specific latent heat of **water** = 2260 J/g |
| Specific latent heat of **ethanol** = 850 J/g |

Unfortunately, he gets the two liquids confused. He cannot tell which liquid is which.

He heats up both liquids until they start to boil.




liquid **A** liquid **B**

Dave then measures how much mass is lost from each liquid when he heats them for the same time.

Look at his results.

| Liquid | Energy supplied for boiling in J | Mass of liquid lost in g |
|---|---|---|
| **A** | 48 000 | 20 |
| **B** | 48 000 | 53 |

**(i)** Use a calculation to show which liquid is water.

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

**(ii)** When liquids boil, energy is transferred but there is no temperature change.

Write down the name of **another** process in which this happens.

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

**[Total: 5]**

**3** Sam has a microwave oven and a convection oven in her kitchen.

She is going to cook a ready meal for her dinner.

Look at the cooking instructions.

| ***Microwave oven heating*** | ***Convection oven heating*** |
| --- | --- |
| *Pierce the lid several times.*<br><br>*Place on a microwaveable plate and cook on full power (850 W) for 3 minutes. Remove lid and stir. Cook on full power for a further 1 minute. Leave to stand for 1 minute before serving.*<br><br>*ENJOY* | *Pierce the lid several times.*<br><br>*Place in the centre of a preheated oven (200 °C) for 25 minutes.*<br><br>*ENJOY* |

Explain why **microwave** cooking is quick and why the food is stirred and allowed to stand before it is ready.

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

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

**[Total: 6]**

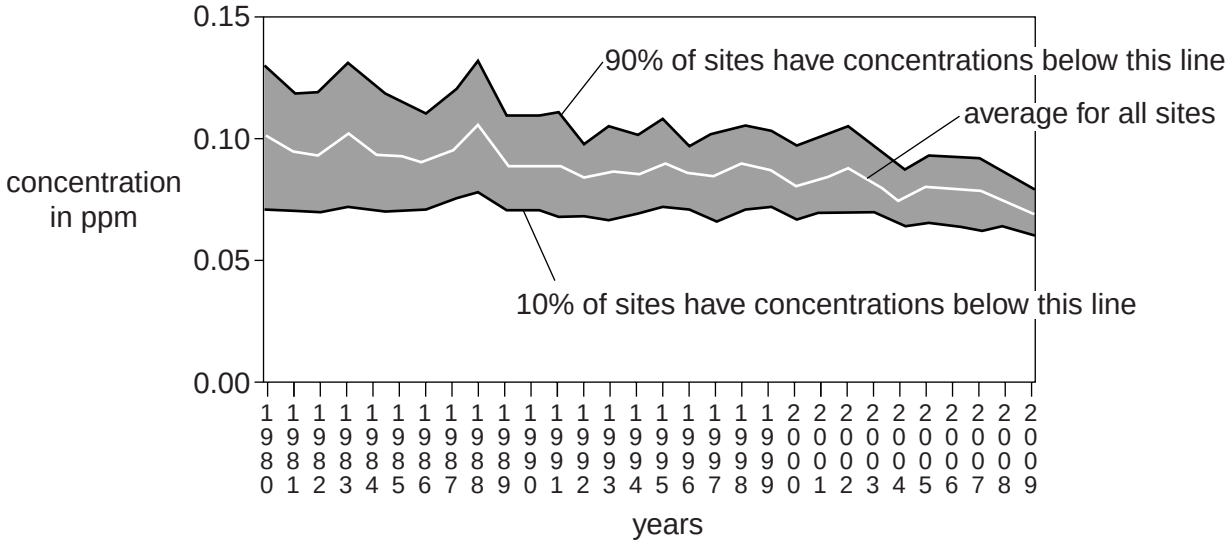
**4** The ozone layer protects us from harmful UV radiation.

This radiation can cause health problems.

**(a)** Data on ozone concentration in parts per million (ppm) is displayed using deciles.

Look at the graph of ozone concentration in the USA from 1980 to 2009.

The data was collected from 255 different sites.




Using data from the graph describe the trends in the data from 1980 to 2009.

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

**(b)** The Antarctic **ozone hole** was discovered in 1985 by British scientists.

This led to changes in people's behaviour across many countries.

Describe and explain these changes.

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



**Turn over for the remainder of question 4**

**(c)** Skin cancers have increased since 1984.

Some scientists think that this is due to the depletion of the ozone layer.

Other scientists think that there may be other factors involved.

**(i)** Suggest another factor which could have led to this increase in skin cancer.

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

**(ii)** People from hot countries such as India, have a **lower** risk of skin cancer.

Explain how **darker** skins can reduce cancer risk.

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

**[Total: 7]**

**5** **Analogue** and **digital** signals are used for communications.

**(a)** Analogue radios have been used for many years.

DAB radios have become more popular. They use digital signals.

**(i)** Each analogue radio station in a town must broadcast at a different frequency.

Several DAB radio stations in the town can broadcast at the same frequency.

Explain why these DAB radio stations do not need to broadcast at different frequencies.

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

**(ii)** Digital and analogue signals become weaker the further they travel and therefore need to be amplified.

Explain why the **amplified** signals remain high quality for digital signals, but decrease in quality for analogue signals.

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

**(b)** Mike has a TV which is controlled using a remote control handset.

On the handset, each button controls a different function on the TV.

Explain how each button controls a different function.

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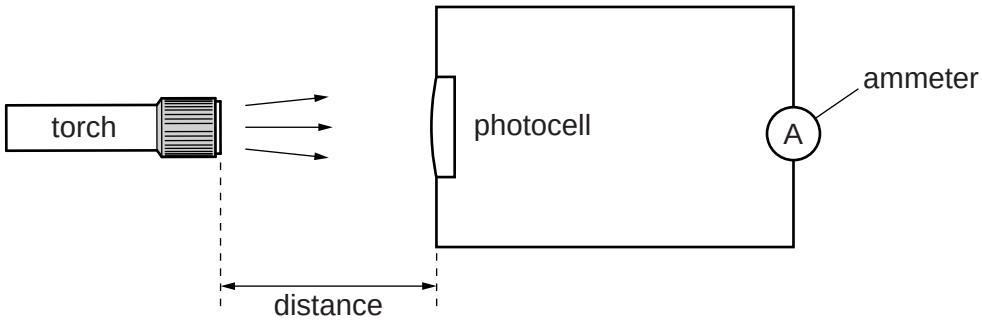
..... **[1]**

**[Total: 5]**

## SECTION B – Module P2

**6** John investigates the current produced by a photocell.

Look at the circuit he uses.




John moves the torch away from the photocell.

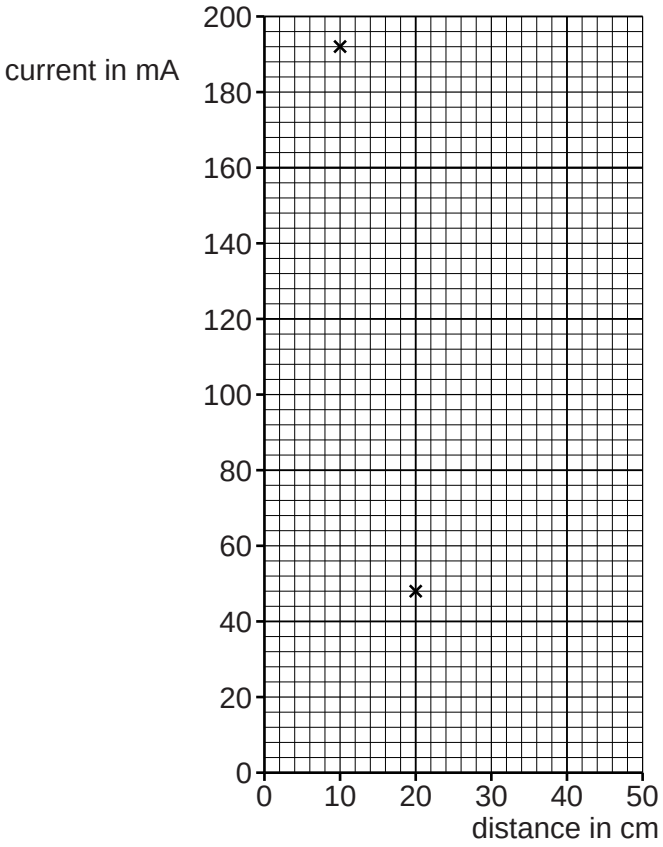
This changes the current through the ammeter.

Look at his results.

| **Distance between torch and photocell in cm** | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| **Current in mA** | 192 | 48 | | 12 | 8 |

**(a) (i)** Use the graph to help predict the current in mA for a distance of 30 cm.

The first two results in the table have been plotted for you.




Current for a distance of 30 cm = ..... mA **[2]**

**(ii)** Write a detailed conclusion about the relationship between the current and the distance between the torch and the photocell.

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

**(iii)** Explain why this trend happens.

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



**Turn over for the remainder of question 6**

**(b)** Light is absorbed by photocells and electricity is produced.

Explain how a photocell produces electricity.

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

**[Total: 7]**

**7** Amy wants to reduce the cost of using electricity in her flat.

She is thinking of changing electricity supplier to a cheaper one.

| **Distas Electricity Company** | **Skinner Electricity Company** |
|---|---|
| **Cost per unit = 16 p** | **Cost per unit = 14 p** |

**(a)** Her main use for electricity is her central heating.

The average power of her central heating is 6500 W.

It is on for 4 hours each day.

She changes her supply from Distas to Skinner Electricity Company.

The cost per unit is the cost for one kilowatt hour of energy.

How much money will she save each day on her central heating costs?

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

**(b)** Amy has a TV. It has a label on it, but it does not tell her about the power in kW.

Look at the label.

| |
|---|
| current = 3 A |
| voltage = 230 V |

Calculate the power of the TV in kW.

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



**Turn over for the remainder of question 7**

**(c)** Amy reads about using **off-peak electricity** in her home. This will be cheaper.

Give one disadvantage to Amy of changing to off-peak electricity.

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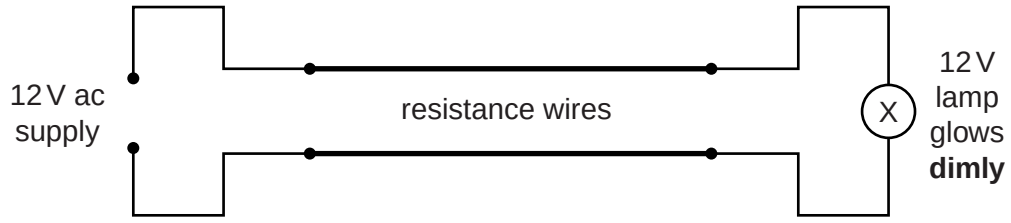
..... **[1]**

**[Total: 6]**

**8** Ian is learning about power transmission and the National Grid.

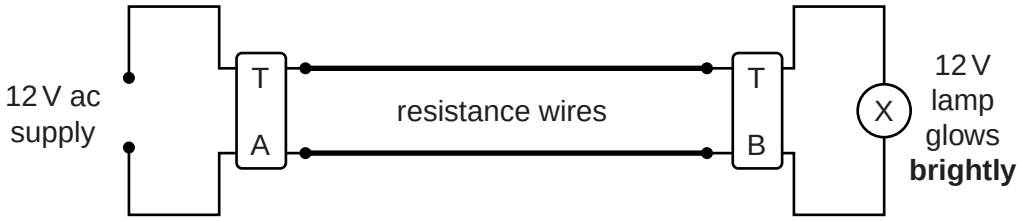
His teacher demonstrates how power loss can be reduced in a model transmission line.

She first sets up a system like this and the light glows dimly.




She adds two transformers (TA and TB) before and after the resistance wires.

The lamp now glows brightly.




Explain these observations, and how this type of arrangement is used to reduce energy losses in the National Grid.

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

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

**[Total: 6]**

**9** Our understanding of the Solar System has developed over centuries.

| Astronomer | Dates | |
|---|---|---|
| **Ptolemy** | 87 to 150 AD | He believed the **Earth** was the centre of the Universe. |
| **Copernicus** | 1473 to 1543 AD | He believed the **Sun** was the centre of the Solar System. |
| **Galileo** | 1564 to 1642 AD | He showed that Copernicus' model was right and that Ptolemy's was wrong. |

**(a) (i)** What did Copernicus do to develop his theory?

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

**(ii)** How was Galileo able to support Copernicus' theory?

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

**(iii)** Why were Copernicus' and Galileo's ideas **controversial** at the time?

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

**(b)** The Big Bang Theory, developed in 1949, states that the Universe began with an 'explosion'.

This made the Universe expand.

What can we conclude about the movement of galaxies from the Big Bang Theory?

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

**(c)** The Big Bang Theory has been accepted by many scientists.

The theory might be changed by future scientists.

Explain why.

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

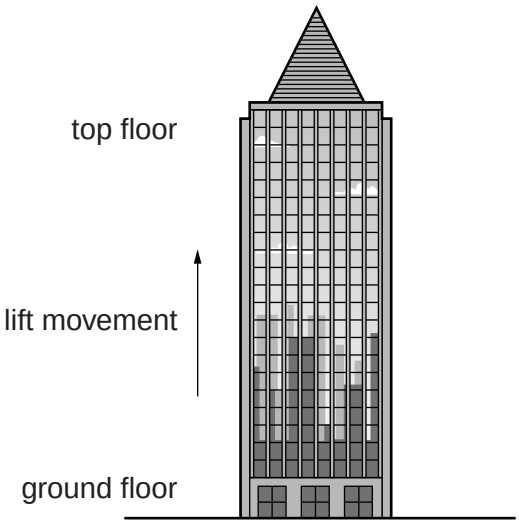
**[Total: 6]**

**Section C begins on page 18**

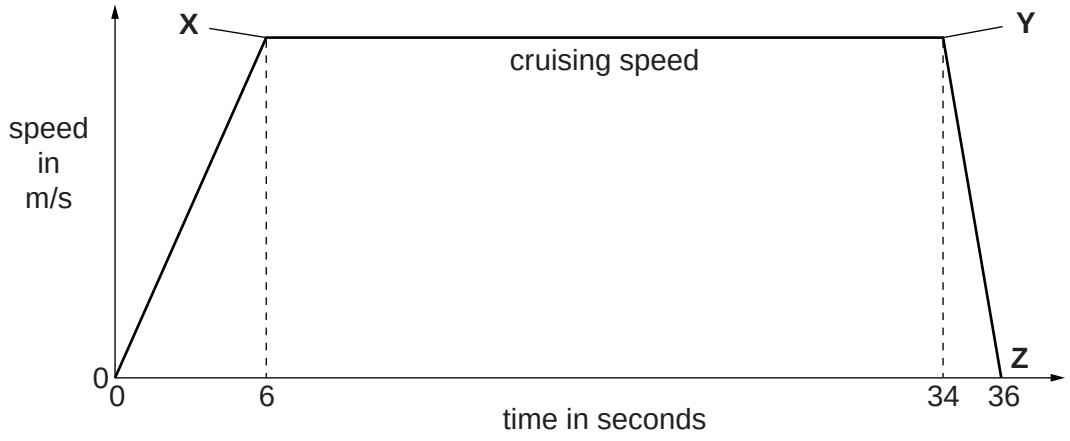
## SECTION C – Module P3

**10** Samuel is investigating the movement and forces in tall buildings (skyscrapers).

Skyscrapers have lifts or elevators to transport people up and down.




Look at the speed-time graph for **part** of the journey of a lift up a skyscraper.




**(a)** The lift travels 30 m before it reaches its cruising speed (at point **X**).

Samuel thinks that the cruising speed is 5 m/s. Use a calculation to explain if he is correct.

calculation .....

.....

.....

answer ..... m/s

How does this compare to what Samuel thinks?

.....

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

**(b)** The lift begins to slow down at point **Y** on the graph.

Compare the acceleration between points **0** and **X** with the acceleration between points **Y** and **Z**.

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**(c)** **(i)** When the lift is moving at its **cruising speed** work is done by the motor pulling the lift.

There are 8 people in the lift. The average weight of **each** person is 600 N.

The weight of the lift is 6000 N.

Calculate the power needed to move the lift and the 8 people at cruising speed.

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

**(ii)** Calculate the total **mass** of the lift and the people in it.

The value of gravitational field strength = 9.8 N/kg.

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Give your answer to **2** significant figures.

answer ..... kg **[2]**

**[Total: 9]**

**11** Look at the extract from a newspaper article promoting electric cars.

> *Will electric cars take over our roads?*
>
> - *no need for fuel*
> - *no emissions*
> - *silent*
> - *economic to purchase*
> - *easy to charge batteries*

Electric cars could become more popular than petrol and diesel cars.

Use the points raised in the extract to identify the arguments **for** and **against** increasing the use of electric cars.


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

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

**[Total: 6]**

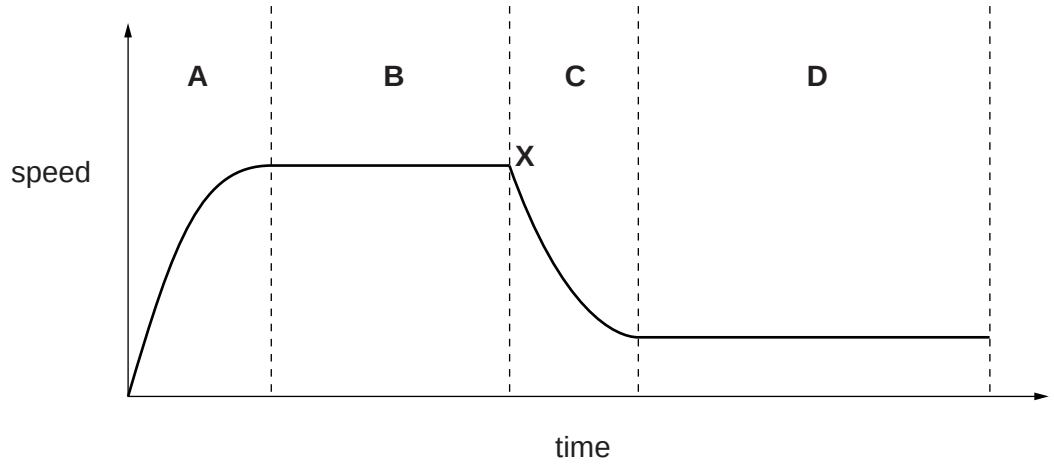
**12** Susie is a skydiver.

Look at the graph.

It shows her speed after she has jumped from an aeroplane.

There are four sections of the graph, labelled **A**, **B**, **C** and **D**.

Susie opened her parachute at point **X** shown on the graph.




**(a)** Write about the forces acting on Susie during her descent to explain the different speeds she travels at.

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..... **[4]**



**Turn over for the remainder of question 12**

**(b)** Susie practises her landings by jumping from a low platform.

She is attached to straps which act like a parachute.


**A** Susie **standing still** on platform.

**B** Susie is **exactly half way** down.

**C** Susie is **on** the ground.

**23**

Look at the statements about Susie's energy as she does her practice fall.

Put a tick (✓) in the box beside any correct statement and a cross (✗) beside any incorrect statement.

The first one has been done for you.

| | |
|---|---|
| At **A** all of Susie's energy is GPE. | ✓ |
| Between **A** and **B** Susie gains **both** GPE and KE. | |
| Between **A** and **B** Susie gains **only** KE. | |
| At **B** her KE is **exactly** half her GPE at **A**. | |
| Just before touching the ground at **C** Susie has her maximum KE. | |
| On the ground at **C** Susie has zero KE. | |
| On the ground at **C** Susie has her maximum GPE. | |

**[3]**

**[Total: 7]**

**Question 13 begins on page 24**

**13** Rufus is driving to work in his car.

In the first part of his journey he drives at a speed of 10 m/s on a dry road.

In the second part of his journey he drives at a speed of 20 m/s and it starts to rain.

Explain how the higher speed and the wet road affect:

- Rufus' thinking distance
- the car's braking distance.

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

**[Total: 3]**

**END OF QUESTION PAPER**