Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2018–2019

Single Award Science: Physics

Unit 3

Higher Tier

[GSA32]

GSA32

WEDNESDAY 22 MAY 2019, AFTERNOON

TIME

1 hour.

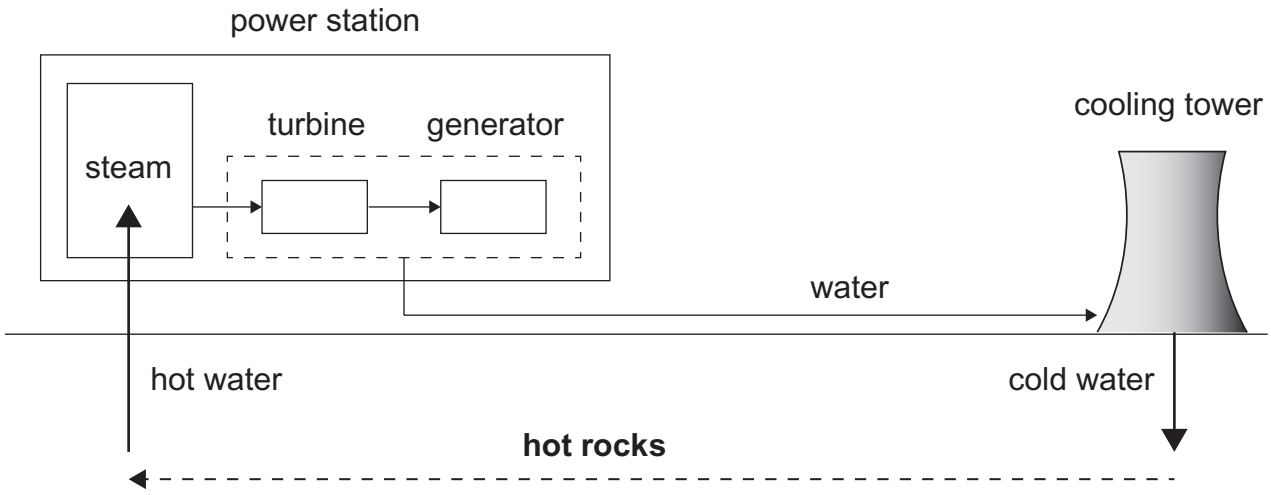
INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **2**.

1 **(a)** The diagram below shows a geothermal power station. Water at high pressure is pumped underground where it gets heated by hot rocks. It then returns to the power station.



Source: Principal Examiner

When the hot water returns to the surface it changes into steam and turns a turbine.

(i) Explain fully how this produces electricity in a generator.

_____

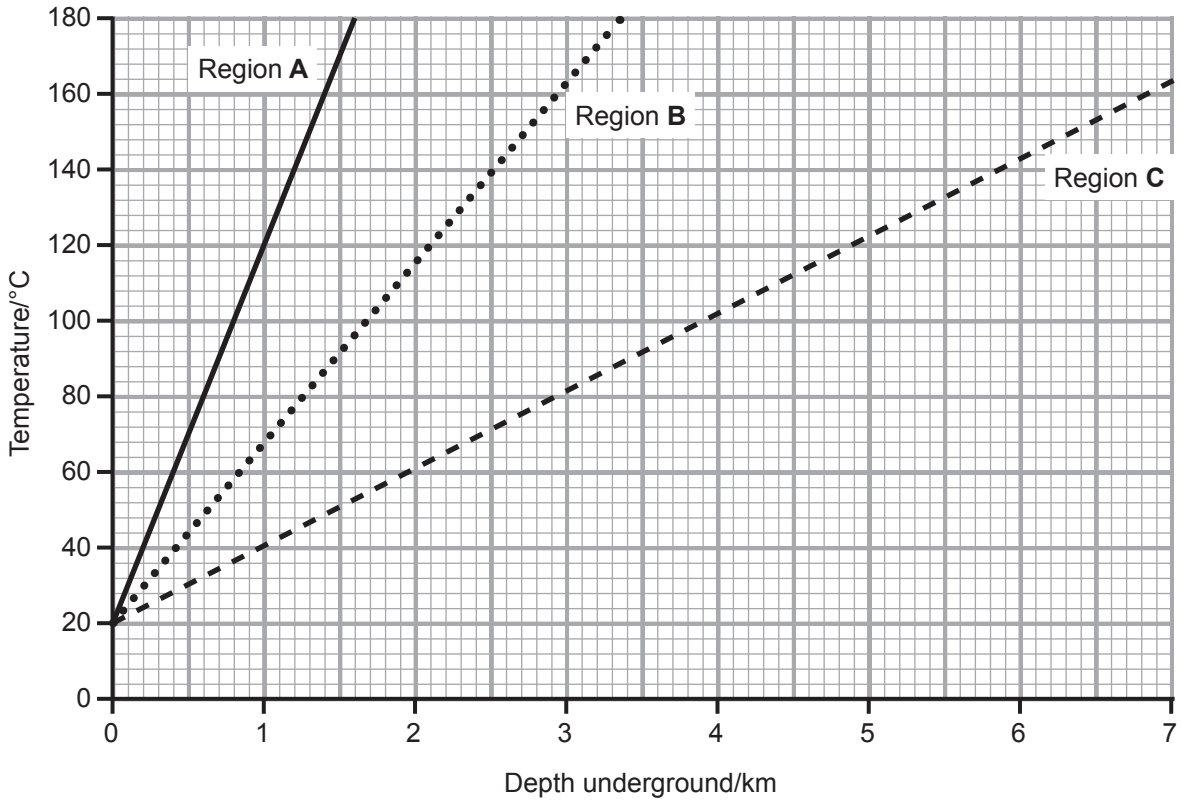
_____ [2]

(ii) Geothermal power stations use renewable energy. What does the term **renewable** mean?

_____

_____ [1]

(b) The graph below shows how the temperature changes as the depth underground increases in three different regions.



(i) In region **A** what depth will the pipe need to be to produce a temperature of 120 °C?

_____ km [1]

(ii) Suggest **one** reason why it may **not** be economical to build a geothermal power station in region **C**.

_____

_____ [1]

[Turn over

(c) A coal-fired power station burns coal containing 300 MJ of energy and produces 102 MJ of electricity.

Use the equation:

$$\textbf{efficiency} = \frac{\textbf{useful output energy}}{\textbf{total input energy}}$$

to calculate the efficiency of the power station.

(Show your working out.)

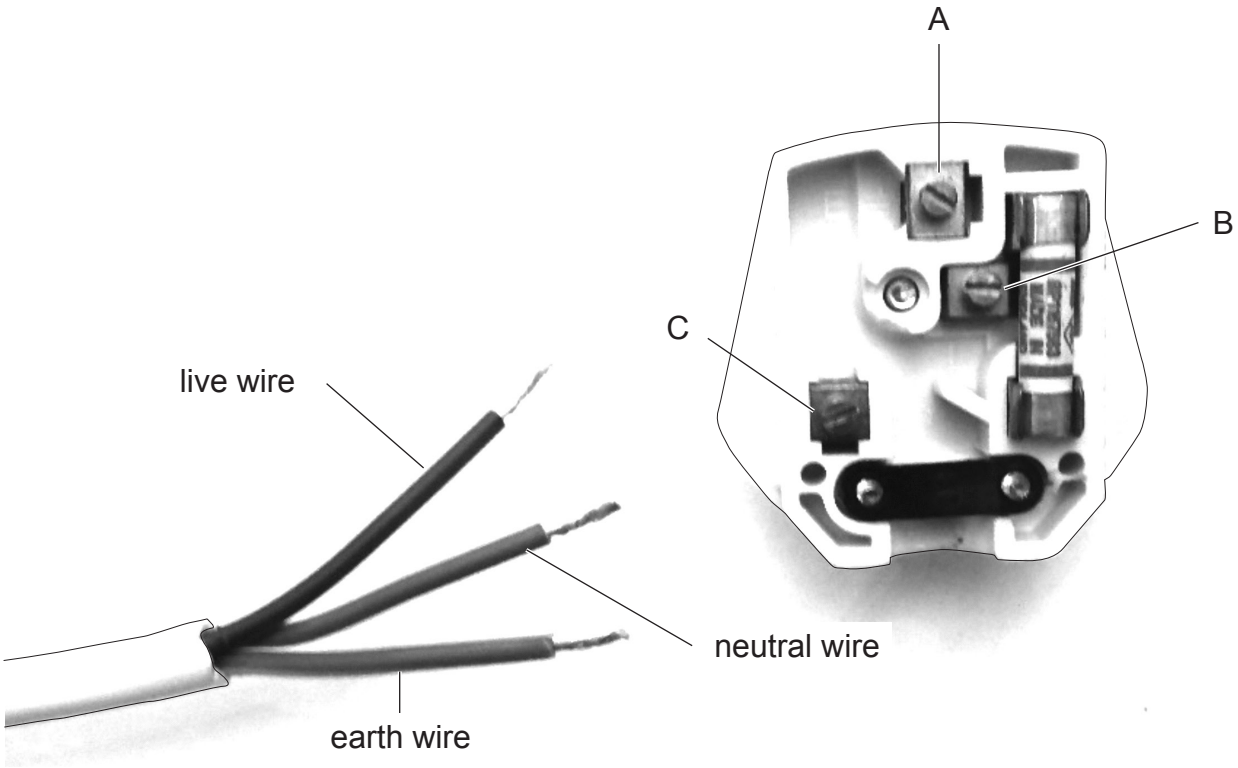
Answer _____ [2]

BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

2 The photograph below shows a 3-pin plug about to be wired.



Source: Principal Examiner

Describe fully how this plug should be wired correctly.

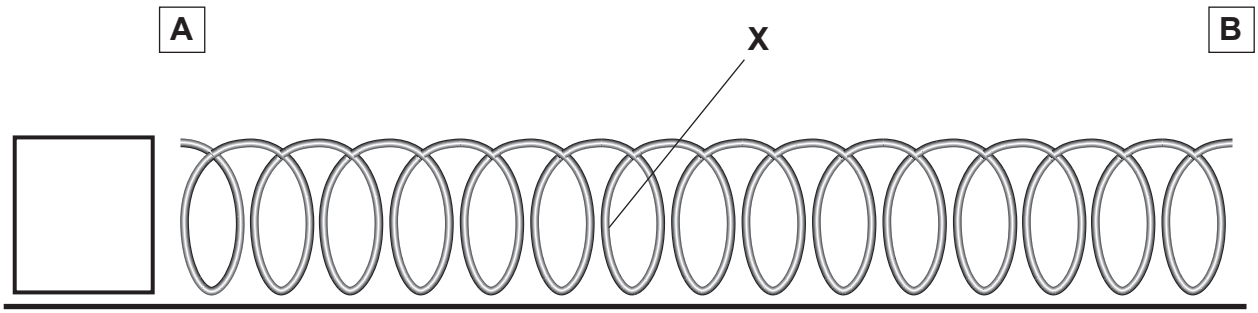
Your answer should include:

- the colour(s) of each named wire
- an explanation of one safety feature found in the plug.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

3 **(a)** The diagram below shows a slinky spring which can be used to demonstrate a **longitudinal** wave travelling from **A** to **B**.



Source: Principal Examiner

(i) In the box at end **A**, draw an arrow to show the direction of energy flow. [1]

(ii) Describe the motion of a particle at **X** in a **longitudinal** wave.

_____

_____

_____ [2]

The table below shows the speed of sound in air at different temperatures.

Temperature/°C	Speed of sound/ m/s
20	343
10	337
0	331
–10	325
–20	319

(b) State the trend shown by this data.

_____

_____ [1]

Shown below are the recommended maximum listening times at different sound levels.

Sound level/dB	Maximum time/hours
88	4
91	2
94	1
97	0.5
100	

(c) Use the trend shown by this data to calculate the recommended maximum time for a sound level of 100 dB.

Answer _____ hours [1]

(d) The table below shows the percentage of sound reflected from different materials at four different frequencies.

	Percentage of sound reflected/%			
Material	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**
brick	98	97	96	95
carpet	76	43	31	29
curtains	65	45	30	28
glass	75	82	88	90

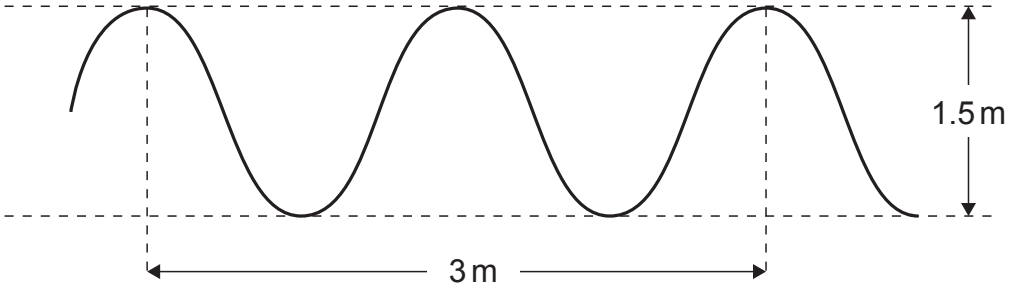
(i) Which material shows the biggest difference in the percentage of sound reflected across this range of frequencies?

_____ [1]

(ii) Which material is the **worst absorber** of sound across this range of frequencies?

_____ [1]

(e) The diagram below represents a transverse wave.



(i) What is the amplitude of this wave?

_____ m [1]

(ii) Use the equation:

wave speed (v) = frequency (f) × wavelength (λ)

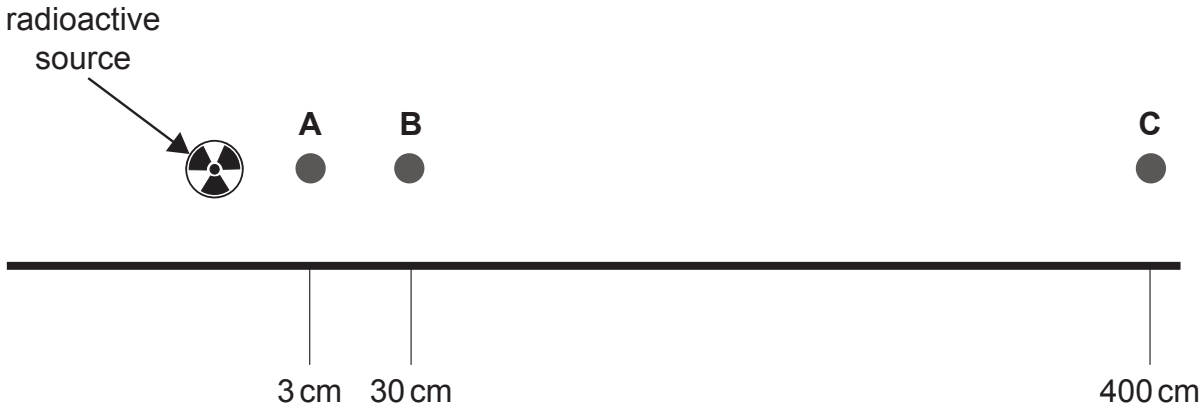
to calculate the speed of a wave which has a frequency of 30 Hz and a wavelength of 150 cm.
Give your answer in metres per second (m/s).

(Show your working out.)

Answer _____ m/s [2]

[Turn over

4 **(a)** The experiment below shows radiation detectors (**A**, **B** and **C**) placed at different distances from a radioactive source.



Source: Principal Examiner

The source emits alpha, beta and gamma radiation.

(i) Which detector **A**, **B** or **C** will detect all three types of radiation?

_____ [1]

(ii) Name the type(s) of radiation that will be detected at point **C**.

_____ [1]

(iii) When alpha or beta particles collide with air molecules, the air molecules become charged. What is the name of this process?

_____ [1]

(b) Fruit can be irradiated with cobalt-60 before being transported long distances.

(i) Explain fully why this is done and how it benefits shopkeepers.

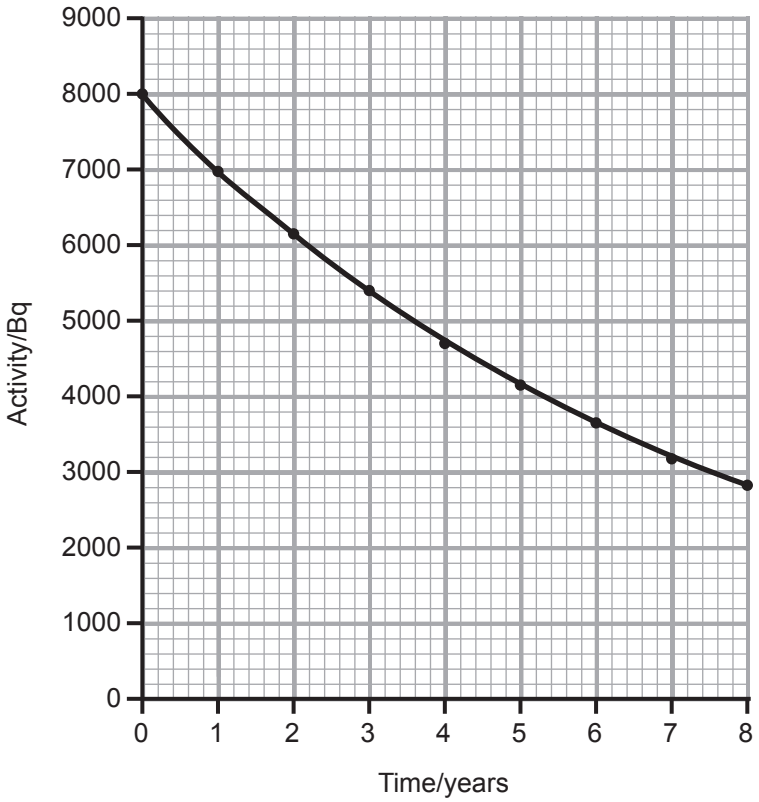
_____

_____

_____

_____ [3]

The graph below shows how the activity of cobalt-60 changes over time.



(ii) Use the graph to find the half-life of cobalt-60.

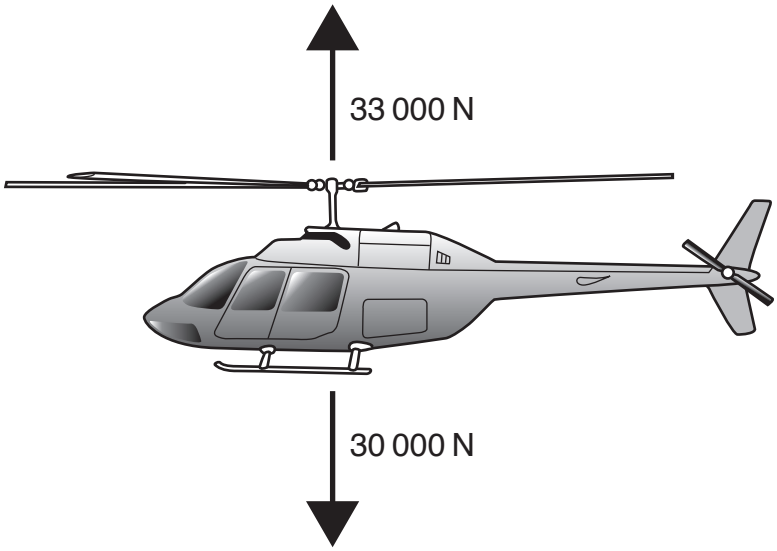
_____ years [1]

(iii) The cobalt-60 source has to be replaced when its activity falls below 1000 Bq. Calculate how long it will take for the activity to fall from 8000 Bq to 1000 Bq.

Answer _____ years [2]

[Turn over

5 The diagram below shows a helicopter which has a mass of 3000 kg and some of the forces acting on it.



Source: Principal Examiner

(a) From the information given, describe and explain the motion, if any, of this helicopter.

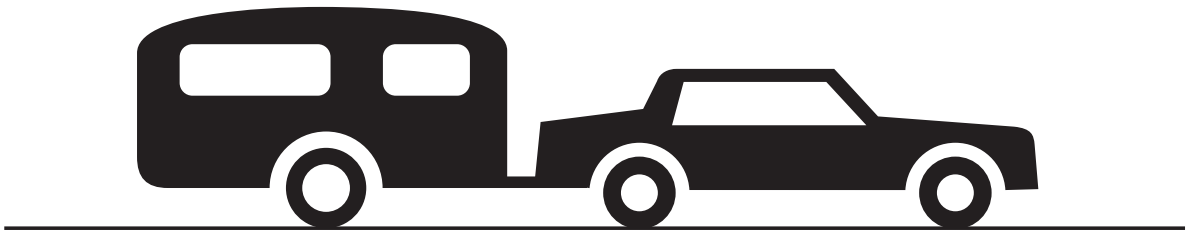
_____

_____

_____

_____ [3]

The diagram below shows a car towing a caravan along a level road at constant speed.



Source: Principal Examiner

(b) Which letter **A**, **B**, **C** or **D** shows the direction of the forces between the car and the caravan?

	Force exerted by the caravan on the car	Force exerted by the car on the caravan
A	→	→
B	←	→
C	→	←
D	←	←

_____ [1]

[Turn over

The table below shows the percentage of children using car seatbelts in recent years.

	Year				
Age	**1995**	**2000**	**2005**	**2010**	**2015**
Under 1 year	96	97	98	98	100
1–4	65	82	92	96	98
5–9	49	68	82	94	96
10–13	47	65	81	93	95

(c) State **two** trends shown by this data.

1. _____

_____

2. _____

_____ [2]

(d) The government still have TV adverts showing the need for children to use seatbelts. Using information from the table, suggest why they continue to advertise.

_____

_____ [1]

(e) Car manufacturers are trying to minimise the reliance on fossil fuels by using substitutes and extenders. Explain fully the difference between substitutes and extenders.

_____

_____

_____ [2]

BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

6 The table below shows data about some asteroids that may hit Earth.

Name of asteroid	Year of possible impact	Probability of impact/%	Diameter of asteroid/km
1979 XB	2056–2113	7.4×10^{-5}	0.662
2001 CA21	2020–2073	1.1×10^{-6}	0.678
2011 KF36	2022–2108	9.9×10^{-8}	0.280
2015 ME131	2019–2089	3.2×10^{-6}	0.499

(a) Give **one** reason why scientists are most concerned about asteroid 1979 XB.

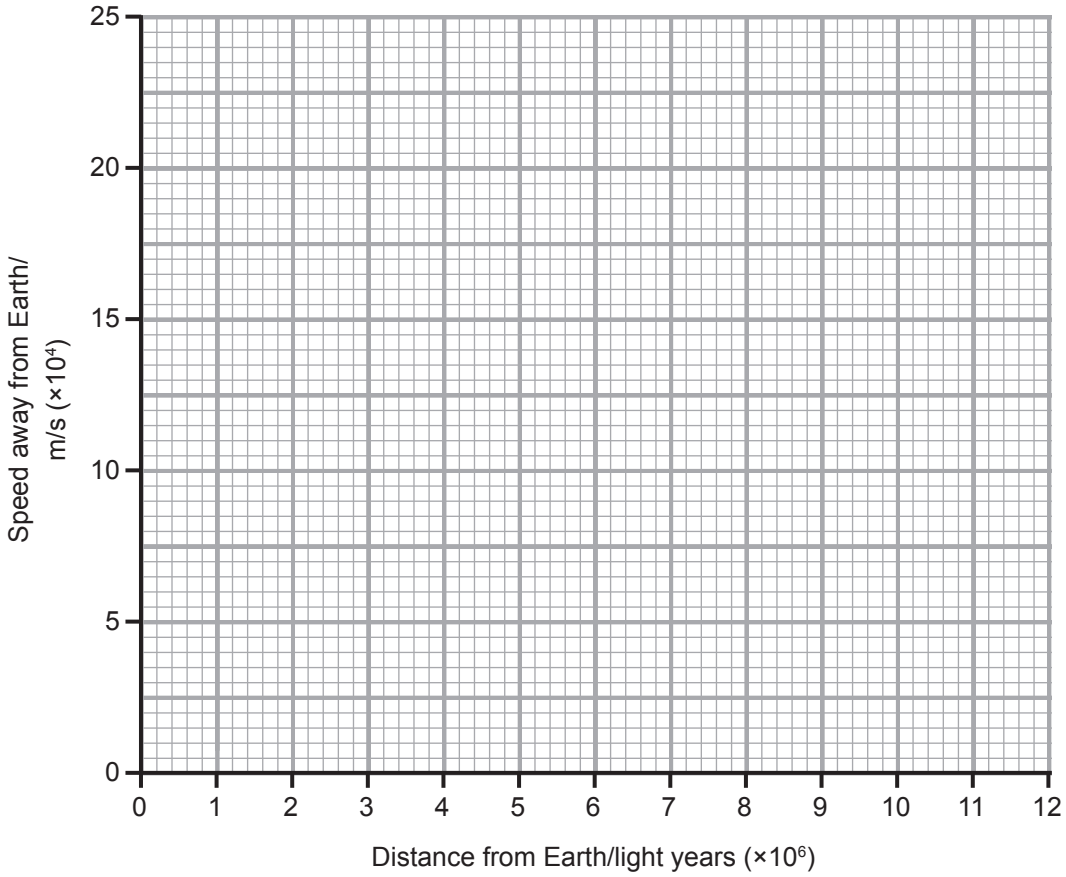
_____

_____ [1]

(b) The table below gives some information about galaxies.

Name of Galaxy	Distance from Earth/ light years ($\times 10^6$)	Speed away from Earth/ m/s ($\times 10^4$)
M110	2.8	6
Sextans B	4.8	10
Dwingloo 1	9.0	20
Maffei 1	9.8	21
Holmberg 11	11.2	23

(i) On the grid below, plot and draw a line graph of this information.



[3]

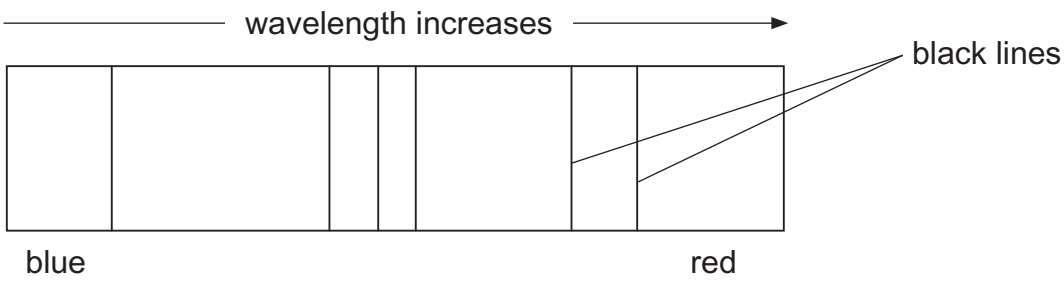
(ii) State the trend shown by this information.

_____

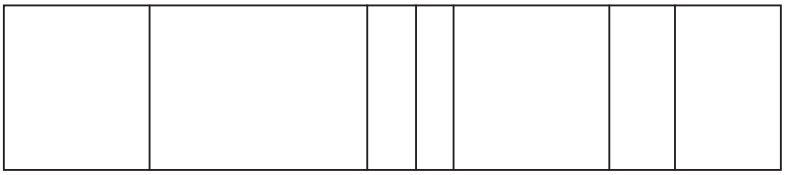
_____ [1]

[Turn over

(c) When scientists analyse the spectrum of light from our galaxy they see the following black lines.



The spectrum from another galaxy (**A**) is shown below.

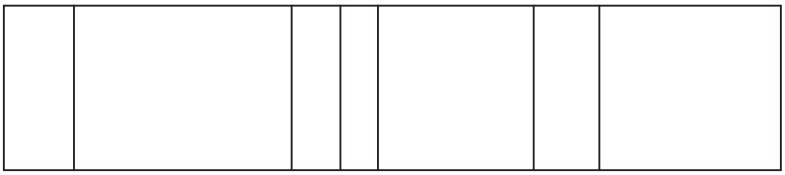


galaxy **A**

(i) What term describes the increase in wavelength shown by the black lines in the spectrum for galaxy **A**?

_____ [1]

The spectrum from another galaxy (**B**) is shown below.

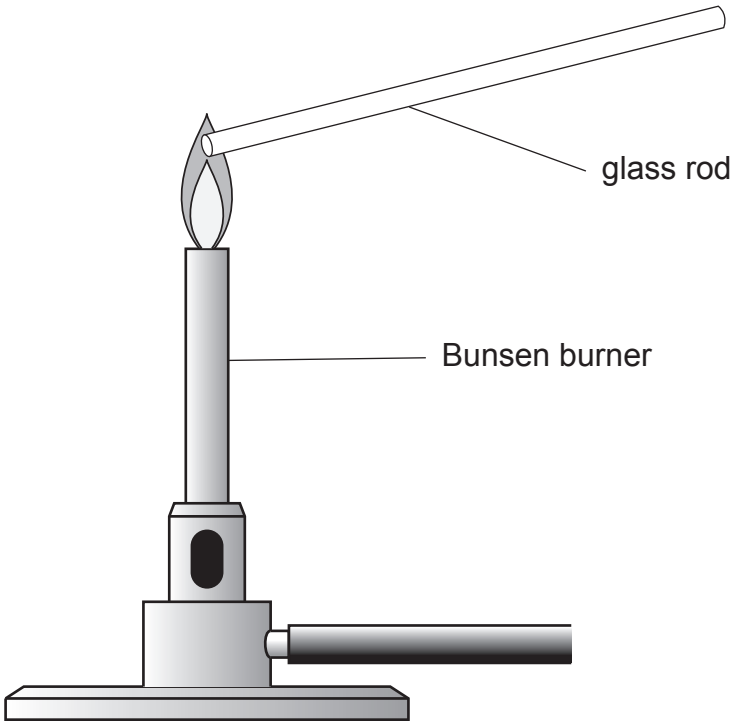


galaxy **B**

(ii) Suggest the movement, if any, of galaxy **B** relative to our galaxy.

_____ [1]

7 Solid materials, like glass and copper, transfer heat by a process called conduction. Copper is a much better conductor than glass.



Source: Principal Examiner

(a) Describe how heat travels through a poor conductor like glass.

_____

_____

_____ [2]

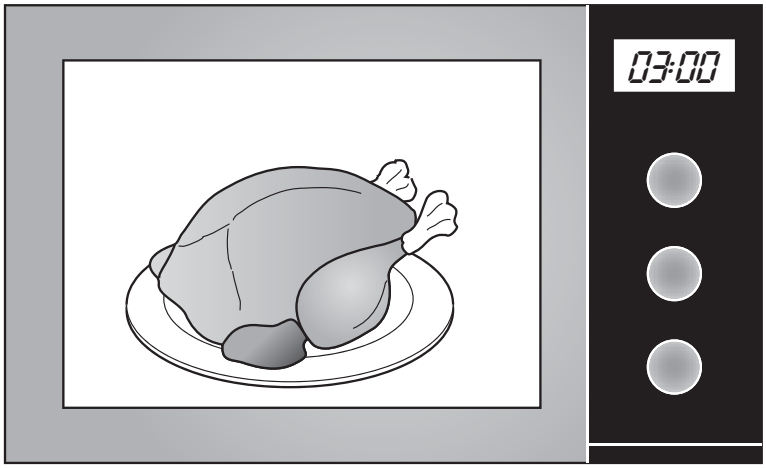
(b) Complete the following sentence.

Copper is a better conductor than glass because it has

_____ which move and carry energy. [1]

[Turn over

8 The diagram below shows a chicken being heated in a microwave oven.



Source: Principal Examiner

Explain fully how microwaves heat the chicken.

[3]

BLANK PAGE

DO NOT WRITE ON THIS PAGE

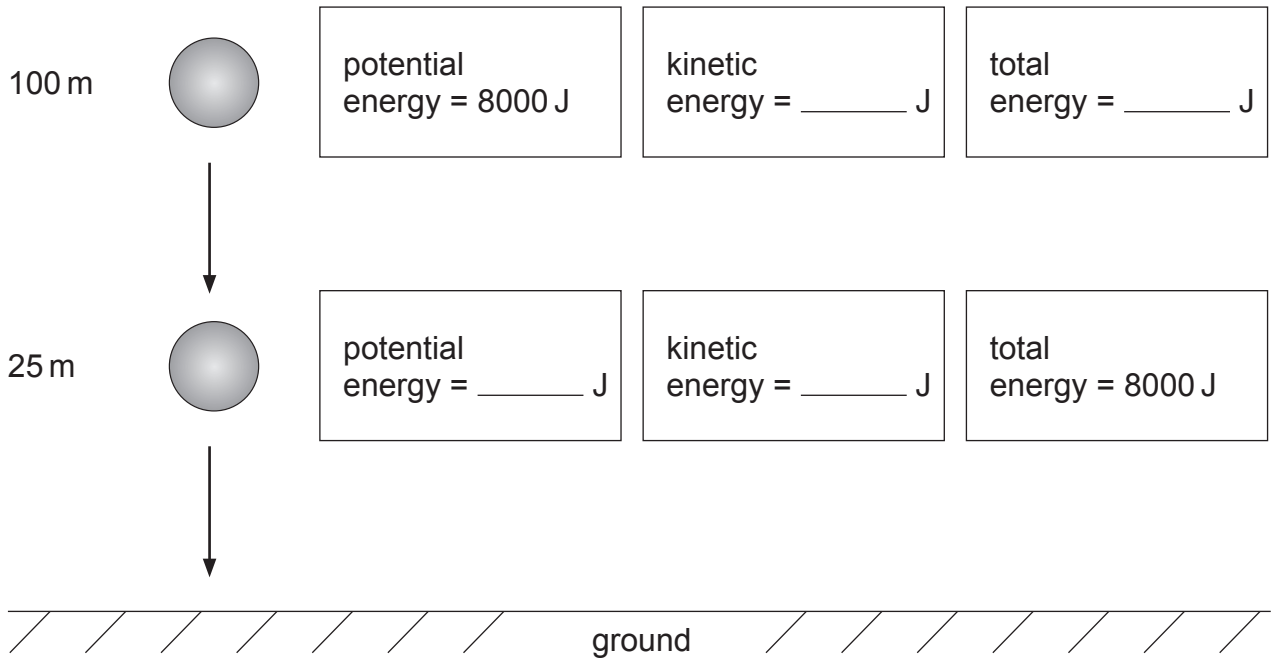
(Questions continue overleaf)

9 **(a)** State the Principle of Conservation of Energy.

_____

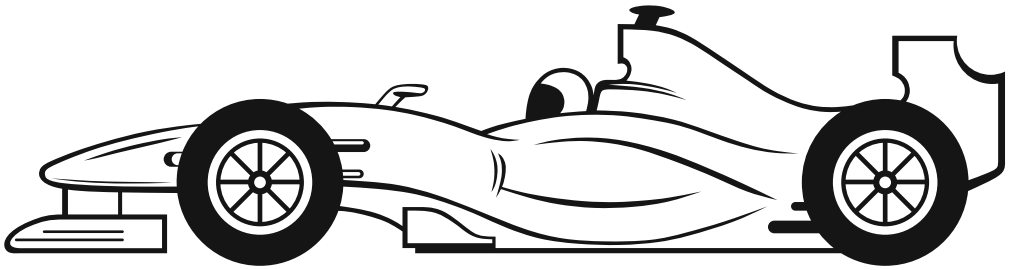
_____ [1]

(b) A ball is held at rest and dropped from a height of 100 m above the ground. Complete the diagram below to give the energy values at 100 m and 25 m from the ground.



[2]

(c) The image below shows a racing car. It is travelling at a velocity of 42 m/s and has a kinetic energy of 646 506 J.



Use the formula:

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

to calculate the mass of the car. Your answer should include the unit.

(Show your working out.)

Answer _____ [3]

THIS IS THE END OF THE QUESTION PAPER

BLANK PAGE

DO NOT WRITE ON THIS PAGE

BLANK PAGE

DO NOT WRITE ON THIS PAGE

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total Marks	

Examiner Number