AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.3.2

Perfect black bodies and radiation

Past-paper questions

Tier	**Foundation**
Question groups	**7**
Available paper years	**2007–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.6.3.2 Perfect black bodies and radiation

Question 01

June 2007 | PHY1A | Original Q8 | Legacy

QUESTION EIGHT

A student investigated the question: Does the type of surface affect how an object loses or gains heat? She carried out two experiments.

In her first experiment, she filled two cans with boiling water. One can had a dull, black surface. The other can had a shiny, silver surface.

Later, she measured the temperature of the water in each can.

These are her results.

	Starting temperature of the water	Temperature of the water 15 minutes later
Can with dull, black surface	100 °C	74 °C
Can with shiny, silver surface	100 °C	93 °C

8A The student wanted her experiment to be a fair test.

Which row of the table is most likely to give a fair test?

	Volume of cans	Volume of water	Metal of the cans	Shape of cans
1	same	different	same	same
2	same	same	different	same
3	same	same	same	different
4	same	same	same	same

8B If her results are reliable, the experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

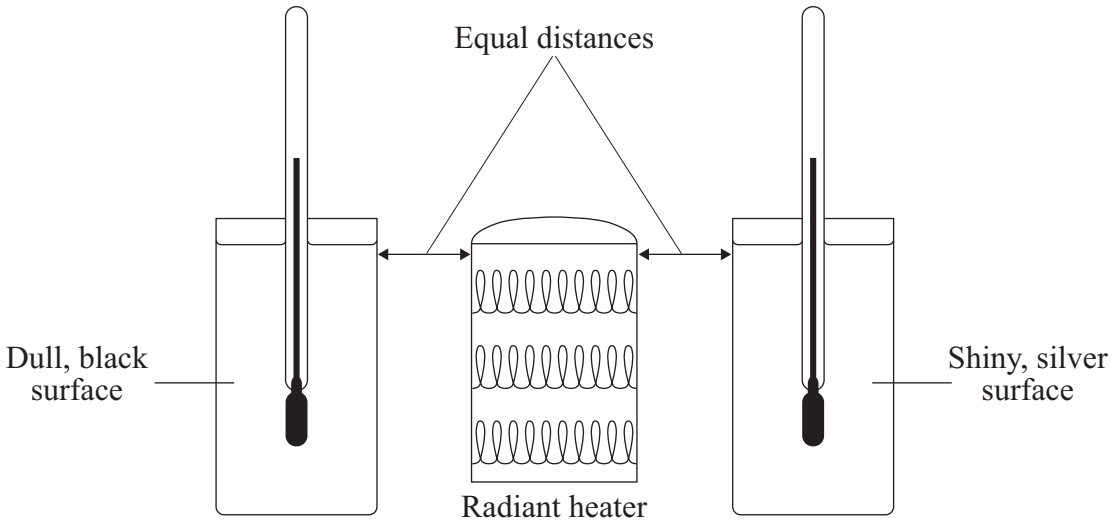
2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.

4.6.3.2 Perfect black bodies and radiation

Question 01 · continued June 2007 | PHY1A | Original Q8 | Legacy



In her second experiment, the student put cold water in each can. She put a heater (which is a source of thermal radiation) between the cans. She switched the heater on and, ten minutes later, she measured the temperature of the water in each can.

These are the results of her second experiment.

	Starting temperature of the water	Temperature of the water 10 minutes later
Can with dull, black surface	16 °C	37 °C
Can with shiny, silver surface	16 °C	23 °C

8C If her results are reliable, the second experiment shows that, compared with a shiny, silver surface, a dull, black surface is a . . .

1 better absorber of thermal radiation.

2 better conductor of thermal radiation.

3 better emitter of thermal radiation.

4 better reflector of thermal radiation.

8D What was the average (mean) rate of the rise in temperature of the water in the can with a dull, black surface?

1 0.9 °C per minute

2 2.1 °C per minute

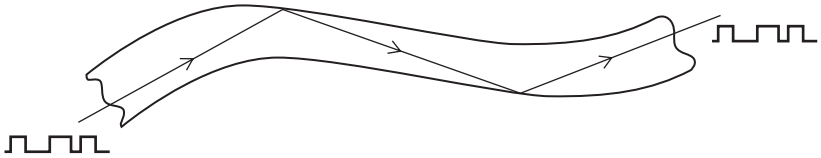
3 9 °C per minute

4 21 °C per minute

4.6.3.2 Perfect black bodies and radiation

Question 02

2 (a) The diagram shows a signal and the path taken by the signal as it travels along an optical fibre.



(i) What name is given to the type of signal shown in the diagram?

.....

(1 mark)

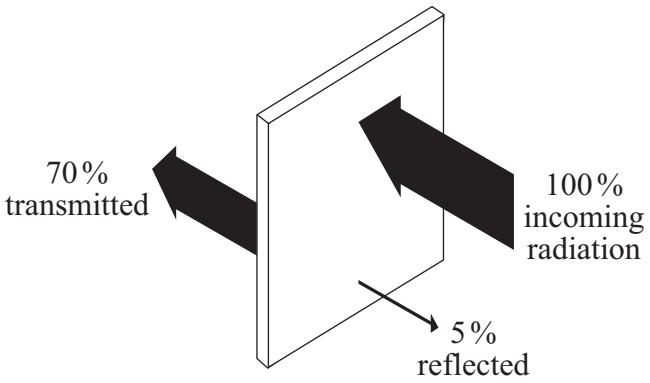
(ii) Name the **two** types of electromagnetic radiation that can be used to send signals along an optical fibre.

1 .....

2 .....

(2 marks)

(b) Infra red radiation can be reflected, absorbed and transmitted by glass.



(i) What percentage of infra red is absorbed by the glass?

.....

(1 mark)

4.6.3.2 Perfect black bodies and radiation

Question 02 · continued

BLANK

(ii) Complete the following sentence by drawing a ring around the correct word or phrase.

The absorbed infra red | increases / does not change / decreases | the temperature of the glass.

(1 mark)

(c) **Two** of the following statements are true. **One** of the statements is false.

Tick (✓) the boxes next to the **two** true statements.

All objects absorb infra red radiation.	
Black surfaces are poor emitters of infra red radiation.	
A hot object emits more infra red than a cooler object.	

(1 mark)

(d) The following statement is false.

Black surfaces are good reflectors of infra red radiation.

Change **one** word in this statement to make it true.

Write down your **new** statement.

.....

.....

(1 mark)

7

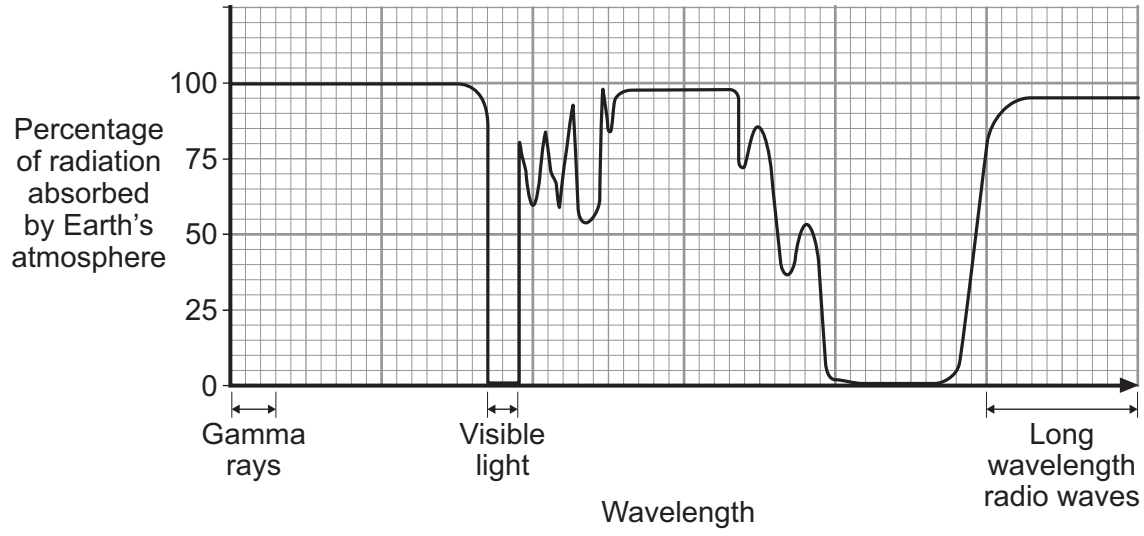
4.6.3.2 Perfect black bodies and radiation

Question 03

March 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

The diagram shows the absorption of electromagnetic radiation by the Earth's atmosphere.



9A The diagram shows that . . .

1 all wavelengths of gamma radiation reach the Earth's surface.

2 all wavelengths of radio waves reach the Earth's surface.

3 all wavelengths of ultraviolet radiation reach the Earth's surface.

4 all wavelengths of visible light reach the Earth's surface.

9B Some objects in space emit X-rays.

Where would you put a telescope to detect these X-rays?

1 above the Earth's atmosphere

2 at the top of a hill

3 at ground level in a hot desert

4 at ground level in the Antarctic

4.6.3.2 Perfect black bodies and radiation

Question 03 · continued

The table gives information about some space telescopes.

Name	Hubble	Compton	Chandra	Spitzer
Launched in	1990	1991	1999	2003
Detects	infra red rays ultraviolet rays visible light	gamma rays	X-rays	infra red rays

9C Which statement about these space telescopes can be deduced from the information in the table?

1 They all collect data using mirrors.

2 They all detect electromagnetic radiation.

3 They are all in space at present.

4 They were all used to study the Earth.

9D From the information in the table, which one of the following emissions could be detected by one of these space telescopes?

1 alpha particles

2 nuclear radiation

3 radio waves

4 sound waves

END OF TEST

4.6.3.2 Perfect black bodies and radiation

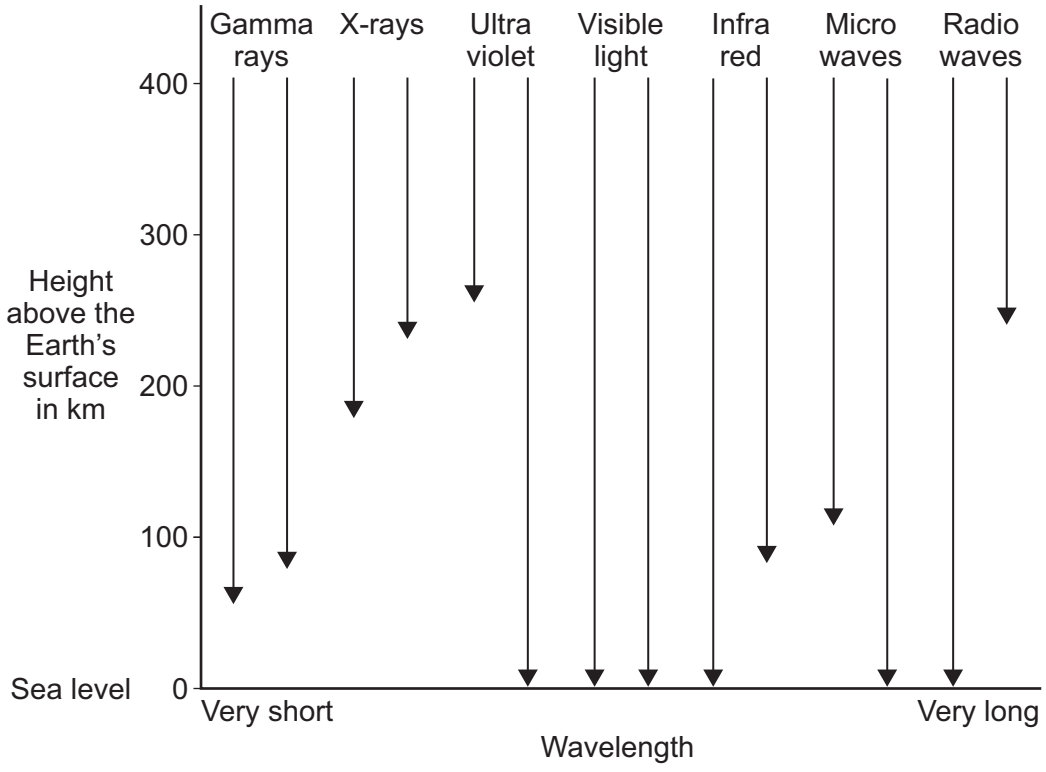
Question 04

June 2011 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Telescopes can be based on the Earth's surface or put into orbit in space.

The diagram shows how far electromagnetic waves penetrate the Earth's atmosphere. For some types of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Telescopes on Earth detect **all** wavelengths of . . .

1 radio waves only.

2 visible light only.

3 radio waves and visible light.

4 visible light and X-rays.

9B Which of the following statements about the use of telescopes in space is true?

1 The atmosphere distorts the image produced by the telescope.

2 The telescopes are affected by light pollution from the Earth.

3 The telescopes can detect electromagnetic waves that cannot reach the Earth's surface.

4 The telescopes are easy to repair and maintain.

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The table gives information about some space telescopes. Each telescope detects a different type of electromagnetic radiation.

Telescope	Wavelength detected in nanometres
INTEGRAL	less than 0.01
Chandra	0.01 – 20
FUSE	20 – 400
Hubble	400 – 700
Spitzer	1000 – 1 000 000

9C The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

9D Which telescope detects X-rays?

1 Chandra

2 FUSE

3 INTEGRAL

4 Spitzer

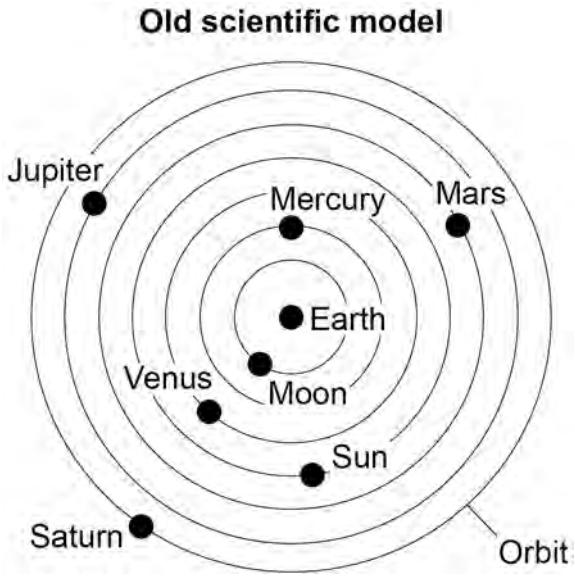
END OF TEST

4.6.3.2 Perfect black bodies and radiation

Question 05

0 4 **Figure 10** shows an old scientific model of the solar system that has now been replaced.

Figure 10



0 4 . 1 Which statement is a reason for replacing an old scientific model with a newer scientific model?

[1 mark]

Tick (✓) **one** box.

The old model cannot explain new observations. ☐

The old model has been used by scientists for a long time. ☐

The old model is too simple. ☐

4.6.3.2 Perfect black bodies and radiation

Question 05 · continued

0 4 . 2 Compare the model of the solar system used now with the old model of the solar system shown in **Figure 10**.

[4 marks]

Question 4 continues on the next page

4.6.3.2 Perfect black bodies and radiation

Question 05 · continued

Table 1 shows data about four planets.

Table 1

Planet	Mean distance from the Sun in millions of kilometres	Time taken for one orbit in Earth years
Mercury	58	0.25
Venus	108	0.60
Earth	150	1.00
Mars	228	1.90

0 4 . 3 How does the time taken for one orbit change as the mean distance from the Sun increases?

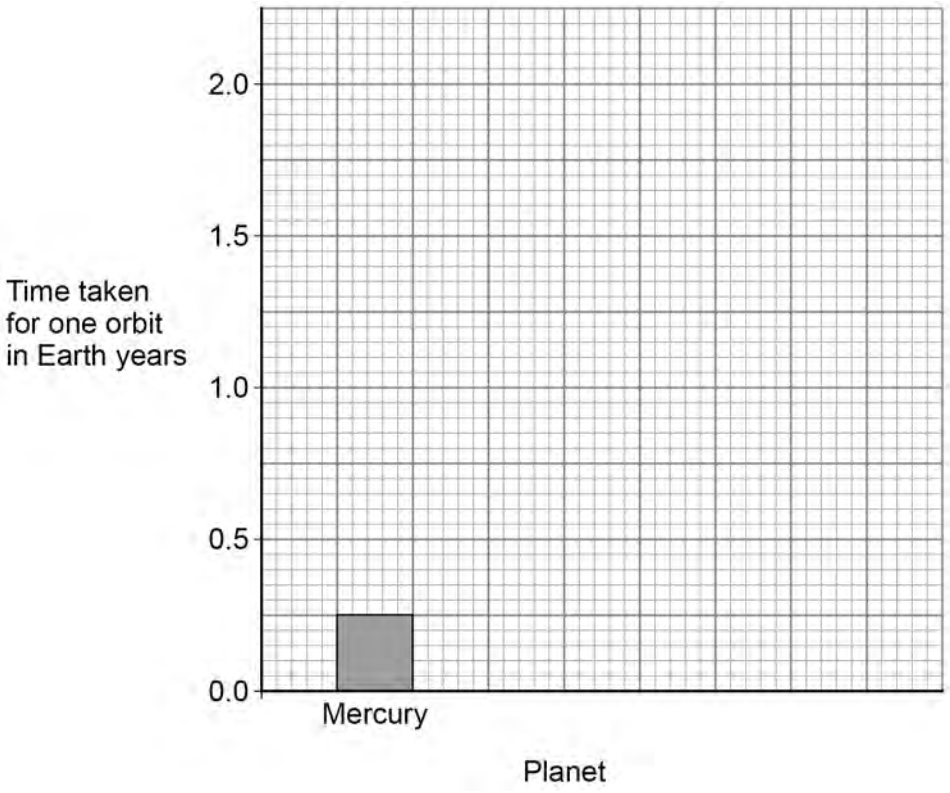
[1 mark]

4.6.3.2 Perfect black bodies and radiation

Question 05 · continued

0 4 . 4 The bar chart in **Figure 11** shows some of the data from **Table 1**.

Figure 11



Complete the bar chart.

Use data from **Table 1**.

[2 marks]

Question 4 continues on the next page

0 4 . 5 All stars have a life cycle.

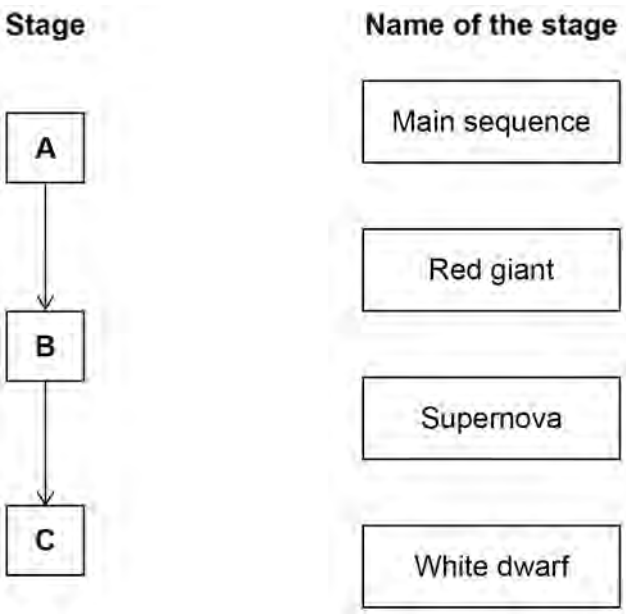
A, **B** and **C** in **Figure 12** represent three stages in the life cycle of the Sun.

The stages are in the correct order.

Draw **one** line from each stage to the name of the stage.

[2 marks]

Figure 12



0 4 . 6 Stars act like black bodies.

Which statement is true for perfect black bodies?

[1 mark]

Tick (✓) **one** box.

They are good reflectors of radiation. ☐

They are the best emitters of radiation. ☐

They easily transmit radiation. ☐

11

4.6.3.2 Perfect black bodies and radiation

Question 06

0 9 Infrared waves are transverse waves.

0 9 . 1 Complete the sentence.

[1 mark]

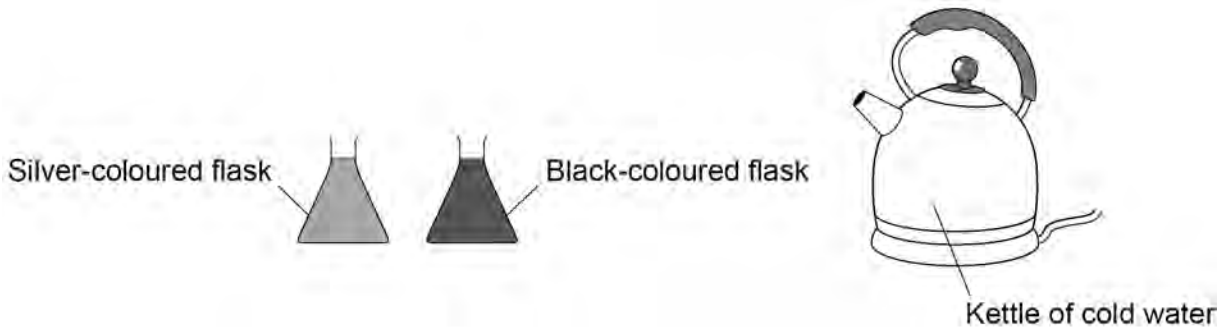
In a transverse wave, the direction of oscillation is _____

to the direction of energy transfer by the wave.

A student investigated how the colour of a surface affects the rate at which the surface emits infrared radiation.

Figure 23 shows some of the equipment used.

Figure 23



4.6.3.2 Perfect black bodies and radiation

Question 06 · continued

0 9 . 2 The student wrote the following hypothesis:

‘The black-coloured flask will emit more infrared radiation than the silver-coloured flask during 10 minutes of cooling.’

Describe a method to test this hypothesis.

[6 marks]

Question 9 continues on the next page

4.6.3.2 Perfect black bodies and radiation

Question 06 · continued

0 9 . 3 When will the flasks emit infrared radiation at the greatest rate?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

During the 1st minute ☐

During the 5th minute ☐

During the 9th minute ☐

Reason _____

_____

4.6.3.2 Perfect black bodies and radiation

Question 06 · continued

Another student investigated the absorption of infrared radiation by different surface colours.

The student filled four hollow metal cubes with cold water.

Each cube was the same size but had a different surface colour.

The cubes were then placed the same distance from an infrared heater.

After 10 minutes, the student measured the temperature increase of the water inside each cube.

0 9 . 4 What was the dependent variable in this investigation?

[1 mark]

0 9 . 5 **Table 2** shows the results.

Table 2

Surface colour of the cube	Temperature increase after 10 minutes in °C
Matt white	3.0
Shiny white	2.0
Matt black	6.5
Shiny black	4.0

Give **two** conclusions that can be made from the results in **Table 2**.

[2 marks]

1

2

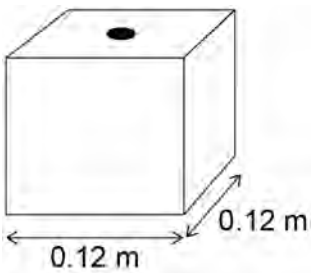
4.6.3.2 Perfect black bodies and radiation

Question 06 · continued

Figure 24 shows one of the cubes. The cube is filled with water.

The weight of the water exerts a pressure on the bottom of the cube.

Figure 24



Use the Physics Equations Sheet to answer questions **09.6** and **09.7**.

0 9 . 6 Which equation correctly links area, force and pressure?

[1 mark]

Tick (✓) **one** box.

pressure = force × area^2 ☐

pressure = force × area ☐

pressure = $\frac{\text{force}}{\text{area}}$ ☐

pressure = $\frac{\text{area}}{\text{force}}$ ☐

4.6.3.2 Perfect black bodies and radiation

Question 06 · continued

0 9 . 7 The water pressure at the bottom of the cube is 1500 Pa.

Calculate the force of the water on the bottom of the cube.

[4 marks]

Force = _____ N

17

Turn over for the next question

4.6.3.2 Perfect black bodies and radiation

Question 07

June 2024 | 8463/2F | Original Q1

0 1 A group of stars is called a galaxy.

0 1 . 1 What is the name of our galaxy?

[1 mark]

Tick (✓) **one** box.

- Black Eye ☐
- Hockey Stick ☐
- Milky Way ☐
- Sculptor Dwarf ☐

0 1 . 2 The Sun is one of the stars in our galaxy.

What was the Sun originally formed from?

[1 mark]

Tick (✓) **one** box.

- Dust and gas ☐
- Heavy elements ☐
- Oxygen ☐

4.6.3.2 Perfect black bodies and radiation

Question 07 · continued

0 1 . 3 Which of the following forces was involved in the formation of the Sun?

[1 mark]

Tick (✓) **one** box.

- Electrostatic force ☐
- Gravitational force ☐
- Magnetic force ☐

0 1 . 4 Stars produce light because they release energy.

Complete the sentence.

Choose the answer from the box.

[1 mark]

combustion	**conduction**	**fusion**

The process which releases energy inside stars is _____.

0 1 . 5 Visible light and infrared radiation travel from the Sun to the Earth.

Which statement describes the time taken for visible light and infrared radiation to travel from the Sun to the Earth?

[1 mark]

Tick (✓) **one** box.

- Visible light takes less time than infrared radiation ☐
- Visible light takes the same time as infrared radiation ☐
- Visible light takes more time than infrared radiation ☐

4.6.3.2 Perfect black bodies and radiation

Question 07 · continued

0 1 . 6 Infrared radiation has a longer wavelength than visible light.

Complete the sentence.

Choose the answer from the box.

[1 mark]

smaller	**the same**	**greater**

Compared with the frequency of infrared radiation, the frequency of visible light is _____.

0 1 . 7 The Sun and the Earth both emit infrared radiation.

How does the rate of infrared radiation emitted by the Sun compare with the rate of infrared radiation emitted by the Earth?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Lower rate than the Earth ☐

Same rate as the Earth ☐

Greater rate than the Earth ☐

8

Reason _____

_____