

YEAR 2 | MODULE 5 | PACK 05

Thermal physics chapter test

Official past-paper questions

2017-2023 | OCR A H556 | Mixed 5.1.1-5.1.4

40 marks | 9 question entries

Suggested time: 55 minutes

Use this after the four topic packs. Every source question in this test has been withheld from those practice packs, including its other assigned subparts.

Conditions: 55 minutes, calculator and the official formula booklet; no notes or mark scheme. Stop at the time limit and record your first-attempt score. The timing is scaled approximately to Paper 1.

A chapter-test percentage is a progress measure, not an OCR grade prediction. Full-paper performance remains a separate check.

Reserved: all 2024 and 2025 papers are excluded. These files contain official examination questions only; no sample, specimen or practice papers.

Name: _____

First attempt: _____ Score: _____ / 40

[Official data, formulae and relationships booklet](#)

Question index

TP identifiers are stable across the question packs and mark schemes; Q numbers refer to this pack.

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Q01 | TP07

1 mark

November 2021 | H556/01 | Q4

- 4 The freezing point of ethanol is 159 K.

What is 159 K in °C?

- A -432 °C
- B -114 °C
- C 114 °C
- D 432 °C

Your answer

[1]

Q02 | TP02

1 mark

June 2018 | H556/01 | Q3

- 3 A metal block of mass 0.28 kg has an initial temperature of 82 °C. It is dropped into cold water. The temperature of the block after 1.2 minutes is 20 °C.
The specific heat capacity of the metal is $130 \text{ J kg}^{-1} \text{ K}^{-1}$.

What is the average thermal power transferred away from the metal block?

- A 31 W
- B 41 W
- C 1900 W
- D 2700 W

Your answer

[1]

Q03 | TP08

1 mark

November 2021 | H556/01 | Q9

- 9 A piston has a fixed amount of trapped ideal gas.

The gas exerts pressure p and has volume V . The thermodynamic (absolute) temperature of the gas is T . The mass of each atom is m . There are N atoms of the gas. The Boltzmann constant is k .

What quantities are required to determine the root mean square speed $\sqrt{c^2}$ of the atoms?

- A k and T
- B p and V
- C p , V and T
- D p , V , N and m

Your answer

☐

[1]

Q04 | TP11

1 mark

June 2022 | H556/01 | Q9

- 9 A container has 1.0 mole of gas at pressure 100 kPa.
The root mean square (r.m.s.) speed of the gas particles is 500 ms^{-1} . The mass of each gas particle is $4.7 \times 10^{-26} \text{ kg}$.

What is the volume of the container?

- A $3.9 \times 10^{-26} \text{ m}^3$
- B $4.7 \times 10^{-5} \text{ m}^3$
- C $2.4 \times 10^{-2} \text{ m}^3$
- D $4.7 \times 10^{-2} \text{ m}^3$

Your answer

☐

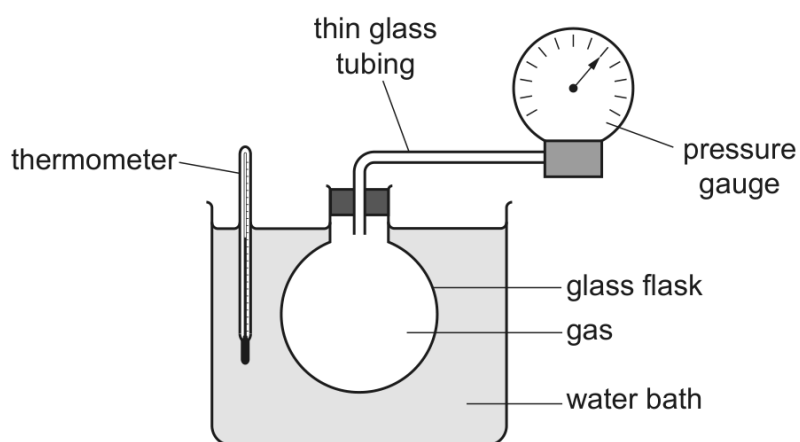
[1]

Q05 | TP13

1 mark

June 2023 | H556/01 | Q10

- 10 An experiment is carried out to estimate the value of absolute zero using the variation of gas pressure with temperature. The apparatus is shown below.



Which variable must be controlled during the experiment?

- A Pressure of the gas
- B Temperature of the gas
- C Volume of the gas
- D None of the above

Your answer

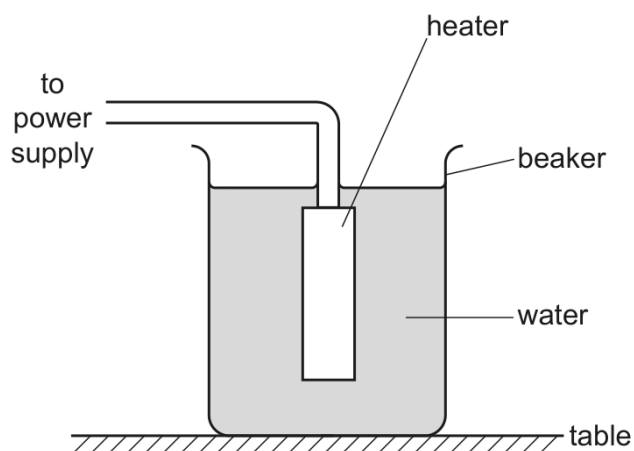
[1]

Q06 | TP26

12 marks

November 2020 | H556/01 | Q17

- 17 (a) A heater is used to heat water in a beaker.



- (i) Before switching on, the metal heater and the water are both at room temperature.

Describe the motion of the atoms of the metal heater and of the water molecules.

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..... [3]

- (ii) The heater is now switched on.
The power of the heater is 200 W.
The mass of the water in the beaker is 500 g.
It takes 10.0 minutes to increase the temperature of the water in the beaker from 20 °C to 60 °C.

Calculate the energy transferred from the water to the **beaker and the surroundings**.

- specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$

energy transferred = ... J [3]

Q06 | TP26 - continued

12 marks

November 2020 | H556/01 | Q17

- (b)* A student is carrying out an experiment to determine the specific latent heat of fusion L_f of ice. The student has two sets of apparatus next to each other on the laboratory bench, as shown in Fig. 17.1 and Fig. 17.2.

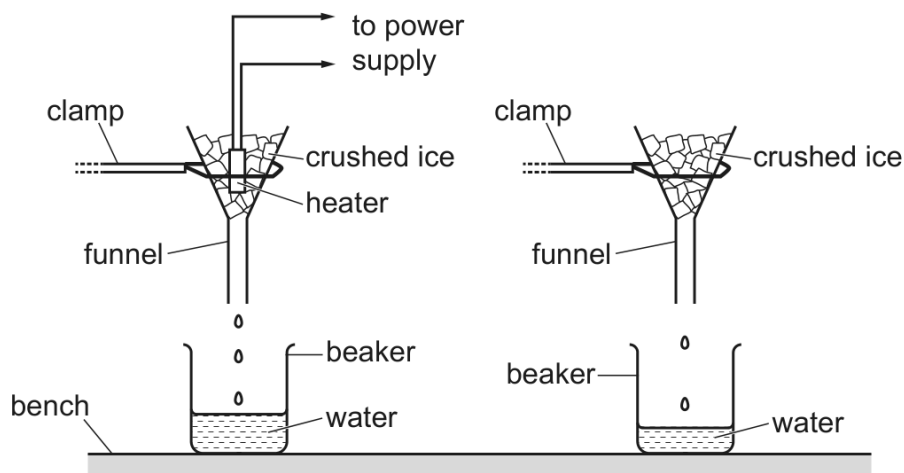


Fig. 17.1

Fig. 17.2

Both funnels are identical and have the same mass of crushed ice at 0°C .

The current in the heater is 5.0A and the potential difference across it is 12V .

Fig. 17.3 shows the variation of mass of water m collected in each beaker with time t .

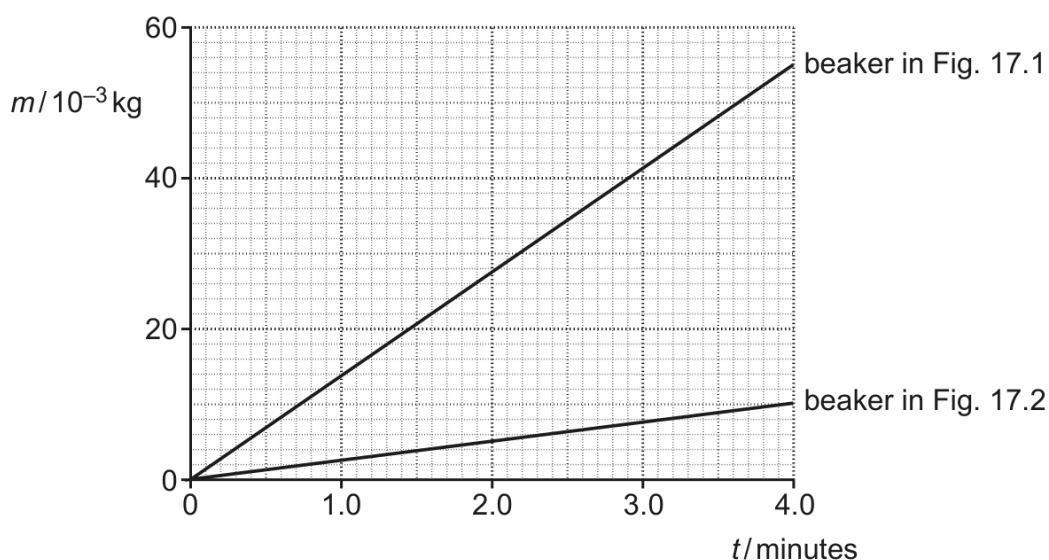


Fig. 17.3

Q06 | TP26 - continued

12 marks

November 2020 | H556/01 | Q17

Describe and explain the shape of the two graphs in **Fig. 17.3** and use them to determine the specific latent heat of fusion L_f of ice. **[6]**

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Additional answer space if required

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Q07 | TP35

6 marks

June 2023 | H556/01 | Q20(a), (b)(i), (b)(iv)

- 20 (a)** A sealed container contains n moles of an ideal gas. The gas has pressure p , absolute temperature T and occupies volume V .

The mass of one mole of the gas is M .

Use an ideal gas equation to show that the density ρ of the gas is given by the expression

$$\rho = \frac{pM}{RT}.$$

[3]

- (b)** An airship has a cabin suspended underneath a gasbag inflated with helium.

The airship is floating above the ground and is stationary.

The volume of the gasbag is $12\,000\text{ m}^3$.

The temperature of the helium and the surrounding air is 20°C .

Atmospheric pressure is $1.0 \times 10^5\text{ Pa}$.

The molar mass of air is 0.029 kg mol^{-1} .

The volume of the cabin is negligible compared to the volume of the gasbag.

- (i)** Show that the density of air under the conditions described is about 1.2 kg m^{-3} .

[1]

Only (a), (b)(i) and (b)(iv) are assigned. Part (b)(iv) links gas density and collisions to buoyancy and gasbag pressure.

Q07 | TP35 - continued

6 marks

June 2023 | H556/01 | Q20(a), (b)(i), (b)(iv)

- (iv) The pressure of the helium in the gasbag is maintained at a value only slightly greater than atmospheric pressure.
Suggest why a larger pressure is not used.

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..... [2]

Only (a), (b)(i) and (b)(iv) are assigned. Part (b)(iv) links gas density and collisions to buoyancy and gasbag pressure.

Q08 | TP23

6 marks

June 2018 | H556/01 | Q22(b)

(b)* There is a lot of helium in the Universe. This was also true of the Earth when it was formed billions of years ago. However, only small traces of helium are now found in the atmosphere of the Earth.

Use the kinetic theory of gases to explain why only small amounts of helium are found in the Earth's atmosphere. Use the information below to do suitable calculations to support your answer.

- typical atmospheric temperature = 10°C
- mass of helium atom = $6.64 \times 10^{-27} \text{ kg}$
- escape velocity from the Earth = 11 km s^{-1}

The original response area continues on the next page, as in the exam paper.

6 marks

[6]

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Q09 | TP32

11 marks

June 2022 | H556/01 | Q19

- 19 (a) A fixed mass of nitrogen changes phase from liquid to gas at a constant temperature.

Explain the change in the total internal energy of nitrogen.

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..... [2]

- (b) In a factory, nitrogen gas is added to packets of food to keep it fresh for longer.
In 1.0 hour, the factory uses 15 m^3 of nitrogen at pressure 100 kPa and temperature 23°C .

- (i) Show that the number of moles n , of nitrogen used per hour is about 600.

[3]

- (ii) Calculate the mass of nitrogen gas used in one hour.

molar mass of nitrogen = $0.028 \text{ kg mol}^{-1}$

mass = ... kg [1]

- (iii) The volume of nitrogen being used cannot be changed.

State how the rate of mass of nitrogen used can be reduced.

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..... [1]

Q09 | TP32 - continued

11 marks

June 2022 | H556/01 | Q19

- (iv) The nitrogen at the factory is stored as a liquid.
The liquid expands at constant temperature to form gas in a short section of pipe.

When the air temperature is 0°C , a thick layer of ice forms on the outside of the pipe from water vapour in the air. In 1.0 hour, the mass of ice formed is 1.3 kg at a temperature of 0°C .

Use the data below and your answer to (b)(ii), to estimate the specific latent heat of vaporisation L of nitrogen.

- specific latent heat of fusion of ice = $3.34 \times 10^5 \text{ J kg}^{-1}$
- specific latent heat of vaporisation of water = $2.26 \times 10^6 \text{ J kg}^{-1}$

$L = \dots\dots\dots \text{ J kg}^{-1}$ [4]