1 A solar panel is mounted on the roof of a house. Fig. 4.1 shows a section through part of the solar panel.

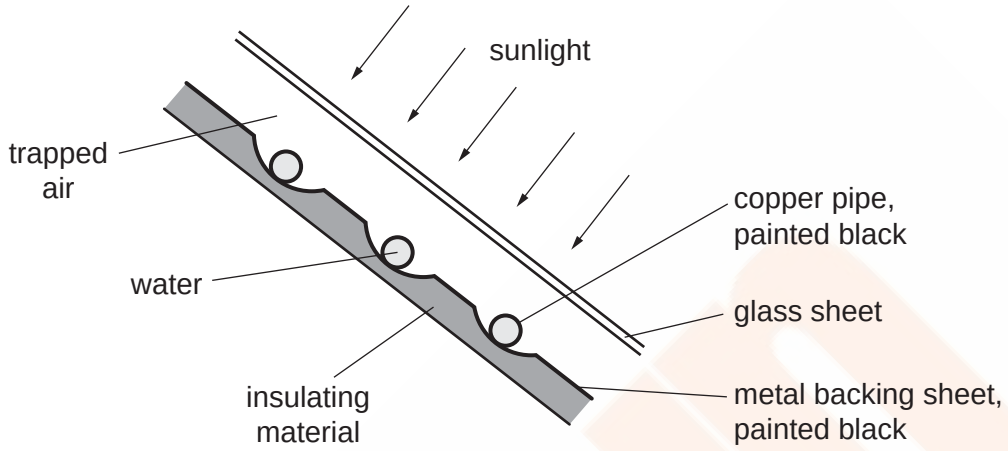


Fig. 4.1

A pump makes water flow through the copper pipes. The water is heated by passing through the solar panel.

(a) Select and explain **three** features of the solar panel that maximise the final temperature of the water.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) During one day, 250 kg of water is pumped through the solar panel. The temperature of this water rises from 16 °C to 38 °C.

The water absorbs 25 % of the energy incident on the solar panel. The specific heat capacity of water is 4200 J / (kg °C).

Calculate the energy incident on the solar panel during that day.

energy = ... [4]

(c) The solar panel in Fig. 4.1 is designed to heat water.

A person is deciding whether to install solar panels on her house.

List and explain **three** pieces of information she needs to consider in order to make her decision.

.....

.....

.....

.....

.....

.....

..... [4]

(d) The Sun releases energy as a result of nuclear fusion.

State the meaning of *nuclear fusion*.

.....

..... [2]

[Total: 14]

2 **(a)** **(i)** State two ways in which the molecular structure of a liquid is different from the molecular structure of a solid.

1. .....

.....

2. .....

.....

[2]

(ii) Explain, in terms of energy, the process which takes place as a solid at its melting point changes into a liquid at the same temperature.

.....

.....

..... [1]

(b) During a severe snowstorm, a layer of snow (ice crystals) forms on the body of an animal in a field. The snow and the surrounding air are at 0 °C. The snow begins to melt.

(i) The mass of snow that falls on the animal is 1.65 kg. The specific latent heat of fusion of snow is 330 000 J / kg.

Calculate the thermal energy needed to melt this snow.

thermal energy = ... [2]

(ii) The animal derives energy from its food to maintain its body temperature.

State the energy change that takes place.

..... [1]

[Total: 6]

3 **(a)** State the type of electromagnetic radiation

(i) used in luggage security checks at airports,

.....

(ii) used by remote controls for TV sets.

.....

[2]

(b) **(i)** The electromagnetic waves used in a microwave oven have a frequency of 2.45×10^9 Hz. The speed of the waves is 3.00×10^8 m/s.

Calculate the wavelength of the waves.

wavelength = ... [2]

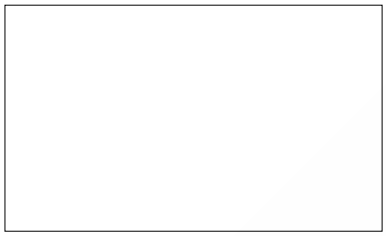
(ii) A 150 g block of ice at 0 °C is placed in the oven. The input power of the oven is 1100 W. The energy absorbed by the block is 65% of the input energy.

Calculate the time taken to melt the ice to water at 0 °C. The specific latent heat of fusion of ice is 330 J/g.

time = ... [4]

[Total: 8]

4 **(a)** In the box below, sketch a diagram to represent the molecular structure of a liquid. Show the molecules as small circles of equal size.



[2]

(b) A teacher in a school laboratory pours liquid ethanol from a bottle into a glass dish. The glass dish rests on an electronic balance. Although the temperature of the laboratory is below the boiling point of ethanol, the mass of ethanol in the dish quickly decreases as ethanol evaporates.

(i) State the effect of this evaporation on the temperature of the remaining ethanol.

..... [1]

(ii) Explain, in terms of the ethanol molecules, why this is happening.

.....

..... [1]

(iii) The specific latent heat of vaporisation of ethanol is 850 J/g.

Calculate the thermal energy required to evaporate 3.4 g of ethanol.

thermal energy = ... [2]

(iv) Suggest **two** ways in which the rate of evaporation of ethanol from the dish can be reduced.

1. .....

2. .....

[2]

[Total: 8]

5 Fig. 3.1 shows a long, plastic tube, sealed at both ends. The tube contains 0.15 kg of small metal spheres.

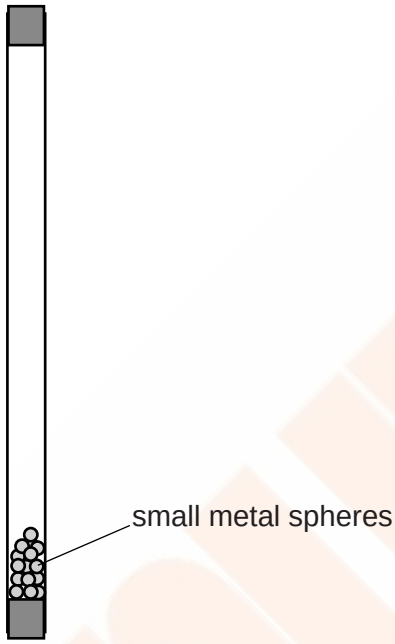


Fig. 3.1

A physics teacher turns the tube upside down very quickly and the small metal spheres then fall through 1.8 m and hit the bottom of the tube.

(a) Calculate

(i) the decrease in gravitational potential energy as the spheres fall 1.8 m,

decrease in gravitational potential energy = ... [2]

(ii) the speed of the spheres as they hit the bottom of the tube.

speed = ... [3]

(b) The gravitational potential energy of the spheres is eventually transformed to thermal energy in the metal spheres. The physics teacher explains that this procedure can be used to determine the specific heat capacity of the metal.

(i) State one other measurement that must be made in order for the specific heat capacity of the metal to be determined.

.....

.....[1]

(ii) Suggest a source of inaccuracy in determining the specific heat capacity using this experiment.

.....

.....[1]

(iii) The teacher turns the tube upside down and lets the spheres fall to the bottom 100 times within a short period of time.

Explain why turning the tube upside down 100 times, instead of just once, produces a more accurate value of the specific heat capacity.

.....

.....

.....[2]

[Total: 9]

6 **(a)** On a hot day, sweat forms on the surface of a person's body and the sweat evaporates.

Explain, in terms of the behaviour of molecules,

(i) the process of evaporation,

.....

.....

.....

(ii) how this process helps the body to cool down.

.....

.....

.....

.....

.....

.....

[3]

(b) The temperature of a person of mass 60 kg falls from 37.2 °C to 36.7 °C.

(i) Calculate the thermal energy lost from the body. The average specific heat capacity of the body is 4000 J/(kg °C).

thermal energy lost = ... [2]

(ii) The cooling of the body was entirely due to the evaporation of sweat.

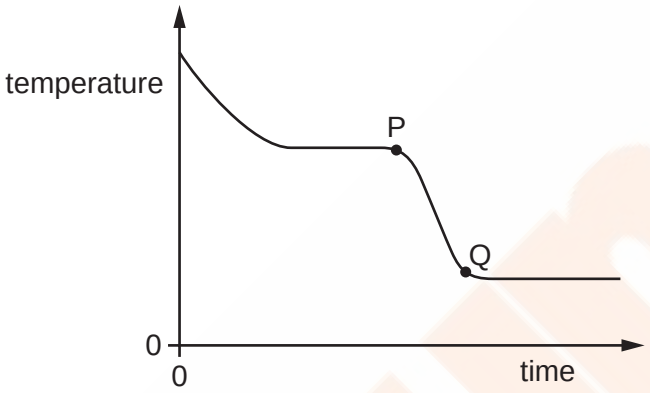
Calculate the mass of sweat which evaporated. The specific latent heat of vaporisation of sweat is $2.4 \times 10^6 \, J/kg$.

mass = ...[2]

[Total: 7]

1 A substance loses thermal energy (heat) to the surroundings at a steady rate.

The graph shows how the temperature of the substance changes with time.



What could the portion PQ of the graph represent?

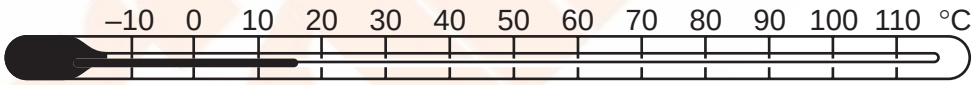
A gas condensing

B gas cooling

C liquid cooling

D liquid solidifying

2 A student wishes to check the upper and the lower fixed points on a Celsius scale thermometer.



She has four beakers P, Q, R and S.

Beaker P contains a mixture of ice and salt.

Beaker Q contains a mixture of ice and water.

Beaker R contains boiling salt solution.

Beaker S contains boiling water.

Which two beakers should she use to check the fixed points?

A P and R **B** P and S **C** Q and R **D** Q and S

3 The same quantity of thermal energy is supplied to two solid objects X and Y. The temperature increase of object X is greater than the temperature increase of object Y.

Which statement explains this?

A X has a lower melting point than Y.

B X has a lower density than Y.

C X has a lower thermal capacity than Y.

D X is a better thermal conductor than Y.

4 Which statement describes what happens as ice at 0 °C starts to melt to become water?

A Energy is absorbed and the temperature remains constant.

B Energy is absorbed and the temperature rises.

C Energy is released and the temperature remains constant.

D Energy is released and the temperature rises.

5 What is meant by the *fixed points* of the scale of a liquid-in-glass thermometer?

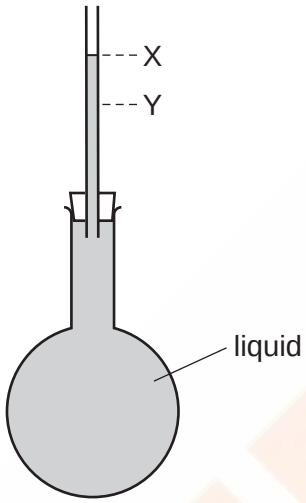
A the distance between one scale division and the next

B the highest and lowest temperatures that the thermometer can record

C the maximum and minimum depth to which the thermometer should be submerged in a liquid

D the two agreed temperatures used for marking the temperature scale

6 A liquid at room temperature fills a flask and a glass tube to level X.



The flask is now placed in ice, and the liquid level in the tube falls to level Y.

Why does the level fall?

A The flask contracts.

B The flask expands.

C The liquid contracts.

D The liquid expands.

7 The melting points of ethanol and mercury are shown.

	melting point / °C
ethanol	–114
mercury	–39

Which of these two liquids is / are suitable to use in a liquid-in-glass thermometer to measure temperatures of –50 °C and –120 °C?

A ethanol only

B ethanol and mercury

C mercury only

D neither ethanol nor mercury

8 Which quantity gives the *thermal capacity* of a beaker?

A the thermal energy required to change the state of the beaker at constant temperature

B the thermal energy required to raise the temperature of the beaker by 1 °C

C the total mass of hot liquid that the beaker can hold

D the total volume of hot liquid that the beaker can hold

9 A jug of water is at room temperature.

Several ice cubes at a temperature of 0 °C are dropped into the water and they begin to melt immediately.

What happens to the temperature of the water and what happens to the temperature of the ice cubes while they are melting?

	temperature of the water	temperature of the ice cubes
A	decreases	increases
B	decreases	stays constant
C	stays constant	increases
D	stays constant	stays constant

10 Which quantity gives the *thermal capacity* of a beaker?

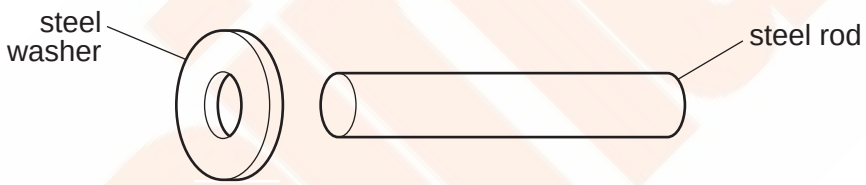
A the thermal energy required to change the state of the beaker at constant temperature

B the thermal energy required to raise the temperature of the beaker by 1 °C

C the total mass of hot liquid that the beaker can hold

D the total volume of hot liquid that the beaker can hold

11 An engineer wants to fix a steel washer on to a steel rod. The rod is just too big to fit into the hole of the washer.



How can the engineer fit the washer on to the rod?

A Cool the washer and then place it over the rod.

B Cool the washer and rod to the same temperature and then push them together.

C Heat the rod and then place it in the hole in the washer.

D Heat the washer and then place it over the rod.

12 The table lists the melting points and the boiling points of four different substances.

Which substance is a liquid at 0 °C?

	melting point / °C	boiling point / °C
A	–219	–183
B	–7	58
C	98	890
D	1083	2582

13 To mark a temperature scale on a thermometer, standard temperatures known as fixed points are needed.

Which of these is a fixed point on the Celsius scale?

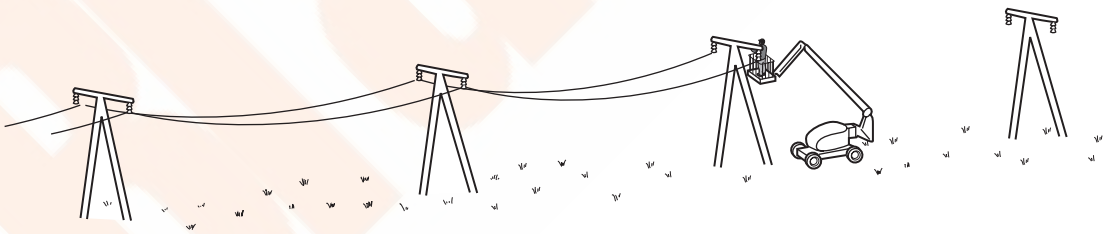
A room temperature

B the temperature inside a freezer

C the temperature of pure melting ice

D the temperature of pure warm water

14 The diagram shows electricity cables being put up on a warm day. The cables are left loose between the poles, as shown in the diagram.



Why are the cables left loose?

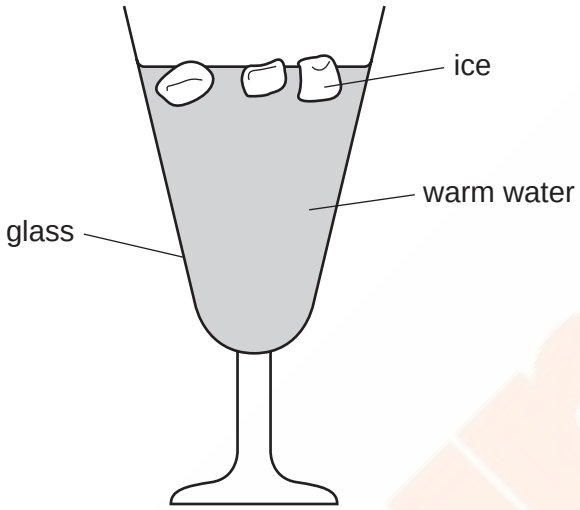
A They will contract on cold days.

B They will contract on very warm days.

C They will expand on cold days.

D They will expand on very warm days.

15 The diagram shows some ice being used to lower the temperature of some warm water.



What is the main process by which the water at the bottom of the glass becomes cool?

A condensation

B conduction

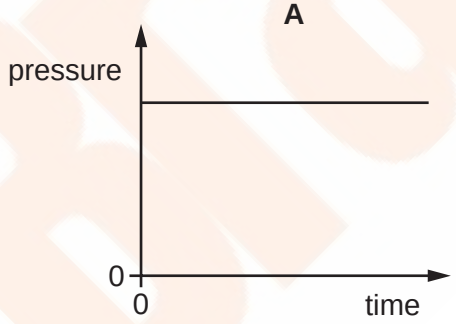
C convection

D radiation

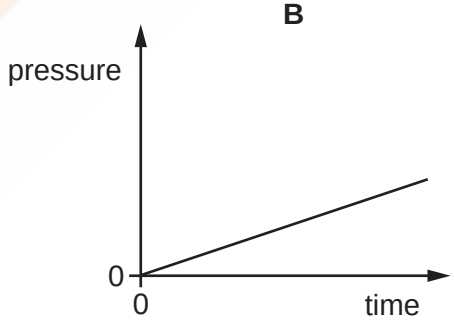
16 The pressure of a fixed mass of gas in a cylinder is measured. The temperature of the gas in the cylinder is then slowly increased. The volume of the cylinder does not change.

Which graph shows the pressure of the gas during this process?

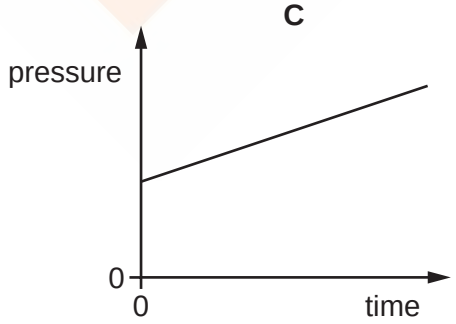
A



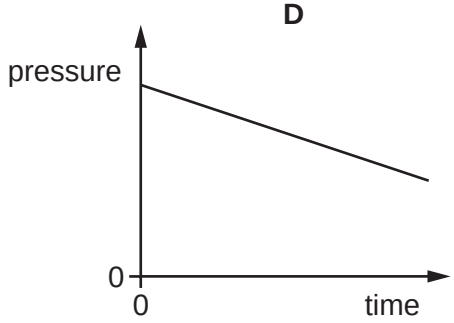
B



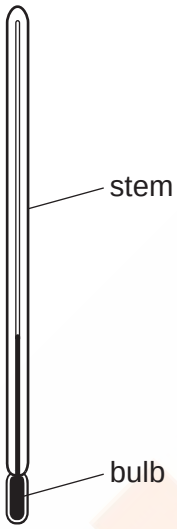
C



D



17 The thermometer in the diagram has no scale.



Where must the bulb be placed so that 0 °C can be marked on the stem?

A in a freezer

B in pure boiling water

C in pure cold water

D in pure melting ice

18 Two metal blocks X and Y are at room temperature. Each block is heated so that its temperature rises by 10 °C.

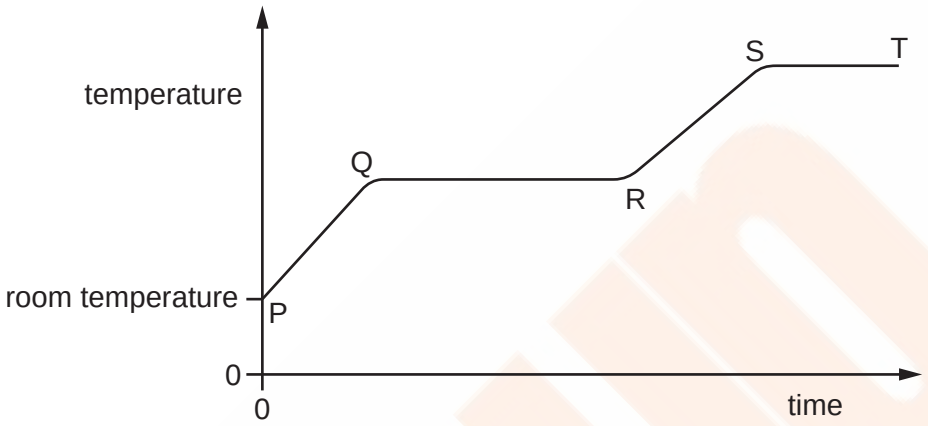
The blocks are now allowed to cool back to room temperature.

Block Y has a greater thermal capacity than block X.

Which block needs more thermal (heat) energy to heat it up by 10 °C and which block loses more thermal (heat) energy as it cools back to room temperature?

	more energy	
	heating	cooling
A	X	X
B	X	Y
C	Y	X
D	Y	Y

19 A solid is heated from room temperature. The graph shows how its temperature changes with time as it is heated constantly.



Between which labelled points on the graph is the substance partly solid and partly liquid?

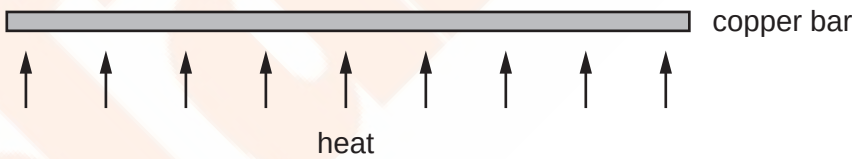
A between P and Q

B between Q and R

C between R and S

D between S and T

20 A long thin bar of copper is heated evenly along its length.



What happens to the bar?

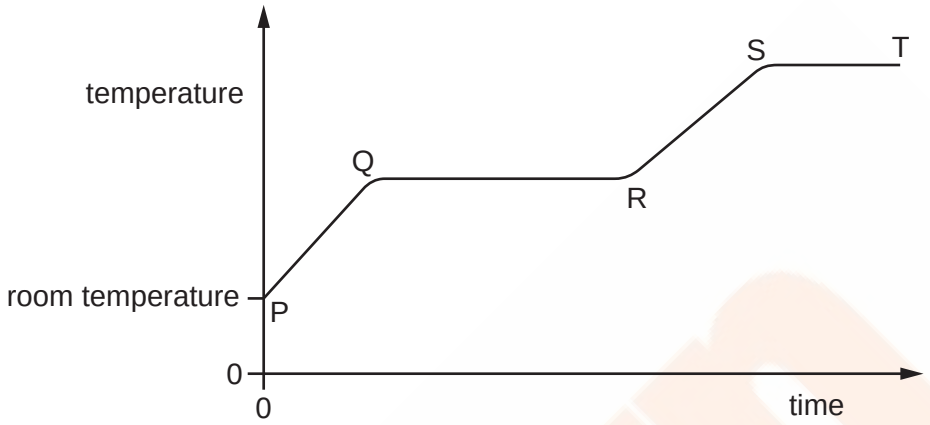
A It becomes less heavy.

B It becomes longer.

C It becomes shorter.

D It bends at the ends.

21 A solid is heated from room temperature. The graph shows how its temperature changes with time as it is heated constantly.



Between which labelled points on the graph is the substance partly solid and partly liquid?

A between P and Q

B between Q and R

C between R and S

D between S and T

22 The diagram shows four markings on a liquid-in-glass thermometer.

Which temperatures are the upper and lower fixed points?

	upper fixed point / °C	lower fixed point / °C
A	110	0
B	110	–10
C	100	0
D	100	–10

23 The thermal capacity of solid Y is greater than that of solid Z.

What is a consequence of this?

A Solid Y needs less thermal energy to melt it than solid Z.

B Solid Y needs less thermal energy to raise its temperature by 1 °C than solid Z.

C Solid Y needs more thermal energy to melt it than solid Z.

D Solid Y needs more thermal energy to raise its temperature by 1 °C than solid Z.

24 A circular metal disc is heated.

Which quantity decreases?

A its density

B its diameter

C its thickness

D its volume

25 The same quantity of thermal (heat) energy is given to two objects X and Y. The temperature rise of object X is less than the temperature rise of object Y.

What accounts for this difference?

A X has a larger thermal capacity than Y.

B X is a better thermal conductor than Y.

C Y has a larger thermal capacity than X.

D Y is a better thermal conductor than X.

26 A block of copper and a block of lead are heated. The internal energy of each block increases by the same amount.

The block of copper has a lower thermal capacity than the block of lead.

Which conclusion can be made from this information?

A The temperature increase of the copper is greater than the temperature increase of the lead.

B The temperature increase of the copper is the same as the temperature increase of the lead.

C The temperature increase of the copper is less than the temperature increase of the lead.

D The melting point of copper is lower than the melting point of lead.

27 The diagram shows a mercury-in-glass thermometer. The scale of the thermometer has not been marked.

The length l increases uniformly with temperature.

The length l is measured when the thermometer bulb is placed in water at 0 °C, and also when it is in water at 100 °C. The table shows the results.

temperature / °C	length l / cm
0	2.
100	2

What is the value of l when the bulb is placed in water at 50 °C?

A 12.0 cm **B** 13.0 cm **C** 14.0 cm **D** 16.0 cm

28 When steam condenses it becomes liquid water. When liquid water solidifies it becomes ice.

What happens to the temperature of steam while it is condensing, and what happens to the temperature of water while it is solidifying?

	temperature of steam while it is condensing	temperature of water while it is solidifying
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

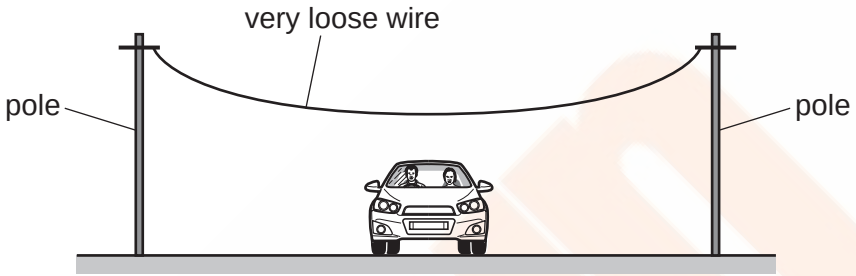
29 A thermometer has graduations which start at –10 °C and end at 110 °C.

What is the lower fixed point and what is the upper fixed point of the Celsius scale?

	lower fixed point / °C	upper fixed point / °C
A	–10	100
B	–10	110
C	0	100
D	0	110

30 A telephone engineer connects a wire between two poles when the weather is very cold.

He makes the wire very loose. The wire passes over a road.



The weather changes and it becomes very hot.

What could happen to the wire and why?

	what could happen	why
A	it breaks	it contracts
B	it breaks	it expands
C	it sags and touches cars on the road	it contracts
D	it sags and touches cars on the road	it expands

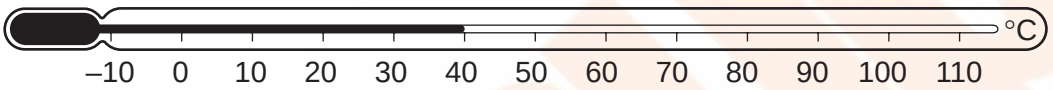
31 In an experiment, a thermometer is placed in a test-tube of hot liquid. The temperature of the liquid is recorded every half minute. The table shows the results.

time / minutes	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
temperature / °C	73	65	59	55	55	55	51	48	45	42	40	38	36	35	34	33

What is the melting point of the substance?

A 0 °C **B** 33 °C **C** 55 °C **D** 73 °C

32 A liquid-in-glass thermometer is marked with a scale in °C.



What is the temperature difference between the two fixed points for this thermometer?

A 40°C **B** 50°C **C** 100°C **D** 120°C

33 Which statement gives the thermal capacity of a solid body?

A the energy needed to melt the body without a change in temperature

B the energy per degree Celsius needed to raise the temperature of the body

C the increase in the volume of the body when its temperature is raised by one degree Celsius

D the total amount of internal energy in the body

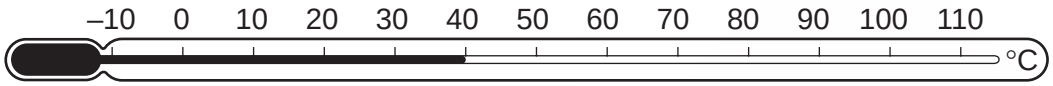
34 In an experiment, a thermometer is placed in a test-tube of hot liquid. The temperature of the liquid is recorded every half minute. The table shows the results.

time / minutes	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
temperature / °C	73	65	59	55	55	55	51	48	45	42	40	38	36	35	34	33

What is the melting point of the substance?

A 0 °C **B** 33 °C **C** 55 °C **D** 73 °C

35 Which points are the fixed points of the liquid-in-glass thermometer shown?



A the beginning and end points of the column of liquid

B the beginning and end points of the thermometer scale

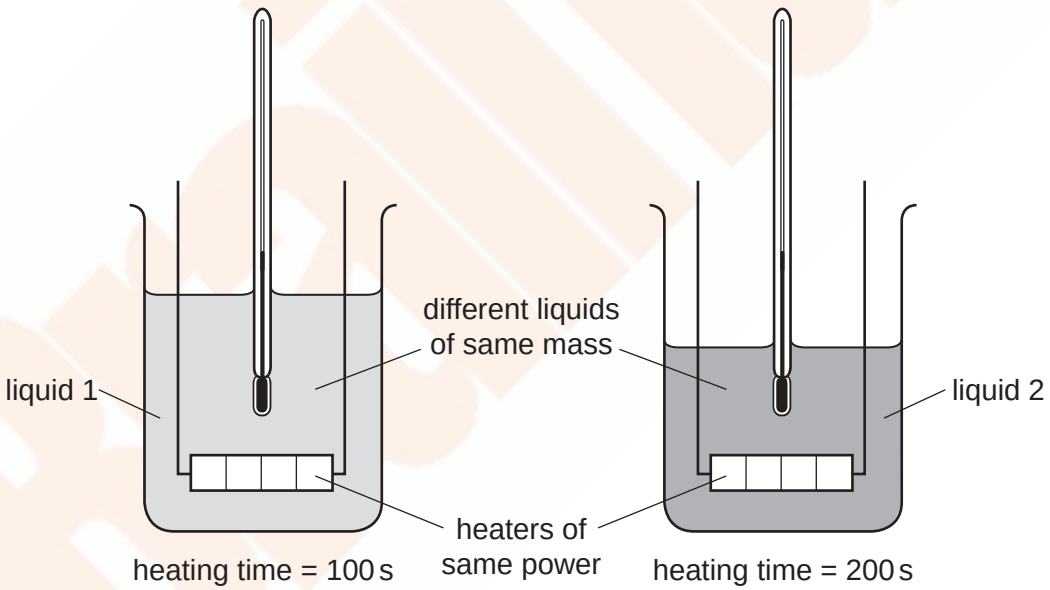
C the points marked 0 °C and 100 °C

D the top and bottom points of the thermometer bulb

36 Equal masses of two different liquids are put into identical beakers.

Liquid 1 is heated for 100 s and liquid 2 is heated for 200 s by heaters of the same power.

The temperature of both liquids increases by the same amount.



Which statement is correct?

A Both liquids receive the same amount of energy.

B Liquid 1 receives more energy than liquid 2.

C Both liquids have equal thermal capacity.

D The thermal capacity of liquid 1 is less than the thermal capacity of liquid 2.

37 The metal surface of a kettle is hot.

What happens to the cool air outside the kettle when it comes into contact with the hot kettle?

A The density of the air decreases and the air falls.

B The density of the air decreases and the air rises.

C The density of the air increases and the air falls.

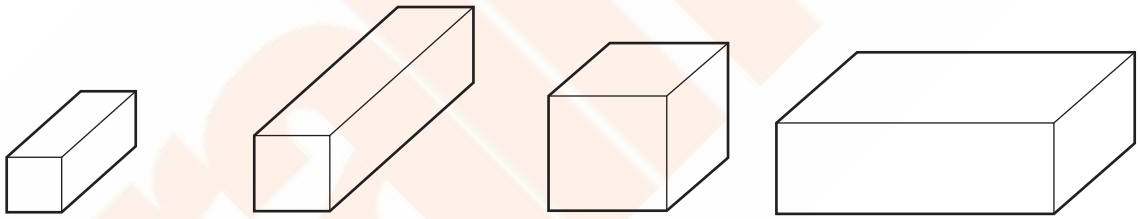
D The density of the air increases and the air rises.

38 The diagrams show four blocks of steel. The blocks are all drawn to the same scale.

The same quantity of thermal energy (heat) is given to each block.

Which block shows the greatest rise in temperature?

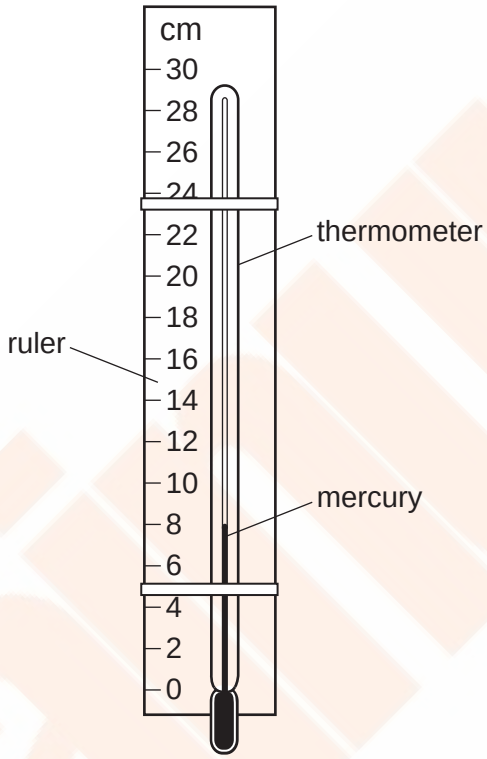
A **B** **C** **D**



39 A mercury thermometer with no scale is taped to a ruler as shown.

When the thermometer is placed in steam, the mercury level rises to 22.0 cm.

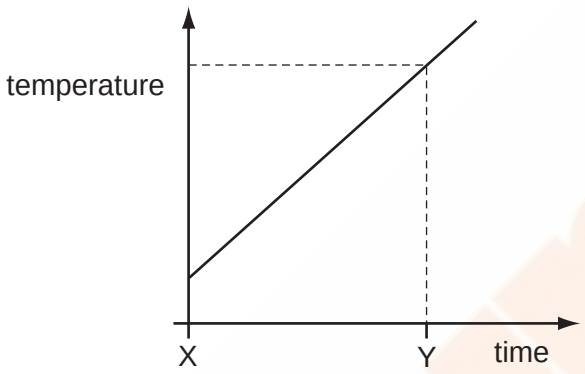
When the thermometer is placed in pure melting ice, the mercury level falls to 2.0 cm.



Which temperature is shown by the mercury level in the diagram?

A 6 °C **B** 8 °C **C** 30 °C **D** 40 °C

40 A gas storage tank has a fixed volume. The graph shows how the temperature of the gas in the tank varies with time.



At time Y, the gas molecules are

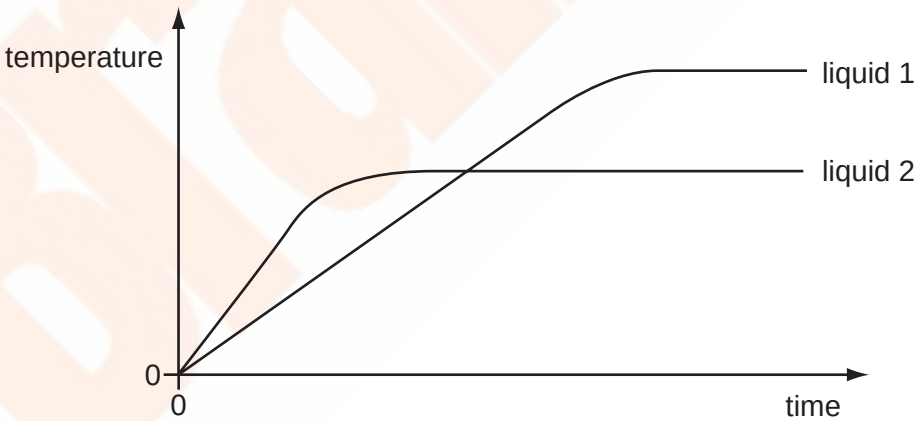
A closer together than at time X.

B hitting the sides of the tank harder than at time X.

C larger in size than at time X.

D moving more slowly than at time X.

41 Equal masses of two different liquids are heated using the same heater. The graph shows how the temperature of each liquid changes with time.



What does the graph tell us about the liquids?

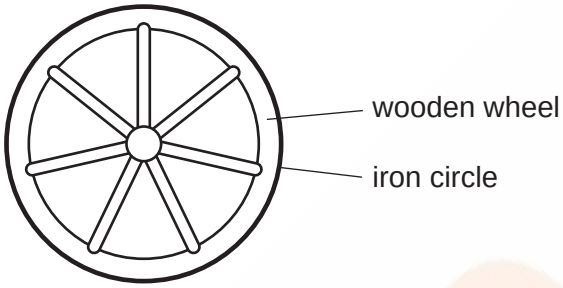
A Liquid 1 has a higher melting point than liquid 2.

B Liquid 1 has a higher boiling point than liquid 2.

C Liquid 1 starts to melt sooner than liquid 2.

D Liquid 1 starts to boil sooner than liquid 2.

42 A wooden wheel can be strengthened by putting a tight circle of iron around it.



Which action would make it easier to fit the circle over the wood?

A cooling the iron circle

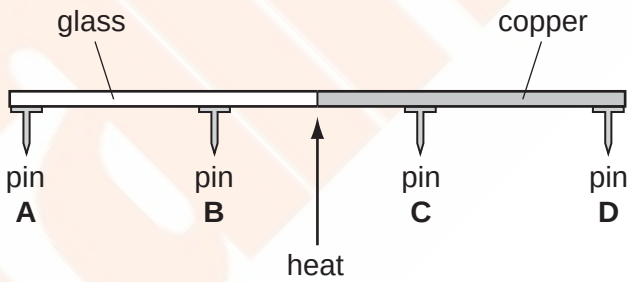
B heating the iron circle

C heating the wooden wheel and cooling the iron circle

D heating the wooden wheel but not heating or cooling the iron circle

43 A rod is made half of glass and half of copper. Four pins, **A**, **B**, **C** and **D** are attached to the rod by wax. The rod is heated in the centre as shown.

Which pin falls off first?



44 Which pair contains **only** physical quantities that vary with temperature and so could be used in making a thermometer?

A activity of a radioactive source, volume of a gas

B mass of a liquid, volume of a liquid

C activity of a radioactive source, mass of a solid

D volume of a gas, volume of a liquid

45 A heater supplies 80 J of energy to a block of metal. The temperature of the block rises by 20 °C.

What happens to the block of metal when its temperature falls by 10 °C?

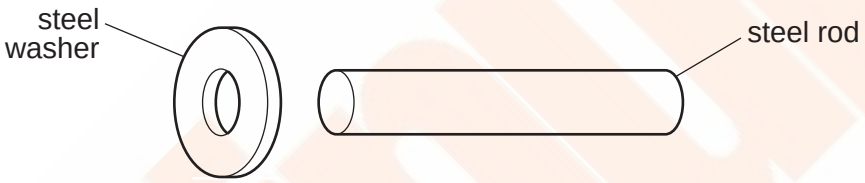
A Its internal energy decreases by 40 J.

B Its internal energy decreases by 160 J.

C Its internal energy increases by 40 J.

D Its internal energy increases by 160 J.

46 An engineer wants to fix a steel washer on to a steel rod. The rod is just too big to fit into the hole of the washer.



How can the engineer fit the washer on to the rod?

A Cool the washer and put it over the rod.

B Cool the washer and rod to the same temperature and push them together.

C Heat the rod and then place it in the hole.

D Heat the washer and then place it over the rod.

47 A solid object has a very large thermal capacity.

What does this mean?

A A large amount of energy is needed to make the object become hot.

B A large amount of energy is needed to make the object melt.

C A small amount of energy is needed to make the object become hot.

D A small amount of energy is needed to make the object melt.

48 A hot drink is left in a room that is at a temperature of 20 °C.

What has happened to the drink after ten minutes?

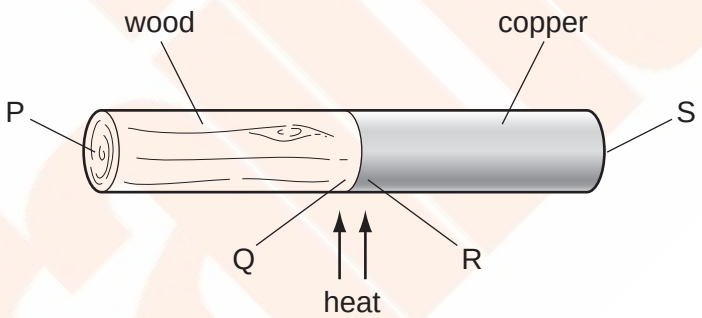
A Its density is lower.

B Its internal energy is lower.

C Its particles have equal energies.

D Its particles move more quickly.

49 A rod is made of copper and wood joined together.

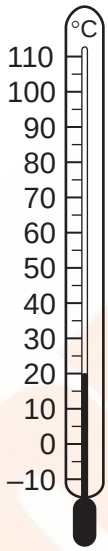


The rod is heated at the join in the centre for about a minute.

At which labelled point will the temperature be lowest, and at which point will it be highest?

	lowest temperature	highest temperature
A	P	Q
B	P	R
C	S	P
D	S	R

50 The diagram shows a thermometer calibrated in degrees Celsius.



What are the values of the lower fixed point and of the upper fixed point on the Celsius scale?

	lower fixed point / °C	upper fixed point / °C
A	–10	110
B	0	20
C	0	100
D	20	100

51 An ice cube at a temperature of 0 °C is put into a drink at a temperature of 10 °C.

After a short time, some of the ice has melted and the drink has cooled to a temperature of 8 °C.

What is the temperature of the remaining ice?

A 0 °C **B** 2 °C **C** 4 °C **D** 8 °C

52 To mark the lower fixed point of a Celsius scale on a thermometer, the thermometer should be placed in

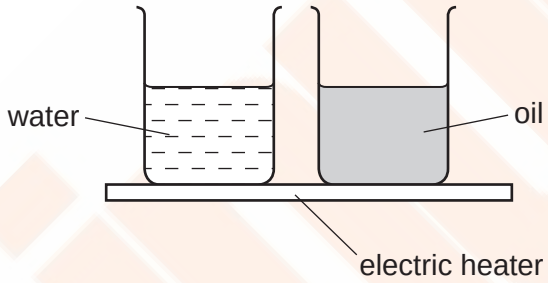
A pure alcohol.

B pure distilled water.

C pure melting ice.

D pure mercury.

53 The diagram shows an electric heater being used to heat a beaker of water and an identical beaker of oil for several minutes.



The temperature of the water and the temperature of the oil increase constantly. The rise in temperature of the oil is much greater than that of the water.

Why is this?

A The oil has a higher boiling point than water.

B The oil has a higher thermal capacity than water.

C The oil has a lower boiling point than water.

D The oil has a lower thermal capacity than water.

54 Which statement about evaporation is correct?

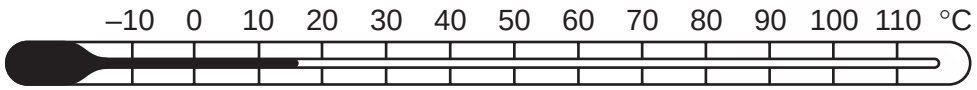
A Evaporation causes the temperature of the remaining liquid to decrease.

B Evaporation does not occur from a cold liquid near its freezing point.

C Evaporation does not occur from a dense liquid, such as mercury.

D Evaporation occurs from all parts of a liquid.

55 A student wishes to check the upper and the lower fixed points on a Celsius scale thermometer.



She has four beakers P, Q, R and S.

Beaker P contains a mixture of ice and salt.

Beaker Q contains a mixture of ice and water.

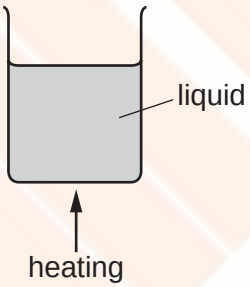
Beaker R contains boiling salt solution.

Beaker S contains boiling water.

Which two beakers should she use to check the fixed points?

A P and R **B** P and S **C** Q and R **D** Q and S

56 A liquid is heated in a beaker.



The density of the liquid changes as its temperature increases. This causes energy to be transferred throughout the liquid.

How does the density change and what is this energy transfer process?

	density	energy transfer process
A	decreases	conduction
B	decreases	convection
C	increases	conduction
D	increases	convection

57 Which statement describes what happens as ice at 0 °C starts to melt to become water?

A Energy is absorbed and the temperature remains constant.

B Energy is absorbed and the temperature rises.

C Energy is released and the temperature remains constant.

D Energy is released and the temperature rises.

58 A liquid is at a temperature below its boiling point.

The liquid is then heated so that it becomes a gas at a temperature above its boiling point.

Which row correctly compares the liquid with the gas?

	average distance between the particles	average speed of the particles
A	greater in the liquid	greater in the liquid
B	greater in the liquid	smaller in the liquid
C	smaller in the liquid	greater in the liquid
D	smaller in the liquid	smaller in the liquid

59 5.0 g of water at 25 °C is dropped onto a large block of ice at 0 °C. The water cools to 0 °C and some of the ice melts.

Assume that all the energy lost by the water is gained by the ice.

What is the mass of ice that melts?

The specific heat capacity of water is 4.2 J / (g °C).

The specific latent heat of fusion of ice is 340 J / g.

A 0.062 g **B** 0.087 g **C** 1.5 g **D** 10 g

60 What causes the random, zig-zag movement (Brownian motion) of smoke particles suspended in air?

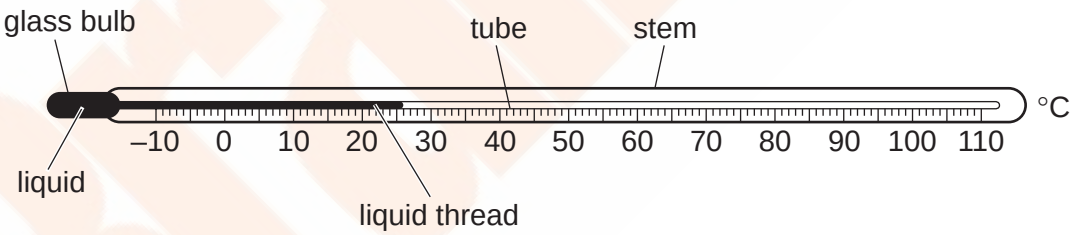
A air molecules colliding with smoke particles

B convection currents as the hot smoke rises

C smoke particles colliding with each other

D smoke particles reacting with oxygen molecules in the air

61 The diagram shows a liquid-in-glass thermometer.



How can the thermometer be made more sensitive?

A increase the internal diameter of the tube containing the liquid thread

B increase the internal volume of the glass bulb and the volume of the liquid

C increase the length of the tube and stem

D increase the thickness of the glass in the glass bulb

62 In an experiment to measure specific heat capacity, a block of aluminium is heated and its rise in temperature is measured.

The amount of energy gained by the block is E. The mass of the block is m. The rise in temperature of the block is ΔT.

Which expression gives the specific heat capacity of aluminium?

A $\frac{m}{E\Delta T}$ **B** $\frac{m\Delta T}{E}$ **C** $\frac{E}{m\Delta T}$ **D** $\frac{E\Delta T}{m}$

63 Which quantity gives the *thermal capacity* of a solid object?

A the energy lost by radiation from the object in 1.0 s

B the energy needed to melt the object

C the energy needed to raise the temperature of the object by 1.0 °C

D the total amount of thermal energy in the object

64 To mark a temperature scale on a thermometer, standard temperatures known as fixed points are needed.

Which of these is a fixed point on the Celsius scale?

A room temperature

B the temperature inside a freezer

C the temperature of pure melting ice

D the temperature of pure warm water

65 In an experiment, a liquid is heated at a constant rate.

The temperature of the liquid increases and eventually becomes constant.

Which statement about the experiment is correct?

A Boiling occurs at all temperatures but only on the liquid surface.

B Boiling occurs throughout the liquid but only at the constant temperature.

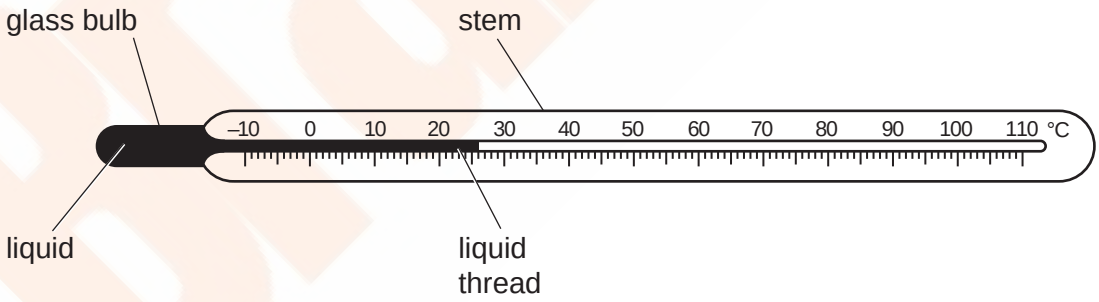
C Evaporation occurs throughout the liquid and at all temperatures.

D Evaporation occurs only at the constant temperature and only on the liquid surface.

66 Which line in the table shows the relative expansion of the three states of matter from the most expansion to the least expansion?

	most expansion				least expansion
A	solids	>	liquids	>	gases
B	solids	>	gases	>	liquids
C	gases	>	liquids	>	solids
D	gases	>	solids	>	liquids

67 The diagram shows a liquid-in-glass thermometer.



Which two features both affect the sensitivity of the thermometer?

A mass of liquid and diameter of liquid thread

B mass of liquid and length of stem

C thickness of glass bulb and diameter of liquid thread

D thickness of glass bulb and length of stem

68 A student wishes to calculate the specific heat capacity of copper.

He has a block of copper and an electrical heater. He knows the power of the heater.

Which other apparatus does he need?

	balance	watch	thermometer
A	✓	✓	✓
B	✓	✓	×
C	✓	×	✓
D	×	✓	✓

key

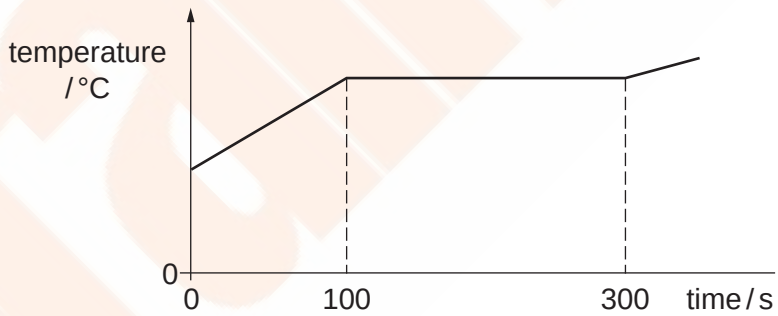
✓ = needed

× = not needed

69 A mass of 0.20 kg of a substance is initially solid.

It is heated at a steady rate of 500 W.

The graph shows how the temperature of the substance changes with time.



What is the specific latent heat of fusion of the substance?

A 20 000 J / kg

B 30 000 J / kg

C 500 000 J / kg

D 750 000 J / kg

1 **(a** three valid features listed without explanation [1]

any three features explained from:

copper/metal is a good conductor (of heat)
NOT of electricity

black is good absorber/bad reflector
ignore emitter

insulating material will reduce heat lost/conducted away (from pipes/sheet)
NOT prevents heat loss owtte

glass/trapping of air reduces/prevents convection/warm air being blown away

glass produces greenhouse effect/reference to far and near I.R. [max 3]

(b) 38 – 16 OR 22 [1]
$mc\theta$ OR 250 × 4200 × candidate's temperature difference [1]
2.31×10^7 (J) e.c.f. from previous line [1]
9.24×10^7 J OR e.c.f. from previous line × 4 correctly evaluated [1]
no unit penalty if J seen anywhere in **(b)** clearly applied to an energy

(c) valid explanation relating to at least one of the reasons below: [1]
note: if no explanation, this mark is not awarded even if more than three reasons are given

any three reasons from:
which direction roof faces
estimate output of panels
household needs / whether household will use all hot water
cost of panel / installation
time to recoup cost
whether roof is shaded
relevant environmental consideration (e.g. not using wood or other fuel to heat water) [max 3]

(d) nuclei join together, accept hydrogen for nuclei
to produce a different element / helium (and energy) [2]

2 **(a) (i)** any 2 from: max. B2
- liquid molecules not in fixed positions / can move about / move past each other OR solid molecules have a fixed position
- liquid molecules have random arrangement OR solid molecules arranged regularly / in patterns / layers / lattice
- liquid molecules are (slightly) further apart (than solid molecules) OR reverse argument

(ii) energy / work / thermal energy / (latent) heat required
AND
to break bonds (between molecules) / to overcome attractive forces (between the molecules) / to increase the potential energy of the molecules B1

(b) (i) $E = ml$ in any form OR ml OR $1.65 \times 330\,000$ C1
$= 540\,000$ J OR 544 500 J A1

(ii) chemical (energy in body) converted to thermal / internal (energy) B1

[Total: 6]

3 **(a) (i)** X-rays B1

(ii) Infra-red B1

(b) (i) $v = f\lambda$ in any form OR $v \div f$ OR $3.0 \times 10^8 \div (2.45 \times 10^9)$ C1
0.12 m A1

(ii) ($Q =$) ml OR 150×330 C1
49 000 (J) OR 49 000 (J) OR 50 000 (J)

$P = Q/t$ in any form OR ($t =$) Q/P OR (0.65×1100) OR 715 C1
69 s A1

[Total: 8]

4 **(a** diagram shows (molecules) randomly positioned M1
diagram shows most (molecules) touching/very closely spaced A1

(b) (i) (temperature) decreases B1

(ii) more energetic/faster molecules escape from surface/overcome forces of attraction B1

(iii) $E = ml$ in any form **OR** ml C1
2900 J A1

(iv) any two from:
- cover/decrease surface area
- reduce temperature
- reduce draught owtte
- increase humidity of air B2

[Total: 8]

5 **(a (i)** (g.p.e. =) mgh **OR** $0.15 \times 10 \times 1.8$ C1
2.7 J ignore minus sign A1

(ii) (k.e. **OR** 2.7 =) $\frac{1}{2}mv^2$ **OR** $\frac{1}{2} \times 0.15v^2$ C1
(v^2 =) 36 C1
6.0 m/s A1

(b) (i) initial temperature (of metal) **OR** final temperature (of metal)
OR temperature change (of metal) B1

(ii) thermal energy transferred to something specific e.g. air/tube/stopper/thermometer/surroundings/environment
OR small spheres lost before/after weighing
OR not all the spheres fall the same distance B1

(iii) higher temperature increase **OR** calculate mean of (100) readings M1
small measurements less accurate owtte A1

[Total: 9]

6 **(a)** **(i)** and **(ii)** marked together to maximum of 3 marks

(i) molecules escape/leave the liquid/form gas or vapour B1

(ii) evaporation OR heat/(thermal) energy needed for evaporation leaves sweat cooler B1
fast(er) molecules/high(er) energy molecules escape
OR slow(er) molecules left behind B1
heat flows from body to warm the sweat (so body cools) B1

(b) (Q =) $mc\Delta\theta$ OR mcT OR $60 \times 4000 \times 0.50$ C1
1.2×10^5 J / 120 kJ A1

(ii) $Q = mL$ in any form OR (m =) Q/L OR either with numbers C1
($m = 1.2 \times 10^5 / 2.4 \times 10^6$ =) 0.05 kg e.c.f from **(b)(i)** A1

[Total 7]

1	C
2	D
3	C
4	A
5	D
6	C
7	D
8	B
9	B
10	B
11	C
12	C
13	A
14	D
15	C
16	C
17	D
18	D
19	B
20	B

21	B
22	C
23	D
24	A
25	A
26	A
27	C
28	D
29	C
30	D
31	C
32	C
33	B
34	C
35	C
36	D
37	B
38	A
39	C
40	B

41 B

42 B

43 C

44 D

45 A

46 D

47 A

48 B

49 A

50 C

51 A

52 C

53 D

54 A

55 D

56 B

57 A

58 D

59 C

60 A

61 B

62 C

63 C

64 C

65 B

66 C

67 A

68 A

69 C

1 **(a)** The following are three statements about boiling.

- A liquid boils at a fixed temperature.
- During boiling, vapour can form at any point within the liquid.
- Without a supply of thermal energy, boiling stops.

Complete the following equivalent statements about evaporation.

- A liquid evaporates at .....

  ..... .
- Du ing evaporation .....

  ..... .
- Without a supply of thermal energy, evaporation ..... .

[3]

(b) A pan containing water boiling at 100 °C is standing on an electrically heated hot-plate. In 20 minutes, 0.075 kg of water is lost as steam. The specific latent heat of vaporisation of water is 2.25×10^6 J / kg.

(i) Calculate the energy used in converting 0.075 kg of boiling water to steam.

energy = ... [2]

(ii) The hot-plate operates at 240 V, 0.65 A.

Calculate the energy supplied to the hot-plate in 20 minutes.

energy = ... [2]

(iii) Suggest why the answers to **(b)(i)** and **(b)(ii)** are not the same.

.....

..... [1]

[Total: 8]

2 **(a)** Complete the following statements by writing appropriate words in the spaces.

The pressure of a gas in a sealed container is caused by the collisions of

..... with the container wall.

An increase in the temperature of the gas increases the pressure because the

..... of the ..... increases.

The force on the wall due to the gas is the pressure multiplied by the .....

of the wall. [2]

(b) A mountaineer takes a plastic bottle containing some water to the top of a mountain. He removes the cap from the bottle, drinks all the water and then replaces the cap, as shown in Fig. 6.1.

On returning to the base of the mountain, he finds that the bottle has collapsed to a much smaller volume, as shown in Fig. 6.2.

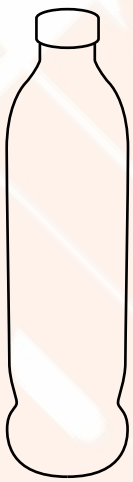


Fig. 6.1

Fig. 6.2

(i) Explain why the bottle collapsed.

.....

.....

.....

..... [2]

(ii) At the top of the mountain the atmospheric pressure was 4.8×10^4 Pa and the volume of the bottle was 250 cm^3.

Calculate the volume of the bottle at the base of the mountain where the pressure of the air inside the bottle is 9.2×10^4 Pa. Assume no change of temperature.

volume = ... [3]

[Total: 7]

3 During a period of hot weather, the atmospheric pressure on the pond in Fig. 3.1 remains constant. Water evaporates from the pond, so that the depth *h* decreases.

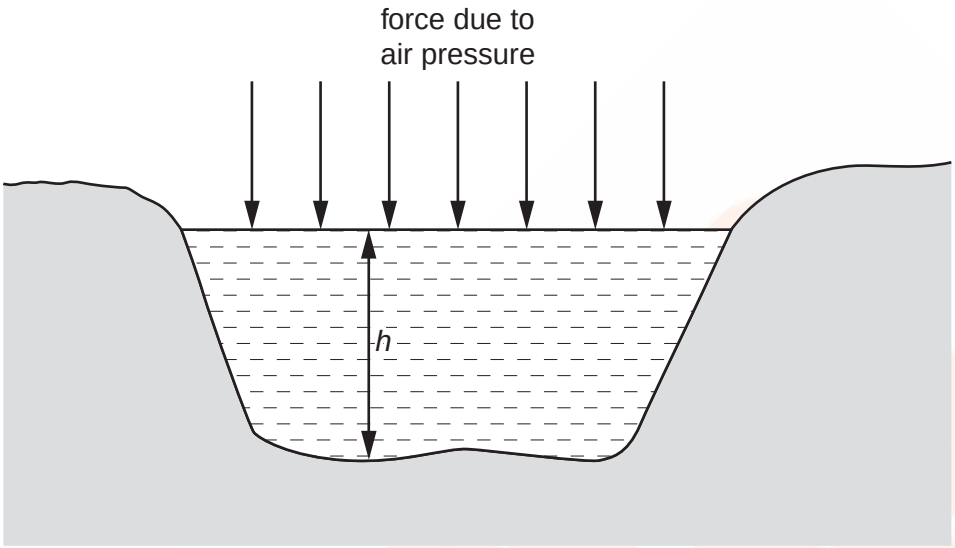


Fig. 3.1

(a) Study the diagram and state, giving your reason, what happens during this hot period to

(i) the force of the air on the surface of the pond,

.....

.....[1]

(ii) the pressure at the bottom of the pond.

.....

.....[1]

(b) On a certain day, the pond is 12 m deep.

(i) Water has a density of 1000 kg / m^3.

Calculate the pressure at the bottom of the pond due to the water.

pressure due to the water = ...[2]

(ii) Atmospheric pressure on that day is 1.0×10^5 Pa.

Calculate the total pressure at the bottom of the pond.

total pressure = ...[1]

(iii) A bubble of gas is released from the mud at the bottom of the pond. Its initial volume is $0.5\,cm^3$.

Ignoring any temperature differences in the water, calculate the volume of the bubble as it reaches the surface.

volume = ...[2]

(iv) In fact, the temperature of the water is greater at the top than at the bottom of the pond.

Comment on the bubble volume you have calculated in **(b)(iii)**.

.....

.....

.....[1]

[Total: 8]

4 A vertical cylinder has a smooth well-fitting piston in it. Weights can be added to or removed from a tray on the top of the piston.

(a) Weights are added to the tray, as shown in Fig. 6.1.

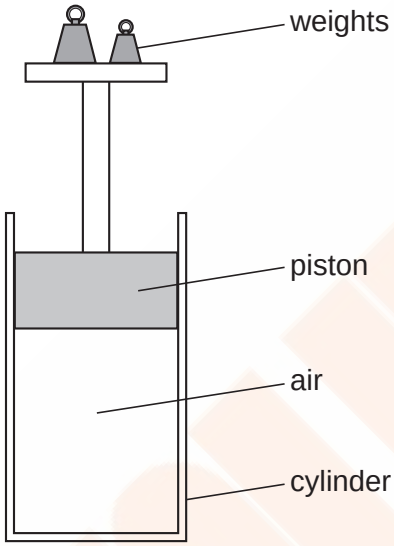


Fig. 6.1

(i) State what happens to the pressure of the air in the cylinder as a result of adding these weights.

..... [1]

(ii) The initial pressure of the trapped air is 1.05×10^5 Pa. When the weights are added, the volume of the air decreases from 860 cm^3 to 645 cm^3.

The temperature of the air does not change.

Calculate the final pressure of the trapped air.

pressure = ... [3]

(iii) The area of the piston is $5.0 \times 10^{-3}\,m^2$.

Calculate the weight that is added to the piston.

weight added = ... [4]

(b) The weights are kept as shown in Fig. 6.1. The temperature of the air in the cylinder is increased.

(i) State what happens to the volume of the air in the cylinder as a result of this temperature rise.

..... [1]

(ii) State how, if at all, the pressure of the air changes as the temperature changes.

..... [1]

(iii) State what must be done to prevent the volume change in **(b)(i)**.

..... [1]

(iv) The volume change in **(b)(i)** is prevented. State what happens to the pressure of the air in the cylinder.

..... [1]

[Total: 12]

5 **(a)** Fig. 5.1 shows a tank used for evaporating salt solution to produce crystals.

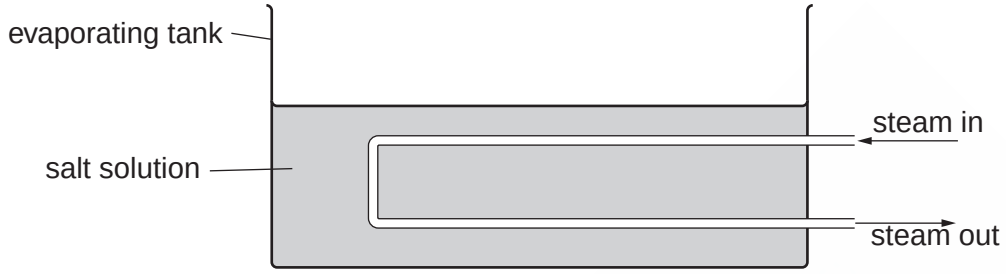


Fig. 5.1

Suggest two ways of increasing the rate of evaporation of the water from the solution.
Changes may be made to the apparatus, but the rate of steam supply must stay constant.
You may assume the temperature of the salt solution remains constant.

1. .....

.....

2. .....

.....[2]

(b) A manufacturer of liquid-in-glass thermometers changes the design in order to meet new requirements.

Describe the changes that could be made to

(i) give the thermometer a greater range,

.....[1]

(ii) make the thermometer more sensitive.

.....[1]

(c) A toilet flush is operated by the compression of air. The air inside the flush has a pressure of 1.0×10^5 Pa and a volume of 150 cm^3. When the flush is operated the volume is reduced to 50 cm^3. The temperature of the air remains constant during this process.
Calculate the new pressure of the air inside the flush.

pressure = ...[2]

[Total : 6]

1 A cup contains hot liquid.

Some of the liquid evaporates.

What happens to the mass and what happens to the weight of the liquid in the cup?

	mass	weight
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

2 Which statement about evaporation is correct?

A Evaporation causes the temperature of the remaining liquid to decrease.

B Evaporation does not occur from a cold liquid near its freezing point.

C Evaporation does not occur from a dense liquid, such as mercury.

D Evaporation occurs from all parts of a liquid.

3 A gas is stored in a sealed container of constant volume. The temperature of the gas increases. This causes the pressure of the gas to increase.

What happens to the gas molecules during this pressure increase?

A The average kinetic energy of the molecules increases.

B The average separation of the molecules decreases.

C The average separation of the molecules increases.

D The volume of each molecule increases.

4 A liquid is evaporating. The liquid is not boiling.

Which statement about the liquid is correct?

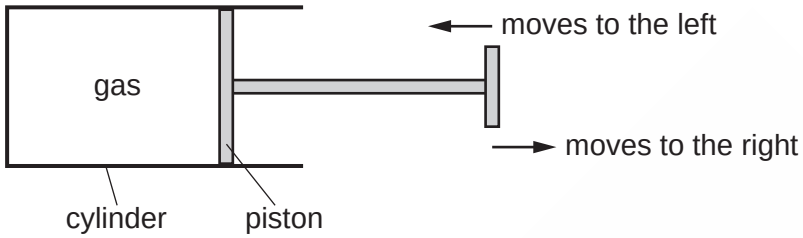
A Any molecule can escape, and from any part of the liquid.

B Any molecule can escape, but only from the liquid surface.

C Only molecules with enough energy can escape, and only from the liquid surface.

D Only molecules with enough energy can escape, but from any part of the liquid.

5 The diagram shows a quantity of gas enclosed in a cylinder by a piston.



The piston is moved to the left or to the right. The temperature of the gas is kept constant.

Which row describes the effect of moving the piston slowly in the direction shown in the table?

	movement of piston	speed of gas molecules	pressure of gas
A	to the left	increases	decreases
B	to the left	no change	increases
C	to the right	increases	decreases
D	to the right	no change	increases

6 What causes the random, zig-zag movement (Brownian motion) of smoke particles suspended in air?

A air molecules colliding with smoke particles

B convection currents as the hot smoke rises

C smoke particles colliding with each other

D smoke particles reacting with oxygen molecules in the air

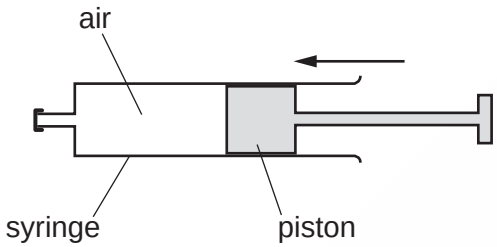
7 A sealed bottle of constant volume contains air.

The air in the bottle is heated by the Sun.

What is the effect on the average speed of the air molecules in the bottle, and the average distance between them?

	average speed of air molecules	average distance between air molecules
A	decreases	decreases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

8 Air in a sealed syringe is slowly compressed by moving the piston. The temperature of the air stays the same.



Which statement about the air is correct?

A The pressure of the air decreases because its molecules now travel more slowly.

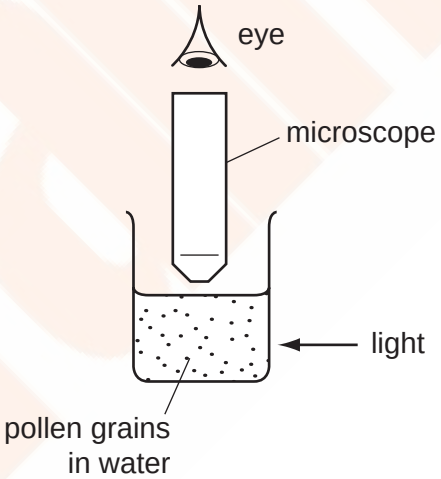
B The pressure of the air decreases because the area of the syringe walls is now smaller.

C The pressure of the air increases because its molecules now hit the syringe walls more frequently.

D The pressure of the air increases because its molecules now travel more quickly.

9 Very small pollen grains are suspended in a beaker of water. A bright light shines from the side.

Small, bright dots of light are seen through a microscope. The dots move in rapidly changing, random directions.



What are the bright dots?

A pollen grains being hit by other pollen grains

B pollen grains being hit by water molecules

C water molecules being hit by other water molecules

D water molecules being hit by pollen grains

10 A sealed gas cylinder is left outside on a hot, sunny day.

What happens to the average speed of the gas molecules and to the pressure of the gas in the cylinder as the temperature of the gas rises?

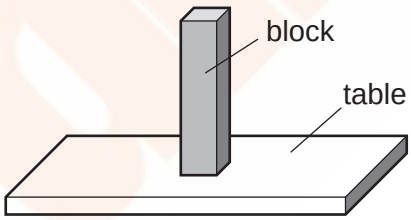
	average speed of gas molecules	pressure of gas in cylinder
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

11 A pool of water evaporates. As molecules escape, the temperature of the water left in the pool changes.

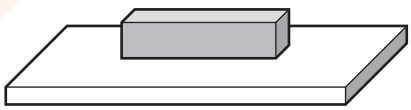
From where do the molecules escape and what is the effect on the temperature of the water in the pool?

	molecules escape from	temperature of water in the pool
A	all parts of the liquid	decreases
B	all parts of the liquid	increases
C	only the liquid surface	decreases
D	only the liquid surface	increases

12 A block with flat, rectangular sides rests on a table.



The block is now turned so that it rests with its largest side on the table.



How has this change affected the force and the pressure exerted by the block on the table?

	force	pressure
A	decreased	decreased
B	decreased	unchanged
C	unchanged	decreased
D	unchanged	unchanged

13 Two states of matter are described as follows.

In state 1, the molecules are very far apart. They move about very quickly at random in straight lines until they hit something.

In state 2, the molecules are quite closely packed together. They move about at random. They do not have fixed positions.

What is state 1 and what is state 2?

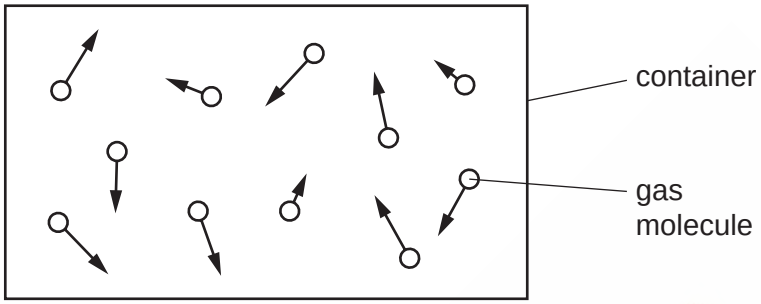
	state 1	state 2
A	gas	liquid
B	gas	solid
C	liquid	gas
D	solid	liquid

14 Puddles of rain water remain after a storm. The water in the puddles gradually evaporates.

How does the evaporation affect the temperature of the water remaining in the puddle, and how does it affect the average speed of the remaining water molecules in the puddle?

	temperature of water in puddle	average speed of water molecules in puddle
A	decreases	decreases
B	decreases	decreases
C	increases	increases
D	increases	increases

15 The diagram represents moving gas molecules in a sealed container of fixed volume.



The temperature of the gas is now increased.

What happens to the pressure of the gas, and what happens to the speed of the gas molecules?

	pressure of gas	speed of molecules
A	increases	increases
B	increases	increases
C	unchanged	unchanged
D	unchanged	unchanged

16 Small smoke particles suspended in air are viewed through a microscope.

The smoke particles move randomly.

What does this show?

A The air consists of fast-moving molecules.

B The pressure of the air is increasing.

C There are convection currents in the air.

D The temperature of the air is increasing.

17 Molecules escape from a liquid during evaporation. The temperature of the remaining liquid changes.

Which molecules escape and how does the temperature change?

	molecules escaping	temperature of remaining liquid
A	least energetic	decreases
B	least energetic	increases
C	most energetic	decreases
D	most energetic	increases

18 The gas in a container is heated but is kept at constant volume.

Why does the gas pressure increase?

A The molecules expand.

B The molecules increase in mass.

C The molecules move further apart.

D The molecules move more rapidly.

19 Which row is correct for the evaporation of a liquid?

	the particles escaping from the liquid are on average	the average kinetic energy of particles remaining in the liquid
A	the least energetic	decreases
B	the least energetic	increases
C	the most energetic	decreases
D	the most energetic	increases

20 A cylinder of constant volume contains a fixed mass of gas. The gas is cooled.

What happens to the pressure of the gas and what happens to the kinetic energy of the gas molecules?

	pressure of gas	kinetic energy of molecules
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

21 A swimmer feels cold after leaving warm water on a warm, windy day.

Why does she feel cold even though the air is warm?

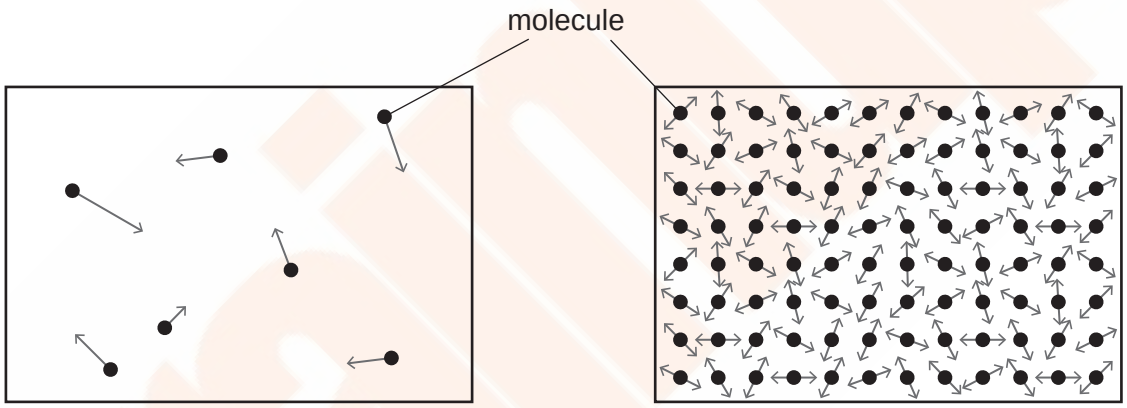
A The less energetic water molecules on her skin escape quickly.

B The more energetic water molecules on her skin do not escape quickly.

C The water on her skin does not evaporate quickly enough to keep her warm.

D The water on her skin evaporates quickly and cools her skin.

22 The diagrams represent the molecules in two different states of matter. The arrows show the motion of the molecules.



What is state 1, and what is state 2?

	state 1	state 2
A	gas	liquid
B	gas	solid
C	liquid	gas
D	liquid	solid

23 The water in a lake is at 5 °C. A diver measures the pressure of the water at two different depths in the lake. He repeats the measurements on a different day when the water is at 15 °C.

The density of the water decreases when its temperature increases.

Which combination of depth and temperature produces the greatest water pressure?

	depth / m	temperature / °C
A	10	5
B	10	15
C	20	5
D	20	15

24 A car tyre has a constant volume.

Why does the pressure of the air in the tyre increase when its temperature increases?

A The air molecules hit each other less often.

B The air molecules hit the inside of the tyre less often.

C The average speed of the air molecules in the tyre is greater.

D There are more air molecules in the tyre.

25 Extremely small pollen grains in water are viewed through a microscope. The grains are seen to move continually and randomly.

What is the reason for this random movement?

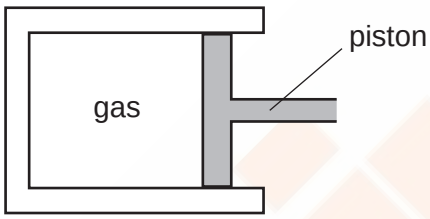
A The grains are moved by randomly moving water molecules.

B The grains are moved by random convection currents in the water.

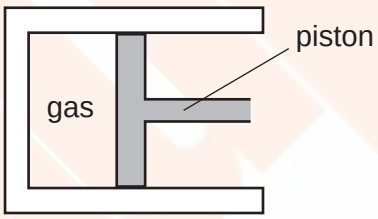
C The grains are moved by random rays of light reflecting off them.

D The grains are moved by the random motion of their own atoms.

26 A gas is compressed in a sealed cylinder by moving a piston.



initial position



after gas has been compressed

Which row in the table states what happens to the density of the gas and to the pressure of the gas when it is compressed?

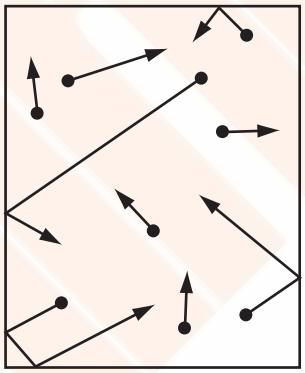
	density	pressure
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

27 During evaporation, molecules escape rapidly from the surface of a liquid.

What happens to the average energy of the molecules of the remaining liquid and what happens to the temperature of the remaining liquid?

	average energy of remaining molecules	temperature of remaining liquid
A	decreases	decreases
B	decreases	increases
C	stays the same	decreases
D	stays the same	increases

28 The diagram represents molecules of gas moving in a container.



What happens to the gas molecules when the temperature of the gas increases?

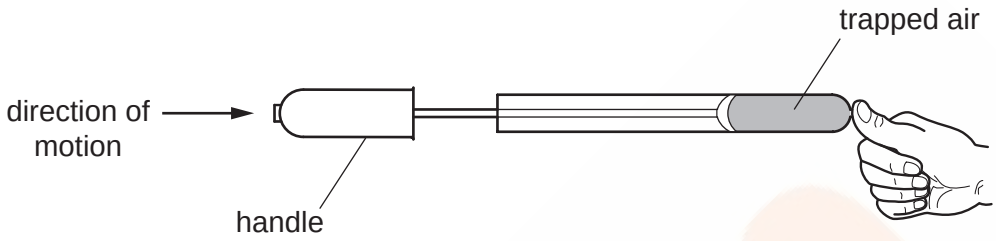
A They move more quickly.

B They move more slowly.

C They vibrate more quickly.

D They vibrate more slowly.

29 A student places his thumb firmly on the outlet of a bicycle pump, to stop the air coming out.

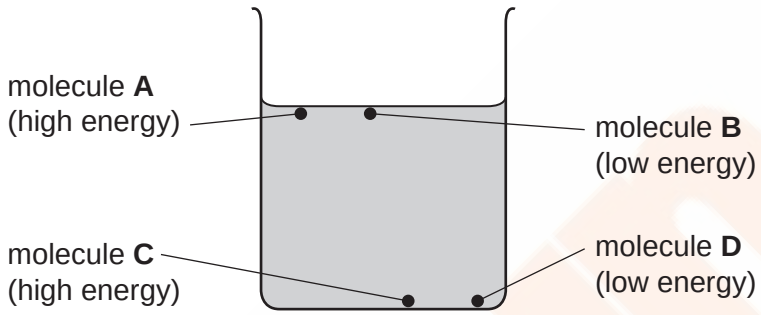


What happens to the pressure and what happens to the volume of the trapped air as the pump handle is pushed in?

	pressure	volume
A	decreases	decreases
B	decreases	remains the same
C	increases	decreases
D	increases	remains the same

30 The diagram shows a beaker of water. Four molecules are labelled. The relative amount of energy of each molecule is shown.

Which molecule is most likely to escape from the liquid?

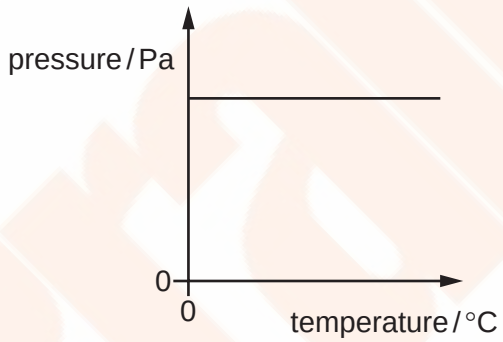


31 Some gas is trapped in a container of fixed volume.

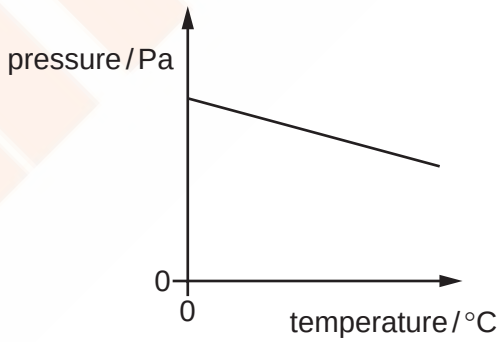
The temperature of the gas increases.

Which graph shows how the pressure of the gas changes with temperature?

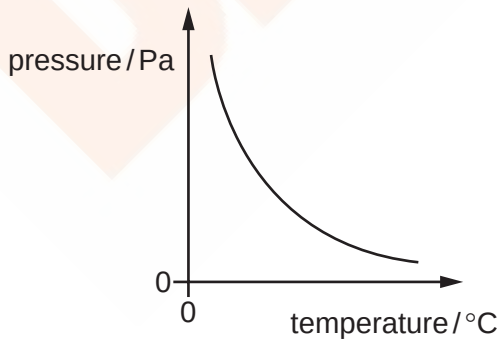
A



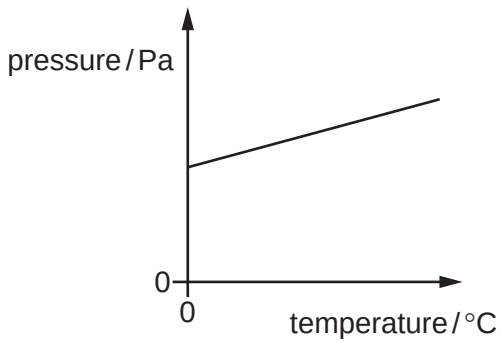
B



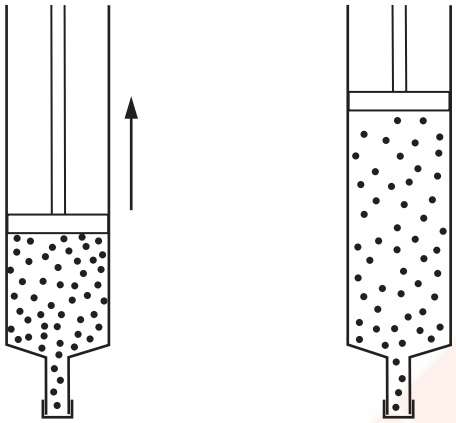
C



D



32 The volume of a gas in a sealed syringe is increased. The temperature of the gas does not change.



before change after change

After this change is made, what has happened to the gas molecules in the syringe?

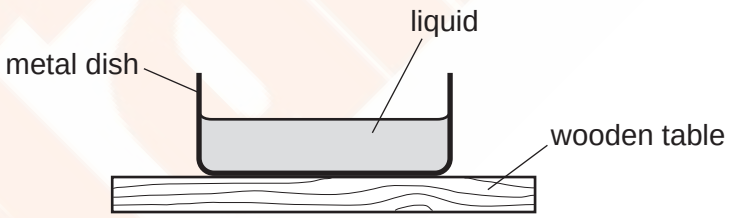
A They move more quickly.

B They move more slowly.

C They hit the syringe walls less often.

D They hit the syringe walls more often.

33 Some liquid is poured into a metal dish on a wooden table. The dish, the liquid, the table and the air around the dish are all at the same temperature.



The temperature of the liquid now starts to decrease.

What could cause this temperature decrease?

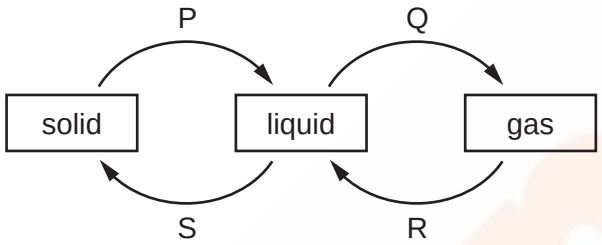
A convection currents in the liquid

B conduction of heat through the metal dish

C evaporation of the liquid

D heat radiation from the liquid

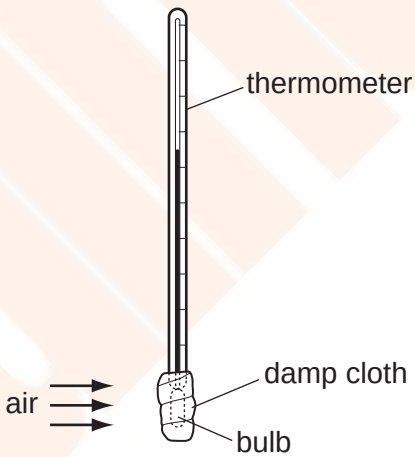
34 The diagram shows four labelled changes of state between solid, liquid and gas.



Which changes need an energy input?

A P and Q **B** Q and R **C** R and S **D** S and P

35 A thermometer bulb is covered by a piece of damp absorbent cloth.



Air at room temperature is blown across the damp cloth.

What happens to the thermometer reading?

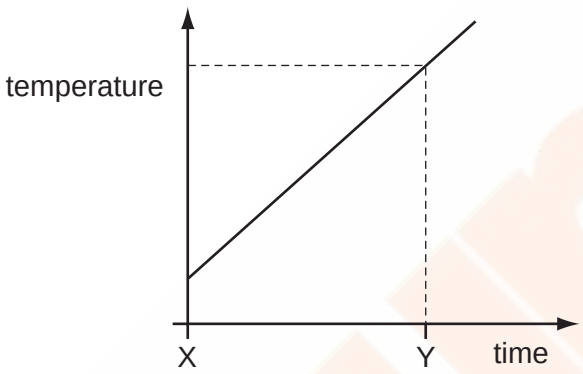
A It remains constant.

B It rises.

C It rises then falls.

D It falls.

36 A gas storage tank has a fixed volume. The graph shows how the temperature of the gas in the tank varies with time.



At time Y, the gas molecules are

A closer together than at time X.

B hitting the sides of the tank harder than at time X.

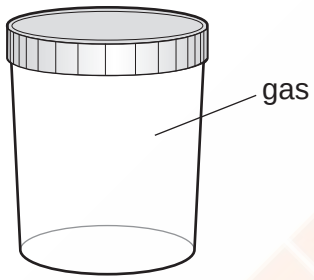
C larger in size than at time X.

D moving more slowly than at time X.

37 Which diagram best shows the path of a gas molecule?

A **B** **C** **D**

38 The diagram shows a sealed jar containing a gas.



Which statement about the gas in the jar is correct?

A The gas molecules collide with the inside of the jar more often as the temperature increases.

B The gas molecules move more slowly as the temperature increases.

C The pressure of the gas decreases as the temperature increases.

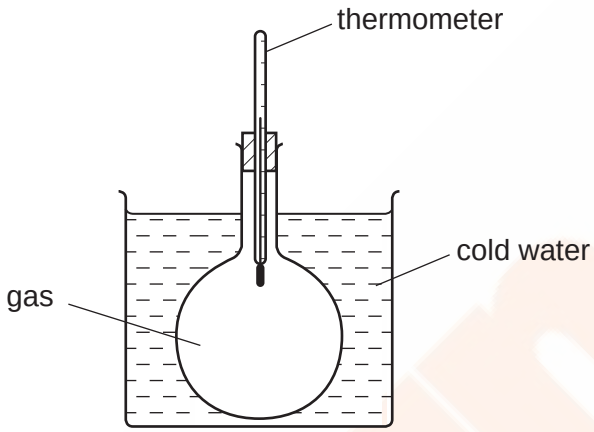
D The pressure of the gas is higher at the top of the jar than at the bottom of the jar.

39 A block of ice cream is prevented from melting by wrapping it in newspaper soaked in water. The water evaporates from the newspaper.

Which molecules escape from the water and what happens to the average speed of the water molecules that remain in the newspaper?

	escaping molecules	average speed of the remaining water molecules
A	the less energetic ones	decreases
B	the less energetic ones	increases
C	the more energetic ones	decreases
D	the more energetic ones	increases

40 A closed flask of gas is placed in a cold-water bath.



As the flask cools, the temperature of the gas decreases.

What happens to the molecules of the gas?

A They contract.

B They expand.

C They move more quickly.

D They move more slowly.

41 Brownian motion is observed when looking at smoke particles in air using a microscope.

What causes the smoke particles to move at random?

A Smoke particles are hit by air molecules.

B Smoke particles are moved by convection currents in the air.

C Smoke particles have different weights and fall at different speeds.

D Smoke particles hit the walls of the container.

42 The molecules of a substance become more closely packed and move more quickly.

What is happening to the substance?

A A gas is being heated and compressed.

B A gas is being heated and is expanding.

C A liquid is boiling.

D A liquid is evaporating at room temperature.

43 A metal block is heated until it is completely melted. It is then allowed to solidify.

What happens to the mass of the metal during the changes of state?

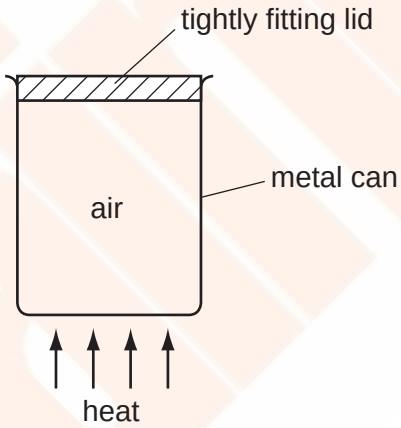
	mass during melting	mass during solidification
A	decreases	increases
B	increases	decreases
C	increases	stays constant
D	stays constant	stays constant

44 On a warm day, a swimmer climbs out of a swimming pool into the open air and water evaporates from his skin.

As the water evaporates, which molecules escape into the air first and what happens to the average speed of the remaining water molecules?

	first molecules to escape	average speed of the remaining molecules
A	least energetic	decreases
B	least energetic	increases
C	most energetic	decreases
D	most energetic	increases

45 Some air is trapped inside a metal can with a tightly fitting lid.



When the can is heated strongly behind a safety screen, the lid is blown off by the increased pressure inside the can.

What causes the increase in pressure of the air inside the can?

A The air molecules expand and take up more room.

B The air molecules move more quickly.

C The number of molecules inside the can increases.

D The volume occupied by the molecules decreases.

46 A sealed gas cylinder is left outside on a hot, sunny day.

What happens to the average speed of the molecules and to the pressure of the gas in the cylinder as the temperature rises?

	average speed of the gas molecules	gas pressure
A	falls	falls
B	falls	rises
C	rises	falls
D	rises	rises

47 When a liquid evaporates, some molecules escape from it and its temperature changes.

From where do the molecules escape and what is the effect on the temperature of the liquid?

	molecules escape from	temperature of liquid
A	all parts of the liquid	decreases
B	all parts of the liquid	increases
C	only the liquid surface	decreases
D	only the liquid surface	increases

48 Evaporation occurs when molecules escape from a liquid surface into the air above it. During this process the temperature of the liquid falls.

Why does the temperature of the liquid fall?

A The molecules in the vapour expand because the pressure is less.

B The molecules left in the liquid have more space to move around.

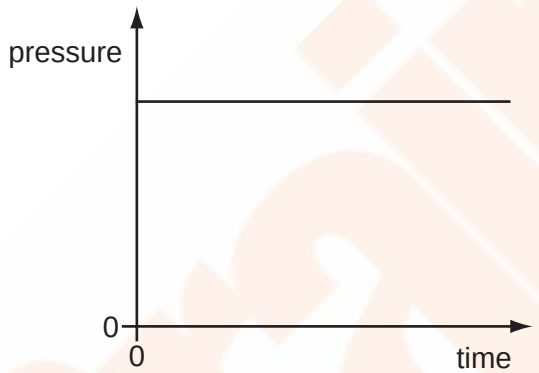
C The molecules move more slowly when they escape into the air.

D The molecules with the highest energies escape into the air.

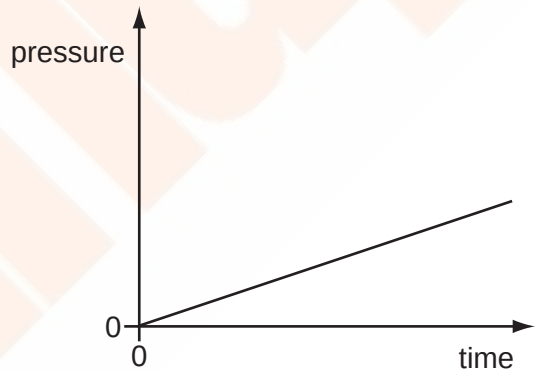
49 The pressure of a fixed mass of gas in a cylinder is measured. The volume of the gas in the cylinder is then slowly decreased. The temperature of the gas does not change.

Which graph could show the change of pressure of the gas during this process?

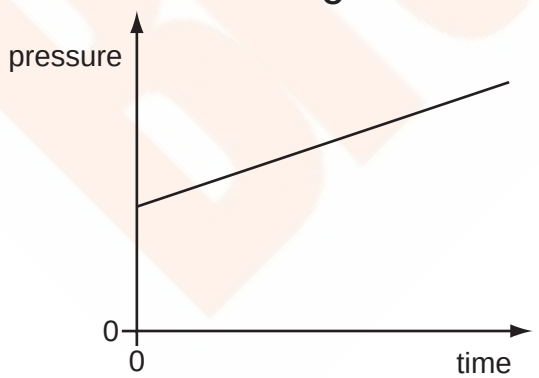
A



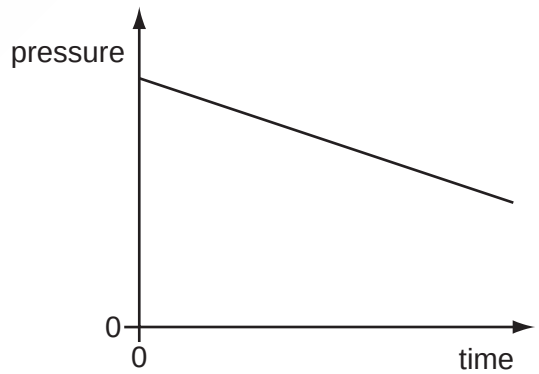
B



C



D



50 A beaker contains 0.500 kg of water at a temperature of 3.0 °C. The beaker is heated, and the internal energy of the water increases by 21.0 kJ.

The specific heat capacity of water is 4200 J / (kg °C).

What is the temperature of the water after it has been heated?

A 5.5 °C **B** 10.0 °C **C** 13.0 °C **D** 31.5 °C

51 Smoke particles, illuminated by a bright light, are seen through a microscope. They move about randomly.

What causes this motion?

A attraction between the smoke particles and the molecules of the air

B collisions between the smoke particles and the molecules of the air

C evaporation of the faster-moving smoke particles

D warming of the smoke particles by the lamp

52 A sealed bottle of constant volume contains air.

The air in the bottle is heated by the Sun.

What is the effect on the average speed of the air molecules in the bottle, and the average distance between them?

	average speed of air molecules	average distance between air molecules
A	decreases	decreases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

53 Gases can be compressed, but liquids cannot.

Which statement explains this difference?

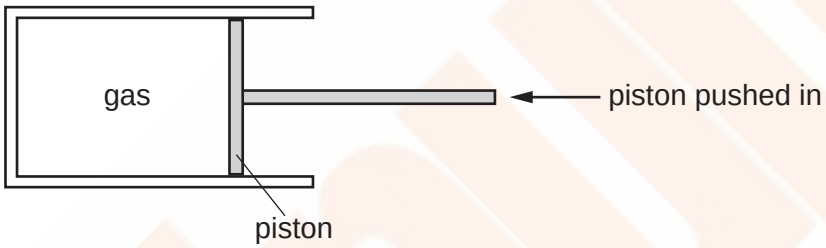
A Each molecule in a gas is more compressible than each molecule in a liquid.

B Molecules in a gas are further apart than molecules in a liquid.

C Molecules in a gas attract each other more strongly than molecules in a liquid.

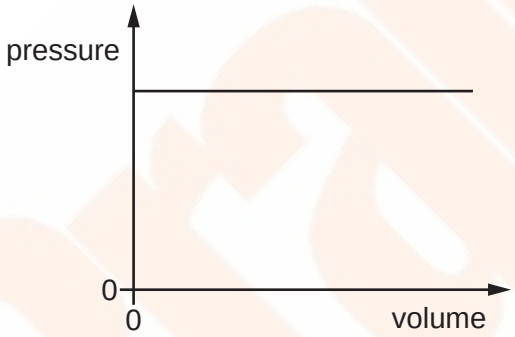
D Molecules in a gas move more slowly than molecules in a liquid.

54 The diagram shows a quantity of gas trapped in a cylinder. The piston is pushed in slowly and the gas is compressed. The temperature of the gas does not change.

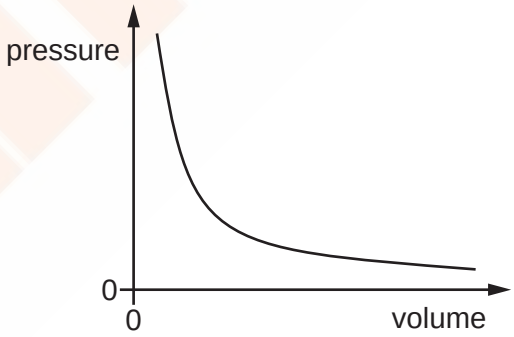


Which graph shows the relationship between the pressure and the volume of the gas?

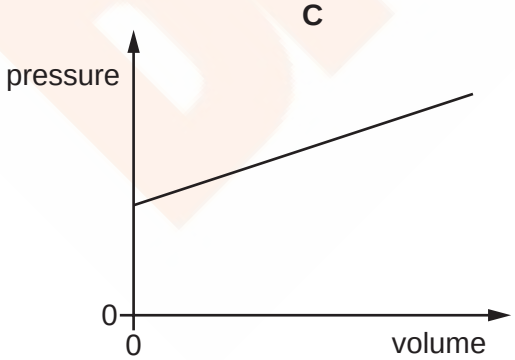
A



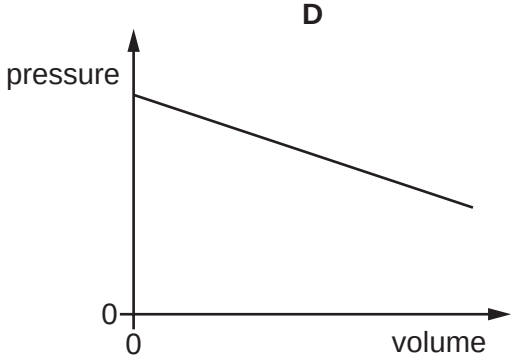
B



C

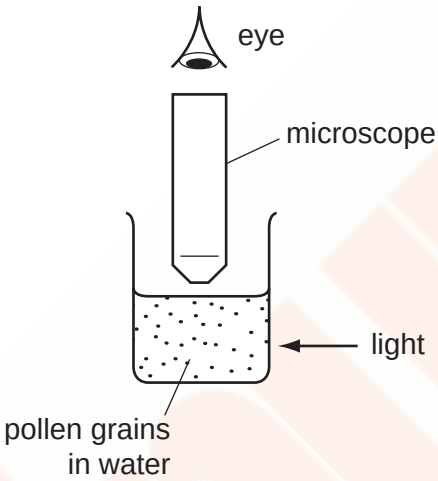


D



55 Very small pollen grains are suspended in a beaker of water. A bright light shines from the side.

Small, bright dots of light are seen through a microscope. The dots move in rapidly changing, random directions.



What are the bright dots?

A pollen grains being hit by other pollen grains

B pollen grains being hit by water molecules

C water molecules being hit by other water molecules

D water molecules being hit by pollen grains

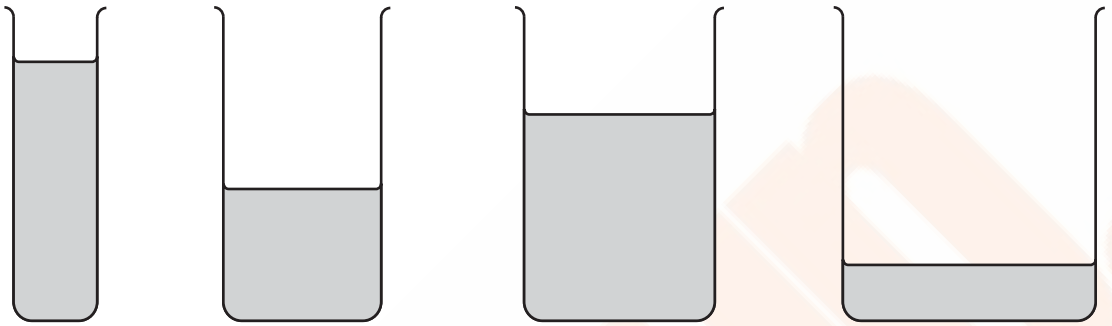
56 A sealed gas cylinder is left outside on a hot, sunny day.

What happens to the average speed of the gas molecules and to the pressure of the gas in the cylinder as the temperature of the gas rises?

	average speed of gas molecules	pressure of gas in cylinder
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

57 The diagram shows four beakers **A**, **B**, **C** and **D**. The beakers contain different amounts of the same liquid at the same temperature. The beakers are left next to each other on a laboratory bench overnight. The diagrams are all drawn to the same scale.

From which beaker does the largest quantity of liquid evaporate?



1 **(a** (a liquid evaporates) at any temperature / below the boiling point / over a range of temperatures / below 100 °C / at different temperatures / not at a fixed temperature B1

(during evaporation) vapour forms at / escapes from the surface of the liquid B1

(without a supply of thermal energy,) evaporation continues / occurs / doesn't stop
OR causes liquid to cool / is slower / reduces

(b) (i) (Q =) mL C1
OR $0.075 \times 2.25 \times 10^6$

1.7×10^5 J A1

(ii) (E =) VIt OR $240 \times 0.65 \times (20 \times 60)$ C1
OR $P = IV$ and $P = E/t$ OR energy / time

1.9×10^5 J A1

(iii) energy is transferred to the surroundings
OR in heating the surroundings / air / atmosphere / hot-plate

[Total: 8]

2 **(a** molecules OR atoms OR particles
speed OR velocity OR kinetic energy
molecules OR atoms OR particles
(Surface) area B2
any four correct gains 2 marks, two or three correct gains 1 mark

(b) (i) (when cap is screwed on) at top of mountain:
pressure of air in bottle = the low pressure of the air outside
OR is less than pressure at bottom of mountain
OR is low B1

(at bottom of mountain) bottle collapses because pressure outside (bottle) is greater than pressure inside B1

(ii) Boyle's law applies OR PV = constant OR $P_1V_1 = P_2V_2$ C1
$9.2 \times 10^4 \times V = 4.8 \times 10^4 \times 250$ C1
130 cm^3 A1

[Total: 7]

3	**(a)**	**(i)**	smaller because <u>area</u> smaller	B1
		(ii)	smaller because depth/height smaller	B1
	(b)		$h\rho g$ OR $12 \times 1000 \times 10$	C1
			1.2×10^5 Pa OR 1.1772×10^5 Pa OR 1.176×10^5 Pa accept N/m^2	A1
		(ii)	candidate's **(i)** + 1.0×10^5 Pa correctly evaluated with unit (correct value 2.2×10^5)	B
		(iii)	$p_1V_1 = p_2V_2$ in any form	C1
			1.1 cm^3	
			OR 0.5 × candidate's **(ii)**/10^5 correctly evaluated	A1
		(iv)	value in **(iii)** too small OR volume larger o.w.t.t.e.	B1 [8]

4	**(a**	**(i)**	increases		B1
		(ii)	pV = const in any form		C1
			$1.05 (\times 10^5) \times 860 (\times 10^6) = p \times 645 (\times 10^6)$		C
			1.4×10^5 Pa		A1
		(iii)	F = pA in any form accept weight for F		C1
			EITHER increase in pressure = 0.35×10^5 (Pa)		C1
			$0.35 \times 10^5 \times 5.0 \times 10^{-3}$		C1
			175 N (minimum 2 s.f.) c.a.o.		A1
			OR $1.05 \times 10^5 \times 5.0 \times 10^{-3}$ or 525 N or $1.4 \times 10^5 \times 5.0 \times 10^{-3}$ or 700 N		(C1)
			700 – 525 N e.c.f. from **(a) (ii)**		(C1)
			175 N (minimum 2 s.f.) c.a.o.		(A1)
	(b)		increases		B1
		(ii)	no change		B1
		(iii)	extra weight (on tray/piston)		B1
		(iv)	increases		B1

[12]

5	**(a**	increase surface area of tank		B1	
		blow air over surface/put in windy place		B1	**2**
	(b)	**(i)**	capillary tube longer or liquid with lower expansivity	B1	
		(ii)	capillary tube thinner/finer or liquid with higher expansivity or bigger bulb	B1	**2**
	(c)	$p_1v_1 = p_2v_2$ or $1 \times 10^5 \times 150 = p_2 \times 50$		C1	
		$p_2 = 3 \times 10^5$ (Pa)		A1	**2**
					[6]

1	A
2	A
3	A
4	C
5	B
6	A
7	D
8	C
9	B
10	D
11	C
12	C
13	A
14	A
15	A
16	A
17	C
18	D
19	C
20	A

21	D
22	B
23	C
24	C
25	A
26	D
27	A
28	A
29	C
30	A
31	D
32	C
33	C
34	A
35	D
36	B
37	D
38	A
39	C
40	D

41 A

42 A

43 D

44 C

45 B

46 D

47 C

48 D

49 C

50 C

51 B

52 D

53 B

54 B

55 B

56 D

57 D