Thermal Properties of Matter

Question Paper

Level	O Level
Subject	Physics
Exam Board	Cambridge International Examinations
Unit	Energy & Thermal Physics
Topic	Thermal Properties of Matter
Booklet	Question Paper

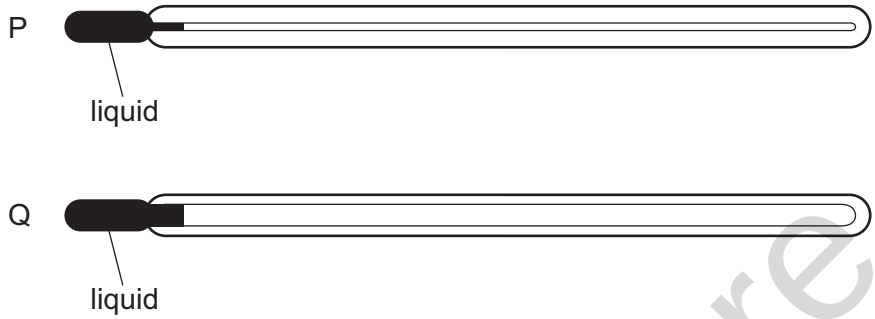
Time Allowed: **58 minutes**

Score: **/48**

Percentage: **/100**

Grade Boundaries:

1 The diagram shows two liquid-in-glass thermometers P and Q.



The thermometers are identical except that Q has a capillary tube with a larger internal diameter than P.

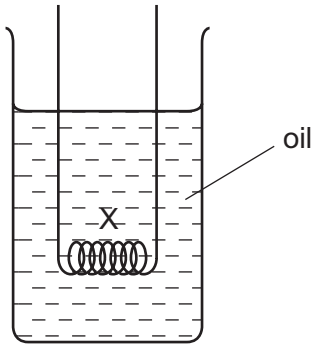
Which thermometer has the larger range and which thermometer has the greater sensitivity?

	larger range	greater sensitivity
A	P	P
B	P	Q
C	Q	P
D	Q	Q

2 Which substance in the table is liquid at 20 °C?

	melting point / °C	boiling point / °C
A	–218	–183
B	–39	357
C	44	280
D	119	444

3 An electrical heater is placed in a beaker of cold oil, as shown.



The heater is switched on.

What happens to the liquid at X?

A It becomes less dense and falls.

B It becomes less dense and rises.

C It becomes more dense and falls.

D It becomes more dense and rises.

4 A pupil adds 37 g of ice at 0 °C to 100 g of water at 30 °C. The final temperature of the water and melted ice is 0 °C. No heat is lost to, or gained from, the surroundings.

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

What is the specific latent heat of ice?

A 47 J / g **B** 341 J / g **C** 4700 J / g **D** 12 600 J / g

5 The heat capacity of an object, of mass 2.0 kg, is *C*. The energy needed to

A increase the temperature of the whole object by Δt is $C\Delta t$.

B increase the temperature of unit mass of the object by Δt is $C\Delta t$.

C melt the whole object is *C*.

D melt unit mass of the object is *C*.

6 An electric shower takes in cold water at 17 °C. The shower gives 6000 J of energy every second to the cold water and heats it to 37 °C. The specific heat capacity of water is 4200 J / (kg °C).

What is the mass of hot water supplied by the shower in one second?

A 0.035 kg **B** 0.039 kg **C** 0.071 kg **D** 0.084 kg

7 What is latent heat of vaporisation?

A the energy required to make molecules expand

B the energy required to make molecules expand and move apart

C the energy required to make molecules move apart

D the energy required to make molecules move faster

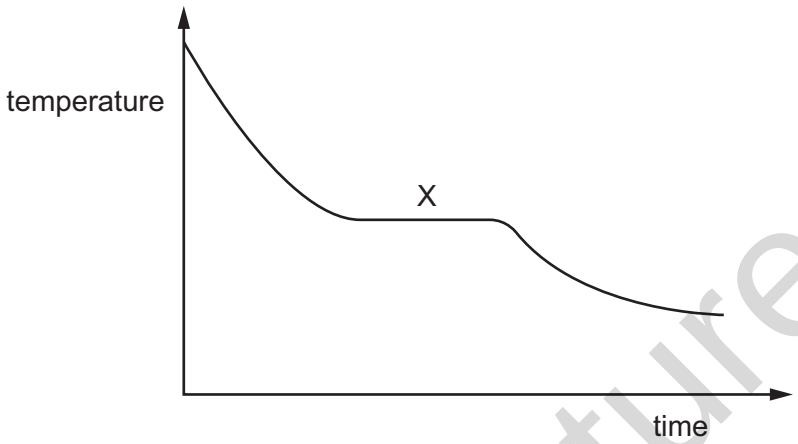
8 An insulated beaker contains 300 g of water, initially at 30 °C. Water at 100 °C is added until the temperature of the mixture reaches 50 °C.

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

How much water is added?

A 60 g **B** 120 g **C** 180 g **D** 750 g

9 A hot liquid is poured into a beaker. The graph shows how the temperature of the liquid changes as it cools towards room temperature.



What is occurring at region X?

A boiling and evaporation

B condensation only

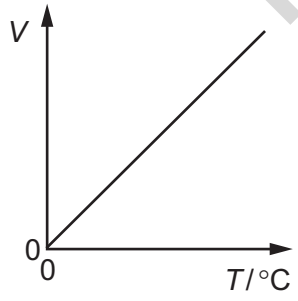
C evaporation only

D solidification and evaporation

10 A fixed mass of gas in a syringe at 0 °C is heated at constant pressure.

Which graph shows the variation of volume *V* with temperature *T*, measured in °C?

A



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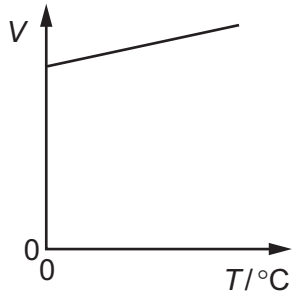

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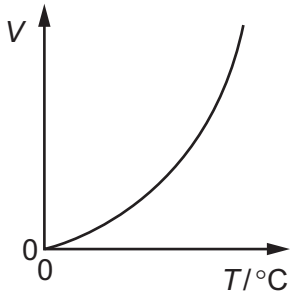

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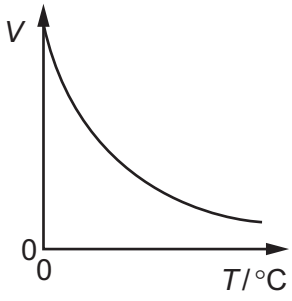


11 Thermal energy is transferred to a solid. First it melts and then it boils to produce a gas.

Which statement about the temperature is correct?

A When melting and boiling the temperature does not change.

B When melting and boiling the temperature increases.

C When melting the temperature increases but when boiling the temperature stays the same.

D When melting the temperature stays the same but when boiling the temperature increases.

12 Steam at 100 °C is passed into some water in a beaker. All the steam condenses in the water.

The mass of water in the beaker rises from 120.0 g to 122.0 g.

The specific latent heat of vaporisation of water is 2250 J / g.

How much thermal energy is lost by the steam as it condenses?

A 8.9×10^{-4} J

B 1.1×10^{3} J

C 4.5×10^{3} J

D 2.7×10^{5} J

13 Using an electric kettle, 200 g of water at 100 °C is converted into steam at 100 °C in 300 seconds.

The specific latent heat of steam is 2250 J / g.

What is the average electrical power used?

A $\frac{2250}{300 \times 200}$ W

B $\frac{200 \times 2250}{300}$ W

C $\frac{300 \times 2250}{200}$ W

D $200 \times 300 \times 2250$ W

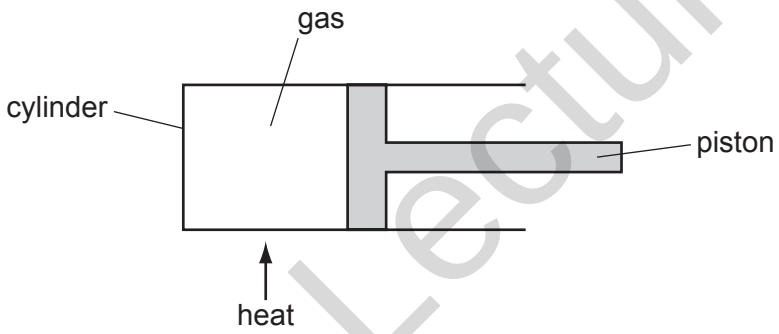
14 Thermal energy of 12 000 J is supplied to a 2.0 kg mass of copper.

The specific heat capacity of copper is 400 J / (kg °C).

What is the rise in temperature?

A 15 °C **B** 30 °C **C** 60 °C **D** 100 °C

15 The diagram shows a fixed mass of gas in a cylinder fitted with a piston that can move easily.



What is the change, if any, in the pressure and volume of the gas after it is heated?

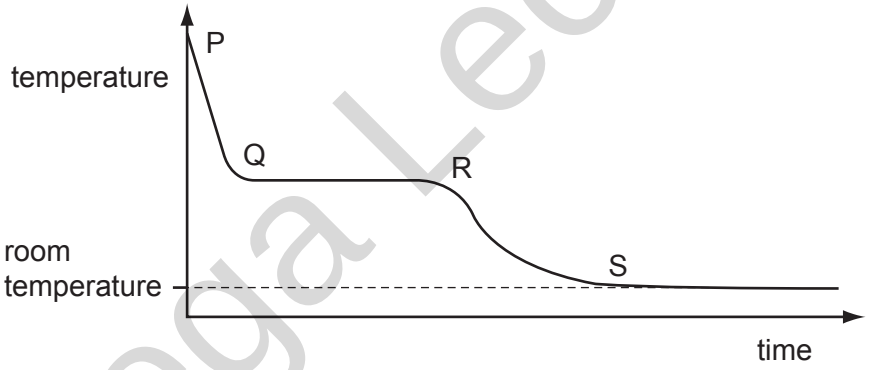
	pressure	volume
A	no change	increases
B	decreases	no change
C	decreases	increases
D	increases	decreases

16 Different amounts of energy are supplied to copper blocks of different masses.

Which block experiences the greatest temperature change?

	mass of block / kg	energy supplied / J
A	0.1	200
B	0.2	200
C	0.4	600
D	0.8	400

17 A hot liquid is allowed to cool. The graph shows the cooling curve.



In which part of the curve is latent heat released?

A PQ **B** QR **C** RS **D** ST

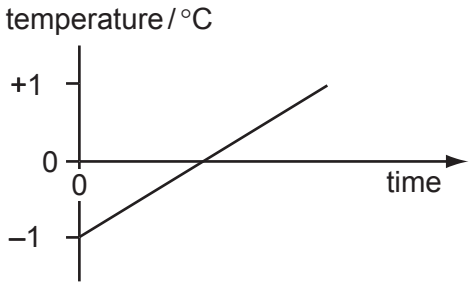
18 For the same temperature rise and the same original volume, which of the three states of matter expands the most and which state expands the least?

	expands most	expands least
A	gas	solid
B	liquid	gas
C	solid	gas
D	solid	liquid

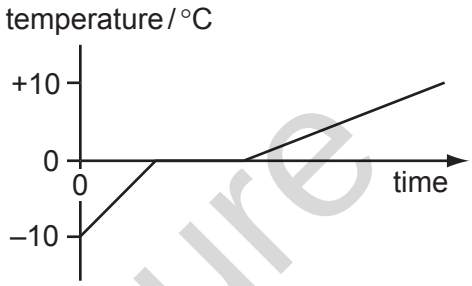
19 Ice at –10 °C is heated until it is water at +10 °C.

Which graph shows how the temperature changes with time?

A



B



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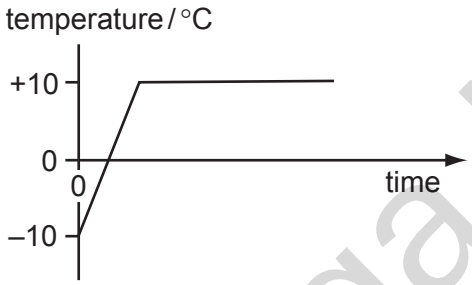

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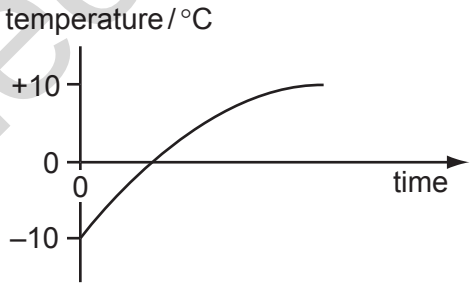


20 Less heat is needed to raise the temperature of 1 kg of copper by 1 °C than is needed to raise the temperature of 1 kg of water by 1 °C.

Which statement explains this?

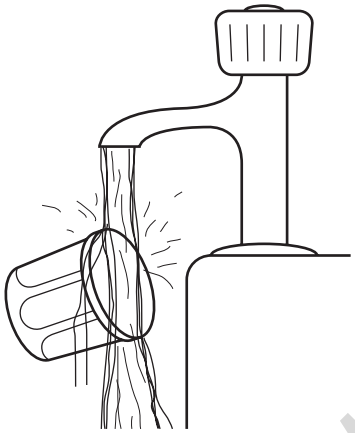
A Copper has a higher melting point.

B Copper has a lower specific heat capacity.

C Copper has a smaller specific latent heat.

D Copper is a better conductor of heat.

21 A person cannot unscrew the metal lid of a pot of jam. The lid can be unscrewed after it has been held under hot, running water for a few seconds.



Why is this?

A The air pressure in the jar falls.

B The glass expands.

C The jam melts.

D The metal lid expands.

22 An ice cube, at a temperature of 0 °C, has a mass of 10 g. The specific latent heat of fusion of water is 3×10^5 J / kg.

How much heat energy is needed to convert the ice cube into 10 g of water at 0 °C?

A 30 J **B** 3000 J **C** 3×10^4 J **D** 3×10^6 J

23 A strip is made from two metals joined together. The diagrams show the strip at room temperature and after it has been cooled.

at room temperature below room temperature

The change in shape occurs because

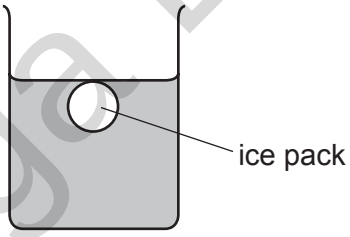
A brass contracts more than invar.

B brass expands when it cools down.

C invar and brass contract by equal amounts.

D invar contracts more than brass.

24 An ice pack is used to cool 0.25 kg of water. The specific heat capacity of water is 4.2 kJ / (kg °C).



How much thermal energy (heat) must the ice pack extract from the water to reduce the water temperature by 15 °C?

A 0.070 kJ **B** 1.1 kJ **C** 16 kJ **D** 250 kJ

25 Fillings in teeth should be made from a material which

A does not expand when heated.

B expands by the same amount as the tooth when heated.

C expands less than the tooth when heated.

D expands more than the tooth when heated.

26 To raise the temperature of a 2.0 kg block of metal by 20 °C, energy of 5.2 kJ is needed.

What is the value of the specific heat capacity of the metal?

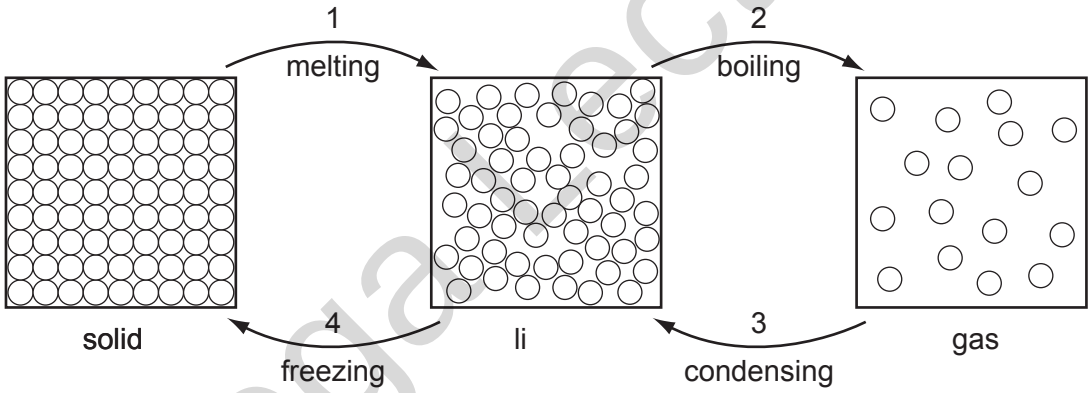
A 0.13 J / (kg °C)

B 52 J / (kg °C)

C 130 J / (kg °C)

D 52 000 J / (kg °C)

27 Substances can change from one state to another as shown.



For substances to change from one state to another, there must be some energy transfer.

Which changes involve the substance taking in energy and which changes involve the substance giving out energy?

	energy taken in	energy given out
A	1 and 2	3 and 4
B	1 and 3	2 and 4
C	2 and 4	1 and 3
D	3 and 4	1 and 2

28 An ice-cube has of mass of 7.50 g. The ice-cube is at 0 °C.

Heat from the surroundings reaches the ice-cube at an average rate of 1.25 J / s.

How long does it take for all of the ice to melt?
(specific latent heat of fusion of ice = 333 J / g)

A 35.5 s **B** 55.5 s **C** 2000 s **D** 3120 s

29 A bimetallic strip made from brass and iron is used as a thermostat.

When the strip is heated, the brass expands more than the iron.

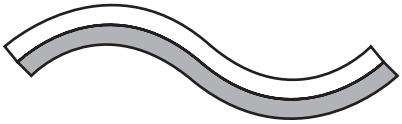
Which shape will the strip become?

A

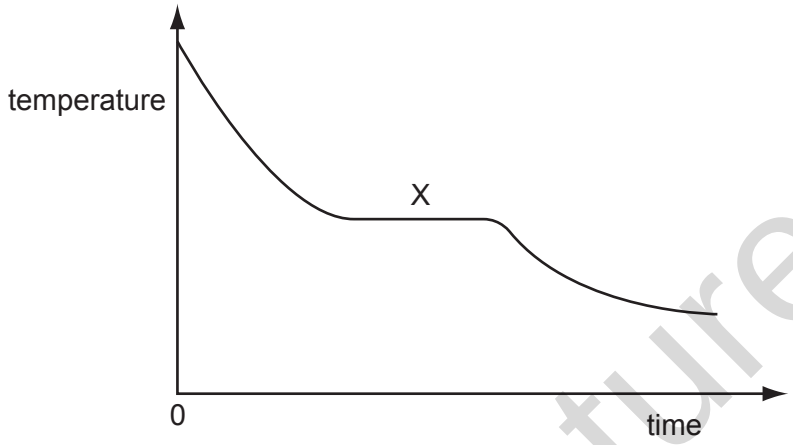
B

C

D



30 A hot liquid is poured into a beaker. The graph shows how its temperature changes as it cools towards room temperature.



Which processes are taking place at region X?

A boiling and evaporation

B condensation only

C evaporation only

D solidification and evaporation

31 What is caused by the thermal expansion of a substance when heated?

A a decrease in the resistance of a tungsten-filament lamp when switched on

B a rise in the pressure of the gas trapped in a gas cylinder placed in hot water

C the blowing of the fuse in a circuit when the current becomes too large

D the upward movement of the air above a Bunsen burner when it is lit

32 A substance that is originally a solid is heated strongly for some time.

At one stage, the energy given to the substance is used as latent heat of vaporisation.

At this stage, what change does the energy cause?

A It breaks the bonds holding the molecules together. Molecules escape from the liquid.

B It breaks the bonds holding the molecules together. The solid becomes liquid.

C It makes the molecules move faster but there is still a strong attraction between them.

D It makes the molecules move faster and so the temperature rises.

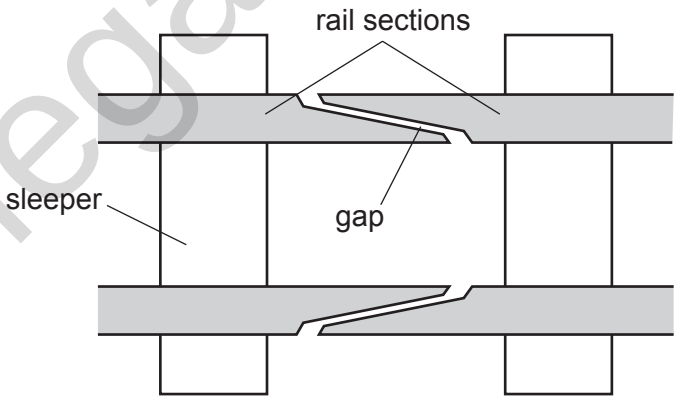
33 A block of metal has a mass of 2.0 kg. Its specific heat capacity is 800 J / (kg °C).

The block is supplied with 2400 J of energy.

What is the rise in temperature?

A 0.17 °C **B** 0.67 °C **C** 1.5 °C **D** 6.0 °C

34 At regular intervals along a railway line there is a gap between the rail sections.



What is the reason for the gap between the rail sections?

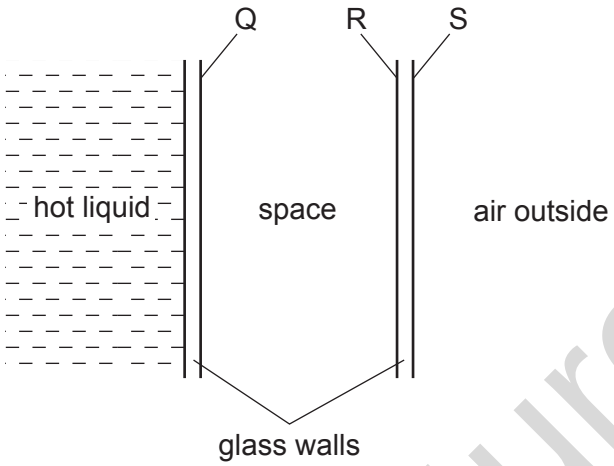
A to allow for expansion of the rail sections during hot weather

B to allow for vibrations of the rail sections as the train passes over them

C to allow rain water to drain from the rail sections

D to keep the wheels of the train and carriages on the rail sections

35 A student needs a double-walled glass vessel to contain a hot liquid.



What reduces heat losses by radiation?

A a vacuum in the space between the walls

B painting surface Q black

C painting surface R black

D painting surface S silver

36 What is the definition of *heat capacity*?

A the quantity of heat required to raise the temperature of an object through 1 °C

B the quantity of heat required to raise the temperature of 1 kg of a substance through 1 °C

C the quantity of heat required to convert an object from solid to liquid without a change in temperature

D the quantity of heat required to change 1 kg of a substance from solid to liquid without a change in temperature

37 Fillings in teeth should be made from a material which

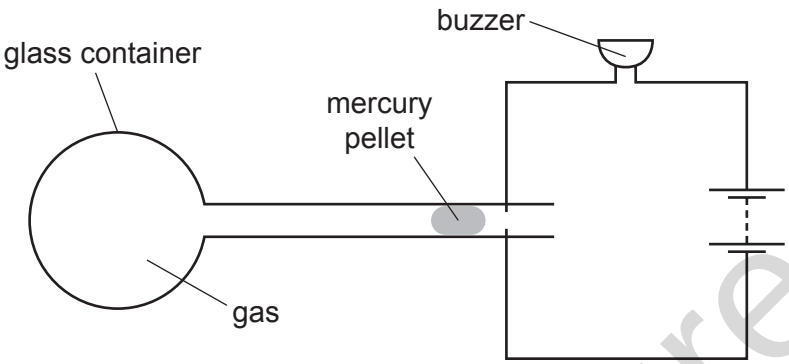
A expands more than the tooth when heated.

B expands by the same amount as the tooth when heated.

C expands less than the tooth when heated.

D does not expand when heated.

38 The diagram shows the design for an alarm.



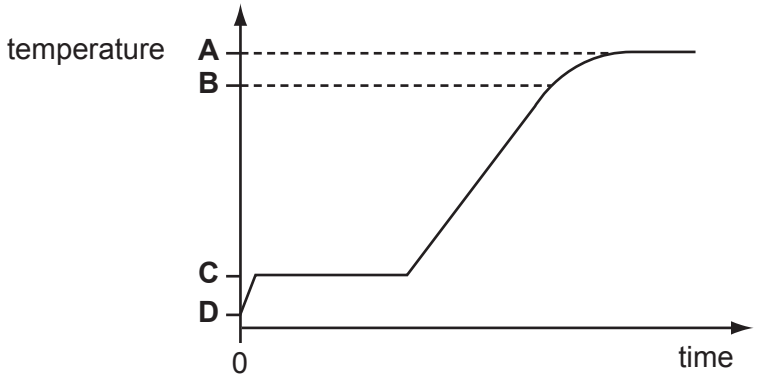
The mercury pellet moves and completes the circuit.

Why does this happen?

	temperature	gas
A	falls	contracts
B	falls	expands
C	rises	contracts
D	rises	expands

39 Some ice cubes are taken from a deep-freeze and placed in a metal container. The container is heated at a constant rate and readings of temperature and time are taken. The results are recorded on a graph.

Which temperature corresponds to 0 °C?



40 The energy required to change liquid water into water vapour at the same temperature is called latent heat of vaporisation.

What does this energy do?

A increases the average separation of the water molecules

B increases the average speed of the water molecules

C raises the temperature of the air near the water

D splits the water molecules into their separate atoms

41 A 2 kW kettle containing boiling water is placed on a balance. It is left there and continues to boil for 5 minutes. The balance reading changes by 0.2 kg.

What does this information give as a value for the specific latent heat of vaporisation of water?

A 2000 J / kg

B 3000 J / kg

C 50 000 J / kg

D 3 000 000 J / kg

42 In an experiment to find the specific heat capacity of a metal, it is found that 5200 J is needed to raise the temperature of a 2 kg block by 20 °C.

What value for the specific heat capacity is given by these results?

A 130 J / (kg °C)

B 520 J / (kg °C)

C 52 000 J / (kg °C)

D 104 000 J / (kg °C)

43 The fillings for a hole in a tooth should be made from a material that

A expands more than the hole in the tooth.

B expands by the same amount as the hole in the tooth.

C expands less than the hole in the tooth.

D does not expand when heated.

44 Heat energy is supplied at the same rate to 100 g of paraffin and to 100 g of water in similar containers.

Why does the temperature of the paraffin rise more quickly?

A The paraffin has a larger specific heat capacity than water.

B The paraffin has a smaller specific heat capacity than water.

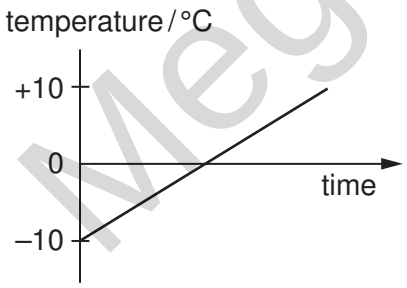
C The paraffin is less dense than water.

D The paraffin is more dense than water.

45 Ice at –10 °C is heated at a constant rate until it is water at +10 °C.

Which graph shows how the temperature changes with time?

A



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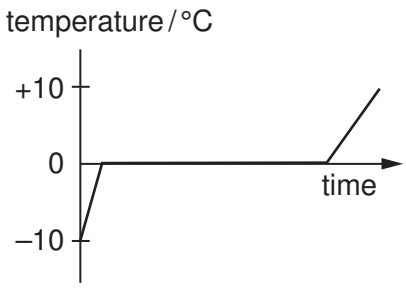

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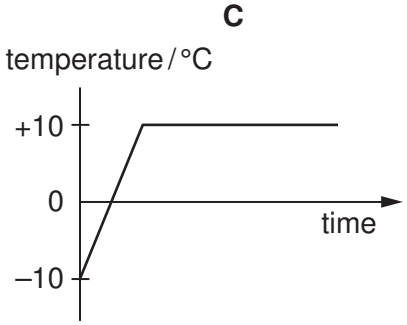

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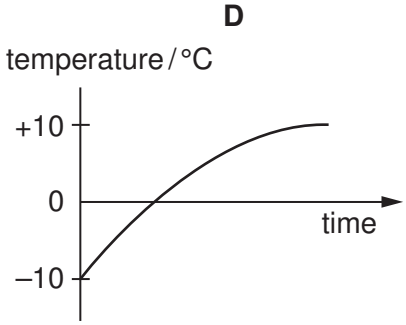
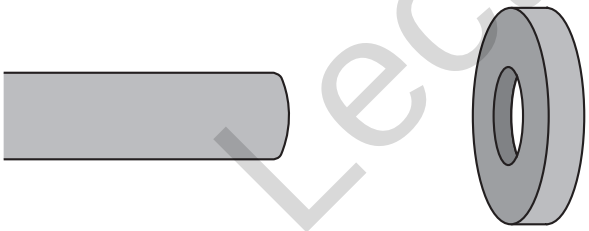


46 A glass jug is designed so that it does not break when boiling water is poured into it.

What sort of glass should be used?

	thickness	expansion
A	thick	expands greatly when heated
B	thick	expands little when heated
C	thin	expands greatly when heated
D	thin	expands little when heated

47 An axle is too large to fit into the hole in a wheel that is made of the same metal.



How can the axle be made to fit into the hole?

A by cooling the axle alone

B by cooling the wheel alone

C by cooling both the axle and the wheel

D by heating both the axle and the wheel

48 A 2 kg mass of copper is heated for 40 s by a heater that produces 100 J / s.

The specific heat capacity of copper is 400 J / (kg K).

What is the rise in temperature?

A 5 K

B 10 K

C 20 K

D 50 K