H2 Physics Revision Topic : First Law of Thermodynamics

Multiple Choice Questions Name: _____

1 A block of iron of mass 15 kg and temperature 35 °C is in thermal contact with a block of iron of mass 30 kg and temperature 95 °C. Heat loss to the surroundings is negligible.

What will be the final temperature of both blocks?

A 60 °C **B** 65 °C **C** 70 °C **D** 75 °C

2 Cooling water enters the heat exchanger in the turbine hall of a nuclear power station at 6.0 °C and leaves at 14.0 °C. The rate of heat removal by the water is 6.7×10^9 J per minute.

The specific heat capacity of water is 4200 J $kg^{-1}K^{-1}$.

What is the rate of water flow?

A $\frac{6.7\times10^9\times60}{4200\times8}\ kgs^{-1}$

B $\frac{6.7\times10^9}{4200\times8\times60}\ kgs^{-1}$

C $\frac{4200\times8}{6.7\times10^9\times60}\ kgs^{-1}$

D $\frac{4200\times8\times60}{6.7\times10^9}\ kgs^{-1}$

3 A small ice cube of mass 20 g is heated and changes from the solid to the liquid state. During the change in state, the temperature of the substance does not change.

Which statement about this change in state is incorrect?

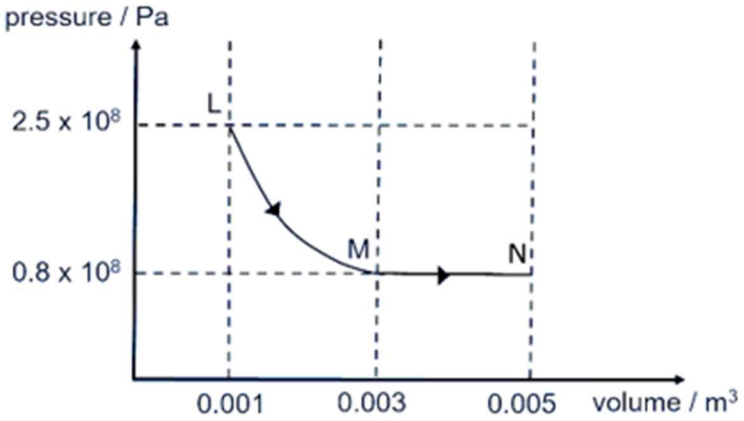
A The amount of energy the ice absorbs is equal to the specific latent heat of fusion.

B The average kinetic energy of the molecules remains unchanged.

C The average potential energy of the molecules increases.

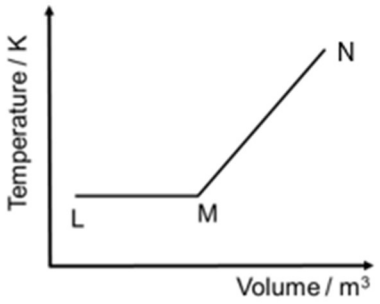
D The total mass of ice and water remains constant throughout.

4 A fixed mass of ideal gas undergoes changes of pressure and volume starting at L and ending at N, as shown.



Which graph shows how temperature changes with volume?

A



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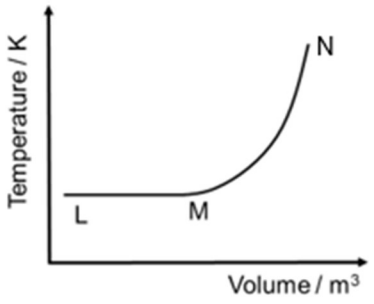

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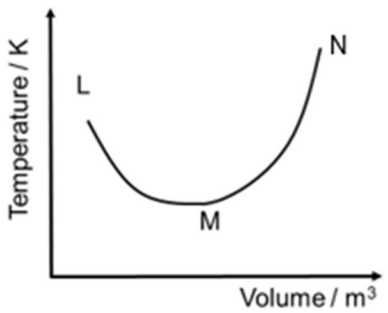

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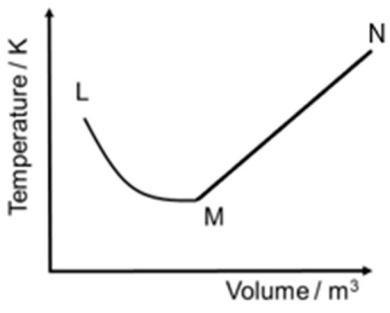


5 A solid X is in thermal equilibrium with a solid Y, which is at the same temperature as a third solid Z. The three bodies are of different materials and masses. Which one of the following statements is certainly correct?

A X and Y have the same heat capacity.

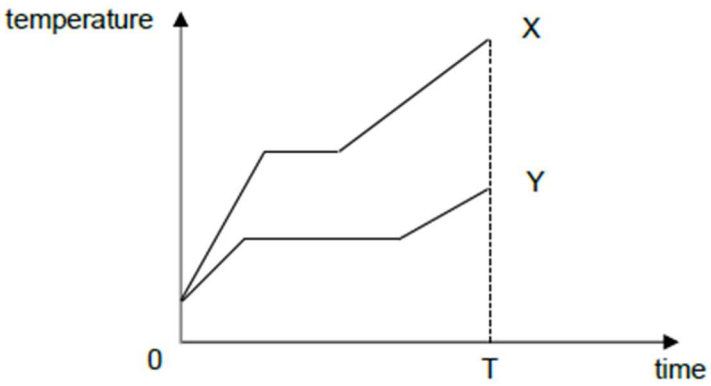
B Y and Z have the same internal energy.

C The atoms of X and Y have the same speed.

D There is no net transfer of energy if Y is placed in thermal contact with Z.

6 Equal masses of two solids X and Y are heated from the same temperature. Energy is supplied by heating at the same constant rate to each solid.

The graph shows how the temperature of each solid varies with time after heating starts.



What can be deduced from the graph?

A X has the higher boiling point.

B X has the larger specific latent heat of fusion.

C When X and Y are solids, Y has the larger specific heat capacity.

D At time T, X gained more internal energy than Y.

7 An ideal monatomic gas has 1000 J of heat added to it and it does 500 J of work; its thermodynamic temperature changes by ΔT_1. When twice the amount of heat is added to it and it does the same amount of work, its temperature changes by ΔT_2. The ratio of $\Delta T_1 / \Delta T_2$ is

A 1/5 **B** 1/3 **C** 3/5 **D** 1

8 A fixed mass of ideal gas undergoes a contraction in volume from 80×10^{-3} m^3 to 40×10^{-3} m^3 at a constant pressure of 25 kPA. During this contraction, 2500 J of heat is removed from the gas.

What is the change in internal energy of the gas?

A –3500 J **B** –1500 J **C** 1500 J **D** 3500 J

9

A polystyrene cup contains a mass of 88 g of water at 30 °C. A cube of ice of mass 12 g and temperature 0 °C is placed in the water. The water, of specific heat capacity 4.2×10^3 J kg K^{-1}, is stirred till all the ice melts.

Assuming neligible heat loss to the cup and surroundings, what is the final temperature of the water?

specific latent heat of fusion of ice = 3.3×10^5 J kg K^{-1}.

A 17 °C

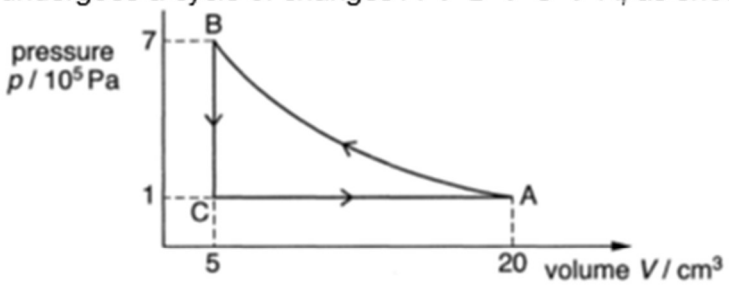
B 19 °C

C 21 °C

D 23 °C

10

An ideal gas undergoes a cycle of changes A → B → C → A, as shown.



Which of the following statements is correct?

A Process A → B is isothermal.

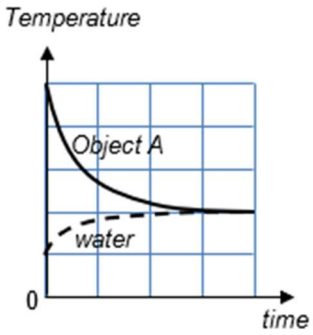
B Process B → C is isochoric.

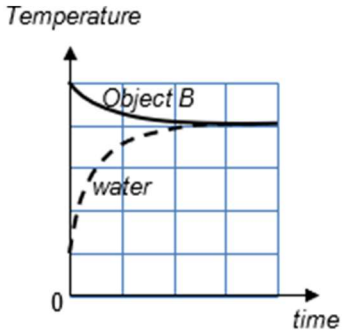
C Work of 15 J is done by the gas in process C → A.

D The internal energy of the gas is zero.

11 Object A is dropped into water inside a thermally insulated container of negligible heat capacity. The object and water are then allowed to come to thermal equilibrium.

The experiment is repeated with a different object, B. The two objects have the same mass and initial temperature, and the mass and initial temperature of the water are the same in the two experiments. For each of the experiments, the following graphs show the variation with time of the temperatures of the object and the water.





If c_A and c_B are the specific heat capacities of object A and object B respectively, what is the relationship between c_A and c_B ?

A $c_A = \frac{1}{9} c_B$ **B** $c_A = \frac{1}{3} c_B$ **C** $c_A = 3 c_B$ **D** $c_A = 9 c_B$