Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic: Thermal Physics

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Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

A student measures the power of a microwave oven. He places 200 g of water at 23 °C into the microwave and heats it on full power for 1 minute. When he removes it, the temperature of the water is 79 °C.

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

What is the average rate at which thermal energy is gained by the water?

A 780 W ⬭

B 840 W ⬭

C 1.1 kW ⬭

D 4.6 kW ⬭

(Total 1 mark)

Q2.

A continuous stream of water falls through a vertical distance of 100 m.
Assume no thermal energy is transferred to the surroundings.
The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the temperature difference of the water between the top and bottom of the waterfall?

A 0.023 K ⬭

B 0.23 K ⬭

C 2.3 K ⬭

D 4.3 K ⬭

(Total 1 mark)

Q3.

The composition of a carbon dioxide (CO_2) molecule is one atom of $^{12}_{6}C$ and two atoms of $^{16}_{8}O$.

What is the number of molecules of CO_2 in 2.2 kg of the gas?

A 1.0×10^{22} ⬭

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B 3.0×10^{22} ⬭

C 3.0×10^{25} ⬭

D 4.7×10^{25} ⬭

(Total 1 mark)

Q4.

What is the total internal energy of 2.4 mol of an ideal gas which has a temperature of 15 °C?

A 6.0×10^{-21} J ⬭

B 1.4×10^{-20} J ⬭

C 4.5×10^{2} J ⬭

D 8.6×10^{3} J ⬭

(Total 1 mark)

Q5.

Which of the following is **not** used as valid assumption when deriving the equation $P = \frac{1}{3} Nm\,(c_{\text{rms}})^2$ in the simple kinetic theory of gases?

A The molecules suffer negligible change of momentum on collision with the walls of the container. ⬭

B Attractive forces between molecules are negligible. ⬭

C The duration of a collision is negligible compared with the time between collisions. ⬭

D The volume of the molecules is negligible compared with the volume of the gas. ⬭

(Total 1 mark)

Q6.

Specimens **P** and **Q** of the same gas exert the same pressure. **P** is at a temperature of 280 K and contains 10^{20} molecules per unit volume. The temperature of **Q** is 350 K.

What is the number of molecules per unit volume in **Q**?

A 0.09×10^{20} ⬭

B 0.75×10^{20} ⬭

C 0.80×10^{20} ⬭

D 1.25×10^{20} ⬭

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(Total 1 mark)

Q7.

An ice cube of mass 0.010 kg at a temperature of 0 °C is dropped into a cup containing 0.10 kg of water at a temperature of 15 °C.

What is the maximum estimated change in temperature of the contents of the cup?

specific heat capacity of water = 4200 J kg^{-1} K^{-1}
specific latent heat of fusion of ice = 3.4×10^5 J kg^{-1}

A 1.5 K ⬭

B 8.7 K ⬭

C 13.5 K ⬭

D 15.0 K ⬭

(Total 1 mark)

Q8.

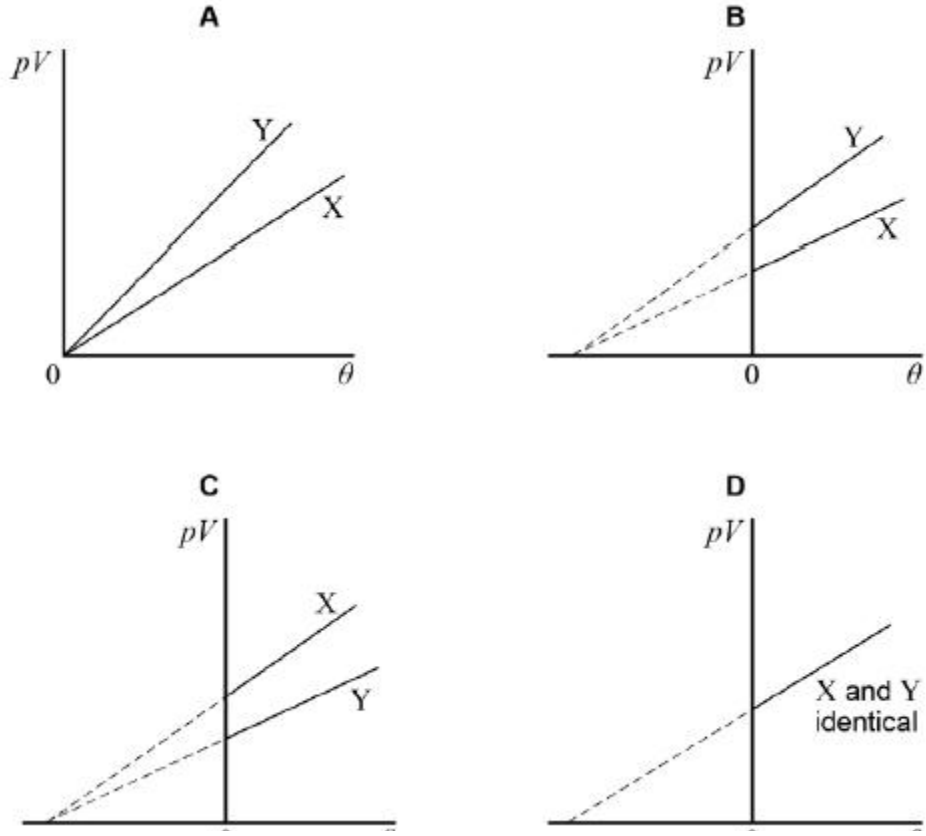
One mole of gas occupies a volume V at a pressure p and Celsius temperature θ.

The graphs, **A** to **D**, show variation of pV with θ.
Line X is for one mole of nitrogen and line Y is for one mole of oxygen.

Relative molecular mass of nitrogen = 28
Relative molecular mass of oxygen = 32

Which graph is correct?

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A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

Q9.

A liquid flows continuously through a chamber that contains an electric heater. When the steady state is reached, the liquid leaving the chamber is at a higher temperature than the liquid entering the chamber. The difference in temperature is Δt.

Which of the following will increase Δt with no other change?

A Increasing the volume flow rate of the liquid ⬭

B Changing the liquid to one with a lower specific heat capacity ⬭

C Using a heating element with a higher resistance ⬭

D Changing the liquid to one that has a higher density ⬭

(Total 1 mark)

Q10.

The temperature of a hot liquid in a container falls at a rate of 2 K per minute just before it begins to

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solidify. The temperature then remains steady for 20 minutes by which time all the liquid has all solidified.

What is the quantity $\frac{\text{Specific heat capacity of the liquid}}{\text{Specific latent heat of fusion}}$?

A $\frac{1}{40}\text{K}^{-1}$ ⬭

B $\frac{1}{10}\text{K}^{-1}$ ⬭

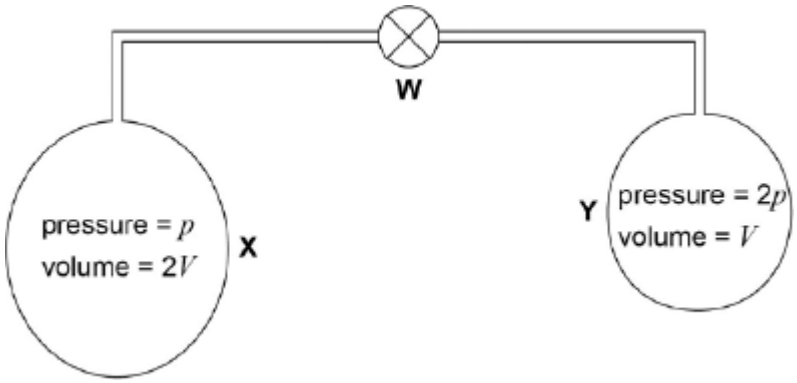
C $10\ \text{K}^{-1}$ ⬭

D $40\ \text{K}^{-1}$ ⬭

(Total 1 mark)

Q11.

X and **Y** are two gas bottles that are connected by a tube that has negligible volume compared with the volume of each bottle.



Initially the valve **W** is closed.

X has a volume $2V$ and contains hydrogen at a pressure of p.
Y has a volume V and contains hydrogen at a pressure of $2p$.
X and **Y** are both initially at the same temperature.

W is now opened. Assuming that there is no change in temperature, what is the new gas pressure?

A $\frac{2}{3}p$ ⬭

B $\frac{5}{3}p$ ⬭

C $\frac{4}{3}p$ ⬭

D $\frac{3}{2}p$ ⬭

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(Total 1 mark)

Q12.

A fixed mass of gas occupies a volume V. The temperature of the gas increases so that the root mean square velocity of the gas molecules is doubled.
What will the new volume be if the pressure remains constant?

A $\frac{V}{2}$ ⬭

B $\frac{V}{\sqrt{2}}$ ⬭

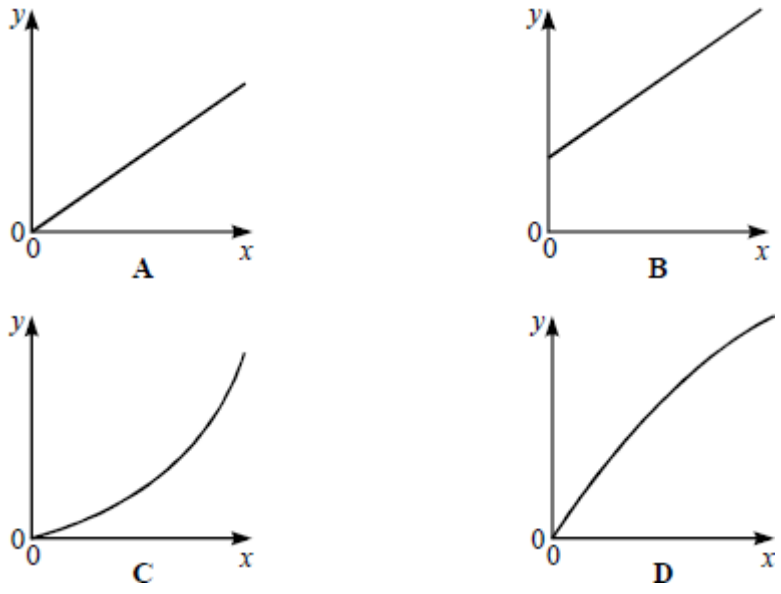
C $2V$ ⬭

D $4V$ ⬭

(Total 1 mark)

Q13.

Which one of the graphs below shows the relationship between the internal energy of an ideal gas (y-axis) and the absolute temperature of the gas (x-axis)?

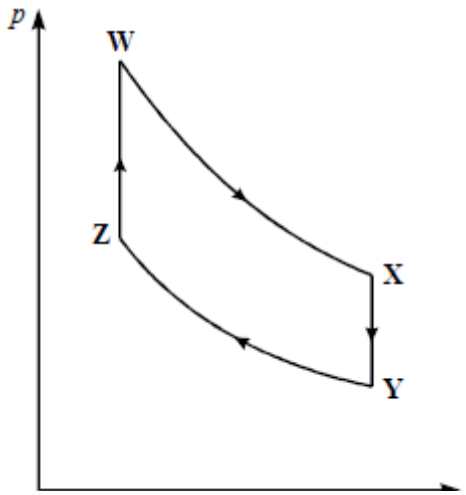


(Total 1 mark)

Q14.

The diagram shows the p-V diagram of an ideal hot-air engine. **WX** and **YZ** are isothermal changes.

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Which line of the table below correctly indicates the nature of the work done **on** or **by** the air in each part of the cycle?

	WX	XY	YZ	ZW	
A	zero	by	zero	on	⬭
B	by	zero	on	zero	⬭
C	zero	on	zero	by	⬭
D	on	zero	by	zero	⬭

(Total 1 mark)

Q15.

The temperature of a room increases from 283K to 293K. The r.m.s. speed of the air molecules in the room increases by a factor of

A 1.02 ⬭

B 1.04 ⬭

C 1.41 ⬭

D 2.00 ⬭

(Total 1 mark)

Q16.

A car of mass M travelling at speed V comes to rest using its brakes. Energy is dissipated in the brake discs of total mass m and specific heat capacity c. The rise in temperature of the brake discs can be estimated from

A $\frac{mV^2}{2Mc}$ ⬭

B $\frac{2MV^2}{mc}$ ⬭

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C $\frac{MV^2}{2mc}$ ⬭

D $\frac{2mc}{MV^2}$ ⬭

(Total 1 mark)

Q17.

A fixed mass of an ideal gas initially has a volume V and an absolute temperature T. Its initial pressure could be doubled by changing its volume and temperature to

A $V/2$ and $4T$ ⬭

B $V/4$ and $T/2$ ⬭

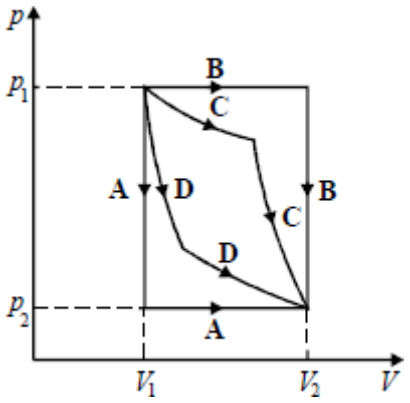
C $2V$ and $T/4$ ⬭

D $4V$ and $2T$ ⬭

(Total 1 mark)

Q18.

The diagram shows a p-V graph for a fixed mass of gas. The volume increases from V_1 to V_2 while the pressure falls from p_1 to p_2.



Which one of the paths **A**, **B**, **C** or **D** will result in the greatest amount of work being done by the gas?

(Total 1 mark)

Q19.

Which one of the following is **not** an assumption about the properties of particles in the simple kinetic theory?

A $< c^2 >$ is the average speed of the particles ⬭

B The forces between the particles are negligible except when particles collide ⬭

C The time spent by particles in collision is negligible compared with the time spent between collisions ⬭

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D The volume of the particles is negligible compared to the volume of the container ⬭

(Total 1 mark)

Q20.

A raindrop of mass m falls to the ground at its terminal speed v. The specific heat capacity of water is c and the acceleration of free fall is g. Given that 25% of the energy is retained in the raindrop when it strikes the ground, what is the rise in temperature of the raindrop?

A $\frac{mv^2}{8c}$ ⬭

B $\frac{v^2}{4mc}$ ⬭

C $\frac{mg}{4c}$ ⬭

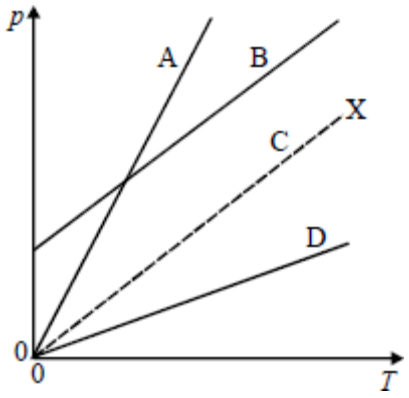
D $\frac{v^2}{8c}$ ⬭

(Total 1 mark)

Q21.

In the diagram the dashed line **X** shows the variation of pressure, p, with absolute temperature, T, for 1 mol of an ideal gas in a container of fixed volume.

Which line, **A**, **B**, **C** or **D** shows the variation for 2 mol of the gas in the same container?

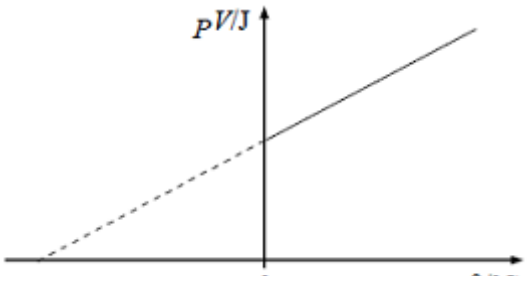


(Total 1 mark)

Q22.

The graph shows the relation between the product *pressure* × *volume*, pV, and temperature, θ, in degrees celsius for 1 mol of an ideal gas for which the molar gas constant is R.

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Which one of the following expressions gives the gradient of this graph?

A $\frac{1}{273}$ ○

B $\frac{pV}{\theta}$ ○

C $\frac{pV}{(\theta - 273)}$ ○

D R ○

(Total 1 mark)

Q23.

At a certain temperature, the root-mean-square speed of the molecules of a fixed volume of an ideal gas is c. The temperature of the gas is changed so that the pressure is halved. The root-mean-square speed of the molecules becomes

A $\frac{c}{4}$ ○

B $\frac{c}{2}$ ○

C $\frac{c}{\sqrt{2}}$ ○

D $2c$ ○

(Total 1 mark)

Q24.

A 1.0 kΩ resistor is thermally insulated and a potential difference of 6.0 V is applied to it for 2.0 minutes. The thermal capacity of the resistor is 9.0 J K^{-1}. The rise in temperature, in K, is

A 1.3×10^{-3} ○

B 8.0×10^{-3} ○

C 0.48 ○

D 0.80 ○

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(Total 1 mark)

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