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

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Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

(a) State what is meant by the internal energy of an ideal gas.

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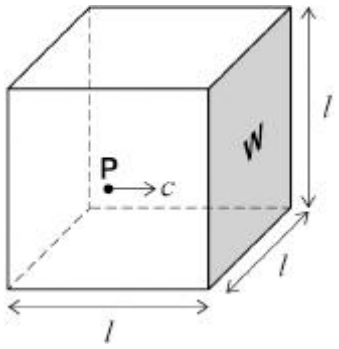
(1)

The figure below shows a single gas particle **P** of an ideal gas inside a hollow cube.



The cube has side length l and volume V.
P has mass m and is travelling at a velocity c perpendicular to side **W**.

(b) Explain why **P** has a change in momentum of $-2mc$ during one collision with **W**.

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(1)

(c) **P** collides repeatedly with **W**.

Show that the frequency f of collisions is $\frac{c}{2l}$.

(1)

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(d) Deduce an expression, in terms of m, c and V, for the contribution of **P** to the pressure exerted on **W**.
Refer to appropriate Newton's laws of motion.

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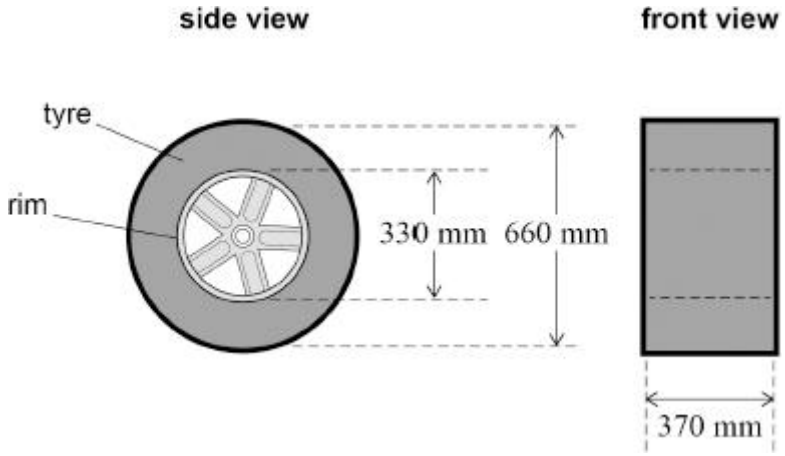
(2)

(Total 5 marks)

Q2.

The figure below shows a wheel used in motorsport. A rubber tyre is fitted around a cylindrical metal rim. The tyre is filled with a gas.
The dimensions shown in the figure are for the volume of the gas in the tyre.

Assume that this volume remains constant throughout this question.



(a) The mass of the wheel is measured when the gas in the tyre is at a pressure of 1.01×10^5 Pa. More of the same gas is added to the tyre and the mass of the wheel is measured again.

The table below shows the pressure in the tyre and the mass of the wheel before and after the addition of the extra gas.
The gas is kept at a constant temperature of 100 °C.

	Pressure in tyre / Pa	**Mass of wheel / kg**
Before	1.01×10^5	14.897
After	2.11×10^5	14.991

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Determine, in $\mathrm{kg\ mol^{-1}}$, the molar mass of the gas.

molar mass = _____ $\mathrm{kg\ mol^{-1}}$

(5)

(b) Motorsport regulations specify a minimum amount of gas in the tyre.

The amount of gas in the tyre is checked by measuring the pressure before the wheel is put onto the car. The regulations also specify a maximum temperature for the tyre when making this measurement.

Explain why a maximum temperature is specified.

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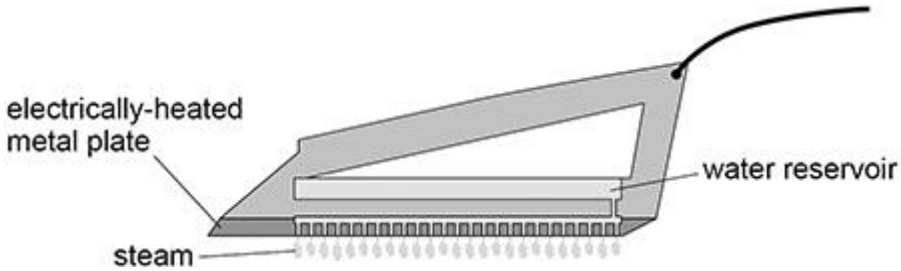
(2)

(Total 7 marks)

Q3.

The figure below shows an electric steam iron.



Water from a reservoir drips onto an electrically-heated metal plate. The water boils and steam

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escapes through holes in the metal plate.

The electrical power of the heater inside the iron is $2.1\ \text{kW}$.

Assume that all the energy from the heater is transferred to the metal plate.

(a) The metal plate has a mass of $1.2\ \text{kg}$ and is initially at a temperature of $20\ °\text{C}$.
The heater is switched on. After a time *t* the metal plate reaches its working temperature of $125\ °\text{C}$.

Calculate *t*.

specific heat capacity of the metal = $450\ \text{J kg}^{-1}\ \text{K}^{-1}$

t = _____ s

(2)

(b) The metal plate is maintained at its working temperature.
Water at $20\ °\text{C}$ drips continuously onto the metal plate.
Steam at $100\ °\text{C}$ emerges continuously from the iron.

The maker claims that the iron can generate steam at a rate of $60\ \text{g min}^{-1}$.

Determine whether this claim is true.

specific latent heat of vaporisation of water = $2.3 \times 10^{6}\ \text{J kg}^{-1}$
specific heat capacity of water = $4200\ \text{J kg}^{-1}\ \text{K}^{-1}$

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(3)

(Total 5 marks)

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