Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic : 9_Thermodynamics

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Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

The photograph shows a filament bulb.

The filament is an emitter with 35% of the power output of a black body radiator of the same temperature.
When a potential difference (p.d) of 2.0 V is applied across the bulb, there is a current of 0.37 A in the filament.
surface area of filament = 3.9×10^{-6} m^2

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Temperature = ...

(Total for question = 3 marks)

Q2.

Chocolate is a solid at room temperature, but melts just below body temperature.
One type of chocolate melts at a temperature of 32°C.
The energy released when 65 g of this chocolate is digested is 345 kcal.
It is suggested that the energy used to melt a piece of this chocolate is at least 15% of the energy released when

the chocolate is digested.

Assess the accuracy of this suggestion.

initial temperature of chocolate = 15°C
specific heat capacity of chocolate = 3.9×10^3 J kg^{-1} K^{-1}
specific latent heat of chocolate = 1.50×10^5 J kg^{-1}
1 kcal = 4200 J

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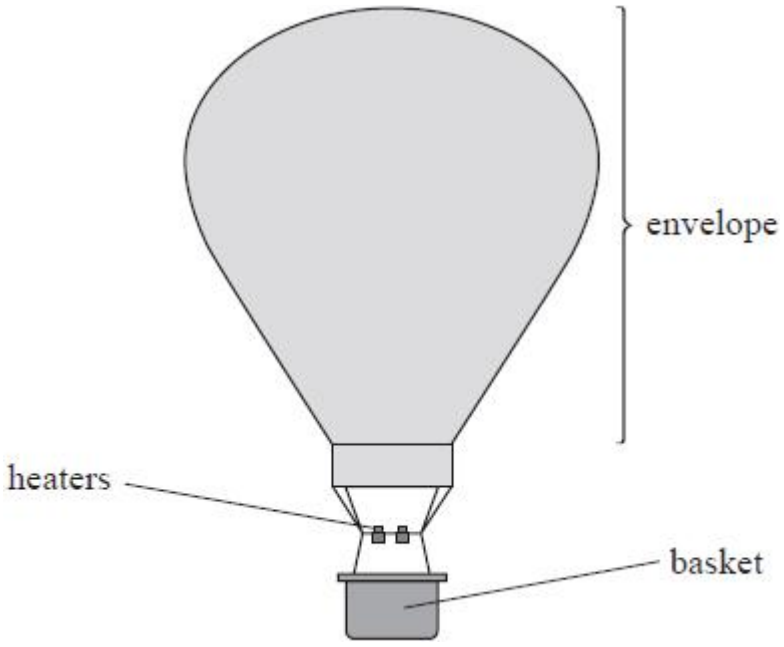
(Total for question = 6 marks)

Q3.

A hot air balloon consists of a fabric envelope, heaters and a basket, as shown.



When the balloon is set up, the envelope is partly filled with air at 20°C. The air is then heated to 120°C and expands to fill the envelope and becomes less dense.

The air pressure inside the envelope is always equal to the air pressure outside the envelope because the envelope is open at the bottom.

The balloon takes off when the upthrust is more than the total weight of the balloon, the air in the envelope and the passengers.

Deduce whether the balloon can take off.

volume of air at 120°C in inflated envelope = 2800 m^3
density of air at 20°C = 1.2 kg m^{-3}
mass of balloon = 380 kg
mass of passengers = 340 kg
upthrust when the envelope is full = 33 000 N

(i) State one assumption of the kinetic theory of gases.

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(ii) Derive an equation to show that, for a gas at temperature *T*,

the mean kinetic energy of the molecules $= \frac{3}{2} kT$

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(iii) Calculate the root-mean-square speed of nitrogen molecules at a temperature of 120°C.

mass of nitrogen molecule = 28 u

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Root-mean-square speed = ...

(Total for question = 6 marks)

Q4.

Helium is available in small metal canisters. The helium can be used to fill party balloons.

A full canister contains helium gas at a temperature of 18.5°C and a pressure of 1.65×10^7 Pa. The canister is approximately spherical, with a radius of 4.36×10^{-2} m.

Calculate the mass of helium gas in the full canister.

mass of 6.02×10^{23} atoms of helium = 4.00×10^{-3} kg

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Mass of helium = ...

(Total for question = 5 marks)