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

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

Q1.

An old type of camping lamp used a 'gas mantle'. The gas mantle is heated by the gas flame on the lamp and emits a bright white light. Gas mantles used to contain thorium-230.

Thorium-230 decays by alpha emission to form an isotope of radium. A student keeps a radioactive gas mantle in a sealed polythene bag. The student suggests that over a period of a year a significant volume of helium gas will be collected, since an alpha particle is a helium nucleus.

A particular gas mantle contains 5.18×10^{-5} g of thorium-230.

(i) Show that the activity of the thorium-230 in the mantle is about 4.0×10^{4} Bq.

230 g of thorium-230 contains 6.02×10^{23} atoms
half-life of thorium-230 = 75 400 years
number of seconds in 1 year = 3.15×10^{7}

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(ii) Determine the volume of helium gas that could be collected in a year as a result of alpha emission.

Assume that the temperature is 22.0 °C and the pressure is 1.00×10^{5} Pa.

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Volume = ...

(iii) Calculate the root mean square speed of the atoms in the helium gas at a temperature of 22.0 °C.

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Root mean square speed = ...

(Total for question = 11 marks)

Q2.

An electric iron rated at 2600 W contains a steel plate which is heated to a working temperature of 215 °C. Room temperature is 18°C.

Deduce whether the plate could reach its working temperature in less than 1 minute.

mass of steel plate = 890 g

specific heat capacity of steel = 450 J kg^{-1} K^{-1}

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(Total for question = 3 marks)

Q3.

A cup contains 180 g of black coffee at a temperature of 82 °C. 68 g of milk at a temperature of 2.7 °C is added to the coffee. An ideal temperature range for drinking coffee is said to be 50 °C to 60 °C.

Deduce whether the coffee will be within the ideal temperature range when the milk is added.

initial temperature of milk = 2.7 °C

specific heat capacity of black coffee = 4.2×10^3 J kg^{-1} K^{-1}

specific heat capacity of milk = 3.9×10^3 J kg^{-1} K^{-1}

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(Total for question = 3 marks)

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