***3 HOURS***

***SECTION A (60 MARKS) ATTEMPT ANY 3***

1. (a)(i). what is meant a black body. (1mk)

(ii). State the relation between the total power radiated by a black body and the temperature of the body. (1mk)

(iii). State the factors that determine the rate at which a body losses heat by radiation. (02)

(b). A strip of platinum foil coated black is placed on the ground. The area of the strip exposed to the radiation from the sun is 10-2m2. The radiation from the sun falls normally on the strip to obtain a certain temperature rise. The strip is then shielded from the sun radiation, and a current of 1.4A is maintained through the foil under a potential difference of 4.0V to obtain the same temperature rise. Assuming that only 40% of the intensity of radiation incident on the earth’s atmosphere reached the earths’ surface; estimates the surface temperature of the sun. (5mks)

(c)(i). Define the thermal conductivity of a material. (1mk)

(ii). Explain the mechanism of heat transfer in metals and insulator. (4mks)

(iii). Sketch on the same axes a graph to show how temperature varies with distance along the length of well lagged and unlagged good conductor of heat. (2mks)

(d). One square face of a sheet of cork of side 20cm and thickness 4mm is placed in contact with a sheet of glass of the same square section and thickness 6mm. the outer faces of the composite sheet are maintained at 100oC and 20oC. Conductivity of cork is 6.3Wm-1K-1 and that of glass is 7.2 Wm-1K-1.

Find the rate of heat conduction through the sheets. (4mks)

(e) Describe an experiment to compare the energy radiated by two surfaces of different nature

(04marks)

1. a) (i) What is meant by a black body radiation? ***(1mark)***

(ii) State Stephan’s law of black body radiation. ***(1mark)***

b) The filament of an electric bulb that radiates as a black body is 0.5m long and has a radius of 1.0 x 10-4m. The filament melts when connected across 240V and the current through it is 0.40A.

(i) Calculate the temperature at which the filament melts. ***(4marks)***

(ii) Find the wave length for which the energy radiated by the filament is a maximum. (Wien’s constant = 2.9 x 10-3mk) ***(2marks)***

c) A uniform composite metal of diameter 4.0cm is made of copper and

Aluminium and arranged as shown in the figure below. One end is maintained at 1000c and the other kept in melting ice.

89cm 40cm

1000 copper Aluminium melting ice

The ice melts at a rate of 5.36g min-1. If the thermal conductivity of Aluminium is 210Wm-1k-1, find,

1. The temperature of the interface between Copper and Aluminium. ***(2marks)***
2. The thermal conductivity of copper. ***(4marks)***

(Specific latent heat of fusion of ice = 3.36 x 105Jkg-1)

d) Describe how a thermoscope and a bolometer are used to detect radiation. (06 marks)

e) (ii) The earth receives energy from the sun at the rate of 1.4x103Wm-2 If the ratio of the earth earth’s orbit to the suns radius is 216, calculate the surface temperature of the sun

3. (a) Define the terms emissivity and emissive power. (02marks)

(b) Describe an experiment to determine the thermal conductivity of copper (04marks)

(c) A double glazed window has two glass sheets each of thickness 4.0mm, separated by a layer of air of thickness 1.5mm. If the two inner air-glass surfaces have steady temperature of 25 and 4 respectively, find the

(i) Temperature of the outer air-glass surface

(ii) Amount of heat that flows across an area of the window of 2 in 2hours

[Conductivity of glass 0.72 Wm-1K-1, and that of air 0.025Wm-1K-1] (03marks)

(d) (i) What is solar constant?

(ii) Explain how a welder can protect the eyes from damage (02marks)

(iii) Calculate the wavelength of the radiation emitted by a black body at 6000K

(Wien’s displacement constant= 2.9x10-3Wm) (02 marks)

1. Explain with the aid of a diagram how a black body can be approximated (02marks)
2. What are factors on which heat flow depends?(02 marks)
3. How a thermopile detects infra-red radiations. (03 marks)
4. a(i) Compare the mechanism of heat transfer in **poor** and **good solid** conductors. (03 marks)

(ii) A cylindrical iron vessel with a base of diameter 15cm and thickness 0.30cm has it’s base coated with a thin film of soot of thickness 0.1cm. It is then filled with water at 1000C and placed on a large block of ice at 00C. Calculate the initial rate at which the ice will melt. [The conductivity of soot=0.12Wm-1K-1, conductivity of iron=75Wm-1K-1]

i) State Prevost theory of heat exchanges (01marks)

Explain the occurrence of land and sea breeze (04marks)

The average distance of Pluto from the sun is a bout 40times that of earth from the sun. If the sun radiates as a black body at 6000K, and is 1.5x1011m from the earth, calculate the surface temperature of Pluto.

A solid metal sphere is placed in an enclosure at temperature of 270C when temperature of the metal is 2270C, it cools at rate of 30C per minute. What is the rate of cooling when solid sphere of same metal but twice the radius at 1270C is placed in the same enclosure

A solid copper sphere of diameter 10mm and temperature of 150K is placed in an enclosure maintained at temperature of 290K. Calculate stating any assumption made the initial rate of rise of temperature of sphere. ( of copper 8.95x103kg/m3, S.H.C of copper 3.7x102Jkg-1K-1)

If the mean equilibrium temperature of the earth’s surface is T and the total rate of energy emission by the sun is E, show that 

Where is Stefan’s constant and R is the radius of the earth orbit around the sun

(b) Assuming that the sun is a sphere of radius 7.0 108 m at a temperature of 6000 K, estimate the temperature of mars if its distance from the sun is

2.26 1011 m. (4marks)

(c) The heat radiation received by the earth from the sun is 1.4 103 W m-2.

Assuming that this is 90% of what the sun emits as a black body, estimate the temperature of the sun. (4marks

(d) (i) Draw sketch graphs to show the variations of relative intensity of black body radiation with wavelength for three different temperatures. (2marks)

(ii) Describe the features of the sketch graphs in (d) (i) above. (3marks)

(e) (i) Distinguish between high grade and low grade energy giving two examples of each. (3marks)

(ii) Explain how greenhouse effect causes global warming. (3marks)

1. (a) Define thermal conductivity of a substance.  *(01 mark)*

(b) Explain how heat transfer takes place in a liquid.  *(03 marks)*

(c) (i) Describe an experiment to determine the thermal conductivity of a poor conductivity of heat and state precautions during the experiement.  *(07 marks)*

*(02 marks)*

(e) (i) Radiation from a spherical black body of radius 20m falls normally on a surface of arch 10m2. The surface is 50.0m from the black body and attains equilibrium temperature of 400C. Calculate the temperature of the black body.  *(03 marks)*

1. With the aid of sketch graphs, describe the salient features of the spectral

Distribution of black body radiation (3)

1. The filament of an electric bulb attains a temperature of 1600k when the jpower supplied to it is 25W

(i) Find the temperature of the filament if the power supply is increased to 60W (3)

(ii) Find the length of the filament at 1600k if the diameter is 5.0 x 10-5m (2)

(iii) Calculate the change in the maximum wavelength of the radiation emitted at the two temperatures. Assume the filament radiates as a blackbody (4)

Rods of copper, brass and steel are welded together to form Y-Shaped figure. The cross sectional area of each rod is 2cm2 .The end of copper rod maintained at 100oC and the ends of brass and steel rod at 0oC, assume that there is not heat loss from surface of rod and that length of rods are 46cm, 13cm and 12cm respectively. Calculate the;

(i) temperature of junction.

(ii) heat current in the copper rod (thermal conductivities of copper, brass and steel are respectively 385Wm-IK-I, 109Wm-1K-1 and 50.2Wm-1K-1

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