**Specific latent heat of copper=400J/kg/K**

**Specific latent heat of ice=2100J/Kg/K**

**Specific latent heat of vapourisation of water=2.26x106J/Kg**

**Specific latent heat of fusion of ice=3.50x105J/Kg**

**SECTION A (60 marks)**

**ATTEMPT ANY *THREE* QUESTIONS**

1. (a)(i)what are thermometric properties of substance (1mk)

(ii)Give 4 examples of these properties. (2 mks)

(iii)What are fixed temperature points? (1mk) (b)i) Define the scale of thermometer on a constant volume gas thermometer. (1mk)

(ii)With the help of a labeled diagram describe the mode of operation of a practical constant volume gas thermometer. (4mks)

(iii) State the corrections necessary in the thermometer in (b) (ii) (2mks). (iv) Explain how a Kelvin scale of temperature is established. (2marks)

C (i) The resistance of platinum varies with the temperature 0c measured on the gas thermometer according to the equation.. Calculate the temperature as measured by the resistance thermometer when the gas thermometer measures 600c.(04 mks)

(ii) With reference to a platinum resistance thermometer, explain how the thermodynamic scale of temperature can be established. *(03 marks)*

1. **(a)** (i)What is meant by the term fixed points in thermometry. Give two examples of such points (02marks)

(ii) How is temperature on a Celsius scale defined on a mercury in glass thermometer? (02marks)

(b) Explain the extent to which thermometer based on different properties but calibrate using the same fixed points are likely to agree when used to measure a temperature

(i) Near one of the fixed points (02marks)

(ii) Midway between the two fixed points (02marks)

(d) What are the advantages of a thermocouple over a constant volume gas thermometer in measuring temperature.(03 mks)

(b) (i) What is a pyrometer? (1mark)

(ii) With the aid of a labelled diagram, describe the structure and operation of a disappearing filament pyrometer (6marks) (ii) With a constant volume gas thermometer, the following observations were recorded on a day when the barometer reading was 750mmHg.

|  |  |  |
| --- | --- | --- |
|  | Mercury level in closed limb (mm) | Mercury level in open limb (mm) |
| Bulb in melting ice  Bulb in steam  Bulb in water | 126  126  126 | 112  390  157 |

1. What is the thermometric property of the thermometer (1 mark)
2. Calculate the temperature of the water (5 marks)
3. (a) Explain what is meant by saying that a temperature is 60oC on the scale of a particular resistance thermometer. (2 )
4. A certain device has electrical resistance R given by the expression

Rθ = Ro

(1 + α θ2)

where Ro is its resistance at 0oC, θ is the centigrade temperature measured with a gas thermometer and α is a constant

1. Calculate the values of R at temperatures of 100oC, 150oC and 200oC on the gas thermometer. If Ro = 10.0 Ω and α = 5.0 x 10– 5 K – 1 (3)

(ii) If the device above were used as a resistance thermometer and its scale defined in the usual way, what values would it give for temperatures that are 100oC, 150oC and 200oC according to a gas thermometer? Comment on your answers. (4)

1. By the use of a clearly labelled sketch diagram, describe how a thermocouple is used to measure temperature (4)
2. State two advantages of a thermocouple used in (d) above (1)
3. The resistance of the element of a platinum resistance thermometer is 4.00Ω at the ice-point and 5.46Ω at the steam point. What temperature on the platinum resistance scale would correspond to a resistance of 9.84Ω? (3)
4. (i) Explain why scales of temperature based on different thermometric properties may not agree (1)

(ii) Briefly explain how you would determine the temperature of a furnace using total radiation pyrometer. (3)

1. (a) (i)Describe the steps involved in introducing a celcious scale on mercury in glass thermometer.(04 marks)
2. What are advantages and disadvantages of the thermometer above?(03 marks)
3. (iii) How does the thermocouple overcomes the disadvantages above.(03 marks)
4. Using a graph of pressure against temperature in degrees Celsius, derive an expression for t in oC. (03 marks)

(b)The thermometer is constructed with a liquid which expands according to the equation if V0 is the volume at ice point and a: b=100:1 and ɵ is temperature in oc on mercury in glass thermometer. What will be the reading on this thermometer if mercury in glass thermometer reads 60oC. (04 marks).

(c). A calorimeter of mass 100gm and specific heat capacity 100J/kg/k contains 50gm of ice and 50gm of water. Steam at 100oC, is passed through the water at steady rate until the total mass is 210gm.

(i). Calculate the final temperature (4mks)

(ii). Sketch a graph to show the variation of temperature with time. (1mk)

**SECTION B (60 marks)**

**ATTEMPT ANY *THREE* QUESTIONS**

1. a) (i) Define heat capacity of a substance and state its units. ***(2marks)***

(ii) With the use of a labeled diagram, describe the continuous flow method of determining the specific heat capacity of a liquid. ***(5marks)***

(iii) State any two disadvantages of the continuous flow method described in (ii) above. ***(1mark)***

b) In a continuous flow experiment to determine the specific heat capacity of a liquid, the following results were obtained.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Voltage V/volts | Current/ A | Outflow temperature 0c | Inflow temperature 0c | Volume of liquid collected per minde cm3/min |
| 12.0 | 5 | 24 | 20 | 192 |
| 10.0 | 3 | 24 | 20 | 84 |

Given that the density of the liquid is 1000kgm-3, use the above information to find;

1. The specific heat capacity of the liquid.  ***(4marks)***
2. The power loss to the surrounding. ***(2marks)***

c) (i) State Newton’s law of cooling. ***(1mark)***

(ii) Describe an experiment to verify Newton’s law of cooling. ***(4marks)***

(iii) An electric heater rated 520W is used to raise the temperature of 2.5kg of a liquid from 200c to 1000c in 25 minutes. Given that room temperature is 200c and the rate of heat loss at 1000c is 16W. Estimate the specific heat capacity of the liquid. ***(3marks)***

1. a) Explain why a metal surface feels cooler to the touch than a wooden surface at the same temperature. ***(3marks)***

(b) (i) What is meant by a cooling correction? (01 mark)

(ii) Explain how a cooling correction can be obtained for a poor conductor. (05 marks)

(iii) Explain why a baby must be wrapped well in a woollen cloth on a cold day. (03 marks)

(c) (i) Define specific heat capacity of a substance. (01 mark)

(ii) The temperature of 60 g of a liquid contained in a calorimeter is raised from 18°C to 48°C in 520 s, by an electrical heater dissipating at 10.0 W. When 120 g of liquid is used and the same change in temperature occurs in the same time, the power of the heater is

16.5 W. Calculate the specific heat capacity of the liquid. (04 marks)

(d) Explain why temperature remains constant when a solid changes to liquid.  *(03 marks)*

(e) A copper block of mass 1.2kg is placed in a Bunsen flame. It is then quickly transferred to a calorimeter of heat capacity 64JK-1 containing 55g of ice and 230g of water all at 00C. After stirring the final temperature reached is 200C.

Calculate the temperature of the flame.  *(05 marks)*

1. (a) Define specific latent heat of fusion and state the units. (2 mks)

(b) Describe, giving the relevant theory, an electrical method of determining the specific latent heat of fusion of ice. (4 mks)

1. Explain why the specific latent heat of vapourization is much higher than the specific latent heat of fusion for the same substance. (2 mks)
2. (i) An electrical heater rated 500W is immersed in a liquid of mass 2.0kg contained in large thermos flask of heat capacity 840 Jkg-1 at 28oC. Electric power is supplied to the heater for 10 minutes. If the specific heat capacity of the liquid is 2.5 x 103Jkg-1K-1, its specific latent heat of vapourization is 8.54 x 103Jkg-1 and its boiling point is 78oC, estimate the amount of liquid which boils off. State any assumptions made in your calculation.
3. mks)
4. Sketch a cooking curve of a liquid. (1 mk)
5. Brieflexplain why at night it is much colder in a valley than on top of the hills.

(2 mks)

1. A copper calerimeter of mass 50g contains 100g of a certain liquid. The initial temperature is 20oC. A heater of negligible heat capacity is immersed in the liquid and is operated at 1.5A, 7.5V for exactly 5 minutes. After this time, the temperature is recorded as 28.5oC. Subsequently, the temperature falls steadily to reach 28.0oC after 2,5 minutes has elapsed from the time heating was stopped.

Obtain a value for:-

1. the corrected temperature rise (2)
2. The specific heat capacity of the liquid. (3 )

(take s.h.c of copper = 400Jkg – 1 K – 1)

1. (a) Define specific latent heat of vaporization. (1)

(c) How much water is condensed on 1.0 x 10-3 kg of a metal of specific heat capacity 4.1 x 10-1 kJ kg-1 k-1, originally at 0oC, if the metal is placed in a vessel filled with steam at 100oC. (3)

(b) Describe an electrical method of determining the specific latent heat of vapourisation of a liquid. (4)

1. When electrical power is supplied at a rate of 12.0W to a boiling liquid, a mass of liquid of 8.6 x 10 – 3 kg evaporates in 30 minutes. On reducing the power to 7.0W, 5.0 x 10 – 3 kg of the liquid evaporates in the same time:
2. specific latent heat of vapourisation of the liquid (4)
3. power loss to the surroundings (2)

d. in an experiement to determine specific latent heat of vapourisation by electrical method the following readings were taken in 600seconds.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| V (v) | 30 | 40 | 50 | 60 | 70 |
| I (A) | 1.25 | 1.50 | 1.75 | 2.00 | 2.50 |
| M x 10-3Kg | 8.50 | 13.75 | 22.25 | 31.00 | 46.00 |

Plot a suitable graph and from it determine specific latent heat of vapourisation and energy loss to the environment. (6).