Temperature

Tutorial

Example pg 137 KF Chan

The e.m.f. of a certain thermocouple, when 1 junction is in melting ice and the other in water boiling at atmospheric pressure, is +4.10 mV. When the second junction is removed from the boiling water and placed in boiling propane, the thermoelectric e.m.f. is -1.60 mV. What is the temperature of the boiling propane on the thermocouple centigrade scale? (ans. -39 °C)

Guided example 1 (a), (b) pg 348 Francis

A certain platinum resistance thermometer is found to give resistance values of 3.5 Ω at the ice point, 4.80 Ω at the steam point and 4.15 Ω at an unknown temperature. Calculate:
(a) the value of this temperature on the platinum resistance scale
(b) the resistance value obtained at a temperature of -10 °C on this scale

(ans. 50 °C, 3.37 Ω)

Example Q2 pg 143 KF Chan

When the bulb of a constant volume gas thermometer was placed in a liquid bath, the pressure in the thermometer was 1.95×10^5 Pa; when the bulb was maintained at the triple point of water, the pressure was 1.74×10^5 Pa. Find a value for the temperature of the liquid.
The experiment was then repeated with a smaller mass of gas in the thermometer, and the corresponding pressure reading were 5.26×10^4 and 4.71×10^4 Pa. Why do these readings lead to a different value for the temperature of the liquid? What procedure should be followed to obtain the thermodynamic temperature of the bath?

(ans. 306.1 K, 305.1 K)

J99 P3 Q2

2

(b) By reference to thermal energy transfer, explain what is meant by

(i) two bodies having the same temperature,

(ii) body H having a higher temperature than body C.

[2]

(c) (i) Briefly describe how a physical property may be used to measure temperature on its empirical centigrade scale.

(ii) Hence explain why two thermometers measuring temperature on their empirical centigrade scales do not agree at all temperatures.

[5]

J94 / P3 / Q6

6 (a) Explain how a physical property of a substance which varies with temperature may be used for the measurement of temperature. [2]

(b) (i) Describe the principal features of **one** type of liquid-in-glass thermometer.

(ii) Discuss the relative advantages and disadvantages of a liquid-in-glass thermometer and a resistance thermometer which may be used in the same temperature range. [7]

(c) A resistance thermometer is placed in a bath of liquid at 0 °C and its resistance is found to be 3740 Ω. At 100 °C, its resistance is 210 Ω. The bath is now cooled until the resistance of the thermometer is 940 Ω.

(i) What is the temperature of the bath, as measured using the resistance thermometer?

(ii) The reading taken at the same time on a mercury-in-glass thermometer placed in the bath is 40 °C. Suggest a reason for the difference between this reading and the value calculated in (c)(i). [3]

(d) (i) What do you understand by the absolute (thermodynamic) scale of temperature?

(e) Explain, in terms of the energies of atoms, conditions under which it is possible to increase the total energy of the atoms of a substance without any change of temperature of that substance. [3]

J96 P2

For Examiner's Use

5 (a) State two properties of glass which makes it a particularly suitable material to use in the construction of a mercury-in-glass thermometer.

1. .....

2. .....[2]

(b) Contrary to popular opinion, mercury expands only a small amount when it is heated; there are many liquids which expand a great deal more. State two reasons why mercury is still often used in thermometers.

1. .....

2. .....[2]

(c) Suggest how the following factors affect the operation of a mercury-in-glass thermometer.

(i) The fact that mercury freezes at 234 K

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(ii) The amount of heat required to raise the temperature of the thermometer by 1 K

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(iii) The diameter of the bore of the thermometer's capillary tube

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(iv) The volume of mercury used in the bulb of the thermometer

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[7]