Benha University | **1st level student**
Faculty of science | **First Term, Final Exam.2016-2017**
Physics Department | **Time: 2 hours Date: 14-1-2017**

GENERAL PHYSICS (1) [100ph.]

(A): HEAT

Answer the following questions:

Q_1) Choose the right answer: **[24 Marks]**

1. Calorie/ ^oC are the unit of:
A. Heat capacity. B. Specific heat. C. Latent heat. D. Thermal conductivity.

2. A gram of distilled water at 4^oC, when heated to 10^oC:
A. will decrease slightly in volume B. will increase slightly in weight
C. will increase slightly in volume D. will not change in either volume or weight

3. The coefficient of linear expansion of steel is 11×10^{-6} per ^oC. A steel ball has a volume of exactly 100 cm^3 at $0^\circ C$. When heated to 100 ^oC, its volume becomes:
A. 100.33 cm^3 B. 100.0011 cm^3 C. 100.0033 cm^3 D. 100.000011 cm^3.

4. Two different samples have the same mass and temperature. Equal quantities of energy are absorbed as heat by each. Their final temperatures may be different because the samples have different:
A. coefficients of expansion B. densities C. volumes D. heat capacities

5. During the time that latent heat is involved in a change of state:
A. the temperature does not change B. the substance always expands
C. a chemical reaction takes place D. kinetic energy changes into potential energy

6. A slab of material has area A, thickness L, and thermal conductivity k. One of its surfaces is maintained at temperature T_1 and the other surface is maintained at a lower temperature T_2.
The rate of heat flow by conduction between the two faces is:
A. $kA(T_1 - T_2)/L^2$ B. $kL(T_1 - T_2)/A$ C. $kA(T_1 - T_2)/L$ D. $k(T_2 - T_1)/L$

7. The resistance of a platinum resistance thermometer is 3 Ω at 0 ^oC and 3.5 Ω at100^oC. The resistance becomes 3.2 Ω at temperature …
A. 41 ^oC **B.** 40 ^oC **C.** 313 ^oC. **D.** 44 ^oC .

8. Heat has the same units as:
A. temperature B. energy C. energy/time D. energy/volume

9. The rate of emission of radiation from a black body is proportional to the fourth power of its …
A. Temperature B. Density.
C. Radiation power per unit area. D. Absolute temperature

10. The principle of Joule's method to determine the specific heat of liquids depends on...
A. Newton cooling law B. conservation law of energy C. Stefan law C. Seebeck effect.

11. Possible units for the quantity of heat are:
A. cal · cm/(s · ^oC) B. cal / gm C. cal / ^oC D. calorie.

12. The rate of emission of radiation for a perfect black body at temperature of 127 ^{o}C is:
($\sigma = 5.67 \times 10^{-8}$ watt/m^2.k^4).
A. 1.45×10^{3} W/m^2 B. 1.45×10^{2} W/m^2 C. 5.67×10^{3} W/m^2 D. 5.67×10^{4} W/m^2

13. The coefficient of thermal conductivity for a good conductor can be determined by the method of:
A. Newton B. Joule C. Searle D. Lee.

14. The rate of heat flow by conduction per unit area per unit temperature gradient defined as:
A. the coefficient of linear expansion B. the coefficient of thermal conductivity
C. the coefficient of resistance. D. latent heat of fusion.

15. The platinum resistance thermometer depends on the thermometric property that the:
A. the change of density with temperature B. the increase of electrical resistance with temperature
C. the increase of conductivity with temperature D. the decrease of resistance with temperature.

16. The heat can be transferred by radiation in …
A. conductors B. liquids C. vacuum D. all the previous.

Q$_2$) A) If ρ_1 and ρ_2 be the density of a solid at temperatures T_1 and T_2, respectively ($T_2>T_1$). Prove that the relation between ρ_1 and ρ_2 is: $\rho_2 = \rho_1 [1-\gamma (T_2-T_1)]$. **[5 Marks]**

B) Describe briefly the principle, construction and working of a thermoelectric thermometer? **[5Marks]**

C) 40 gm copper calorimeter contains 50gm of water; both are at 6 ^{o}C. The final temperature of the mixture of 10 grams of iron at 100 ^{o}C and the calorimeter with its contents is 18 ^{o}C. Determine the specific heat of iron? [c_{copper}= 0.094 cal/gm.^{o}C, c_{water}=1 cal/gm.^{o}C] **[6Marks]**

Kind regards

Answer model

1A

2C

3A

4D

5A

6C

7B

8B

9D

10B

11D

12A

13C

14B

15B

16D
****

Q-2
When a solid is heated, its volume increases and consequently the density of the substance decreases. Let m be the mass of a solid. Let V_1 and V_2 be the volumes of the solid at temperatures T_1 and T_2. Since the mass of the solid remains constant at the two temperatures, so
$m = \rho_1 V_1 = \rho_2 V_2$
By using Eq. (10) we get
$V_1=V_o[1+\gamma(T_1-T_o)]$
$V_2=V_o[1+\gamma(T_1-T_o)]$

since
$\rho_1 V_1 = \rho_2 V_2$
The substitution about V_1 and V_2 gives
$\rho_1 = \rho_2 [1+\gamma(T_1 - T_o)]$ (13)
Since
T2 > T1 so $\rho_2 > \rho_1$

Q-3

The principle underlying a thermoelectric thermometer is that when one junction of two different metals such as iron and copper is heated keeping the other cold an emf is generated and a current flows through the circuit, see Fig. (6). This is known as ***Seebeck effect***. The magnitude of the emf generated is proportional to the temperature of the hot junction if that of the cold junction is kept constant. Variation of thermo emf with temperature is given from the expression:

$$E = \alpha T + \beta T^2$$

Where T is the temperature of the hot junction, α and β are constants

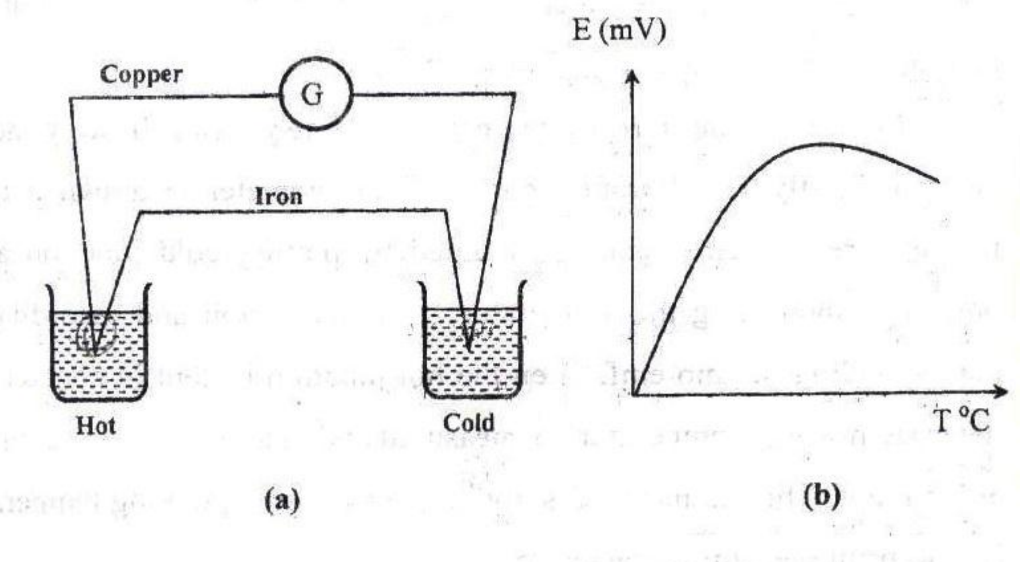

Fig. (6): (a) Thermocouple thermometer. (b) Thermocouple characteristic

It has been found that for temperature up to 300°C, copper constantan and iron constantan are good as they give thermo emf of the order of 40 to 60 microvolt per degree temperature difference between junctions.

The construction details of a simple thermocouple thermometer (or thermoelectric thermometer) are shown in Fig. (7).It consists of a tube B made of silica. Inside the tube a junction A obtained by electrical welding the two wire is kept. The junction A is called the hot junction as it will measure the unknown temperature. The portion of the wires near the hot junction A are insulated with capillary tubes C of hard glass.

These two wires are then passed through mica disks D closely fitted the tube B and attached to terminals P_1, P_2 fixed the cap closing the mouth of tube. To these terminals long wire of the same metals are also connected to form a cold junction being immersed in melting ice at 0°C at a fairly distance place from hot junction

Q-4

0.787 cal/gm.^{o}C