



**ATTEMPT ALL QUESTIONS**

**Q1**

**(13 mark)**

- 1-a) What are the dimensions of each of the following? (i) Young's modulus, (ii) Safety factor, (iii) Wave number, (iv) Intensity of sound (4 marks)
- (b) Sketch a diagram for the Stress-Strain behavior of ductile materials. (4 Marks)
- (c) If the joint in figure 1 is subjected to an axial force of 12 KN, determine the average shear stress developed in each of the 6-mm diameter bolts. (2 Marks)
- (d) The displacement of a 2-Kg block attached to a spring is given by  $X=0.2 \sin (50t+ \pi)$  m. Find the total energy at  $t=0.3T$ . (3 Marks)

**Q2**

**(12 mark)**

- 2-a) Consider the following two waves, which arrive at a point and interfere with each other  
 $y_1 = 0.15 \sin(0.8x - 50.0t)m$ ,  $y_2 = 0.15 \sin(0.8x - 50.0t - 0.3)m$   
 Find the amplitude of the resultant wave. (3 Marks)
- (b) Figure 2 shows a standing wave oscillating at 100 Hz on a string. What is the wave speed? (3 Marks)
- (c) A speaker emits 0.314 W of acoustic power. Assume that it behaves as a point source. At what distance will the intensity level be 90 dB. (3 Marks)
- (d) The siren of a police car moving at 40 m/s has a natural frequency of 600 Hz. A truck in front of the car is moving at 20 m/s in the same direction. What is the sound frequency heard by the truck driver? (speed of sound in air is 340 m/s) (3 Marks)

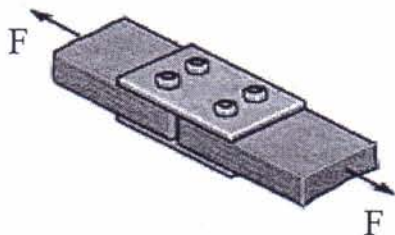


Figure 1

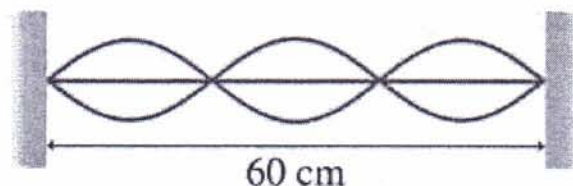


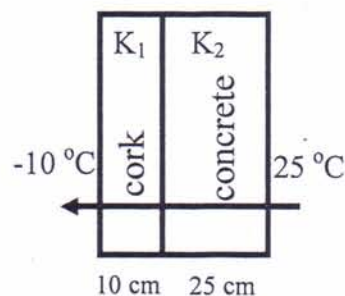
Figure 2

**Q3****(12 mark)**

- 3(a) State the following: (i) Thermo-electric Thermometer, (ii) Thermal expansion of water, (iii) methods of heat transfer. (6 Marks)
- (b) A temperature scale X has an ice point of zero and a steam point of 200. What is the temperature in X when the Celsius temperature is  $50^{\circ}\text{C}$  (2 Marks)
- (c) A long-thin wire of steel was fixed at  $20^{\circ}\text{C}$  between two rigid points separated by a distance equals the wire length. What is the type and magnitude of the thermal stress developed in the wire if the temperature changes to the two cases; (i)  $35^{\circ}\text{C}$  and (ii)  $10^{\circ}\text{C}$ , (Take, for steel,  $\alpha=1.2 \times 10^{-5} \text{ }^{\circ}\text{C}^{-1}$ ,  $E=5 \times 10^{11} \text{ N/m}^2$ ). (4 Marks)

**Q4****(13 mark)**

- 4(a) A 100g of ice at  $0^{\circ}\text{C}$  is added to 400g of water at  $10^{\circ}\text{C}$ . Find the final temperature and composition of the mixture (take  $c_{\text{ice}}=0.5 \text{ cal/g}^{\circ}\text{C}$ ,  $c_{\text{water}}=1 \text{ cal/g}^{\circ}\text{C}$ ,  $L_{\text{f ice}}=80 \text{ cal/g}$ . (4 Marks))
- (b) At what rate is the energy radiated by a sphere of radius 5 cm at 1000 K and with an emissivity of 0.3 ( Stefan's constant =  $6 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$ ). (3 Marks)
- (c) The wall of a freezing plant is composed of 10 cm of corkboard inside 25 cm of solid concrete. (a) If the temperature of the inner wall of the corkboard is  $-10^{\circ}\text{C}$  and that of the outer wall is  $25^{\circ}\text{C}$ , find the temperature of the corkboard-concrete interface. (b) Calculate the heat flow in kilocalories per square meter per second. (Take,  $K_1=1 \times 10^{-5} \text{ Kcal/m.s.}^{\circ}\text{C}$ ,  $K_2=4 \times 10^{-4} \text{ Kcal/m.s.}^{\circ}\text{C}$ ). (6 Marks)



Good luck

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