

1. The displacement of a particle from a reference point at any instant is given by  $s=3t^2-4t+5$ , where  $s$  is in metres and  $t$  is time in seconds. Calculate the average velocity of the particle in the time interval between 3 s and 5 s, and its instantaneous velocity at 4 s.

$$v=20 \text{ ms}^{-1} \text{ and } v=20 \text{ ms}^{-1}$$

2. How much heat is transferred in 1 hour by the process conduction through a concrete wall 2 m high, 3.65 m long and 0.2 m thick if one side of the wall is held at  $20^\circ\text{C}$  and the other side at  $5.0^\circ\text{C}$ ? [Take the thermal conductivity of concrete as  $1.3 \times 10^{-6} \text{ Wm}^{-1}\text{C}^{-1}$ ].

$$2.6 \times 10^6 \text{ J}$$

3. If  $\vec{a}=3\hat{i}-2\hat{j}-\hat{k}$  and  $\vec{b}=\hat{i}+4\hat{j}+\hat{k}$ , find a unit vector  $\hat{n}$  normal to the plane containing  $\vec{a}$  and  $\vec{b}$  such that  $\vec{a}$ ,  $\vec{b}$  and  $\hat{n}$ , in this order, form a right-handed system.

$$\hat{n}=15\hat{j}-25\hat{k}$$

4. Calculate the direction cosines of  $\vec{a}+\vec{b}$ , given that  $\vec{a}=4\hat{i}+7\hat{j}-5\hat{k}$  and  $\vec{b}=3\hat{i}+4\hat{j}+\hat{k}$

$$l=7186, m=11186 \text{ and } n=-4186$$

5. A copper block of mass 0.75 g is removed from a furnace and quickly transferred into a glass beaker of mass 300.0 g containing 200.0 g of water. The temperature of the water rises from  $12.0^\circ\text{C}$  to  $27.0^\circ\text{C}$ . What was the temperature of the furnace?

$$530.0^\circ\text{C}$$

$$6. a = 0, b = 12, c = -12$$

7. A certain resistance thermometer reads 14.5  $\Omega$  in pure melting ice and 18.5  $\Omega$  in steam at standard atmospheric pressure. What will be its resistance at room temperature of  $27.0^\circ\text{C}$ ?

$$15.58 \Omega$$

8. A piece of metal has a mass of 200 g in air and 170 g when immersed in water. Calculate its volume and density. [Density of water is  $1000 \text{ kgm}^{-3}$ . Take  $g=9.8 \text{ ms}^{-2}$ ]

$$3.0 \times 10^{-5} \text{ m}^3, 6.67 \times 10^3 \text{ kgm}^{-3}$$

$$9. x'=x; y'=y; z'=z-vt; t'=t$$

$$10. P=3.25 \times 10^7 \text{ W}; 0.35^\circ\text{C}$$

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