1. A rod is in rest against a smooth vertical wall and a rough horizontal surface. Find the ratio of total reaction by wall & surface.
2. The resistance of a wire is 2Ω at 10°C and 3 Ω at 30°C. Find the temperature coefficient of resistivity.

(1) 0.022  (2) 0.025  (3) 0.033  (4) 0.05

Ans. (3)

Sol. \[ R = R_0 (1 + \alpha \Delta T) \]

\[ 2 = R_0 (1 + 20\alpha) \]

\[ 3 = R_0 (1 + 30\alpha) \]

\[ 1 = 30\alpha \]

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3. An electromagnetic wave moving along x-axis with speed C. Frequency of wave 10^10 Hz and amplitude of electric field \( E_0 = 60 \text{N/C} \). Which of the following option is correct?

(1) \[ \frac{60}{C} \sin \left( 2 \times 10^{10} \pi \left( t - \frac{x}{C} \right) \right) \]

(2) \[ \frac{60}{C} \cos \left( 2 \times 10^{10} \pi \left( t - \frac{x}{C} \right) \right) \]

(3) \[ 60C \sin \left( 2 \times 10^{10} \pi \left( t - \frac{x}{C} \right) \right) \]

(4) \[ 60C \cos \left( 2 \times 10^{10} \pi \left( t - \frac{x}{C} \right) \right) \]

Ans. (2)

Sol. \[ |E| = \frac{E_0}{C} \]

\[ \vec{E} = - (\vec{V} \times \vec{B}) \]

\[ E = - \vec{V} \times \vec{B} \]

4. Angular acceleration of a body is given by \( \alpha = 6t^2 + 2t \)

If \( \vec{u}(t = 0) = 10 \text{ rad/s} \), \( \vec{u}(t = 0) = 4 \text{ rad} \)

Find \( \vec{u}(t) = \)

(1) \[ 4 - 10t + \frac{t^4}{2} + \frac{t^3}{3} \]

(2) \[ 14 - 10t + \frac{t^4}{2} + \frac{t^3}{3} \]

(3) \[ 16 - 10t + \frac{t^4}{2} + \frac{t^3}{3} \]

(4) \[ 4 - 10t + \frac{t^4}{2} + \frac{t^3}{3} \]

Ans. (1)
5. A particle travels first one third of distance with speed 11 m/s, next one third with 22 m/s and last one third with speed 33 m/s. Find the average speed.

(1) 16 m/s  (2) 18 m/s  (3) 20 m/s  (4) 22 m/s

Ans. (2)

6. Two identical bodies are at separation d and force between them is F. If m/3 is removed from one body and added to other body, find the new force.

\[ F = \frac{Gmm}{d^2} \]

(1) 6/9 F  (2) 7/9 F  (3) 8/9 F  (4) 9/6 F

Ans. (3)

7. Find the tension in the string if there is no slipping between disc and string, radius of disc is 10 cm:

\[ 4 \text{ kg} \]
(1) 8 N
(2) 10 N
(3) 12 N
(4) 20 N

Ans. (2)

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Sol. \[ T_r = \frac{4r^2}{\alpha} \]

\[ \alpha = \frac{T}{2r}, \quad \frac{T}{2r} = 0.1 \quad 5T \]

\[ 2g - T = 2a = 2 \times 0.1 \times \alpha \]

\[ 20 - T = 0.2 \times 5T = T \]

\[ 20 = 2T \]

\[ T = 10 \text{ N.} \]

---

8. C_1 is charged to 30 V then connected to C_2. Find final charge on C_2.

\[ C_1 = 5 \mu F \]

\[ C_2 = 10 \mu F \]

(1) 100 \mu C
(2) 200 \mu C
(3) 300 \mu C
(4) 400 \mu C

Ans. (1)

Sol. \[ V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{5 \times 30 + 0}{5 + 10} = 10 \]

\[ Q_2 = C_2V = 10 \times 10 = 100 \mu C \]

---

9. If current through the battery is A/5 then A is : (R = 1Ω)

\[ \frac{3V}{8} \]

(1) 8
(2) 10
(3) 12
(4) 14

Ans. (1)

Sol. \[ R_{eq} = \frac{15}{8} \]

\[ i = \frac{3}{15} = \frac{8}{5} \]

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10. Water is falling from height 40 m at rate of $9 \times 10^4$ kg/hr. If 50% of potential energy is convert in electrical energy by turbine. Then how many bulb of 100 W can be light up.

Ans. (2)

Sol. \[ g = \frac{9 \times 10^4 \text{kg}}{3600 \text{sec}} = 50 \text{N/m}^2 \]
\[ N = 50 \]

11. If force per unit length between 2 parallel wires is \( F/l = 2 \times 10^{-6} \text{ N/m} \). Find current \( i \) in each wire.

\[ \text{(1) } \sqrt{2} \text{ ampere} \quad \text{(2) } 2 \text{ ampere} \quad \text{(3) } \sqrt{3} \text{ ampere} \quad \text{(4) } 3 \text{ ampere} \]

Ans. (1)

Sol. \[ F = \frac{\mu_i l}{2\pi} \]
\[ 2 \times 10^{-6} = \frac{2 \times 10^{-7} i^2}{2} \]
\[ i = 10^{-3} \text{ m} \]

12. Two charges \( q \) & \( -q \) are separated by a distance \( d \). If electric field at the mid-point is \( E = 6.4 \times 10^6 \text{ V/m} \) and \( q = 8 \times 10^{-3} \text{ C} \) find \( d \).

\[ \text{(1) } 3 \times 10^{-6} \text{ m} \quad \text{(2) } 2 \times 10^{-6} \text{ m} \quad \text{(3) } 3 \times 10^{-6} \text{ m} \quad \text{(4) } 4 \times 10^{-6} \text{ m} \]

Ans. (4)

Sol. \[ E = \frac{2Kq}{d^2} = \frac{8Kq}{d^2} \]
\[ 6.4 \times 10^6 = \frac{8 \times 9 \times 10^9 \times 8 \times 10^6}{d^2} \]
\[ d^2 = \frac{9 \times 64 \times 10^{15}}{6.4} = 9 \times 10^{15} \]
\[ d = 3 \times 10^5 \text{ m} \]
14. Given cut-off voltage = 0.6 V of diode

\[ V_c = V_{0.6} = 0.6 \text{ V} \]

15. In L - C - R AC circuit \( V_L = V_c = 2V_n \) and \( R = 5 \Omega \). If \( L = \frac{1}{K_0} \) then find \( K \).

\[ V_L = V_c = 2V_n \]
\[ R = 5 \Omega \]
\[ L = \frac{1}{K_0} \]

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Sol. \[ V_0 = \sqrt{V_n^2 + (V_c - V_n)^2} \]

\[ V_n = V_c = 2V_n \]
\[ V_0 = 2V_n \]
\[ 220 = \frac{220}{5} = 44A \]

\[ V_c = 44 = 2 \times 220 \]
\[ 44 = 440 \]
\[ L_0 = 10 \]
\[ L = \frac{10}{100} = \frac{1}{10} \]

\[ K = 10 \]

16. Measured values of quantity \( x \) are 1.19 mm, 1.20 mm, 1.21 mm and 1.22 mm. Then find % error in \( x \).

\[ \text{Ans.} \]

Sol. Average of \( x \) is

\[ x = \frac{1.19 + 1.20 + 1.21 + 1.22}{4} = 1.205 \]

Total error in \( x \) is 0.040

\[ \% \text{ error in } x = \left( \frac{0.040 \times 100}{1.205} \right) = 3.3\% \]

17. Bend width transmission will be if amplitude modulated signal is given as

\[ E = 10(1 + \cos 10^6 t) \cos (10^8 t) \]

\[ \text{Ans.} \]

Band width = 2f

\[ \text{Ans.} \]

---
18. A time dependent magnetic field is present in coil. If number of turns becomes half and radius is doubled. Then electrical power dissipated becomes –
(1) Double 
(2) Half 
(3) Quadruple 
(4) Same

Ans. (3)
Sol. Resistance of coil remains same if number of turn becomes half and radius is doubled.

\[ E = \frac{N \Delta \phi}{dt} \]
\[ = -\frac{N \Delta A \vec{B}}{dt} \]
\[ P = \frac{E^2}{R} \]
\[ P \propto \frac{N^2 A^2}{R} \propto N^2 \]
\[ (12)^2 : (2)^2 = 2^2 \]

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19. Drop of radius 1 \( \mu \)m is falling with terminal velocity in air. Coefficient of viscosity is \( 1.8 \times 10^{-5} \) \( \text{N.s.m}^{-2} \). Find terminal velocity:

(1) \( 123.4 \times 10^{-4} \) m/s 
(2) \( 62.4 \times 10^{-4} \) m/s 
(3) \( 93.4 \times 10^{-4} \) m/s 
(4) \( 73.4 \times 10^{-4} \) m/s

Ans. (1)
Sol. 
\[ \frac{4}{3} \pi r^3 \rho g - 6 \pi \eta r V = 0 \]
\[ \frac{4}{3} \pi \left( \frac{1}{10}\right)^3 \rho \times 10 - 6 \pi \times 10^{-5} \times 10 \times V = 0 \]
\[ V = 123.4 \times 10^{-4} \text{ m/s} \]

20. Initial internal energy of gas at A is 1560 J. Energy lost from C to A is 80 J. Work done by gas from B to C is 30 J and energy given to gas from B to C is zero. Energy given to gas from A to B is 40 J. Then work done from C to A is:

(1) 50 J 
(2) -50 J 
(3) -60 J 
(4) 60 J

Ans. (1)
Sol. For cycle process
Total heat = \( W_{AC} + \Delta V \)
\[ -60 + 40 + 0 = W_{CA} + W_{AB} + W_{BC} \]
\[ -20 = W_{CA} + 0 + 30 \]
\[ W_{CA} = -50 \]

21. Determine current 2kΩ resistance
For the circuit above, current through Zener diode.

(1) 1.125 mA  
(2) 2.25 mA  
(3) 4 mA  
(4) 4.5 mA

Ans.  (1)

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22. Two particles are moving with uniform acceleration \(a_1\) & \(a_2\) from rest. Their acceleration and velocity are related as \(V_2 = \frac{n^2}{m} V_1\), \(a_2 = \frac{n}{m} a_1\). Which of the following relations are correct.

(1) \(t_2 = \frac{n^2}{m} t_1\)
(2) \(t_2 = \frac{n^2}{m} \sqrt{s_1}\)
(3) \(t_2 = n^{\frac{3}{2}} t_1\)
(4) \(t_2 = n^2 t_1\)

Ans.  (3)

Sol.  
\[
\begin{align*}
\frac{m}{n^2} &= \frac{t_1}{t_2} \\
\frac{t_2}{t_1} &= n^{\frac{2}{3}} \\
V_1^2 &= 2a_1 s_1 \\
V_2^2 &= 2a_2 s_2 \\
m^2 &= \frac{n^2}{m} s_1 \\
s_2 &= n^2 s_1 \\
m &= \frac{n^2}{m} \sqrt{s_1}
\end{align*}
\]
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