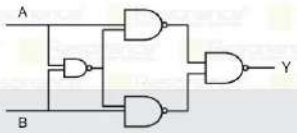
PART : PHYSICS

1. Find output y.



(1)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(2)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(3)

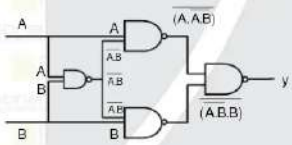
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(4)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

Ans. (1)

Sol. We can write this by using demorgn theorm



$y = \left(\overline{A.A.B}\right) + \left(\overline{A.B.B}\right)$ as $\bar{\bar{x}} = x$

$y = \left(A.\overline{A.B}\right) + \left(\overline{A.B}.B\right)$

$= A.\left(\bar{A} + \bar{B}\right) + \left(\bar{A} + \bar{B}\right).B$

$= A.\bar{A} + A\bar{B} + \bar{A}.B + \bar{B}.B$

A	B	$\overline{A.B}$	$A.\overline{A.B}$	$\overline{A.B.B}$	y
0	0	1	0	0	0
0	1	1	0	1	1
1	0	1	1	0	1
1	1	0	0	0	0

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2. Find the tension in string

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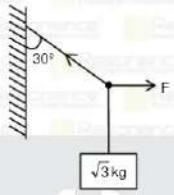


(1) 10 N (2) 20 N (3) 30 N (4) 40 N

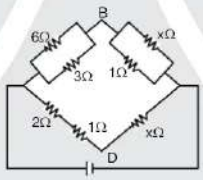
Ans. **(2)**

Sol. $T\cos 30^\circ = \sqrt{3}g$

$T \times \frac{\sqrt{3}}{2} = \sqrt{3}g$

$T = 20$ N

3. In given circuit potential of B & D is same and $x = \frac{1}{n}$ then find the value of n.



(1) 6 (2) 2 (3) 8 (4) 12

Ans. **(2)**

Sol. If $V_B = V_D$ then using wheat stone bridge

$\frac{2}{3} = \frac{x}{\frac{x+1}{x}}$

$2x^2 + 2x = 3x$

$2x^2 + 2x - 3x = 0$

$2x^2 - x = 0$

$x(2x - 1) = 0$

$x = \frac{1}{2}$

$x = \frac{1}{n} = \frac{1}{2}$

$n = 2$

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4. A car is moving with velocity with 3 km/hr for 4 km and next 4 km is moving with 5 km/hr. then find average speed.

(1) $\frac{10}{2}$ (2) $\frac{15}{3}$ (3) $\frac{15}{4}$ (4) $\frac{20}{4}$

Ans. **(3)**

Sol. Average speed $= \frac{2V_1V_2}{V_1+V_2} = \frac{2\times3\times5}{3+5} = \frac{15}{4}$ km/hr

5. **Statement-1 :** Efficiency of carnot cycle is maximum at –273°C

Statement-2 : $\eta = 1-\frac{T_2}{T_1}$

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True

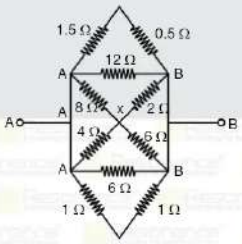
Ans. **(1)**

Sol. At ΔK, $\eta = 1-\frac{T_{sink}}{T_{source}}$

$\eta = 1-\frac{0}{T}$ when $T_{sink} = 0$

$\eta = 1$

6. Find equivalent, resistance across A & B.



(1) $\frac{50}{149}\ \Omega$ (2) $\frac{200}{149}\ \Omega$ (3) $\frac{100}{149}\ \Omega$ (4) $\frac{300}{149}\ \Omega$

Ans. **(3)**

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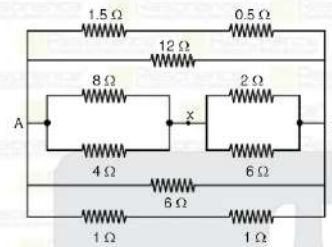
Sol.

Sol.



$$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{12} + \frac{6}{25} + \frac{1}{6} + \frac{1}{2}$$

$$\frac{1}{R_{eq}} = \frac{150 + 25 + 72 + 50 + 150}{300}$$

$$R_{eq} = \frac{300}{447} = \Omega$$

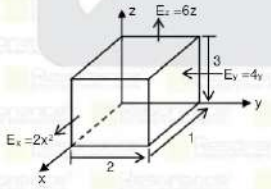
$$R_{eq} = \frac{100}{149}$$

7. If $\vec{E} = 2x^2\hat{i} - 4y\hat{j} + 6z\hat{k}$ find the charge in cuboid of side (1,2,3) with one vertex at origin.

(1) $14\varepsilon_0$ (2) $18\varepsilon_0$ (3) $24\varepsilon_0$ (4) $5\varepsilon_0$

Ans. (3)

Sol.



As $\phi = \vec{E}.\vec{A}$

then are 6 surface so will find it for every surface.

(i) face at x =0

$\phi_{x=0} = E_{x=0}.A = 0$

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(ii) face at x = 1

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$\phi_{2x} = 2(1)^2 \times (3 \times 2) = 2 \times 6 = 12$

(iii) face at y = 0

$\phi_{0y} = 0$ [$\because E_{y=0} = 4 \times 0 = 0$]

(iv) face at y = 2

$\phi_{2y} = -4 \times 2 \times 3 \times 1 = -24$

(negative sign: area vector & $\vec{E}$ are opposite)

(v) face at z = 0, $\phi_{0z} = 0$

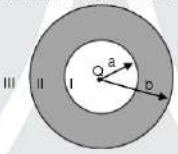
(vi) face at z = 3, $\phi_{3z} = (6 \times 3) \times 1 \times 2 = 36$

$\phi_{net} = \phi_{0x} + \phi_{1x} + \phi_{0y} + \phi_{2y} + \phi_{0z} + \phi_{3z} = 0 + 12 - 24 + 0 + 0 + 36$

$\phi_{net} = 24$

as $\phi_{net} = q/\varepsilon_0 \Rightarrow q = 24\varepsilon_0$

8. A Solid conducting sphere has a cavity there is a charge inside the cavity. Radius of inner surface & outer surface are 'a' & b respectively electric field at I, II & III are.



(1) $E_I \neq 0$, $E_{II} = 0$, $E_{III} \neq 0$ (2) $E_I = 0$, $E_{II} \neq 0$, $E_{III} = 0$

(3) $E_I = 0$, $E_{II} = 0$, $E_{III} = 0$ (4) $E_I \neq 0$, $E_{II} \neq 0$, $E_{III} = 0$

Ans. **(1)**

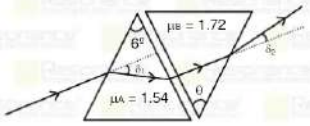
9. Two prism A & B are placed such a way that the mean deviation through prism is zero. The angle of prism A & B are 6° & θ°. Then find θ. ($\mu_A = 1.54$, $\mu_B = 1.72$)

(1) 2.5 (2) 1.5 (3) 4.5 (4) 9

Ans. **(3)**

Sol. As we know

$S_1 + S_2 = 0$



$A(\mu_A - 1) - B(\mu_B - 1) = 0$

$6(1.54 - 1) - \theta(1.72 - 1) = 0$

$6 \times 0.54 - \theta \times 0.72 = 0$

$\Rightarrow \theta = \frac{6 \times 3}{4} = 4.5^\circ$

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10. Current flowing through sides of equilateral triangular loop having side $4\sqrt{3}$ m is 2A. Find the magnetic

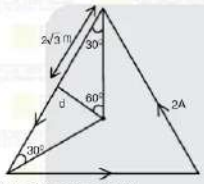
10. Current flowing through sides of equilateral triangular loop having side $4\sqrt{3}$ m is 2A. Find the magnetic field at centroid.

(1) $\sqrt{3}\times10^{-7}$ T (2) $3\sqrt{5}\times10^{-7}$ T (3) $3\sqrt{3}\times10^{-7}$ T (4) $3\sqrt{2}\times10^{-7}$ T

Ans. (3)

Sol. $\tan30^\circ = \frac{d}{2\sqrt{3}}$

$\frac{1}{\sqrt{3}} = \frac{d}{2\sqrt{3}}$ $d = 2m$



$B_{net} = B_1 + B_2 + B_3$ (•)

But $B_1 = B_2 = B_3 = B$

Between : $B = \frac{3\times\mu_0 i}{4\pi d}$ [sin60° + sin60°]

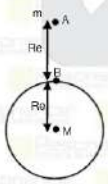
$3\times2\times10^{-7}\times\frac{2}{2}\times2\times\frac{\sqrt{3}}{2} = 3\sqrt{3}\times10^{-7}$ T

11. A particle is released from a height equal to radius of earth, above the surface of earth. Its velocity when it hits the surface of earth is equal to

(1) $V=\sqrt{\frac{2GM}{Re}}$ (2) $V=\sqrt{\frac{GM}{2Re}}$ (3) $V=\sqrt{\frac{3GM}{Re}}$ (4) $V=\sqrt{\frac{GM}{Re}}$

Ans. (4)

Sol.



By energy conservation, $PE_A + KE_A = PE_B + KE_B$

$\frac{-GMm}{2Re}+0=\frac{-GMm}{Re}+\frac{1}{2}mV^2 \Rightarrow \frac{GMm}{2Re}=\frac{1}{2}mV^2$

$V=\sqrt{\frac{GM}{Re}}$

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12. In the AC circuit shown in the figure the Value of I_{rms} is equal to

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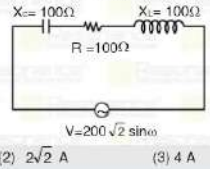

(1) 2 A (2) $2\sqrt{2}$ A (3) 4 A (4) $\sqrt{2}$ A

Ans. **(1)**

Sol. $I_{RMS} = \frac{V_{RMS}}{Z}$

$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{100^2 + (100-100)^2} = 100$

$V_{RMS} = \frac{200\sqrt{2}}{\sqrt{2}} = 200$; $I_{RMS} = \frac{200}{100} = 2A$

13. A faulty scale reads 5°C at melting point and 95°C at steam point. Find original temperature if this faulty scale reads 41°C

(1) 213.15K (2) 375.15K (3) 113.15K (4) 313.15K

Ans. **(4)**

Sol. $\frac{X - LFP}{UFP - LFP} = \text{constant}$

$\frac{41-5}{95-5} = \frac{C-0}{100-0}$

$\frac{36}{90} = \frac{C}{100}$

$C = 40°C$

in k $C \rightarrow 40+273.15$

$C = 313.15$ K

14. Ratio of De-Broglie wavelength when electron is accelerated by V & 2V

(1) $\frac{1}{\sqrt{2}}$ (2) $\sqrt{2}$ (3) 1 (4) $\frac{1}{2}$

Ans. **(2)**

Sol. $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2meV}}$ .....(1)

$\lambda' = \frac{h}{\sqrt{2m(e2V)}}$ $\Rightarrow$ $\frac{\lambda}{\lambda'} = \frac{\sqrt{2}}{1}$

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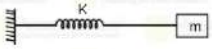
15. Ratio of angular frequency where m_1 = 1 & m_2 = 2

15. Ratio of angular frequency where $m_1 = 1$ & $m_2 = 2$.



(1) $\frac{1}{\sqrt{2}}$ (2) 2 (3) 1 (4) $\sqrt{2}$

Ans. **(1)**

Sol. $F = kx$

$ma = Kx$ $\omega^2 = K/m$

$a = \frac{K}{m}x$ $\omega = \sqrt{\frac{K}{m}}$

$\frac{\omega_2}{\omega_1} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$

16. Two wave of same intensity from source in phase are made to superimpose at a point. If path difference between these two coherent wave is zero then resultant intensity is I_0. If the path difference is $\lambda/2$. Where λ is wavelength of these waves then resultant intensity is I_1 & if the path difference is $\lambda/4$ then resultant intensity is I_2. Value of $\frac{I_0}{I_1 + I_2}$ is equal to :

(1) 2 (2) 4 (3) 6 (4) 8

Ans. **(1)**

Sol. As, resultant intensity $I_{net} = 4I\cos^2(\phi/2)$

where I is the intensity of both source & ϕ is phase difference.

For I_0

$I_0 = 4I\cos^2(0°) = 4I$ .....(1)

For I_1

Phase difference $= \frac{2\pi}{\lambda}$ (Path difference)

$I_1 = 4I\cos^2(\pi/2) = 0$

So, $I_2 = 4I\cos^2\left(\frac{\pi}{4}\right) = 2I$

So, $\frac{I_0}{I_1 + I_2} = \frac{4I}{0 + 2I} = 2$

17. Match the column

(A) Impulse	(p) ML^2T^{-2}
(B) Energy density	(q) $ML^{-1}T^{-2}$
(C) Pressure Gradient	(r) MLT^{-1}
(D) Torque	(s) $ML^{-2}T^{-2}$

(1) A – p ; B – s ; C - q; D – r (2) A – r ; B – q ; C - s; D - p

(3) A – s ; B – p ; C - q; D – r (4) A – p ; B – r ; C - s; D - q

Ans. **(2)**

18. Match the columns & choose the correct option

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(A) Attenuation	:	(i) Reverse process of modulation
(B) Repeater	:	(ii) a device/arrangement which converts one form of energy into another
(C) Demodulator	:	(iii) loss of signal strength during its propagation.
(D) Transducer	:	(iv) converts the message signal into a form suitable for transmission
(E) Transmitter	:	(v) An arrangement which help us to improve the range of signal

(1) A-(ii), B-(iii), C-(i), D-(iv), E-(v) (2) A-(iii), B-(v), C-(i), D-(ii), E-(iv)
(3) A-(iii), B-(v), C-(ii), D-(i), E-(iv) (4) A-(ii), B-(iii), C-(iv), D-(v), E-(i)

Ans. **(2)**

19. A gun of mass 10 kg & bullet of 20 g & 180 bullets fired/min with velocity 100 m/s. What is recoil velocity after 1 sec.

(1) 0.4 m/s (2) 0.6 m/s (3) 0.8 m/s (4) 1.0 m/s

Ans. **(2)**

Sol. Momentum conservation

$nM_BV_B = M_GV_G$

$M_GV_G = -nM_BV_B$

$V_G = \frac{-nM_BV_B}{M_G}$

$V_G = 0.6$ m/s