JEE MAIN

QUESTION PAPER
WITH SOLUTION

PHYSICS

25th June 2022 | Shift - 2

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JEE (Main+Advanced) | NEET | NTSE | Olympiads | Boards

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- AIR-1 TO 10 — 25 TIMES
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NATION'S BEST SELECTION
PERCENTAGE (%) RATIO

STUDENT QUALIFIED IN NEET

2021	3276 / 3411 = 93.12%
2020	2663 / 2843 = 93.66%
2019	2041 / 2212 = 92.27%

STUDENT QUALIFIED IN JEE ADVANCED

2021	1256 / 2994 = 41.95%
2020	994 / 2538 = 39.16%
2019	769 / 2105 = 36.53%

STUDENT QUALIFIED IN JEE MAIN

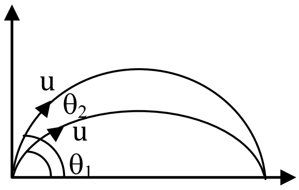
2021	2994 / 4087 = 73.25%
2020	2538 / 3554 = 71.44%
2019	2288 / 3316 = 68.99%

NITIN VIJAY (NV Sir)
Founder & CEO

SECTION - A

1. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**
Assertion A: Two identical balls A and B thrown with same velocity 'u' at two different angles with horizontal attained the same range R. If A and B reached the maximum height h_1 and h_2 , respectively, then $R = 4\sqrt{h_1 h_2}$
Reason R: Product of said heights.
$h_1 h_2 = \left(\frac{u^2 \sin^2\theta}{2g}\right).\left(\frac{u^2\cos^2\theta}{2g}\right)$
Choose the correct answer :
(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is NOT the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Sol. **(A)**



Ball A and B both have same velocity and same range then
$\theta_1 + \theta_2 = 90$
$\theta_1 = \theta$ and $\theta_2 = 90 - \theta$
$h_1 = \frac{u^2 \sin^2}{2g}$.....(1) $h_2 = \frac{u^2\sin^2(90-\theta)}{2g}$
$h_2 = \frac{u^2}{2g}\cos^2\theta$ ...... (2)
$h_1 h_2 = \frac{u^2\sin^2\theta}{2g}.\frac{u^2\cos^2\theta}{2g}$
$h_1 h_2 = \frac{(u^2 \sin\theta.\cos\theta)^2}{(2g)^2}$
$4h_1 h_2 = \left(\frac{2u^2\sin\theta\cos\theta}{2g}\right)^2 \left(\frac{u^2\sin 2\theta}{2g}\right)^2 = \left(\frac{R}{2}\right)^2$
$4.h_1.h_2 \times 4 = R^2$ $\boxed{R = 4\sqrt{h_1.h_2}}$

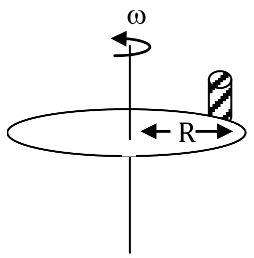
2. Two buses P and Q start from a point at the same time and move in a straight line and their positions are represented by $X_p(t) = \alpha t + \beta t^2$ and $X_Q(t) = ft - t^2$. At what time, both the buses have same velocity?
(A) $\frac{\alpha - f}{1+\beta}$ (B) $\frac{\alpha+f}{2(\beta-1)}$ (C) $\frac{\alpha+f}{2(1+\beta)}$ (D) $\frac{f-\alpha}{2(1+\beta)}$

Sol. **(D)**
$x_p = \alpha t + \beta t^2$ ...(1)
$x_Q = ft - t^2$ ...(2)
$V_P = \alpha + 2\beta t$ ....(3)
$V_Q = f - 2t$ ....(4)
$V_P = V_Q$ (according to question)
$\alpha + 2\beta t = f - 2t$
$2t(1+\beta) = f - \alpha \Rightarrow t = \frac{(f-\alpha)}{2(1+\beta)}$

3. A disc with a flat small bottom beaker placed on it at a distance R from its center is revolving about an axis passing through the center and perpendicular to its plane with an angular velocity ω. The coefficient of static friction between the bottom of the beaker and the surface of the disc is μ. The beaker will revolve with the disc if :

(A) $R \le \frac{\mu g}{2\omega^2}$ (B) $R \le \frac{\mu g}{\omega^2}$ (C) $R \ge \frac{\mu g}{2\omega^2}$ (D) $R \ge \frac{\mu g}{\omega^2}$

Sol. **(B)**



$f_r = m\omega^2 R$

Now

$f_r \le \mu N$

$m\omega^2 R \le \mu mg$

$\omega^2 R \le \mu g$

$\boxed{R \le \frac{\mu g}{\omega^2}}$

4. A solid metallic cube having total surface area 24 m^2 is uniformly heated. If its temperature is increased by 10°C. calculate the increase in volume of the cube. (Given $\alpha = 5.0 \times 10^{-4}\ °C^{-1}$.

(A) 2.4×10^6 cm^3 (B) 1.2×10^5 cm^3 (C) 6.0×10^4 cm^3 (D) 4.8×10^5 cm^3

Sol. **(B)**

Area of cube = $6a^2 = 24m^2$ a→ side of cube

$a^2 = 4 \Rightarrow \boxed{a = 2} \Rightarrow v_0 = 2^3 = 8$

$\Delta T = 10°C$

$\alpha = 5.0 \times 10^{-4} \frac{1}{°C}$

We know for solid materials $\gamma = 3\alpha$

So $\gamma = 3 \times 5 \times 10^{-4} = 15 \times 10^{-4}/°C$

$\Delta V = v_0\, \gamma . \Delta T$

$\Delta V = 8 \times 15 \times 10^{-4} \times 10 = 1200 \times 10^{-4}\ m^3 = 12 \times 10^{-2} \times (10^2)^3\ cm^3$

$\Delta V = 12 \times 10^4\ cm^3$

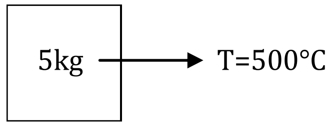
$\boxed{\Delta V = 1.2 \times 10^5 cm^3}$

5. A copper block of mass 5.0 kg is heated to a temperature of 500°C and is placed on a large ice block. What is the maximum amount of ice that can melt?

[Specific heal of copper: 0.39 J $g^{-1}\ °C^{-1}$ and latent heat of fusion of water: 335 Jg^{-1}

(A) 1.5 kg (B) 5.8 kg (C) 2.9 kg (D) 3.8 kg

Sol. **(C)**



$S_{cu} = 0.39 \frac{J}{g \times °C}$

$L_f = 335\frac{J}{gm}$

When block is placed on ice block then heat will transferred from Cu block to ice then

$|\Delta H_{loss}| = |\Delta H_{gain}|$

$(ms_{cu}.\Delta T) = (m_{ice}L_f)$

$5000 \times 0.39 \times 500 = m_{ice} \times 335$

$m_{ice} = \frac{25\times10^5\times0.39}{335} = \frac{9.75}{335}\times10^5$

$m_{ice} = 0.029\times10^5 gm$

$\boxed{m_{ice} = 2.9\times10^3 gm = 2.9kg}$

6. The ratio of specific heats $\left(\frac{C_P}{C_V}\right)$ in terms of degree of freedom (f) is given by :

(A) $\left(1+\frac{f}{3}\right)$ (B) $\left(1+\frac{2}{f}\right)$ (C) $\left(1+\frac{f}{2}\right)$ (D) $\left(1+\frac{1}{f}\right)$

Sol. **(B)**

$\frac{C_P}{C_v} = \frac{C_v+R}{C_v} = 1+\frac{R}{C_v}$ ....(1)

We know $C_v = \frac{fR}{2}$ So From eq.2

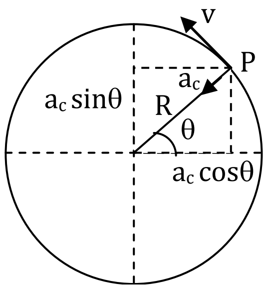
$\boxed{\frac{C_p}{C_v} = 1+\frac{2R}{fR} = 1+\frac{2}{f}}$

7. For a particle in uniform circular motion. the acceleration $\vec{a}$ at any point P(R,θ) on the circular path of radius R is (where θ is measured from the positive x-axis and v is uniform speed) :

(A) $-\frac{v^2}{R}\sin\theta\hat{i}+\frac{v^2}{R}\cos\theta\hat{j}$ (B) $-\frac{v^2}{R}\cos\theta\hat{i}+\frac{v^2}{R}\sin\theta\hat{j}$

(C) $-\frac{v^2}{R}\cos\theta\hat{i}-\frac{v^2}{R}\sin\theta\hat{j}$ (D) $-\frac{v^2}{R}\hat{i}+\frac{v^2}{R}\hat{j}$

Sol. **(C)**



v → uniform speed

So tangential acc. will be zero $a_t = 0$

$\vec{a} = \vec{a}_t + \vec{a}_c$

So $\boxed{\vec{a} = \vec{a}_c}$

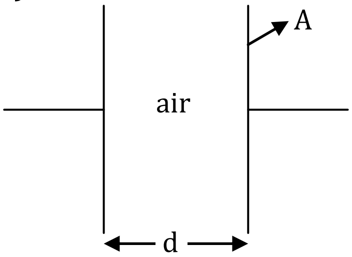
$\vec{a}_c = -\frac{v^2}{R}(\hat{R})$

$\boxed{\vec{a}_c = -\frac{v^2}{R}\cos\theta\hat{i}-\frac{v^2}{R}\sin\theta\hat{j}}$

8. Two metallic plates from a parallel plate capacitor. The distance between the plates is 'd '. A metal sheet of thickness $\frac{d}{2}$ and of area equal to area of each plate is introduced between the plates. What will be the ratio of the new capacitance to the original capacitance of the capacitor?

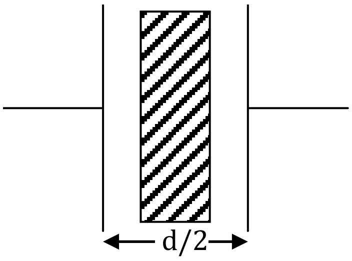
(A) 2:1 (B) 1:2 (C) 1:4 (D) 4:1

Sol. **(A)**



$C = \frac{\varepsilon_0 A}{d}$ ...(1)

When metal sheet of d/2 width is placed inside the capacitor-



dielectric constant for metal → ∞

$C' = \frac{\varepsilon_0 A}{\left(\frac{t_1}{k_1}+\frac{t_2}{k_2}+...\right)}$

$C' = \frac{\varepsilon_0 A}{\frac{d/2}{1}+\frac{d/2}{\infty}} = \frac{\varepsilon_0 A}{d/2}$

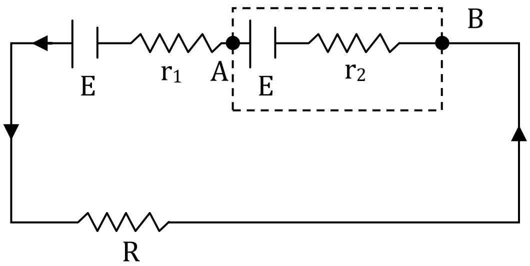
$C' = 2\frac{\varepsilon_0 A}{d}$....(2)

$\frac{C'}{C} = \frac{\left(2\frac{\varepsilon_0 A}{d}\right)}{\frac{\varepsilon_0 A}{d}} = \frac{2}{1} \Rightarrow \boxed{\frac{C'}{C} = \frac{2}{1}}$

9. Two cells of same emf but different internal resistances r_1 and r_2 are connected in series with a resistance R. The value of resistance R, for which the potential difference across second cell is zero, is :

(A) $r_2 - r_1$ (B) $r_1 - r_2$ (C) r_1 (D) r_2

Sol. **(A)**



$I = \frac{2E}{r_1+r_2+R}$ ....(1)

Potential difference across the 2nd call is $V_{AB} = 0$ then

$V_{AB} = E - Ir_2$

$0 = E - \frac{2Er_2}{(r_1+r_2+R)}$

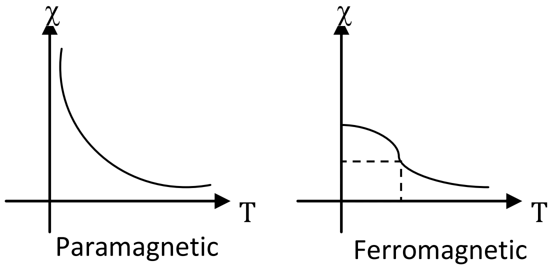
$E = \frac{2Er_2}{r_1+r_2+R}$

$\Rightarrow r_1 + r_2 + R = 2r_2$

$\boxed{R = r_2 - r_1}$

10. Given below are two statements:
Statement - I : Susceptibilities of paramagnetic and ferromagnetic substances increase with decrease in temperature.
Statement - II : Diamagnetism is a result of orbital motions of electrons developing magnetic moments opposite to the applied magnetic field.
Choose the correct answer from the options given below :-
(A) Both Statement - I and Statement - II are true
(B) Both Statement - I and Statement - II are false .
(C) Statement - I is true but Statement - II is false.
(D) Statement – I is false but Statement – II is true.

Sol. **(A)**



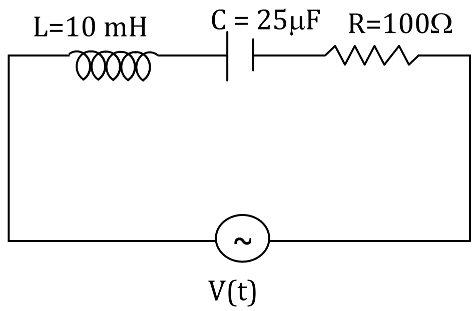
as the temp. decreases $\chi_C \uparrow$ and diamagnetism occurs due to orbital motion of e^-

11. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of magnetic field will be equal to
(A) B (B) 2B (C) 4B (D) $\frac{B}{2}$

Sol. **(A)**
$B = \mu_0 nI$ ...(1) $n \rightarrow$ No. of turn per unit length
$I \rightarrow$ Current
$B' = \mu_0 (n/2) 2I$
$B' = \mu_0 nI$ ...(2)
$\boxed{B' = B}$

12. A sinusoidal volatage V(t) = 210 sin3000t volt is applied to a series LCR circuit in which L = 10mH, C = 25μF and R = 100Ω. The phase difference (Φ) between the applied voltage and resultant current will be:
(A) $\tan^{-1}(0.17)$ (B) $\tan^{-1}(9.46)$ (C) $\tan^{-1}(0.30)$ (D) $\tan^{-1}(13.33)$

Sol. **(A)**



$v(t) = 210 \sin(3000t)$ .... (1)
$L = 10$ mH
$X_L = \omega L = 3000 \times 10 \times 10^{-3}$

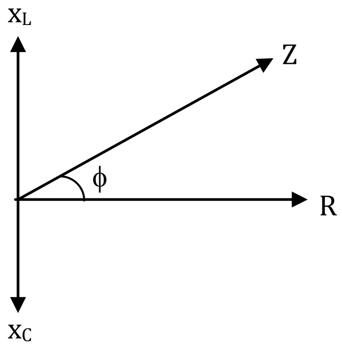
$X_L = 30\Omega$ .... (2)

C= 25μF

$X_C = \frac{1}{\omega C} = \frac{1}{3000\times25\times10^{-6}} = \frac{1000\times1000}{25\times3000} = \frac{40}{3}\Omega$

R = 100Ω

using phasor diagram :-

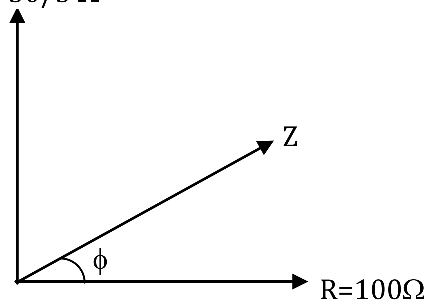


$X = X_L - X_C$

$= 30 - \frac{40}{3} = \frac{50}{3}\Omega$

R= 100Ω

So



$\tan\phi = \frac{50/3}{100}$

$\tan\phi = \frac{1}{6} = 0.167$

$\boxed{\phi = \tan^{-1}(0.167)}$

↓

$\boxed{\phi \simeq \tan^{-1}(0.17)}$

13. The electromagnetic waves travel in a medium at a speed of 2.0×10^8 m/s. The relative permeability of the medium is 1.0. The relative permittivity of the medium will be :

(A) 2.25 (B) 4.25 (C) 6.25 (D) 8.25

Sol. **(A)**

$V_m = 2\times10^8 m/s$ $\mu_r = 1$ $\varepsilon_r = ?$

$v_m = \frac{C}{\sqrt{\mu_r\varepsilon_r}} \Rightarrow 2\times10^8 = \frac{3\times10^8}{\sqrt{1.\varepsilon_r}}$

$\sqrt{\varepsilon_r} = \frac{3}{2} \Rightarrow \varepsilon_r = \frac{9}{4}$

$\boxed{\varepsilon_r = 2.25}$

14. The interference pattern is obtained with two coherent light sources of intensity ratio 4:1 . And the ratio $\frac{I_{max}+I_{min}}{I_{max}-I_{min}}$ is $\frac{5}{x}$. Then the value of x will be equal to :

(A) 3 (B) 4 (C) 2 (D) 1

Sol. **(B)**

$\frac{I_2}{I_1} = \frac{4}{1}$ let suppose $I_1 = I_0$ then

$I_2 = 4I_0$

$I_{max} = (\sqrt{I_2} + \sqrt{I_1})^2 = (\sqrt{4I_0} + \sqrt{I_0})^2 = (3\sqrt{I_0})^2 = 9I_0$

$I_{min} = (\sqrt{I_2} - \sqrt{I_1})^2 = (2\sqrt{I_0} - \sqrt{I_0})^2 = I_0$

So,

$\frac{I_{max}+I_{min}}{I_{max}-I_{min}} = \frac{9I_0+I_0}{9I_0-I_0} = \frac{10I_0}{8I_0} = \frac{5}{4}$

$\frac{5}{4} = \frac{5}{x} \Rightarrow \boxed{x = 4}$

15. A light whose electric filed vectors are completely removed by using a good polaroid, allowed to incident on the surface of the prism at Brewster's angle.

Choose the most suitable option for the phenomenon related to the prism.

(A) Reflected and refracted rays will be prependicular to each other.

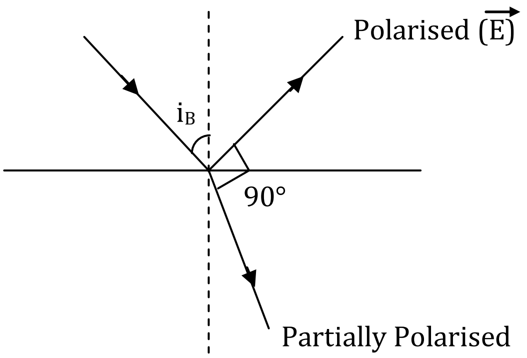
(B) Wave will propagate along the surface of prism.

(C) No refraction, and there will be total reflection of light.

(D) No reflection. and there will be total transmission of light.

Sol. **(D)**

When unpolarised light is incidence on the denser medium from rarer medium then reflected part of light is pure polarised with electric field component only and refracted light is partially polarised.



When electric field vector is removed then only refraction take place.

16. A proton, a neutron, an electron and an α- particle have same energy. If λ_p, λ_n, λ_e and λ_α are the de broglie's wavelengths of proton, neutron, electron and α particle respectively, then choose the correct relation from the following :

(A) $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$ (B) $\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$

(C) $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$ (D) $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$

Sol. **(B)**

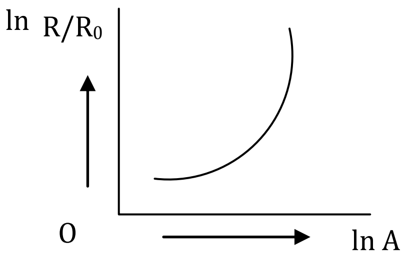
$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2m(K.E)}}$

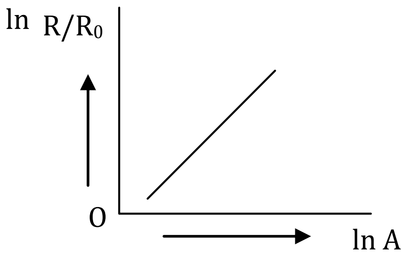
$\lambda \propto \frac{1}{\sqrt{m}}$

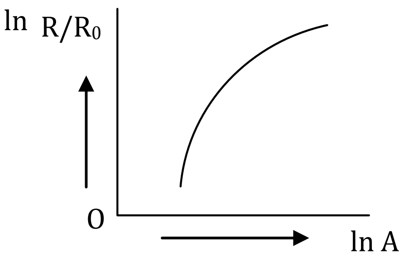
$m_e < m_p < m_n < m_\alpha$

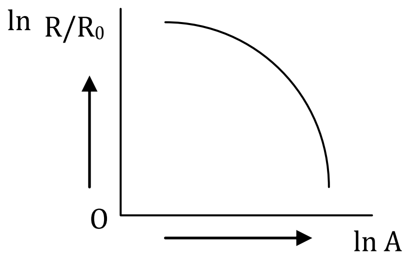
$\boxed{\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e}$

17. Which of the following figure represents the variation of $l_n\left(\frac{R}{R_0}\right)$ with l_nA (if R = radius of a nucleus and A = its mass number)

(A)


(B)


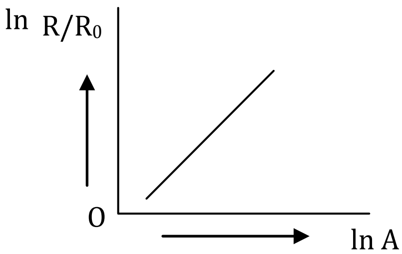
(C)


(D)


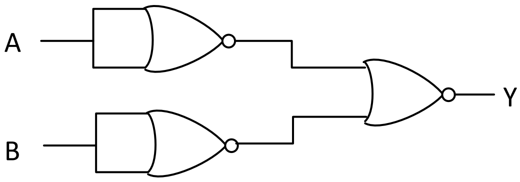
Sol. **(B)**

$R = R_0A^{\frac{1}{3}}$

$\frac{R}{R_0} = A^{1/3} \Rightarrow \ell n(\frac{R}{R_0}) = \frac{1}{3}\ell n(A)$

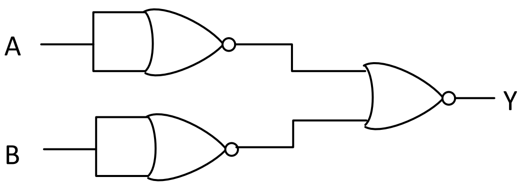


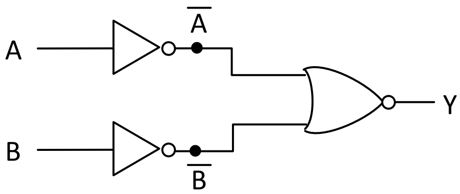
18. Identify the logic operation performed by the given circuit:



(A) AND gate (B) OR gate (C) NOR gate (D) NAND gate

Sol. **(A)**





$Y = \overline{(\overline{A} + \overline{B})} = \overline{(\overline{A.B})}$

$\boxed{Y = A.B}$

19. Match List I with List II

A. Facsimile	I. Static Document Image
B. Guided media Channel	II. Local Broadcast Radio
C. Frequency Modulation	III. Rectangular wave
D. Digital Signal	IV. Optical Fiber

Choose the correct answer from the following options :

(A) A-IV, B-III, C-II, D-I
(B) A-I, B-IV, C-II, D-III
(C) A-IV, B- II, C-III, D-I
(D) A-I, B-II, C-III, D-IV

Sol. **(B)**

(B) Guided media channel → Optical fiber (IV)
(C) digital signal → Rectangular wave (III)
(D) Frequecy modulation → Local Broad Cast (II)
(A) Facsimile → Static Document Image (I)

20. if n represent the actual number of deflections in a converted galvanometer of resistance G and shunt resistance S. Then the total current I when its figure of merit is K will be :

(A) $\frac{KS}{(S+G)}$ (B) $\frac{(G+S)}{nKS}$ (C) $\frac{nKS}{(G+S)}$ (D) $\frac{nK(G+S)}{S}$

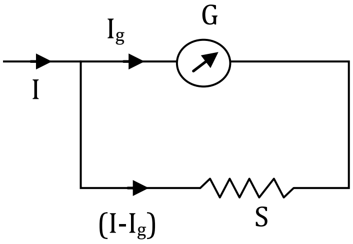
Sol. **(D)**

Figure of merit = $\frac{\text{current}}{\text{division}} = K = \frac{I_g}{n}$

Total no. of division = n

$I_g = nk$ .... (1)

Total current = I



Now

$I_g . G = (I - I_g)s$

$I_g(G + S) = IS \Rightarrow I = I_g \frac{(G+S)}{S}$

$\boxed{I = \left(\frac{G+S}{S}\right). nK}$

SECTION - B

21. For $z = a^2x^3y^{\frac{1}{2}}$, where 'a' is a constant. If percentage error in measurement of 'x' and 'y' are 4% and 12% respectively, then the percentage error for 'z' will be ___%.

Sol. **(18)**

$z = a^2x^3y^{1/2}$

a= constant

$\frac{\Delta z}{z} \times 100 = 2\left(\frac{\Delta a}{a} \times 100\right) + 3\left(\frac{\Delta x}{x} \times 100\right) + \frac{1}{2}\left(\frac{\Delta y}{y} \times 100\right)$

$= 2(0) + 3(4) + \frac{1}{2}(12)$

$\boxed{\frac{\Delta z}{z} \times 100 = 12 + 6 = 18\%}$

22. A curved in a level road has a radius 75m. The maximum speed of a car turning this curved road can be 30m/s without skidding. If radius of curved road is changed to 48m and the coefficient of friction between the tyres and the road remains same, then maximum allowed speed would be _______m/s.

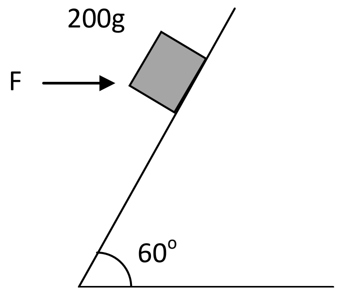
Sol. **(24)**

$V = \sqrt{\mu rg}$

$\frac{V_2}{V_1} = \sqrt{\frac{r_2}{r_1}} \Rightarrow \frac{V_2}{30} = \sqrt{\frac{48}{75}} = \sqrt{\frac{16\times3}{25\times3}}$

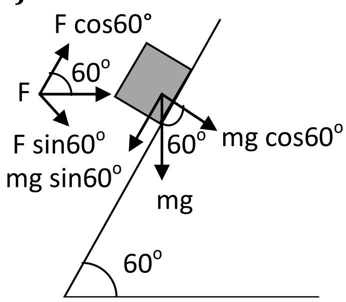
$\frac{V_2}{30} = \frac{4}{5} \Rightarrow \boxed{V_2 = 24m/s}$

23. A block of mass 200 g is kept stationary on a smooth inclined plane by applying a minimum horizontal force $F = \sqrt{x}N$ and shown in figure.



The value of x = _______.

Sol. **(12)**



$F\cos60° = mg\sin60°$

$F.\frac{1}{2} = 0.2 \times 10\frac{\sqrt{3}}{2}$

$F = 2\sqrt{3}$

$\sqrt{x} = 2\sqrt{3}$

$\boxed{x = 4 \times 3 = 12}$

24. Moment of Intertia (M.I.) of four bodies having same mass 'M' and radius '2R' are as follows :

(A) I_1 = M.I. of solid sphere about its diameter

(B) I_2 = M.I. of solid cylinder about its axis

(C) I_3 = M.I. of solid circular disc about its diameter

(D) I_4 = M.I. of thin circular ring about its diameter

If $2(I_2+I_3)+ I_4 = x. I_1$ then the value of x will be ______.

Sol. (5)

$I_1 = \frac{2}{5}mR^2$ .... (1)

$I_2 = \frac{mR^2}{2}$ .... (2)

$I_3 = \frac{mR^2}{4}$ .... (3)

$I_4 = \frac{mR^2}{2}$ .... (4)

$2(I_2 + I_3) + I_4 = xI_1$

$2[\frac{mR^2}{2} + \frac{mR^2}{4}] + \frac{mR^2}{2} = x.\frac{2}{5}mR^2$

$\frac{3}{2}mR^2 + \frac{mR^2}{2} = \frac{2x}{5}mR^2$

$2mR^2 = \frac{2x}{5}mR^2 \Rightarrow \boxed{x = 5}$

25. Two satellites S_1 and S_2 are revolving in circular orbits around a planet with radius R_1 = 3200 km and R_2 = 800 km respectively. The ratio of speed of satellite S_1 to the speed of satellite S_2 in their respective orbits would be $\frac{1}{x}$ where x = _____.

Sol. (2)

$V = \sqrt{\frac{Gm}{r}} \Rightarrow V \propto \frac{1}{\sqrt{r}}$

$\frac{V_1}{V_2} = \sqrt{\frac{R_2}{R_1}} = \sqrt{\frac{800}{3200}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

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

26. When a gas filled in a closed vessel is heated by raising the temperature by 1°C, its pressure increases by 0.4%. The initial temperature of the gas is ______ K.

Sol. (250K)

V= contant , $\Delta T = 1°C = 1K$

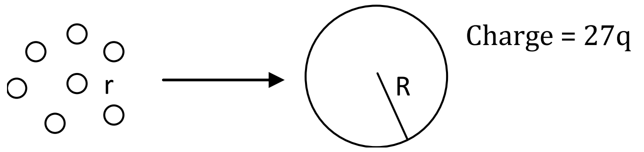
$P \propto T$

$\frac{\Delta P}{P} \times 100 = \frac{\Delta T}{T} \times 100 \Rightarrow 0.4 = \frac{1}{T} \times 100$

$\boxed{T = \frac{100}{0.4} = 250K}$

27. 27 identical drops are charged at 22V each. They combine to form a bigger drop. The potential of the bigger drop will be ____V.

Sol. (198)



drops = 27

radius = r

charge = q

$(vol)_1 = (vol.)_f$

$27\left(\frac{4\pi}{3}r^3\right) = \frac{4\pi}{3}R^3$

$\boxed{3r = R}$

Potential of small drops → $22 = \frac{kq}{r}$ ...(1)

Potential of big drop → $v' = \frac{k27q}{R}$

$v' = \frac{kq}{3r}.27 = 9(\frac{kq}{r})$

$v' = 9(22)$ from (1)

$\boxed{v' = 198}$

28. The length of given cylindrical wire is increased to double of its origianl length. The percentage increase in the resistance of the wire will be _______ %.

Sol. **(300%)**

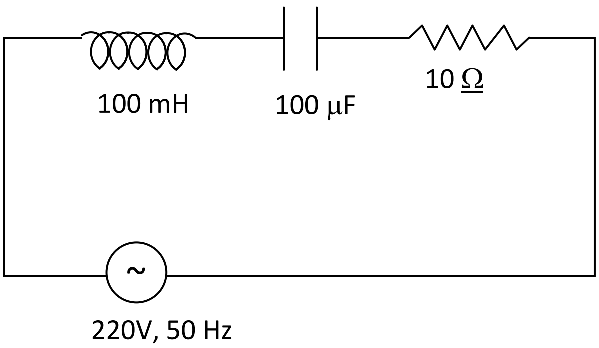
$R = \frac{\ell}{A}.\frac{\ell}{\ell} = \frac{\ell^2}{vol.} \Rightarrow R \propto \ell^2$

$\frac{R_2}{R_1} = \frac{(2\ell)^2}{\ell^2} = 4 \Rightarrow \boxed{R_2 = 4R_1}$

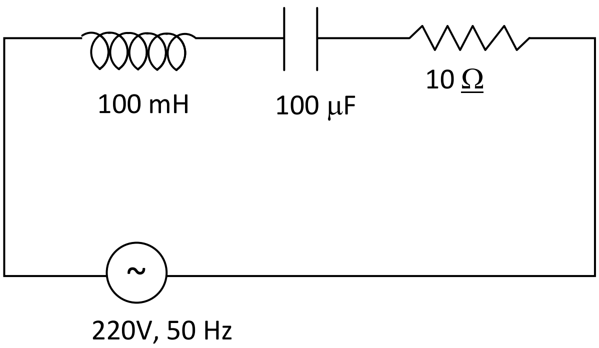
$\frac{\Delta R}{R_1} \times 100 = \frac{R_2 - R_1}{R_1} \times 100 = \frac{4R_1 - R_1}{R_1} \times 100$

$\boxed{\Delta R\% = 300\%}$

29. In a series LCR circuit, the inductance, capacitance and resistance are L= 100 mH, C = 100μF and R = 10Ω respectively. They are connected to an AC source of voltage 220V and frequency of 50Hz. The approximate value of current in the circuit will be _______ A.



Sol. **(22)**



L=100 mH

$X_L = \omega L = 2\pi fL$

$X_L = 2\pi(50)(100 \times 10^{-3})$

$X_L = 100\pi \times 10^{-1} = 10\pi = 31.4\Omega$

$C = 100\mu C$

$X_C = \frac{1}{\omega C} = \frac{10^6}{2\pi(50)\times 100} = \frac{1000}{10\pi} = \frac{100}{\pi} = 31.8\Omega$

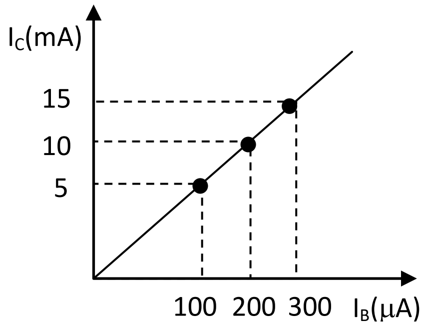
$R = 10\Omega$

$z = \sqrt{(x_L - x_C)^2 + R^2} = \sqrt{(0.4)^2 + 10^2} = (100 + 0.16)^{1/2}$

$z = 10[1 + \frac{0.16}{100}]^{\frac{1}{2}} = 10[1 + \frac{0.08}{100}] = 10\Omega$

$I_{rms} = \frac{V_{rms}}{z} = \frac{220}{10} = \boxed{22A}$

30. In an experiment of CE configuration of n-p-n transistor, the transfer characteristics are observed as given in figure.



If the input resistance is 200Ω and output resistance is 60Ω, the voltage gain in this experiment will be ____.

Sol. **(15)**

$\beta = \frac{I_C}{I_B} = \frac{15\times 10^{-3}}{300\times 10^{-6}} = \frac{5\times 1000}{100} = 50$

$V_{gain} = \frac{V_{out}}{V_{in}} = \frac{I_{out}}{I_{in}}.\frac{R_C}{R_B} = \beta\frac{R_C}{R_B} = 50\times\frac{60}{200}$

$\boxed{V_{gain} = 15}$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