DEEPER

TRIAL SET
ANSWERS & SOLUTIONS

For

JEE (MAIN) - 2017

(PHYSICS, CHEMISTRY & MATHEMATICS)

For
Deeper Students
(Only Private Circulation)

PART – A : PHYSICS

Q.1 Ans.: 3) 1.96 m

Solution: $h = \frac{1}{2} \times 9.8 \times t^2 = 4.9 \times 4 = 19.6\,\text{m}$

$\frac{\Delta h}{h} = 2\frac{\Delta t}{t} = 2 \times \frac{0.1}{2} = 0.1$

$\Delta h = 0.1 \text{ x } 19.6 = 1.96$ m

Q.2 Ans.: 4) 3.38 mm

Solution: L.C = $\frac{0.5}{50} = 0.01\,\text{mm}$

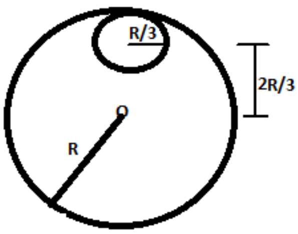
Zero error = - 0.03 mm

Correction = + 0.03 mm

Observed diameter = 3.35 + 0.03 = 3.38 mm

Q.3 Ans.: 1) $4MR^2$

Solution:



Mass per unit area = $\frac{9M}{\pi R^2}$

Mass of removed disc = $\left(\frac{9M}{\pi R^2}\right) x \pi \left(\frac{R}{3}\right)^2 = M$

M. I. of removed portion about O, (by parallel axes theorem)

$$= I_R = \frac{M}{2}\left(\frac{R}{3}\right)^2 + M\left(\frac{2R}{3}\right)^2$$

$$= \frac{1}{2}MR^2$$

M. I. of complete disc = $I_c = \frac{1}{2}gMR^2$

M. I. of remaining portion about O is

$$= I_C - I_R$$

$$= \frac{9}{2}MR^2 - \frac{1}{2}MR^2 = 4MR^2$$

Q.4 Ans.: 1) $\tan\theta\left(1 - \frac{1}{n^2}\right)$

Solution: For smooth plane (inclined)

$$V = \sqrt{2g\sin\theta}$$

For rough plane,

$$\frac{V}{2} = \sqrt{2g(\sin\theta - \mu\cos\theta)}$$

$$n^2 = \frac{\sin\theta}{\sin\theta - \mu\cos\theta}$$

By rearranging

$$\mu = \left(\frac{n^2 - 1}{n^2}\right)\tan\theta$$

$$\mu = \left(1 - \frac{1}{n^2}\right)\tan\theta$$

Q.5 Ans.: 4) 12.89×10^{-3} kg

Solution: efficiency = $\eta = \frac{\text{work done by the man}}{\text{energy in fats}}$

$$= \frac{nmgh}{m \times 3.8 \times 10^7}$$

$$\frac{1}{5} = \frac{1000 \times 9.8 \times 1 \times 10}{3.8 \times 10^7 \times m}$$

$$m = 12.89 \times 10^{-3}$$

Q.6 Ans.: 4) $\sqrt{gR}\left(\sqrt{2} - 1\right)$

Solution: Orbital velocity of the satellite

$$V_0 = \sqrt{\frac{GM}{R+h}} = \sqrt{\frac{GM}{R}} \quad (h << R)$$

Minimum velocity required by the satellite to escape from its orbit

$$\frac{1}{2}mV_{e^2} = \frac{GmM}{R+h}$$

$$V_e = \sqrt{\frac{2Gm}{R+h}} = \sqrt{\frac{2Gm}{R}} \qquad (h << R)$$

Required increment in the orbital velocity

$= V_e - V_o$

$$= \sqrt{\frac{2Gm}{R}} - \sqrt{\frac{Gm}{R}} = \sqrt{\frac{Gm}{R}}\sqrt{2} - 1$$

$$= \sqrt{gR}\left(\sqrt{2} - 1\right)$$

Q.7 Ans.: 1) 25^0 C , $\alpha = 1.85 \times 10^{-5} / {}^0C$

Solution: Time period of the pendulum clock at temperature θ is

$$T = 2\pi\sqrt{\frac{\ell\theta}{g}}$$

$$= 2\pi\sqrt{\frac{\ell_o(1+\alpha\theta)}{g}}$$

$$T = 2\pi\sqrt{\frac{\ell_0}{g}}(1+\alpha\theta)^{\frac{1}{2}}$$

$$T = T_0\left(1+\frac{1}{2}\alpha\theta\right) \quad \text{........(1)}$$

→ Assume pendulum clock gives correct time at temperature θ_0

$$\therefore\ T_{\theta_o} = T_o\left(1+\frac{1}{2}\alpha\theta_o\right) \quad \text{........(2)}$$

At $\theta = 40°C > \theta_0$ as clock loses time.

$$T_{40} = T_0\left(1+\frac{1}{2}\alpha\times 40\right) \quad \text{........ (3)}$$

At $\theta = 20°C < \theta_0$ as clock gains time

$$T_{20} = T_0\left(1+\frac{1}{2}\alpha\times 20\right) \quad \text{.......... (4)}$$

From (2) and (3)

$$\frac{T_{40} - T\theta_0}{T_0} = \frac{1}{2}\alpha\left(40-\theta_0\right)$$

$125 = \alpha (40 - \theta_0)$ ....(5)

∴ from (2) and (4)

$$\frac{T\theta_0 - T_{20}}{T_0} = \frac{1}{2}\alpha\left(\theta_0 - 20\right)$$

$4s = \alpha(\theta_0 - 20)$ ....(6)

∴ from (5) and (6)

$3(\theta_0 - 20) = (40 - \theta_0)$

$\theta_0 = 25°C$

From (6)

∴ $\alpha = 1.85 \times 10^{-5}$ °C

Q.8 Ans.: 2) 16 times

Solution: $V_{rms} \propto \sqrt{T}$

$$\frac{T_2}{T_1} = \frac{1}{4} \qquad .....(1)$$

For adiabatic expansion

$$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$$

$$\left(\frac{V_2}{V_1}\right)^{\gamma-1} = \left(\frac{T_1}{T_2}\right)$$

$$\frac{V_2}{V_1} = \left(\frac{T_1}{T_2}\right)^{\frac{1}{\gamma-1}} = (4)^{\frac{1}{\gamma-1}}$$

$$= 4^{\frac{1}{(1.5-1)}}$$

$$= 4^{\frac{1}{0.5}}$$

$$= 4^2$$

$$\frac{V_2}{V_1} = 16$$

Q.9 Ans.: 1) $\frac{4P_0V_0}{nR}$

Solution: from the slope of line

$$p - p_0 = \left(\frac{3p_0 - p_0}{v_0 - 3v_0}\right)(v - 3v_0)$$

$$p - p_0 = -\frac{2p_0}{2v_0}(v - 3v_0)$$

$$p - p_0 = -\frac{p_0}{v_0}v + 3p_0$$

$$p = \frac{-p_0}{v_0}v + 4p_0$$

$$pv = -\frac{p_0}{v_0}v^2 + 4p_0v \qquad ....(1)$$

$$nRT = -\frac{p_0}{v_0}v^2 + 4p_ov$$

$$T = \left(-\frac{p_0}{v_0}v^2 + 4p_0 v\right) \times \frac{1}{n_R} \quad \text{........(2)}$$

For maximum value of T, $\frac{dT}{dv} = 0$

OR $\frac{-P_0}{v_0} \times 2v + 4p_0 = 0$

$\therefore$ $2v = \frac{4p_0 v_0}{p_0}$

$\therefore$ $v = 2v_0$

Sub in (2)

$$T_{max} = \left(-\frac{p_0}{v_0} \times 4v_0^2 + 4p_0 \times 2v_0\right) x \frac{1}{nR}$$

$$T_{max} = \frac{4p_0 v_0}{nR}$$

Q.10 Ans.: 3) $\sqrt{2}A$

Solution:

$$\frac{1}{2}kA^2 + \frac{1}{2}kA^2 = m\omega^2 A^2 \quad \text{.....(1) } (k = m\omega^2)$$

New amplitude is A^1

$$\frac{1}{2}m\omega^2 A'^2 = m\omega^2 A^2 \quad \text{.... (2)}$$

$\therefore$ $A' = \sqrt{2}A$

Q.11 Ans.: 2) $2\sqrt{2}$ s

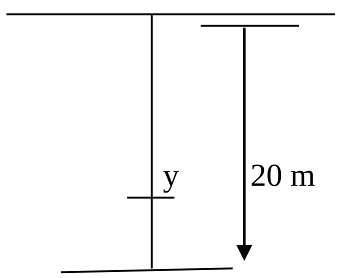
Solution: Tension at y distance from bottom is

$$T = \frac{m}{\ell} yg$$

$\therefore$ Velocity of pulse travelling along string is

$$v = \sqrt{\frac{T}{m}} = \sqrt{\frac{\frac{m}{\ell} \times yg}{\frac{m}{\ell}}} = \sqrt{yg}$$

$$\frac{dy}{dt} = \sqrt{gy}$$



$$\int dy = \int_0^t \sqrt{gy}\,dt$$

$$\int_0^{20} \frac{1}{\sqrt{gy}} dy = \int_0^t dt$$

$$\therefore \quad \int_0^{20} \frac{dy}{\sqrt{y}} = \int_0^t \sqrt{g}\,dt$$

$$2\sqrt{20} = \sqrt{g} \times t$$

$$2\sqrt{20} = \sqrt{10} \times t$$

$t = 2\sqrt{2}$ sec

Q.12 Ans.: 1) 400/189

Solution: for open pipe

$$n_A = \frac{V_A}{2L}$$

For closed pipe

$$n_B = \frac{V_B}{4L}$$

As $2n_A = 3n_B$

$$\frac{V_A}{V_B} = \frac{3}{4} \quad \text{......(1)}$$

$$V_A = \sqrt{\frac{\gamma_A RT}{m_A}},\ V_B = \sqrt{\frac{\gamma_B RT}{m_B}}$$

$$\therefore \quad \frac{V_A}{V_B} = \sqrt{\frac{\gamma_A}{\gamma_B} \times \frac{m_B}{m_A}} \quad \text{.....(2)}$$

γ_A = for monoatomic gas = 5/3

From (1) and (2)

γ_B = diatomic gas = 7/5

$$\frac{3}{4} = \sqrt{\frac{5/3}{7/5} \times \frac{m_B}{m_A}}$$

$$\frac{m_A}{m_B} = \frac{400}{189}$$

Q.13 Ans.: 2) $2\pi\alpha R^2$

Solution: $\phi = E\int ds = E \times 4\pi r^2$

Charge enclosed $Q_{enclosed} = q + \int_R^r \rho dV$

$$= q + \int_R^r \frac{\alpha}{x} 4\pi x^2 dx$$

$$= q + \left[2\pi x^2\right]_R^r$$

$Q = q + 2\pi[r^2 - R^2]$

$$E = \frac{1}{4\pi \epsilon_0 r^2}\left[q + 2\pi\alpha\left(r^2 - R^2\right)\right]$$

$$E = \frac{\alpha}{2\epsilon_0} + \frac{1}{\epsilon_0}\left[\frac{\alpha}{4\pi r^2} - \frac{\alpha}{2}\frac{R^2}{r^2}\right]$$

For E to be independent of r

2^{rd} term is zero

$$\therefore \frac{q}{4\pi r^2} - \frac{\alpha}{2}\frac{R^2}{r^2} = 0$$

$\therefore E = \frac{\alpha}{200}$ and

$q \Rightarrow 2\pi\alpha R^2$

Q.14 Ans.: 3) 420N/C

Solution:

Ceq. = 3μC

Charge on 3μF = 24μC

Charge on 9 μF = 18 μC

$\therefore$ charge on (3μF and 9μF) = 42 μC

$$\therefore \quad E = \frac{1}{4\pi \epsilon_0} \cdot \frac{Q}{r^2}$$

$$= \frac{9\times10^9 \times 42\times10^{-6}}{9\times10^2}$$

$$= 420 \text{ N/C}$$

Q.15 Ans.: 2) $\frac{\mu_0 i}{3\pi a}\sqrt{4+\pi^2}$

Solution: Magnetic field due to 1 is

$$B_1 = \frac{\mu_0 i}{4\pi\left(3\frac{a}{2}\right)}(-g)$$

$$B_2 = \frac{\mu_0 i}{4\left(3\frac{a}{2}\right)}\hat{k}$$

$B_3 = 0$

$$B_4 = \frac{\mu_0 i}{4\left(\frac{a}{2}\right)}(-k)$$

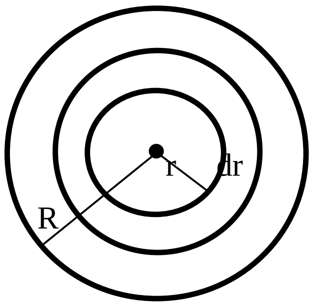
$$B_5 = \frac{\mu_0 i}{4\pi\left(\frac{a}{2}\right)}(-\hat{j})$$

$\therefore$ $$B_{net} = \sqrt{(B_5 - B_2)^2 + (B_5 - B_1)^2}$$

$$= \frac{\mu_0 i}{3\pi a}\sqrt{\pi^2 + 4}$$

Q.16 Ans.: 1) $\frac{J_0 A}{3}$

Solution:



$dI = J(2\pi r)dr$

$$= J_0\left(1 - \frac{r}{R}\right)2\pi r dr$$

$$= 2\pi\hat{j}_0\left(1 - \frac{r}{R}\right)rdr$$

$$I_2 \int_{R_0}^{R} dI$$

$$= \int_0^{R_0}\left(I - \frac{r}{R}\right)rdr \quad \Rightarrow \quad 2\pi J_0\left[\frac{r^2}{2} - \frac{r^3}{3R}\right]_0^R$$

$$= 2\pi J_0\left[\frac{R^2}{2} - \frac{R^2}{3}\right]$$

$$= 2\pi J_0 \times \frac{R^2}{6}$$

$$I = \frac{J_0 A}{3}$$

Q.17 Ans.: (3)

Q.18 Ans.: (1) 1) D, B, A, C

Q.19 Ans.: 1) 3.75 m/s

Solution: Apparent velocity of fly is $\frac{d}{dt}(\mu x)$

$V_{Ap(fly)} = \mu V_{fly}$

For fish, relative velocity of fly = 8 m/s

$V_{fish} + V_{fly} = 8$ m/s

$3 + \mu V_{fly} = 8$

$$V_{fly} = \frac{5}{\mu}$$

$$= 5 \times \frac{3}{4} \qquad \left(\mu_{water} = \frac{4}{3}\right)$$

$$V_{fly} = 3.75$$

Q.20 Ans.: 3) $a = \sqrt{\lambda L}$ and $b_{min} = \sqrt{4\lambda L}$

Solution: Size of spot = Geometric spread + diffraction spread

$$b = a + \frac{L\lambda}{a}$$

for minimum spread $\frac{db}{da} = 0$ OR

$$= 1 - \frac{L\lambda}{a^2} = 0$$

$\therefore$ $a = \sqrt{L\lambda}$

$\therefore$ $b_{min} = \sqrt{L\lambda} + \frac{L\lambda}{\sqrt{L\lambda}}$

$$= \sqrt{L\lambda} + \sqrt{\lambda L} = 2\sqrt{L\lambda}$$

$$b_{min} = \sqrt{4\lambda L}$$

Q.21 Ans.: 2) 4λ

Solution: $eV = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$ .....(1)

$$\frac{eV}{3} = hc\left[\frac{1}{2\lambda} - \frac{1}{\lambda_0}\right] \quad .....(2)$$

$$3 = \frac{\frac{1}{\lambda} - \frac{1}{\lambda_0}}{\frac{1}{2\lambda} - \frac{1}{\lambda_0}}$$

$$3\left[\frac{1}{2\lambda} - \frac{1}{\lambda_0}\right] = \frac{1}{\lambda} - \frac{1}{\lambda_0}$$

Solving $\lambda_0 = 4\lambda$

Q.22 Ans.: 1) 6 hr

Solution: $\frac{ny}{nx} = \frac{7}{1} \therefore \frac{ny}{nx} + 1 = 7 + 1$

$$\frac{ny + nx}{nx} = 8$$

$$\frac{nx}{ny + nx} = \frac{1}{8} = \frac{N}{NO} \Rightarrow \left(\frac{1}{2}\right)^n$$

$\therefore$ n = 3

$\therefore$ t = nT $\Rightarrow$ 3 x 2 = 6 hrs

Q.23 Ans.: 4) X → Y + Z

Solution: energy will be released when stability increases i.e. BE/nucleon increases

Reactant	Product
(1) 60 x 8.5 = 510	2 x 30 x 5 = 300 meV
(2) 120 x 7.5 = 900	90 x 8 + 30 x 5 = 870
(3) 120 x 7.5 = 900	2 x 60 x 8.5 = 1020
(4) 90 x 8 = 720	60 x 8.5 + 30 x 5 = 600

Q.24 Ans.: 4) $\alpha = \frac{\beta^2}{1+\beta^2}$

Solution: $\alpha = \frac{I_c}{I_e}$ $\beta = \frac{I_c}{I_e}$

OR $\frac{1}{\alpha} = \frac{1}{\beta} + 1$

Hence answer option is option 4.

Q.25 Ans.: 4) 6

Solution: Frequency of pipe closed at one end is

$$n_c = \frac{V}{4L} = \frac{34000}{4x85} = 100\,\text{Hz}$$

Fundamental frequency = 100 Hz

Only odd harmonics are present in a pipe closed at one end.

$\therefore$ possible frequencies are

100, 300, 500, 700, 900, 1100

= 6

Q.26 Ans.: 3) 6%

Solution: apparent frequency sound as the train passes

$$n^1 = n\left(\frac{V}{V+Vs}\right)$$

$$\frac{n^1}{n} = \frac{V}{V+V_s} = 1 - \frac{n_1}{n} = 1 - \frac{V}{V+V_s}$$

$$\frac{n-n_1}{n} = \frac{V_s}{V+V_s} = \frac{20}{340} = \frac{1}{17}$$

% change is

$$\frac{n-n^1}{n} \times 100 = \frac{1}{17} \times 100 \approx 6\%$$

Q.27 Ans.: 3) 10

Explanation: $\frac{T_1}{T_2} = \frac{8}{1}, \frac{l_1}{l_2} = \frac{36}{35}, \frac{d_1}{d_2} = \frac{4}{1}$

and $\frac{p_1}{p_2} = \frac{1}{2}$

$$\therefore \quad \frac{n_2}{n_1} = \frac{l_1}{l_2}\frac{d_1}{d_2}\sqrt{\frac{T_2}{T_1}\frac{\rho_1}{\rho_2}}$$

$$= \frac{36}{35} x \frac{4}{1} x \sqrt{\frac{1}{8} x \frac{1}{4}}$$

$$\frac{n_2}{n_1} = \frac{36}{35} \quad ....(1)$$

$\therefore$ $n_2 > n_1$

$$\frac{360}{n_1} = \frac{36}{35}$$

$\therefore$ $n_1 = 350$ Hz

$\therefore$ $n_2 - n_1 = 10$ Hz

Q.28 Ans. 1) 1A

Solution: $Z = \sqrt{(\omega L)^2 + R^2} = \frac{24}{10 \times 10^{-3}} = 2400 \quad ...(1)$

$$Z^1 = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega c}\right)^2} = \frac{24}{10x10^{-3}} = 2400 \quad ....(2)$$

From (1) and (2)

$$(\omega L)^2 = \left(\omega L - \frac{1}{\omega c}\right)^2$$

$\therefore$ $\omega L = \pm\left(\omega L - \frac{1}{\omega c}\right)$

$$2\omega L = \frac{1}{\omega_C}$$

$$L = \frac{1}{2\omega_2 C} = 5\,\text{henry}$$

seb in (1)

$$(2400)^2 = (\omega L)^2 + R^2$$

$$= (2\pi ft)^2 + R^2$$

$$(2400)^2 = (500\pi)^2 + R^2$$

$$(2400)^2 = 2500x100\pi^2 + R^2$$

$$24 \times 24x10^4 = 25x10^4 x\pi^2 + R^2$$

$$576x10^4 = 250x10^4 + R^2$$

$$326x10^4 = R^2$$

$$180 \approx R$$

$\therefore \quad I = \frac{V}{R} = \frac{180}{180} \approx 1A$

Q.29 Ans.: 3) $36\omega^2$

Solution: $x = 12\sin\omega t - 16\sin^3\omega t$

$= 12\sin\omega t - 4\left[4\sin^3\omega t\right]\left(\sin 3\theta = 3\sin\theta - 4\sin^3\theta\right)$

$= 12\sin\omega t - 4\left[3\sin\omega t - \sin 3\omega t\right]$

$x = 4 \sin 3 \omega t$

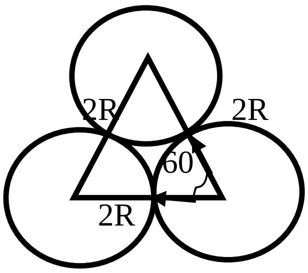
$\therefore \quad v = 12\omega \cos 3 \omega t$

$a = - 36\omega^2 \sin^3\omega t$

$a_{max} = 36 \omega^2$

Q.30 Ans.: 4) $\frac{\sqrt{3}GM^2}{4R^2}$

Explanation:



$F_R = \sqrt{F^2 + F^2 + 2F^2 \cos 60} = \sqrt{3}F$

and $F = \frac{Gm^2}{(2R)^2} = \frac{Gm^2}{4R^2}$

$\therefore \quad F_R = \frac{\sqrt{3}Gm^2}{4R^2}$

PART – B : CHEMISTRY

Q.31 Reason/Explanation for correct answer :- (3) CO

Q.32 Reason/Explanation for correct answer :- (3)

With increase in stability of carbocation formed rate of SN^1 increases

II < I < III

Q.33 Reason/Explanation for correct answer :- (3)

(n + l) Rule.

(A) 3 + 0 = 3

(B) 3 + 1 = 4

(C) 3 + 2 = 5

(D) 4 + 0 = 4

Q.34 Reason/Explanation for correct answer :- (4)

As we move left to right along period, acidic strength increases.

Q.35 Reason/Explanation for correct answer :- (3)

If anions is same, the ionic character or covalent character depends on size and charge on cation. Smaller size and larger the charge on cation, more will be polarizing power. Therefore Al^{+3} has higher covalent character. [Fajan Rule]

Q.36 Reason/Explanation for correct answer :- (2) 3

Oxidation no. of Mn in MnO_4^- = +7

Oxidation no. of Mn in MnO_2 = +4

$\therefore$ change in oxidation no. = 7 – 4 = 3

Q.37 Reason/Explanation for correct answer :- (1)

With increase in stability of carbocation formed as intermediate, the rate of reaction of alkene with HBr increases.

Q.38 Reason/Explanation for correct answer :- (4) Chlorophyll – Chromium

Chromium chlorophyll contains magnesium.

Q.39 Reason/Explanation for correct answer :- (2)

$$M=\frac{n_1}{V}=\frac{6.02\times10^{20}\times1000}{6.02\times10^{23}\times1000}=0.01$$

Q.40 Reason/Explanation for correct answer :- (1)

Arrhenius equation

$$K = A\, e^{\frac{-Ea}{RT}}$$

$$\ln K= \ln A \ \frac{-Ea}{RT}$$

$$\log_{10} K = \log A - \frac{Ea}{2.303\ RT}$$

$$\log K = 15 - \frac{10^6}{T}$$

Comparing (i) and (ii)

Log A = 15

$A = 10^{15}$

$$\frac{Ea}{2.303R}=10^6$$

$\therefore$ Ea = 1.9 x 10^4 kJ

Q.41 Ans.: (1) O_2^{-2}

Explanation: Since the number of electrons is greater than 14

$$\sigma^2{}_{1s} < \sigma^{*2}{}_{1s} < \sigma^2{}_{2s} < \sigma^{*2}{}_{2s}$$

$$< \pi^2_{2px} = \pi^2_{2py} < \sigma^2_{2pz} < \pi^*_{2px} = \pi^*_{2py} < \sigma^*_{2pz}$$

For O_2 $BO = \frac{10-6}{2} = 2$

$$O_2^- = \frac{10-7}{2} = 1.5$$

$$O_2^{-2} = \frac{10-8}{2} = 1$$

$$O_2^+ = \frac{10-5}{2} = 2.5$$

$$\text{Bond length} \propto \frac{1}{\text{Bond border}}$$

Q.42 Ans.: (4) 400 kJ/mole

Explanation: $N_2H_4 \rightarrow N_2H_2 + H_2$

Δ H = Σ BD of reactant - Σ BD of product

x = (163 – 109) + (782 – 436)

$\therefore$ x = 54 + 346

x = 400

Q.43 Ans.: (1) 10 g

Explanation: $p_0 = \frac{80}{100} p_0$

$$\frac{p^o - p_s}{p^o} = \frac{p^o - 0.8p}{p^o}$$

$0.2 = x_1$

$x_2 = 0.8$

$$\frac{x_1}{x_2} = \frac{n_1}{n_2} = \frac{w_1 M_2}{M_1 w_2} = \frac{1}{4}$$

$$\frac{w_1(114)}{40x114} = \frac{1}{4}$$

$w_1 = 10$ g

Q.44 Ans.: (1) Meta borate of transition metal

Explanation: Ions of transition metals are coloured Co^{+2} will form blue colour bead

$CoO + B_2O_3$ □ $Co(BO_2)_2$

Q.45 Ans.: (2) – 240.80°C

Explanation: $(u_{mps})H_2 = \sqrt{\frac{2RT_{H_2}}{M_{H_2}}}$

$$(u_{rms})N_2 = \sqrt{\frac{3RT_{N_2}}{M_{N_2}}}$$

$$\sqrt{\frac{2RT_{H_2}}{M_{H_2}}} = \sqrt{\frac{3RT_{N_2}}{M_{N_2}}}$$

$$\frac{2T_{H_2}}{2} = \frac{300}{28}x3$$

$$T_{H_2} = \frac{900}{28}K = 32.14\ K$$

$$T_{H_2} = 32.14 - 273 = -240.86°C$$

Q.46 Ans.: (3) $CH_3 - C \equiv C - COOH$

Explanation:

$$CH_3 - C \equiv C - H \xrightarrow{CH3MgBr} CH_4 + CH_3 - C \equiv C - MgBr \xrightarrow[H_3O^+]{CO_2} CH_3 - C \equiv C - COOH$$

Q.47 Ans.: (1) Vitamin D

Q.48 Ans.: (1) Ti < Zr < Hf

Explanation: In transition metals as we go down the group, in d block elements.

Q.49 Ans.: (2) $4\sqrt{1.6x10^{-30}}/27$

Explanation: $Cr(OH_3) \rightleftharpoons Cr^{+3} + 2OH^-$

$Ksp = [Cr^{+3}]\ [OH^-]^3$

$Ksp = 27\ S^4$

$S = \left(\frac{ksp}{27}\right)^{\frac{1}{4}}$

$$= \left(\frac{1.6x10^{-30}}{27}\right)^{\frac{1}{4}}$$

Q.50 Ans.: (2) $Na^{+} < Ba^{+2} < Al^{+3}$

Explanation: Coagulating power will be more if magnitude of charge on active ion is more.

Q.51 Ans.: (4) 0.28 V

Explanation:

$$E^{o}_{cell} = E^{o}_{Fe^{+3}|Fe} - E^{o}_{Cr^{+3}/Cr}$$

$$E^{o}_{cell} = 0.3$$

$$E_{cell} = 0.3 - \frac{0.059}{3}\log 10$$

$$Ecell = 0.3 - 0.019 = 0.281V$$

Q.52 Ans.: (1) Galena

Explanation: Theory based. It is mainly used for sulphide ore.

Q.53 Ans.: (2) – Natural Polymer

Explanation :-

It is obtained by Co-Polymerization of. 1, 3 – butadiene and acrylonitrile

Q.54 Ans.: (1) - $Fe_4 [Fe (CN)_6]_3$

Explanation.:

$Na + C + N \xrightarrow{\Delta} NaCN$

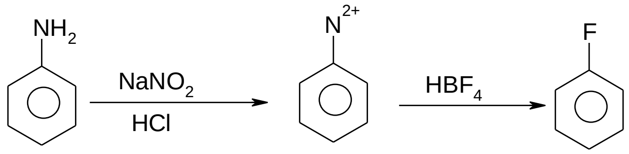
$CN^{-} + Fe^{+2} \rightarrow [Fe (CN)_6]^{4-}$

$Fe^{+3} + [Fe (CN)_6]^{-4}$ □ $Fe_4 [Fe (CN)_6]_3 . xH_2O$

Prussian Blue.

Q.55 Ans:- (3) Benzenediazoniumchloride and flurobenzene

Explanation:-



Q.56 Ans :- (4) 152 pm

Explanation :-

$$4r = \sqrt{3}\,a.$$

$$r = \frac{\sqrt{3}}{4}\,a.$$

$$= \sqrt{3}\ (88)$$

$$\cong 150$$

Q.57 Ans :- (3) XeO_2F_2

Explanation :-

$XeO_2F_2 \rightarrow SP^3d.$

$CH_2F_2 = SP^3$

$XeOF_4 = SP^3d^2$

$HgCl_2$ SP

Q.58 Ans :- (1) $NH_2 - NH_2\ OH^-$

Explanation :-

Wolfkischner reduction.

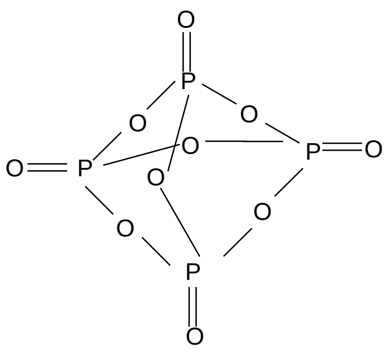
Q.59 Ans :- (3)
$$\begin{array}{l} CH_3-CH_2-CH-COOH \\ \qquad\qquad\quad\;\; | \\ \qquad\qquad\quad\; Cl \end{array}$$

Explanation :-

-I effect increases acidity.

Q.60 Ans :- (1) 12

Explanation:-



No of sigma bonds = 12

π bonds = 4

PART – C : MATHEMATICS

Q.61 **Ans.:** (4) b + ai

Explanation: Given $a^2 + b^2 = 1$ $\therefore b^2 + a^2 = 1$

$$\therefore (b + ia)(b - ia) = 1$$

$$\therefore b + ai = \frac{1}{b - ai}$$

$$\frac{1+(b+ai)}{1+(b-ai)} = \frac{1+\frac{1}{b-ai}}{1+(b-ai)}$$

$$= \frac{[1+(b-ai)]}{[1+(b-ai)](b-ai)}$$

$$= \frac{1}{b-ai}$$

= b +ai Option (4)

Q.62 **Ans.:** (4) 10 $\log_{10}$

Explanation: $y = \log_{10}\left(\log_{10}^{x}\right)$

$$y = \frac{\log_e\left(\log_{10}^{x}\right)}{\log_e 10}$$

∴ $$\left(\log_{10}^{e}\right)\left[\log\left(\frac{\log x}{\log 10}\right)\right] = \left(\log_{10}^{e}\right)\left[\log(\log x) - \log(\log 10)\right]$$

∴ $$\frac{dy}{dx} = \frac{\log_{10}^{e}}{x\log x} = \frac{\log_{10}^{e}}{f(x)}$$

∴ f(x) = x log x

∴ f(10) = 10 log 10 Option (4)

Q.63 Ans.: (1) (-1, 1) ∪ (3, ∞)

Explanation: $\frac{x^2 - 3x + 4}{x+1} > 1$

∴ $$\frac{x^2 - 3x + 4}{x+1} - 1 > 0$$

∴ $$\frac{x^2 - 4x + 3}{x+1} > 0$$

Case(i) Let $x^2 - 4x + 3 > 0$ and x + 1 > 0

∴ (x – 1) (x – 3) > 0 and x > - 1

∴ (x < 1) or x > 3 and x > - 1

∴ x ∈ (-1, 1) ∪ (3, ∞)

Which is reqd. option (1)

Case (ii) Let $x^2 - 4x + 3 < 0$ and x + 1 < 0

∴ (x – 1) (x – 3) < 0 and x < -1

∴ 1 < x < 3 and x < -1

No intersection ∴ No x ∈R satisfies

both |x-1| (x-3) < 0 and x < -1

∴ (1) is correct answer.

Q.64 Ans.: (4) 7

Explanation:

$$\text{Area of } \Delta ABC = \frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \frac{1}{2}\begin{vmatrix} 4 & 4 & 1 \\ 3 & -2 & 1 \\ 3 & -16 & 1 \end{vmatrix}$$

$$= \frac{1}{2}\left[4(-2+16) - 4(3-3) + 1(-48+6)\right]$$

$$= \frac{1}{2}[4\times 14 - 0 - 42] = \frac{14}{2} = 7 \text{ sq. units}$$

Q.65 **Ans.:** (3) $\geq 3\sqrt{3}$

Explanation:

As in ΔABC tan A + tan B + tan C = tan A tan B tan C

$$AM \geq GM$$

$$\frac{\tan A + \tan B + \tan C}{3} \geq \sqrt[3]{\tan A \tan B \tan C}$$

$$\frac{\tan A + \tan B + \tan C}{3} \geq (\tan A \tan B \tan C)^{1/3}$$

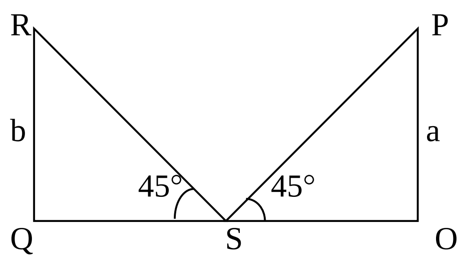
$$\frac{\tan A \tan B \tan C}{3} \geq (\tan A \tan B \tan C)^{1/3}$$

$$(\tan A \tan B \tan C)^{2/3} \geq 3$$

$$\tan A \tan B \tan C \geq 3^{3/2}$$

Q.66 **Ans.:** (3) 2ab

Explanation:



here $PS^2 = 2a^2$, $RS^2 = 2b^2$

Also, $\angle PSR = 90°$

$\therefore$ $PR^2 = PS^2 + RS^2$

$= 2(a^2 + b^2)$

Q.67 Ans.: (2) 10

Explanation: $\begin{vmatrix} \log_3^{512} & \log_4^3 \\ \log_3^8 & \log_4^9 \end{vmatrix} \times \begin{vmatrix} \log_2^3 & \log_8^3 \\ \log_3^4 & \log_3^4 \end{vmatrix}$

$$= \left(\log_3^{512}\times\log_4^9 - \log_3^8\times\log_4^3\right)\times\left(\log_2^3\times\log_3^4 - \log_3^4\log_8^3\right)$$

$$= \left(\frac{\log 512}{\log 3}\times\frac{\log 9}{\log 4}-\frac{\log 8}{\log 3}\times\frac{\log 3}{\log 4}\right)\times\left[\frac{\log 3}{\log 2}\text{x}\frac{\log 4}{\log 3}-\frac{\log 4}{\log 3}\text{x}\frac{\log 3}{\log 8}\right]$$

$$= \left(\frac{\log 2^9}{\log 3}\times\frac{\log 3^2}{\log 2^2}-\frac{\log 2^3}{\log 3}\times\frac{\log 3}{\log 2^2}\right)\times\left(\frac{\log 3}{\log 2}\text{x}\frac{\log 2^2}{\log 3}-\frac{\log 2^2}{\log 3}\text{x}\frac{\log 3}{\log 2^3}\right)$$

$$= \left(\frac{9\log 2}{\log 3}\times\frac{2\log 3}{2\log 2}-\frac{3\log 2}{\log 3}\times\frac{\log 3}{2\log 2}\right)\times\left(\frac{\log 3}{\log 2}\text{x}\frac{2\log 2}{\log 3}-\frac{2\log 2}{\log 3}\text{x}\frac{\log 3}{3\log 2}\right)$$

$$= \left(9-\frac{3}{2}\right)\times\left(2-\frac{2}{3}\right)=\frac{15}{2}\left(\frac{4}{3}\right)=10$$

Q.68 Ans.: (3) 2

Explanation:

As $\sin^{-1}\left(\frac{2x}{1+x^2}\right)=2\tan^{-1}x$ for $-1\le x\le 1$

$$\lim_{x\to 0}\frac{1}{x}\sin^{-1}\left(\frac{2x}{1+x^2}\right)=\lim_{x\to 0}2\left(\frac{\tan^{-1}x}{x}\right)=2\times\lim_{x\to 0}\frac{\tan^{-1}x}{x}$$

$= 2 \text{ x } 1$

$= 2$

$$\lim_{x\to 0}\frac{\sin^{-1}\left(\frac{2x}{1+x^2}\right)}{x}$$

$$=\lim_{x\to 0}\left[\frac{\sin^{-1}\left(\frac{2x}{1+x^2}\right)}{\left(\frac{2x}{1+x^2}\right)}\right]^{\left(\frac{2}{1+x^2}\right)}$$

$$[1].\left(\frac{2}{1}\right)=2$$

Q.69 Ans.: (1) 81

Explanation: $(0.05)^{\log_{\sqrt{20}}(0.1+0.01+0.001+.....\infty)}$

$$=\left(\frac{5}{100}\right)^{\log_{(20)^{\frac{1}{2}}}\frac{0.1}{1-0.1}}$$

$S_\infty=\frac{a}{1-r}$ for $|r|<1$

$$=\left(\frac{1}{20}\right)^{2\log_{20}\frac{0.1}{0.9}}$$

Using $a^{\log_{\sqrt{c}}b}=a^{2\log_c b}$

$$=\left(20^{-1}\right)^{2\log_{20}\frac{1}{9}}$$

$= 20^{-2\log_{20}^{\frac{1}{9}}}$

$= 20^{\log_{20}^{\left(\frac{1}{9}\right)^{-2}}}$

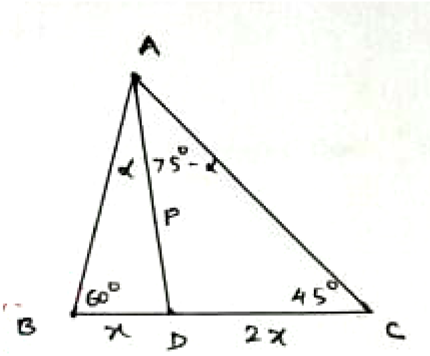
$= 20^{\log_{20}^{(9^2)}} = 81$ as $a^{\log_a^x} = x$

Q.70 Ans.: (2) $\frac{\sqrt{3}}{2\sqrt{2}}$

Explanation: By sine rule in Δ^s ABD and ADC,

$$\frac{\sin\alpha}{x} = \frac{\sin 60°}{p} = \frac{\sqrt{3}}{2p} \quad \text{———— (1)}$$

$$\frac{\sin(75°-\alpha)}{2x} = \frac{\sin 45°}{p} = \frac{1}{\sqrt{2}p} \quad \text{———— (2)}$$



$m\angle A = 180° - (60° + 45°) = 75°$

$$(1) \div (2) \Rightarrow \frac{2\sin\alpha}{\sin(75°-\alpha)} = \frac{\sqrt{3}}{\sqrt{2}}$$

$$\Rightarrow \frac{\sin\angle BAD}{\sin\angle CAD} = \frac{\sqrt{3}}{2\sqrt{2}}$$ Option (2)

Q.71 Ans.: (1) 0

Explanation: $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$,

is possible if and only if each term = $\frac{\pi}{2}$

i.e. $\sin^{-1}x = \sin^{-1}y = \sin^{-1}z = \frac{\pi}{2}$,

For any x ∈ [-1, 1], $\sin^{-1}x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

For sum to be $\frac{3\pi}{2}$ each term must be $\frac{\pi}{2}$ because no term can be bigger than $\frac{\pi}{2}$

∴ If one term is $< \frac{\pi}{2}$, then to balance it other term must be bigger than $\frac{\pi}{2}$ (i.e. e.g. 90°+70°+110°=270° is not possible)

$\therefore \sin^{-1}x = \frac{\pi}{2} \Rightarrow x = \sin\frac{\pi}{2} = 1$

y = 1, z = 1

$\left(x^{2017}+y^{2017}+z^{2017}\right)-\left(x^{2016}+y^{2016}+z^{2016}\right)$

= (1 + 1 + 1) – (1 + 1 + 1) = 0 option (1)

Q.72 **Ans.:** (1) 6

Explanation: Here BC = I

$(BC)^2 = (BC)^3 = \ldots. = I$

$$\text{tr}(A)+\text{tr}\left[\frac{A(BC)}{2}\right]+\text{tr}\left[\frac{A(BC)^2}{4}\right]+\text{tr}\left[\frac{A(BC)^3}{8}\right]+.....+\infty$$

$$=\text{tr}(A)+\text{tr}\left(\frac{A}{2}\right)+\text{tr}\left(\frac{A(BC)^2}{4}\right)+\text{tr}\left(\frac{A(BC)^3}{8}\right)+....+\infty$$

$$=\text{tr}(A)+\text{tr}\left(\frac{A}{2}\right)+\text{tr}\left(\frac{A}{4}\right)+\text{tr}\left(\frac{A}{8}\right)+....+\infty$$

$$=\text{tr}(A)\left[1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+....+\infty\right]$$

$$=3\left[\frac{1}{1-\frac{1}{2}}\right]$$

= 6

Q.73 **Ans.:** (1) 1, 2, 1

Explanation: As f is continuous at x = 0

$$2=\lim_{x\to 0}\frac{ae^{x}-b\cos x+ce^{-x}}{x.\sin x}$$

This limit is of the form $\frac{0}{0}$ if a – b + c = 0 ________(1)

$\therefore$ By L. H. rule

$$2=\lim_{x\to 0}\frac{ae^{x}+b\sin x-ce^{-x}}{x\cos x+\sin x}$$

$\frac{0}{0}$ form if a – c = 0 ______(2)

By L.H. rule

$$2 = \lim_{x\to 0} \frac{ae^{x} + b\cos x + ce^{-x}}{-x\sin x + \cos x + \cos x}$$

$$2 = \frac{a+b+c}{2} \quad \therefore\ a+b+c=4 \qquad \text{\_\_\_\_\_\_\_(3)}$$

Solving (1), (2) and (3) as follows:

(1) + (3) ⇒ a + c = 2 ________(1)

a – c = 0 ________(2)

a = 1, c = 1, b = 2

∴ values are 1, 2, 1 Option (1)

Q.74 **Ans.:** (3) 19/14

Explanation:

$$8f(x) + 6f\left(\frac{1}{x}\right) - x = 5;\ x \neq 0 \qquad \text{\_\_\_\_\_\_\_\_\_(1)}$$

On differentiating w.r.t. x,

$$8f'(x) + 6f'\left(\frac{1}{x}\right)\left(-\frac{1}{x^2}\right) - 1 = 0$$

At x = 1 ⇒ 8f'(1) + 6f'(1) (-1) = 1

⇒ 2f'(1) = 1

⇒ f'(1) = ½

$8f(x) + 6f\left(\frac{1}{x}\right) - x = 5$

Put x = 1

∴ 8f(1) (2) (3) (4) + 6f(1) – 1 = 5

∴ 8f(1) + 6f(1) = 6

$\therefore\ f(1) = \frac{3}{7}$

$\therefore\ \frac{dy}{dx} = y.x^2.f(x)$

$\left(\frac{dy}{dx}\right)_{x=1} = 2f(1) + f'(1)$

$\Rightarrow \left(\frac{dy}{dx}\right)_{x=1} = 2\left(\frac{3}{2}\right) + \frac{1}{2} = \frac{19}{14}$

Q.75 Ans.: (1) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$

Explanation: f(x) = $\tan^{-1}$ (sinx + cos x)

If f'(x) = $\frac{\cos x - \sin x}{1 + (\sin x + \cos x)^2} > 0$, then f is

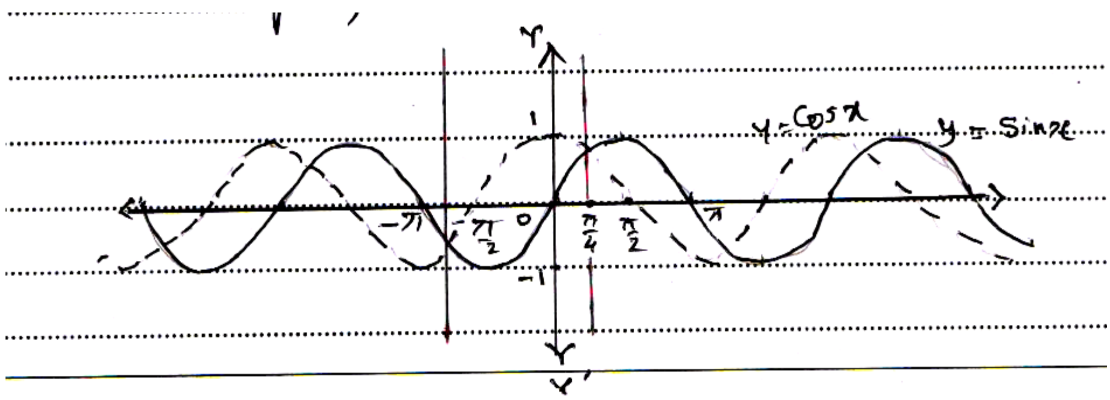
Increasing function.

Clearly denominator > 0 $\forall x \in R$

For cos x – sin x > 0 we must have

cos x > sin x

$\therefore$ Dotted graph must be above non dotted graph



For $x \in \left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$ dotted graph is above non dotted graph.

$\therefore$ For $x \in \left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$ function f is increasing. Option (1).

Q.76 Ans.: (2) $\frac{3\pi}{4}$

Explanation: $\frac{-4}{p}\left[f(x)\right]^p + c = \int \sqrt{2\sin^3 2x}\,\text{cosec}^5 x dx$

$$= 2\int \frac{\sin^{3/2} x.\cos^{3/2} x}{\sin^5 x} dx$$

$$= 2\int \sqrt{\sin^3 x \cos^3 x.\text{cosec}^6 x}.\,\text{cosec}^2 x dx$$

$$= -2\int \sqrt{\cot^3 x}\left(-\text{cosec}^2 x\right)dx$$

$= -2\int \sqrt{t^3}dt$ Sub cot x = t $\therefore$ $-\text{cosec}^2 x dx = dt$

$$-\frac{4}{p}\left[f(x)\right]^p + c = \left(-2.\frac{2}{5}.t^{5/2} + c\right)$$

$\therefore$ $$-\frac{4}{p}\left[f(x)\right]^p = \left(-\frac{4}{5}\right)\left(\sqrt{\cot x}\right)^5$$

f(x) = $\sqrt{\cot x}$ is not defined when cot x < 0

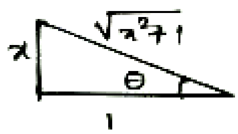
Among the given options for $x = \frac{3\pi}{4}$, $\cot x < 0$

$\therefore$ (2) is right option.

Q.77 Ans.: (1) $\log\left|\frac{x}{\sqrt{x^2+1}}\right| + \frac{x^2}{2\left(x^2+1\right)} + C$

Explanation: $I = \int \frac{\left(x^{-2}+2\right)dx}{\left(x^{3/2}+x^{-1/2}\right)^2}$

$$= \int \frac{1+2x^2}{x^2\left(x^3+2x+\frac{1}{x}\right)}dz = \int \frac{\left(1+2x^2\right)dx}{x\left(x^2+1\right)^2}$$



Let x = tan θ $\therefore$ $dx = \sec^2\theta d\theta$

$$I = \int \frac{\left(1+2\tan^2\theta\right)\sec^2\theta d\theta}{\tan\theta.\sec^4\theta} = \int \frac{\left[1+\tan^2\theta+\tan^2\theta\right]}{\tan\theta-\sec^2\theta}d\theta$$

$$=\int\frac{\left(\sec^2\theta+\tan^2\theta\right)d\theta}{\tan\theta.\sec^2\theta}=\int\cot\theta d\theta+\int\frac{\tan\theta}{\sec^2\theta}d\theta$$

$$=\int\cot\theta d\theta+\int\sin\theta\cos\theta d\theta$$

For the second integral on RHS put sinθ = t $\therefore$ cosθdθ = dt

$$=\int\cot\theta d\theta+\int tdt=\log|\sin\theta|+\frac{t^2}{2}+C=\log\left|\frac{x}{\sqrt{x^2+1}}\right|+\frac{x^2}{2\left(x^2+1\right)}+C$$

Q.78 Ans.: (1) $\sqrt{1-x^{-2}+\frac{x^{-4}}{2}}+C$

Explanation: $I=\int\frac{\left(x^2-1\right)dx}{x^3\sqrt{x^4-x^2+\frac{1}{2}}}$ Dividing N & D by x^5

$$=\int\frac{\left(x^{-3}-x^{-5}\right)dx}{\sqrt{1-x^{-2}+\frac{x^{-4}}{2}}}$$ sub. $1-x^{-2}+\frac{x^{-4}}{2}=t^2$

$$\int\frac{t.dt}{t}=\int dt=t+C$$ $\therefore$ $(2x^{-3}-2x^{-5})\,dx=2tdt$

$$=\sqrt{1-x^{-2}+\frac{x^{-4}}{2}}+C$$ $\therefore$ $(x^{-3}-x^{-5})dx=t.dt$

Option (1)

Q.79 Ans.: (1) $-\frac{1}{2}$

Explanation: $\int_{-1/2}^{1/2}[x]+\int_{-1/2}^{1/2}\log\left(\frac{1+x}{1-x}\right)dx$

Let $f(x)=\log\left(\frac{1+x}{1-x}\right)$

$$f(-x)=\log\left(\frac{1-x}{1+x}\right)$$

$$=\log\left(\frac{1+x}{1-x}\right)^{-1}$$

Now $I=\int_{-1/2}^{1/2}[x]dx+0$

$$=\int_{-1/2}^{0}[x]dx+\int_{0}^{1/2}[x]dx$$

$$=\int_{-1/2}^{0}-1dx+\int_{0}^{1/2}0\,dx$$

$f(-x) = -\log\left(\frac{1-x}{1+x}\right)$ $= [-x]_{-1/2}^{0}$

$\therefore$ $\log\left(\frac{1+x}{1-x}\right)$ is an odd fun. = -1/2

$\therefore$ $\int_{-1/2}^{1/2} \log\left(\frac{1+x}{1-x}\right)dx = 0$

Q.80 Ans.: (2) 2 sq. units

Explanation: The equation of curve is |x|+ |y| = 1

We know that

$|x| = \begin{cases} x & x > 0 \\ -x & x < 0 \end{cases}$ $|y| = \begin{cases} y & y > 0 \\ -y & y < 0 \end{cases}$

|x| + |y| = 1 ⇒ x + y = 1 for x > 0, y > 0 ______ Line AB

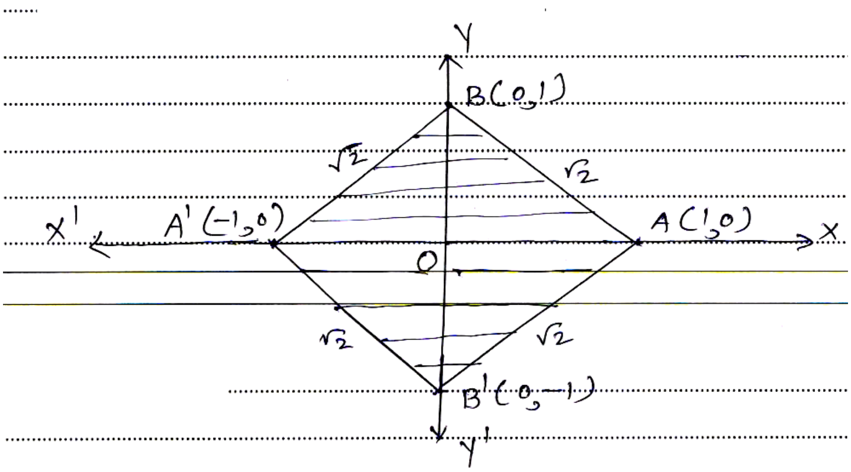
-x + y = 1 for x < 0, y > 0 ______ Line A'B

x – y = 1 for x > 0, y < 0 ______ Line AB'

- x - y = 1 for x < 0, x < 0 ______ Line A'B'

OA = OA' = 1

OB = OB' = 1



By Pythagoras theorem

AB' = AB = $\sqrt{2}$ = A'B = A'B'

Area of the region = Area of the square = (side)^2 = $\left(\sqrt{2}\right)^2 = 2$ sq. units

Q.81 Ans.: (2) 1

Explanation: In ΔABC, by triangle law

$$\overline{BC} = \overline{BA} + \overline{AC} = \overline{AC} - \overline{AB} = \frac{\bar{p}}{|\bar{p}|} - \frac{\bar{q}}{|\bar{q}|} - \frac{2\bar{p}}{|\bar{p}|}$$

$$\overline{BC} = -\left[\frac{\bar{p}}{|\bar{p}|} + \frac{\bar{q}}{|\bar{q}|}\right]$$

$$\overline{AC}.\overline{BC} = \left[\frac{\bar{p}}{|\bar{p}|} - \frac{\bar{q}}{|\bar{q}|}\right].\left\{-\left[\frac{\bar{p}}{|\bar{p}|} + \frac{\bar{q}}{|\bar{q}|}\right]\right\}$$

$$= -\left[\frac{|\bar{p}|^2}{|\bar{p}|^2} - \frac{|\bar{q}|^2}{|\bar{q}|^2}\right]$$

$= 0$

$\therefore$ AC $\perp$ BC $\therefore m\angle C = 90°$ $\therefore$ cos2C = - 1

$m\angle C = 90° \Rightarrow m\angle A + m\angle B = 90°$

$\therefore$ (cos 2A + cos 2B) + cos 2C = 2cos(A + B) . cos (A – B) – 1

$$= 2\cos\left(\frac{\pi}{2}\right).\cos(A-B) - 1$$

= -1

Q.82 Ans.: Equation of the line through p(1, 3, 3) and parallel to the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{4}$ with drs 1, 2, 4 is

$$\frac{x-1}{1} = \frac{y-3}{2} = \frac{z-3}{4} = \lambda(\text{say})$$

M = (λ+1, 2λ+3, 4λ+3) is any pt. on this line which also lies on the plane x + y + z = 14.

$\therefore \lambda + 1 + 2\lambda + 3 + 4\lambda + 3 = 14$ $\therefore \lambda = 1$

$\therefore$ M(2, 5, 7) P(1, 3, 3) by distance formula $(PM)^2 = 1 + 4 + 16 = 21$

$\therefore$ l(PM) = $\sqrt{21}$ units

Q.83 Ans.: (1) Both (1) and (2) are true

Explanation: Line $\perp^r$ plane $\perp^r$ normal

Line is || to normal drs of line are 2, 2, 1 and it passes through P(1, 2, 3) its equation is

$$\frac{x-1}{2} = \frac{y-2}{2} = \frac{z-3}{1}$$

$$\sqrt{2^2 + 2^2 + 1^2} = 3$$

Equation of line is

$$\frac{x-1}{2/3}=\frac{y-2}{2/3}=\frac{z-3}{1/3}=\lambda=3$$

Pt. on this line at a distance of λ = 3 is (3, 4, 4) which lies the plane

$2x + 2y + z = \alpha$

$6 + 8 + 4 = \alpha$ $\alpha = 18$

Foot of the perpendicular is (3, 4, 4)

Both the statements 1 and 2 are true.

Q.84 Ans.: (4) $2\sqrt{5}$

Explanation: A(1, 0, -3), B(1, -5, 7)

Minimum distance is zero,

∴ point P lies on line AB

Suppose point p divides seg. AB in the ratio λ:1

$$P\equiv\left(\frac{\lambda+1}{\lambda+1},\frac{-5\lambda}{\lambda+1},\frac{7\lambda-3}{\lambda+1}\right)$$

This point P lies on the plane $2x + 3y + 5z = 1$

$$\frac{2\lambda+2}{\lambda+1}-\frac{15\lambda}{\lambda+1}+\frac{35\lambda-15}{\lambda+1}=1$$

$$2\lambda+2-15\lambda+35\lambda-15=\lambda+1$$

$21\lambda=14$ $\therefore \lambda=\frac{2}{3}$

∴ P ≡ (1, -2, 1) A(1, 0, -3)

∴ $(AP)^2 = 4 + 16 = 20$ ∴ $l(AP) = 2\sqrt{5}$ units Option (4)

Q.85 Ans.: (1) [(p ∨ q) ∧ ~ p]

Explanation:

p	q	~p	~q	p∨q	(a) ∧~p	(b)∧(~q)
T	T	F	F	T	F	F
T	F	F	T	T	F	F
F	T	T	F	T	T	F
F	F	T	T	F	F	F

Q.86 Ans.: (2) $m_1n_2 - m_2n_1,\ n_1l_2 - n_2l_1,\ l_1m_2 - l_2m_1$

Explanation:

The vector perpendicular to both lines

$$= \begin{vmatrix} \bar{i} & \bar{j} & \bar{k} \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix}$$

$$= \bar{i}\left(m_1n_2 - m_2n_1\right) - \bar{j}\left(l_1n_2 - l_2n_1\right) + \bar{k}\left(l_1m_2 - m_1l_2\right)$$

$\therefore$ Dcs are $m_1n_2 - m_2n_1,\ n_1l_2 - n_2l_1, l_1m_2 - l_2m_1$

Q.87 Ans.: (1) 2, 1

Explanation: $ax^2 + by^2 = 1$ ________(1)

$\therefore$ $2ax + 2byy' = 0$

$\therefore$ $ax + byy' = 0$ ________(2)

$\therefore$ $a + b[yy'' + (y')^2] = 0$

Eliminating a and b

$$\begin{vmatrix} x^2 & y^2 & 1 \\ x & yy' & 0 \\ 1 & yy'' + (y')^2 & 0 \end{vmatrix} = 0$$

$\therefore$ $xyy'' + x(y')^2 - yy' = 0$

Which has order 2 and degree 1 Option (1)

Q.88 Ans.: (3) 10.1

Explanation: $\bar{x} = \dfrac{1 + (1+d) + (1+2d) + ... + (1+100d)}{101}$ which is AP

$$= \frac{\frac{101}{2}\left[1 + (1+100d)\right]}{101} \qquad \because Sn = \frac{n}{2}(a+e)$$

$= 1 + 50d.$

Mean deviation= $\dfrac{1}{101}\sum_{r=0}^{100}\left|(1+rd) - (1+50d)\right|$

$$= \frac{1}{101}\sum_{r=0}^{100}\left|rd - 50d\right|$$

$$= \frac{d}{101}\sum_{r=0}^{100}|r-50| = \frac{d}{101}\times 2\sum_{r=1}^{50} r$$

$$255 = \frac{2d}{101} x \frac{50(51)}{2}$$

$$\frac{255x101}{50x51} = d = 10.1$$

Q.89 Ans.: (1) 2 or $-\frac{3}{2}$

Explanation: If two circles intersect orthogonally then

$2(q_1 : q_2 + f_1 : f_2) = C_1 + C_2$

$2[(1)(0) + k(k)] = 6 + k$

$2k^2 - k - 6 = 0$

$(2k + 3)(k - 2) = 0$

$\therefore$ $k = 2$ or $-\frac{3}{2}$

Q.90 Ans.: (3) $\frac{2^n}{n+1}$

Explanation: Mean of ${}^nC_0, {}^nC_1, {}^nC_2, ..., {}^nC_n$ is

$$\bar{n} = \frac{{}^nC_0 + {}^nC_1 + {}^nC_2 + {}^nC_3 + ... + {}^nC_n}{n+1}$$