No. :

DEEPER®

TRIAL SET : (JEE-MAIN) - 2018

PHYSICS, CHEMISTRY & MATHEMATICS

Test Booklet code

11

Do not open this Test Booklet until you are asked to do so.

Read carefully the Instructions on the Back Cover of this Test Booklet.

This booklet contains **32** pages solutions.

Day and Date:
Sunday, 25th March, 2018

Duration : 9.15 am to 12.15 pm
Total Marks : 360

Important Instructions :

1. Immediately fill in the particulars on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of 3 hours duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are three parts in the question paper. The distribution of marks subjectwise in each part is as under.
   Part A - PHYSICS (120 marks) - Question No. 1 to 30 - **FOUR (4)** marks each.
   Part B - CHEMISTRY (120 marks) - Question No. 31 to 60 - **FOUR (4)** marks each.
   Part C - MATHS (120 marks) - Question No.61 to 90 - **FOUR (4)** marks each.
6. There are 90 questions. Each correct answer carries 4 marks and for each incorrect answer one mark will be deducted. For every Question there are four choices. Out of these choices only one choice is correct.
7. Use **Blue / Black Ball Point Pen** only for writing particulars / marking responses on **Side-1** and **Side-2** of the Answer Sheet. **Use of pencil is strictly prohibited.**
8. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
9. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
11. The CODE for this Booklet is **11**. Please write the CODE on **Side-2** of the Answer Sheet same as that on this booklet. In case of any discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
12. **Do not fold or make any stray marks on the Answer Sheet.**

Name of the Candidate (in Capital letters) : _____

Roll Number : In figures | | | | | | | |

:In words _____

Examination Centre Number : | 0 | | | |

Name of Examination Centre (In Capital letters) : _____

Candidate's Signature: _____ **Invigilator's Signature :** _____

PART – A : PHYSICS

Q.1 Ans.: (3) 3 m and 75 cm

Explanation: $\lambda = \frac{C}{v}$

$= \frac{3\times10^8}{1\times10^8}$

$\lambda = 3$ m.

Antena length = $l = \lambda 14$

$= \frac{300}{4}$ cm

= 75 cm.

Q.2 Ans.: (3) $\left(\sqrt{2}-1\right)t$

Explanation: $\theta_1 = 2\pi \times 10 = 20\pi$ and $\theta_2 = 2\pi \times 20 = 40\pi$

$\therefore \quad \theta_2 - \theta_1 = 20\pi$

Now $\theta_1 = \frac{1}{2}\alpha t_1^2 \qquad \therefore \theta_2 - \theta_1 = \frac{1}{2}\alpha\left(t_2^2 - t_1^2\right)$

$\therefore \frac{\theta_2 - \theta_1}{\theta_1} = \frac{t_2^2 - t_1^2}{t_1^2}$

$\therefore \frac{20\pi}{20\pi} = \frac{t_2^2 - t_1^2}{t_1^2}$

$\therefore t_1^2 = t_2^2 - t_1^2$

$\therefore \sqrt{2}t_1 = t_2$

$\therefore \frac{t_2}{t_1} = \sqrt{2}$

$\therefore \frac{t_2 - t_1}{t_1} = \frac{\sqrt{2}-1}{1}$

$\therefore \left(t_2 - t_1\right) = \left(\sqrt{2}-1\right)t_1$

But $t_1 = t$ here $\qquad \therefore (t_2 - t_1) = \left(\sqrt{2}-1\right)t$.

Reason: As there is angular acceleration, time for previous 10 rotations and after 10 rotations is not same.

Q.3 Ans.:(2) 10 m/s

Explanation: $y = a\sin 8\pi\left(\frac{t}{0.16} - \frac{x}{1.6}\right)$

$$y = a\sin 2\pi\left(\frac{t}{0.04} - \frac{x}{0.4}\right)$$

$$y = a\sin 2\pi\left(25t - \frac{x}{0.4}\right)$$

Compare with $y = a\sin 2\pi\left(nt - \frac{x}{\lambda}\right)$

$n = 25$ Hz, $\lambda = 0.4$ m

$v = n\lambda$

$v = 25 \times 0.4$

$v = 10$ m/s.

Q.4 Ans.: (3) 2.75 m

Explanation: For same driver battery

Balancing length in potentiometer x length of potentiometer wire.

$$\therefore \frac{\ell_2}{\ell_1} = \frac{L_2}{L_1}$$

$$\ell_2 = \frac{L_2}{L_1}\ell_1$$

$$= \frac{10+1}{10} x 2.5$$

$$= \frac{11 \times 2.5}{10}$$

$$\ell_2 = 2.75\,m$$

Q.5 Ans.: (3) 10 x 10^{-5} Nm and 0.1 N

Explanation: $\tau = PE\sin\theta$

$$\tau = 4\times10^{-9}\times5\times10^{4}\sin 30°$$

$$\tau = 20\times10^{-5}\times\frac{1}{2}$$

$$\tau = 10\times10^{-5}\ Nm$$

$$F = qE = 2\times10^{-6}\times5\times10^{4}$$

$= 0.1$ N

Q.6 Ans.: (3) 6

Explanation: $n_1\lambda_1 = n_2\lambda_2$

$$n_2 = \frac{n_1\lambda_1}{\lambda_2}$$

$$= 12 \times \frac{600}{400} = 18$$

$\therefore\ n_2 - n_1 = 18 - 12 = 6$

Q.7 Ans.: (1) $\frac{1}{3}$

Explanation: When a polaroid is rotated through 30° with respect to beam A, then beam B is at 60° with it

$$I_A \cos^2 30° = I_B \cos^2 60°$$

$$I_A \left(\frac{\sqrt{3}}{2}\right)^2 = I_B \left(\frac{1}{2}\right)^2$$

$$I_A \frac{3}{4} = \frac{I_B}{4}$$

$\therefore$ $$\frac{I_A}{I_B} = \frac{1}{3}$$

Q.8 Ans.: (1) 2 %

Explanation: $r = mv / Bq$

$rBq = mv$

$r^2B^2q^2 = m^2v^2$

$$\frac{1}{2m} r^2B^2q^2 = \frac{1}{2m} m^2v^2$$

$$rBq = \sqrt{2mK.E.}$$

$$r\alpha\sqrt{K.E.}$$

$$\frac{r'}{r} = \sqrt{\frac{KE^1}{KE}}$$

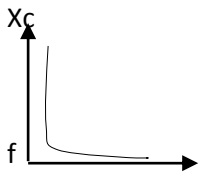
$$r' = \sqrt{0.96}r$$

$r' = 0.98\ r$

$r' = 2\ \%$

Q.9 Ans.:

(3)



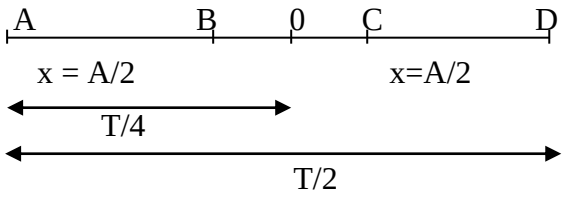
Explanation: Capacitive reactance, $Xc = \frac{1}{Wc} = \frac{1}{2\pi fc}$

$$\therefore Xc \alpha \frac{1}{f}$$

With increase in frequency, Xc decreases hence, Option (c) represents the correct graph.

Q.10 Ans.: (3) T/6

Explanation:



Time from 0 to C is

$x = a \sin(\omega t + \alpha)$

$$\frac{A}{2} = A \sin\left(\frac{2\pi}{T} t_1\right)$$

$$\frac{2\pi t_1}{T} = \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{6}$$

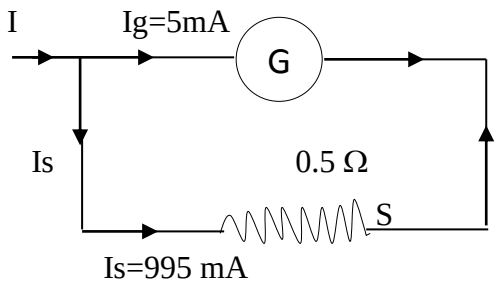
$$t_1 = \frac{T}{12}$$

Time from B to 0 is same as that from 0 to C

$$t' = t_1 + t_1 = \frac{T}{12} + \frac{T}{12} = \frac{T}{6}$$

Q.11 Ans.: (1) 99.5 Ω

Explanation:



In this case,

I_s = 995 mA

S = 0.5 Ω

I = Is + Ig

= 995 + 5

I = 1000 mA

Now, $G = \left(\frac{Is}{I - Is}\right)S$

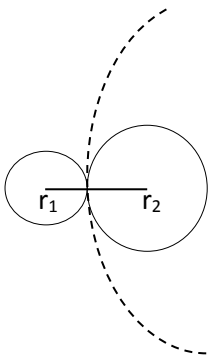
$= \left(\frac{995}{1000 - 995}\right)x0.5$

$= \frac{995}{5}x0.5$

$G = \frac{995}{10} = 99.5\Omega$

Q.12 Ans.: (3) $R = \sqrt{r_1^2 + r_2^2}$

Explanation: Under isothermal condition, Boyle's law is obeyed



∴ $P_1V_1 + P_2V_2 = PV$

$$\frac{4T}{r_1} x \frac{4}{3}\pi r_1^3 + \frac{4T}{r_2} x \frac{4}{3}\pi r_2^3 = \frac{4T}{R} x \frac{4}{3}\pi R^3$$

$$\therefore r_1^2 + r_2^2 = R^2$$

$$\therefore R = \sqrt{r_1^2 + r_2^2}$$

Q.13 Ans.: (2) 208.4 rad/s

Explanation: Here $I_1 = I_2 = 5$ kg $m^2 = I$

$F_1 = 120$ rpm and $F_2 = 180$ rpm

Since coupled in opposite direction,

Angular momentum of system – $\vec{L}_1 + \vec{L}_2 = -I_1\omega_1 + I_2\omega_2$

$= 2\pi\left[F_2 - F_1\right]I_1, \quad I_1 = I_2$ _____(1)

After coupling by weightless shaft rotated with common angular speed ω

Magnitude of total momentum = 2Iω = 4πFI _____(2)

According to law of conservation of angular momentum

$4\pi FI = 2\pi[F_2 - F_1]\ I$

$$F = \frac{F_2 - F_1}{2} = \frac{180 - 120}{2} = \frac{60}{2} = 30\,\text{rpm}$$

Common angular speed ω = 2πF = 6.28 x 30 = 208.4 rad/s

Q.14 Ans.: (3) 5 x 10^{-4} m

Explanation: Since $Y = \frac{FL}{A.\Delta L}, \quad \Delta L = \frac{FL}{A.Y}$

Initially weight suspended in air for steel wire $\left(\Delta L_1\right) = \frac{F_1 L}{A.Y.}$

with suspended on steel immersed in water $\left(\Delta L_2\right) = \frac{F_2 L}{AY}$

$\therefore$ Up thrust due to water = $F_1 - F_2 = V\rho g$

$$\Delta L = \Delta L_1 - \Delta L_2 = \frac{\left(F_1 - F_2\right)L}{A.Y} = \frac{V\rho gL}{A.Y}$$

$$= \frac{10^{-3} x 10^3 x 10 x 10}{1x10^{-6} x 2x10^{11}} = \frac{10^2}{2x10^5}$$

$\Delta L = 0.5 \times 10^{-3} = 5 \times 10^{-4}$ m

Q.15 Ans.: (4) 1.8 x 10^4 m/s and 9 eV

Explanation: $\frac{1}{2}mV^2 = eVs$

$$V_{max} = \sqrt{\frac{2eVs}{m}} = \sqrt{2\left(\frac{e}{m}\right).Vs}$$

$$= \sqrt{2x1.8x10^{11}x9}$$

$$= \sqrt{18x18x10^{10}} = 18x10^5$$

$$V_{max} = 1.8x10^4 \ \ m/s$$

KEmax = (Vs) eV

= 9 eV

Q.16 Ans.: (3) 4.5 x 10^9

Explanation: ni = 1.5 x 10^{16} m^{-3} i.e. number of thermally generated electrons is negligibly small as compared to those produced by doping $\therefore$ ne = N_D $\qquad N_D = \frac{5x10^{28}}{10^6} = 5x10^{22}$

Since $n_e n_h = n_i^2$, The no. of holes = nh

$$\therefore n_h = \frac{ni^2}{n_D} = \frac{\left(1.5x10^{16}\right)^2}{5x10^{22}}$$

$$= \frac{2.25x10^{32}}{5x10^{22}} = 4.5x10^9 \ m^{-3}$$

Q.17 Ans.:(2) 1.50

Explanation: $r_{mixture} = \dfrac{\frac{n_1 r_1}{r_1 - 1} + \frac{n_2 r_2}{r_2 - 1}}{\frac{n_1}{r_1 - 1} + \frac{n_2}{r_2 - 1}}$

$$n_1 = 1,\ r = 5/3,\ n_2 = 1,\ r_2 = \frac{7}{5}$$

$$\therefore \quad r_{mixture} = \frac{\frac{1x\frac{5}{3}}{\left[\frac{5}{3}-1\right]} + \frac{1x\frac{7}{5}}{\left[\frac{7}{5}-1\right]}}{\left[\frac{1}{\frac{5}{3}-1}\right] + \left[\frac{1}{\frac{7}{5}-1}\right]} = \frac{\frac{5}{2}+\frac{7}{2}}{\frac{3}{2}+\frac{5}{2}} = \frac{6}{4}$$

$= \frac{3}{2} = 1.5$

Q.18 Ans.: (1) $\left(\frac{n}{n+1}\right)mgR$

Explanation: Gravitational potential of mass m at any point at a distance r is

$U = -\frac{GMm}{r}$ at the surface of earth $r = R$

$U = -\frac{GMm}{R}$ $\qquad GM = 9R^2$

$U = -mgR$

at height $h = nR$ from the earth surface

$r = R + h = R + nR = (n + 1)R$

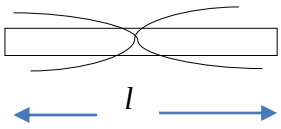
$U_n = -\frac{GMm}{(n+1)R}$ $\therefore$ $GM = 9R^2$

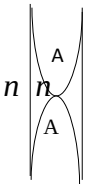
$Un = -\frac{mgR}{n+1}$

Change in potential energy = $Un - U = -\frac{mgR}{n+1} + mgR = \frac{n}{(n+1)}mgR$

Q.19 Ans.: (3) 5.06 km/s

Explanation: When a rod is clamped at middle then it behaves like fundamental mode of vibrations of air column in a tube open at both ends





$\ell = \frac{\lambda}{2}$

$V = n\lambda = n2l$

$= 2.53 \times 2 \times 1 = 5.06$ km/s

Q.20 Ans.: (2) 11.5

Explanation: $s = ut + \frac{1}{2}at^2$

here $s = h$ & $u = 0$

$h = \frac{1}{2}gt^2$

$$t = \sqrt{\frac{2h}{g}}$$

$\therefore$ Time taken by the stone to reach the lake is,

$$t_1 = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2x500}{10}} = 10\,\text{second}$$

Now time taken by sound from lake to the man is,

$$t_2 = \frac{h}{v} = \frac{500}{340} = 1.5 \text{ second}$$

$\therefore$ Total time $t = t_1 + t_2$

$= 10 + 1.5$

$= 11.5$ second

Q.21 Ans.: (3) 655

Explanation: Here

No = 1000

N = 900 at t = 2 s

In I = 2 s number of nuclei left = 90%

In next 9 sec when t = 4 sec. number of nuclei left = 90 % of 900

= 810.

In next 2 s when t = 6s

Number of nuclei left = 90% of 810 = 729

In next 2s when t = 8s

Number of nuclei = 90% of 729 = 0.9 x 729 = 656.1

$656 \approx 655$

Q.22 Ans.:(1) 45°C

Explanation: Newton's law of cooling

$$\frac{\theta_1 - \theta_2}{\Delta t} = k\left[\frac{\theta_1 + \theta_2}{2} - \theta_0\right]$$

First - $\frac{70-60}{5} = k\left[65 - \theta_0\right]$

$\therefore$ $2 = k\left[65 - \theta_0\right] \rightarrow (1)$

Second

$$\frac{60-54}{5} = k\left[57 - \theta_0\right]$$

$\therefore \quad \frac{6}{5} = k\left[57 - \theta_0\right] \rightarrow (2)$

Eq. (1) ÷ Eq. (2)

$\therefore \frac{2}{(6/5)} = \frac{65 - \theta_0}{57 - \theta_0}$

$\therefore \frac{5}{3} = \frac{65 - \theta_0}{57 - \theta_0}$

$\therefore$ 285 - $5\theta_0$ = 195 - $3\theta_0$

$\therefore$ $2\theta_0$ = 90

$\therefore \theta_0$ = 45°C

Q.23 Ans.: (3) 111 J

Explanation: $\vec{s} = \vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k},\ \vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$

$\vec{r} = \vec{r}_2 - \vec{r}_1 = 11\hat{i} + 11\hat{j} + 15\hat{k}$

$\vec{F} = 4\hat{i} + 2\hat{j} + 3\hat{k}$

Now $W = \vec{F}.\vec{s} = \left(11\hat{i} + 11\hat{j} + 15\hat{k}\right).\left(4\hat{i} + 2\hat{j} + 3\hat{k}\right)$

= 44 + 22 + 45

= 111 J

Q.24 Ans.: (4) $\sqrt{\frac{mk}{2t}}$

Explanation: We know $p = \frac{dw}{dt} = k$

$\Rightarrow W = pt$

$\frac{1}{2}mv^2 = pt$

$v = \sqrt{\frac{2pt}{m}}$

$a = \frac{dv}{dt} = \sqrt{\frac{2p}{m}}.\frac{1}{2\sqrt{t}}$

$\therefore$ F = ma

$= m.\sqrt{\frac{2p}{m}}\frac{1}{2\sqrt{t}}$

$= \sqrt{\frac{2km^2}{m}}.\frac{1}{2\sqrt{t}}$

$$F = \sqrt{\frac{mk}{2t}}$$

Q.25 Ans.: (1) $\frac{3}{\pi}M$

Explanation: $M = ml$

$$\ell = \frac{\pi}{3} x\, r \qquad \text{arc} = \text{angle} \times \text{radius}$$

$$\therefore \quad r = \frac{3\ell}{\pi} \qquad \ell = \frac{\pi}{3} xr$$

$$m' = ml$$

Magnetic moment, $m \times r = \frac{m \times 3\ell}{\pi} = \frac{3M}{\pi} \quad \left(\because M = m\ell\right) \left(r = \ell\right)$

Q.26 Ans.: (2) $\left[L^0M^{-1}T^2I^1\right]$

Explanation: $\text{Mobility of electrons}\left(\text{Charge carrier}\right)\mu = \frac{\text{drift velocity}\left(Vd\right)}{\text{electric field } E}$

$$= \frac{ms^{-1}}{Vm^{-1}} = \frac{m^2s^{-1}}{V}$$

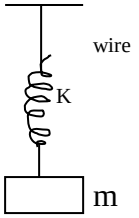
$$\text{Volt} = v = \frac{\text{Joule}}{\text{Coulomb}}$$

$$= \frac{m^2s^{-1}}{\frac{\left[L^2M^1T^{-2}\right]}{\left[I^1T^1\right]}} = \frac{\left[m^2s^{-1}\right]}{\left[L^2M^1T^{-3}I^{-1}\right]}$$

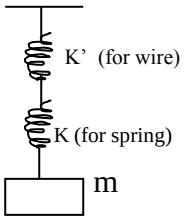
$$= \left[L^0M^{-1}T^2I^1\right]$$

Q.27 Ans.: (2) $2\pi\sqrt{\frac{m\left(yA + KL\right)}{yAK}}$

Explanation:



$\Rightarrow$



Equal to condensers series combination $\frac{1}{K_{ep}} = \frac{1}{K'} + \frac{1}{K}$

$$\therefore y = \frac{FL}{A\ell}$$

$$\therefore F/\ell = \frac{yA}{L}$$

K' = force constant for wire

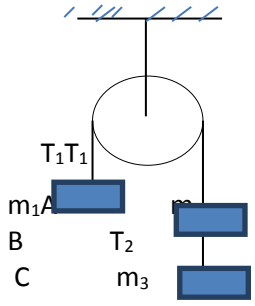
$$\therefore K' = \frac{yA}{L}$$

$$\therefore K_{equivalent} = \frac{KK'}{K+K'} = \frac{kYA/L}{K+\frac{yA}{L}} = \frac{kYA}{KL+YA}$$

$$\therefore T = 2\pi\sqrt{\frac{m}{K_{eq}}} = 2\pi\sqrt{\frac{m(KL+yA)}{KyA}}$$

Q.28 Ans.: (1) 13 N

Explanation: Tension between m_2 and m_3 is given by



$$T = \frac{2m_1m_3}{m_1+m_2+m_3} x\, g$$

$$= \frac{2x2x2}{2+2+2} x9.8$$

$$= \frac{8}{6} x9.8 = \frac{4}{3} x9.8$$

= 4 x 3.26

= 13 N

OR $q = \frac{2mg}{6m} = \frac{9}{3}$

$$ma = T_1 = 2\left(\frac{g}{3}\right)$$

$\therefore T_2 - T_1 = ma$

$$\therefore T_2 = T_1 + ma = \frac{2}{3}g + \frac{2g}{3} = \frac{4g}{3} = \frac{4x9.8}{3}$$

$\approx$ 13 N

Q.29 Ans.: (4) $-\vec{B}$

Explanation: At 'M', $B_{PQ} = \frac{\mu_0 I_1}{2\pi a}$ Right hand rule $= \frac{\mu_0}{2\pi a} \uparrow$

$$\vec{B} = \frac{2\mu_0}{2\pi a} - \frac{\mu_0}{2\pi a} = \frac{\mu_0}{2\pi a}$$

If $I_1 = 2A = 0$, $B_{PQ} = 0$ $\quad B'_m = -\frac{\mu_0}{2\pi_a} = -\vec{B}$

Q.30 Ans.: (4) $\frac{\mu_0}{4\pi} \frac{2\pi I a^2}{\left(x^2 + a^2\right)^{3/2}}$

Explanation: The magnetic field at a point P due to current carrying coil is –

$$B = \frac{\mu_0}{4\pi} \frac{2\pi I a^2}{\left(x^2 + a^2\right)^{3/2}}$$

(As 'P' is point along the axis of coil at a distance 'x')

PART – B : CHEMISTRY

Q.31 Ans.: (4) 44.8 dm^3

Explanation: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ at STP.

1 mole 2 mole 1 mole 2 mole

16 gram 64 gram 44 gram 36 gram at STP.

18 gram $H_2O(g)$ at S.T.P. = 22.4 dm^3

$\therefore$ 36 gram $H_2O(g)$ at S.T.P. = 44.8 dm^3

Reason: 1) 11.2 dm^3 $H_2O \equiv$ 9 gram H_2O (g)

2) 22.4 dm^3 H_2O = 18 gram H_2O (g)

3) 33.6 dm^3 H_2O = 27 gram H_2O (g)

Q.32 Ans.: (1) Mg^{2+}

Explanation:

O^{2-} = Total number of electrons

= 10

Mg^{2+} = Total number of electrons

= 10

$\rightarrow$ Atoms or ions which contain same number of electrons are called as isoelectronic species.

Reason:

2) Ca^{2+} = No. of electrons = 18

3) Cl^- = No. of electrons = 18

4) S^{2-} = No. of electrons = 18

Q.33 Ans.: (1) 0.25

Explanation:

$2HI_{(g)} \rightleftharpoons$	$H_{2(g)}$ +	$I_{2(g)}$
100	0	0
50	25	25

So equilibrium constant (K) = $\frac{[H_2][I_2]}{[HI]^2}$

$$K = \frac{25x25}{[50]^2} = 0.25$$

Q.34 Ans.: (1) 186 pm

Explanation:

For bcc lattice,

Edge length $a = \frac{4r}{\sqrt{3}}$

$$\therefore \quad r = \frac{4.29x10^{-8}\,cmx1.732}{4}$$

$r = 1.86 \times 10^{-8}$ cm

r = 186 pm

Q.35 Ans.: (2) They are anisotropic.

Explanation: Anisotropy is property of crystalline solid.

Q.36 Ans.: (1) 156 mm

Explanation: $P_r = P_A^o X_A + P_B^o X_B$

$$P_A^o = 120\,mm\,Hg,\ P_B^o = 180\,mm\,Hg,\ X_A = \frac{2}{5},\ X_B = \frac{3}{5}$$

$$P_r = 120x\frac{2}{5} + 180x\frac{3}{5}$$

$$P_r = 48 + 108$$

$$P_r = 156\,mm\,Hg.$$

Q.37 Ans.: (3) A solution of low osmotic pressure termed hypertonic

Explanation: A solution of high osmotic pressure is hypertonic.

Q.38 Ans.: (4) 10

Explanation: For reaction $H^+ + e^- \rightarrow \frac{1}{2}H_2$

$$E = E_0 + \frac{2.303RT}{nF}\log\frac{[H^+]}{pH_2^{1/2}}$$

$pH_2^{1/2} = 1$ and $E_0 = 1$ Substituting the value of R,T, n and F,

$$E = 0.059\log[H^+]$$

We know, pH = - log $[H^+]$

E = - 0.591 log $[H^+]$

$$pH = \frac{E^0_{cell}}{0.059} = \frac{0.59}{0.059} = 10$$

Q.39 Ans.: (1) $AgCl_{(s)} + 1e^- \longrightarrow Ag_{(s)} + Cl^-_{aq}$

Explanation: Knowledge based question.

Q.40 Ans. (4) There is no difference between order and molecularity of a reaction.

Explanation: Order may or may not be equal to molecularity.

Q.41 Ans.: (2) $(NH_4)_3PO_4$

Explanation: $(NH_4)_3PO_4$

According to Hardy-Schulze rule

Q.42 Ans.: (2) Leaching

Explanation: Leaching is done for Bauxite $Al_2O_3.2H_2O$

Q.43 Ans.: (4) Urea

Explanation: In Urea

$$4)\ (NH_2CONH_2) = \frac{28}{60}x100 = 46.67\%$$

Reason: 1) $\text{Nitrolim } CaCN_2 = \frac{28x100}{92} = 30.43$

(Calcium cyanamide)

2) Calcium ammonium nitrate $= \frac{56}{244} x100 = 22.95$

$Ca(NO_3)_2.NH_4NO_3$

3) Ammonium sulphate $= \frac{28}{128} x100 = 21.87$

$(NH_4)_2 SO_4$

Q.44 Ans.: (1) V^{+3}, Ni^{+2}

Explanation: unpaired e^- in 'd' orbital.

$_{21}Sc^{+3}$ =	0	=	0	
$_{23}V^{+2}$ =	1	=	1.73	
$_{24}Cr^{+3}$=	4	=	4.90	
$_{25}Mn^{+2}$ =	5	=	5.92	
$_{27}CO^{+2}$=	4	=	4.90	$\left(\mu_{eff} = \sqrt{n(n+2)}\right)$
$_{28}Mi^{+2}$=	2	=	2.83	
$_{30}Zn^{+2}$=	0	=	0	
$_{23}V^{+3}$=	2	=	2.83	

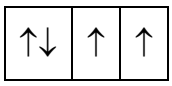
Q.45 Ans.: (1) d^4 (in strong field ligand)

Explanation: Spin only magnetic moment $\sqrt{n(n+2)}$

n = no. of unpaired electrons.

In octahedral complex the strong field ligand results in a low spin complex.

$d^4 \xrightarrow[\text{spin}]{\text{low}} t_2g^4$ e.g. (strong field ligand)

n = 2 

Q.46 Ans.: (2) 24 %

Explanation: Molar mass of AgBr = 108 + 80 = 188 mol^{-1}

188 mg AgBr contains 80 mg bromine

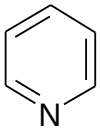
141 mg AgBr contains = $\frac{80x141}{188}$ mg bromine

Percentage of bromine = $\frac{80x141x100}{188x250}$

= 24%

Q.47 Ans.: (4) Pyridine

Explanation: Pyridine is non benzenoid aromatic compound.



Q.48 Ans.: (2) Organo lead compound

Explanation: Organo lead compounds are used as antiknocking agent.

Q.49 Ans.: (3) decrease in demand of oxygen

Explanation: Oxygen is used for decomposition.

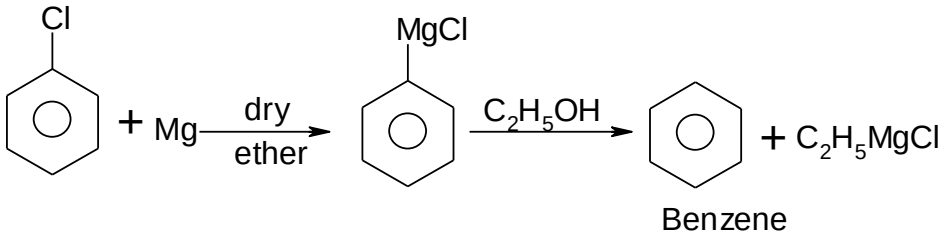
Q.50 Ans.: (2) 2, 2 Dichloropropane

Explanation:

$$H_3C-CH=CH_2+HCl \xrightarrow{\text{Benzoyl peroxide}} \underset{\underset{\text{major}}{\text{Cl}}}{H_3C-CH-CH_3} + H_3C-CH_2-CH_2-Cl$$

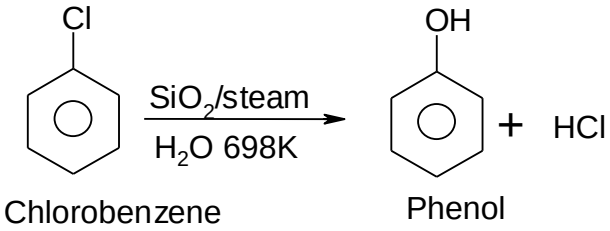
Q.51 Ans.: (2) Benzene

Explanation:



Q.52 Ans.: (2) SiO_2/steam

Explanation:



Q.53 Ans.: (3) diethyl ether

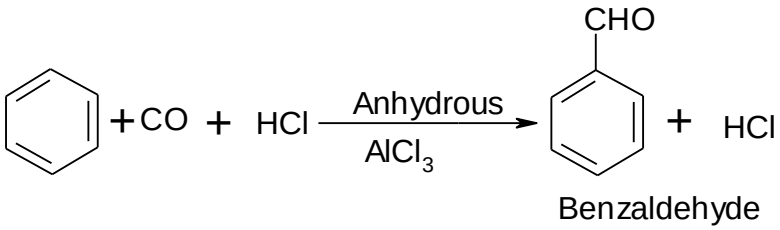
Explanation:

$CH_3-CH_2-CH_2-O-CH_3$ $CH_3-CH_2-O-CH_2-CH_3$

Methyl propyl ether Diethyl ether

Q.54 Ans.: (3) C_6H_5CHO

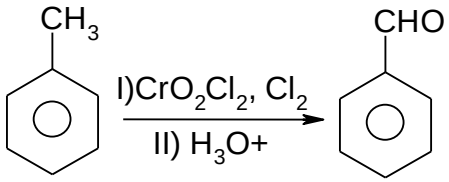
Explanation:



Benzaldehyde

Q.55 Ans.: (3) Etard reaction

Explanation: Etard reaction



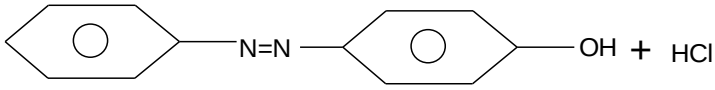
Toluene Benzaldehyde

Q.56 Ans.: (2) Aniline

Explanation:

$$C_6H_5NH_2 + NaNO_2 \xrightarrow{HCl} C_6H_5N_2^+Cl^- \xrightarrow{Phenol}$$

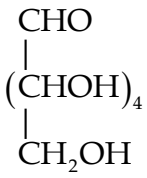
Aniline



P-hydroxyazobenezene

Q.57 Ans.: (2) 4 & 16

Explanation:



No. of Chiral carbon atoms = 4

No. of optical isomers =

$$a = 2^n$$

$$a = 2^4$$

$$a = 16$$

Q.58 Ans.: (2) Wax

Explanation: Steroid, Terpenes, and Prostaglandin are simple lipids and wax is complex lipid.

Q.59 Ans.: (4) Tetrafluoroethene

Explanation: Tetrafluoroethene on polymerization gives Teflon.

Q.60 Ans.: (2) Novestrol

Explanation: Novestrol is antifertility drug.

PART – C : MATHEMATICS

Q.61 Ans.: (4) 4

Explanation: $3\cos 2x - 10\cos x + 7 = 0$

$3(2\cos^2 x - 1) - 10\cos x + 7 = 0$

$6\cos^2 x - 10\cos x + 4 = 0$

$6\cos x(\cos x - 1) - 4(\cos x - 1) = 0$

$(\cos x - 1)(6\cos x - 4) = 0$

$\cos x - 1 = 0$ or $6\cos x - 4 = 0$

$\cos x = 1$ $\qquad$ $\cos x = \frac{4}{6} = \frac{2}{3}$

Since, cos x is in positive in I and IVthquandrant.

Hence, total number of solutions are 4.

$\cos x = 1 = \cos 0$ $\qquad$ Let $\frac{2}{3} - \cos\alpha$

$x = 2n\pi + 0,\ n \in Z.$ $\qquad$ $\cos x = \frac{2}{3} - \cos\alpha$

$x = 2n\pi,\ n \in Z$ $\qquad$ $x,\ 2n\pi \pm \alpha,\ n \in Z$

for n = 0, 1 $\qquad$ for n = 0, 1

x = 0, x = 27 $\qquad$ $x = \pm\alpha$

$x = 2\pi - \alpha$

But $x = -\alpha$ is not positive

$\therefore\ x = \alpha$

$x = 2\pi - \alpha$

$\therefore$ In all 4 values option (4)

Q.62 Ans.: (1) No solution

Explanation: $2\cos^{-1}x + \sin^{-1}x = \frac{11\pi}{6}$

$$\cos^{-1}x + \left(\cos^{-1}x + \sin^{-1}x\right) = \frac{11\pi}{6}$$

$$\cos^{-1}x + \frac{\pi}{2} = \frac{11\pi}{6}$$

$$\cos^{-1}x = \frac{11\pi}{6} - \frac{\pi}{2}$$

$$\cos^{-1}x = \frac{11\pi - 3\pi}{6}$$

$$= \frac{8\pi}{6}$$

$$= \frac{4\pi}{3}$$

Which is not possible as $\cos^{-1}x \in [0, \pi]$

$\therefore$ No solution

Q.63 Ans.:(1) 48 m

Explanation: BC = building, D = window

In ΔDAB, $\tan\theta = \frac{64}{d}$

$\Rightarrow d = \cot\theta\ 64$ _____(1)

In ΔCDE $\tan(90° - \theta) = \frac{(100-64)}{d}$

$\Rightarrow d = 36 \tan\theta$ _____(2)

On multiplying equation (1) and (2)

We get

$d^2 = 36 \times 64$

$\Rightarrow$ $d = 48$

Q.64 Ans.:(1) – 2

Explanation: Given lines are

$$\frac{x-1}{1} = \frac{y+3}{-k} = \frac{z-1}{k} \text{ and } \frac{x-0}{\frac{1}{2}} = \frac{y-1}{1} = \frac{z-2}{-1}$$

$x_1 = 1, y_1 = -3, z_1 = 1, x_2 = 0, y_2 = 1, z_2 = 2$

$a_1 = 1, b_1 = -k, c_1 = k, a_2 = 1, b_2 = 2, c_2 = -2$

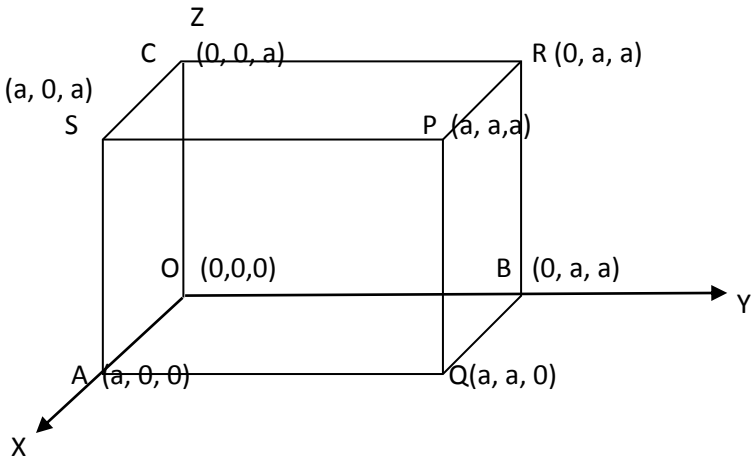
Lines are coplanar

$$\therefore \begin{vmatrix} x_2-x_1 & y_2-y_1 & z_2-z_1 \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} = 0$$

$$\therefore \begin{vmatrix} -1 & 4 & 1 \\ 1 & -k & k \\ 1 & 2 & -2 \end{vmatrix} = 0 \Rightarrow k = -2 \quad \text{Option(1)}$$

Q.65 Ans.:(2) $\frac{1}{3}$

Explanation:



Let a be the length of an edge of the cube with one vertex at the origin.

Diagonal of cube are OP, AR, CQ

Consider diagonals OP and HR

Dr's of OP and AR are

a, a, a and –a, a, a

letθ be angle between OP and AR

$$\cos\theta = \frac{ax(-a)+axa+axa}{\sqrt{a^2+a^2+a^2}.\sqrt{(-a^2)+a^2+a^2}}$$

$$= \frac{-a^2+a^2+a^2}{\sqrt{3a}.\sqrt{3a}}$$

$$= \frac{a^2}{3a^2}$$

$$\cos\theta = \frac{1}{3}$$

Q.66 Ans.:(3) $5\sqrt{2}$

Explanation: since $\bar{a}.(\bar{b}+\bar{c})=0$

$\Rightarrow \bar{a}.\bar{b}+\bar{a}.\bar{c}=0$ _____(1)

Similarly $\bar{b}.\bar{c}+\bar{a}.\bar{b}=0$ _____(2)

and $\bar{c}.\bar{a}+\bar{b}.\bar{c}=0$ _____(3)

on adding equations (1), (2) and (3) we get

$2(\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a})=0$

Now $|\bar{a}+\bar{b}+\bar{c}|^2=|\bar{a}|^2+|\bar{b}|^2+|\bar{c}|^2+2(\bar{a}.\bar{b}+\bar{b}.\bar{c}+\bar{c}.\bar{a})$

$= |\bar{a}|^2+|\bar{b}|^2+|\bar{c}|^2$

$= 9 + 16 + 25$

$= 50$

$\Rightarrow \quad |\bar{a}+\bar{b}+\bar{c}|=5\sqrt{2}$

Q.67 Ans.:(3) $3x + 2y + z = 35$

Explanation: Plane through the intersection of 2 given plane is $(2x + 3y + 4z + 5) + \lambda(x + y + z – 6) = 0$

i.e. $(2 + \lambda)x + (3 + \lambda)y + (4 + \lambda)z + (5 - 6\lambda) = 0$ _____(1)

Also reqd. plane is parallel to $3x + 2y + z – 6 = 0$ _____(2)

$\therefore$ Normal of reqd. plane (1) is parallel to the plane of normal (2)

$\therefore$ Drs. are in proportion

$\therefore \frac{2+\lambda}{3}=\frac{3+\lambda}{2}=\frac{4-\lambda}{1}$

$\therefore 4 + 2\lambda = 9 + 3\lambda = 24 - \lambda \quad \therefore \lambda = -5$

$\therefore$ By (1), reqd. plane has equation

$3x + 2y + z + 35 = 0$ (3)

Q.68 Ans.:(1) $\sqrt{2}:1$

Explanation: Equation of $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

Distance between foci of hyperbola = 2ae

Distance between directrices = $\frac{2a}{e}$

According to the equation

$$\frac{2ae}{\frac{2a}{e}} = \frac{3}{2} \qquad \therefore e^2 = \frac{3}{2}$$

Using $b^2 = a^2(e^2 - 1)$

$$\therefore \frac{b^2}{a^2} = e^2 - 1 = \left(\frac{3}{2}\right)^2 - 1 = \frac{3}{2} - 1 = \frac{1}{2}$$

$$\frac{a^2}{b^2} = 2$$

$$\therefore \quad \frac{a}{b} = \frac{\sqrt{2}}{1}$$

Q.69 Ans.:(4) 8

Explanation: Equation of circle is

$$(x - 4)(x + 2) + (y - 7)(y + 1) = 0$$

$$\Rightarrow x^2 - 2x - 8 + y^2 - 7y - 7 = 0$$

$$\Rightarrow x^2 + y^2 - 2x - 6y - 15 = 0 \qquad \text{\_\_\_\_\_(1)}$$

M_1 Here g = -1, c = - 15

$$\therefore AB = 2\sqrt{g^2 - c}$$

$$= 2\sqrt{1+15}$$

$$= 2\sqrt{16}$$

$$= 2(8)$$

$$= 8 \qquad (4)$$

M_2 where the circle (1) meets x-axis, put y = 0 in equation (1)

$\therefore x^2 - 2x - 15 = 0$

$(x + 3)(x - 5) = 0$

$\therefore$ x = -3 or x = 5 A(-3, 0)

B(5, 0)

$\therefore l(AB) = |5 - (-3)| = 8$ units option(4)

Q.70 Ans.:(1) 3

Explanation:

The equation of a tangent to the parabola y2 = 4x is $y = mx + \frac{1}{m}$.

If it passes through (-2, -1) then $-1 = -2m + \frac{1}{m} \Rightarrow 2m^2 - m - 1 = 0$

$\therefore\ m_1 + m_2 = \frac{1}{2}$ and $m_1 m_2 = \frac{-1}{2}$

Now $\tan\alpha = \pm\frac{m_1 - m_2}{1 + m_1 m_2}$

$= \pm\frac{\sqrt{(m_1 + m_2)^2 - 4m_1 m_2}}{1 + m_1 m_2}$

$= \pm\frac{\sqrt{114 + \frac{4}{2}}}{1 - \frac{1}{2}}$

$= 3$

Q.71 Ans.:(3) fixed radius 1 and variable centre along x-axis

Explanation: $\frac{ydy}{\sqrt{1-y^2}} = dx$

This is variable separable from on integrating.

$-\frac{1}{2}2\sqrt{1-y^2} = x + c$

$-\sqrt{1-y^2} = x + c$

$1 - y^2 = (x + c)^2$

$\therefore (x + c)^2 + y^2 = 1$

Which represent a circle of fixed radius 1 and variable centres (-0, 0) along x-axis.

Q.72 Ans.:(3) sec x = y (tan x + C)

Explanation: $\frac{dy}{dx} = y\tan x - y^2\sec x$ dividing by $-y^2$

$-\frac{1}{y^2}\frac{dy}{dx} = -\frac{1}{y}\tan x + \sec x$

Let $\frac{1}{y} = v$

$\therefore -\frac{1}{y^2}\frac{dy}{dx} = \frac{dv}{dx}$

$\frac{dv}{dx} + v\tan x = \sec x$ which is linear

I.F. $= e^{\int p dx} = e^{\int \tan x dx} = e^{\log(\sec x)} = \sec x$

$\therefore$ Thesolution is

$$v.\sec x = \int \sec^2 x dx + C$$

$$\frac{1}{y}\sec x = \tan x + C$$

$$\sec x = y(\tan x + C)$$

Q.73 Ans.:(1) $-\frac{1}{4}$

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

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

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

$$= \int_{-\frac{1}{2}}^{0} (-1)dx + \int_{0}^{\frac{1}{2}} 0\,dx$$

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

Q.74 Ans.:(1) $\log\left|\frac{x}{\sqrt{x^2+1}}\right| + \frac{x^2}{2\left(x^2+1\right)} + C$

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

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

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

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

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

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

$= \int \cot\theta d\theta + \int t dt$

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

For the second integral on RHS substitute sinθ=t

$\therefore \cos\theta\, d\theta = dt$

Q.75 Ans.:(4) $\frac{9\sqrt{3}}{4}$

Explanation: Given |z| = 3

$\therefore \quad |wz| = |w||z| = (1)(3) = 3$

also $\quad |w^2z + wz| = \left|z\left(w^2+w\right)\right| = |z(-1)| = |z| = 3$

$\therefore$ Given triangle is an equivalent triangle

$\therefore$ area $= \frac{\sqrt{3}}{4}(\text{side})^2 = \frac{\sqrt{3}}{4}|z|^2 = \frac{\sqrt{3}}{4}.3^2 = \frac{9\sqrt{3}}{4}$ (4)

Q.76 Ans.: (3) 0

Explanation:

$T_m = a + (m-1)d = \frac{1}{n}$

$T_n = a + (n-1)d = \frac{1}{m}$

$T_m - T_n = (m-n)d = \frac{1}{n} - \frac{1}{m}$

$\therefore d = \frac{1}{mn}$ and $a = \frac{1}{mn}$

$\therefore$ a – d = 0

Q.77 Ans.:(2) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Explanation: $A = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix} \quad \therefore A^2 = \begin{bmatrix} i^2 & 0 \\ 0 & i^2 \end{bmatrix}$

$\therefore \quad A^4 = \begin{bmatrix} i^4 & 0 \\ 0 & i^4 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

$\therefore \quad \left(A^4\right)^5 = A^4.A^4.A^4.A^4.A^4 = I.I.I.I.I.$

$= I$

$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Q.78 Ans.:(1) $-1, \frac{11}{5}$

Explanation: As system has no unique solution

$\therefore$ system either has no solution or infinitely many solution.

$\therefore$ for both cases $|A| = 0$

$$\Rightarrow \begin{vmatrix} \lambda & -3 & 1 \\ 1 & \lambda & 3 \\ 3 & 1 & 5 \end{vmatrix} = 0$$

$5\lambda^2 - 6\lambda - 11 = 0$

$(5\lambda - 11)(\lambda + 1) = 0$

$\lambda = \frac{11}{5}, \ \lambda = -1$

Q.79 Ans.:(2) 5005

Explanation: $\left[\frac{x+1}{x^{\frac{2}{3}} - x^{\frac{1}{3}} + 1} - \frac{x-1}{x - x^{\frac{1}{2}}}\right]^{15}$

$$= \left[\frac{\left(x^{\frac{1}{3}}+1\right)(x+1)}{\left(x^{\frac{1}{3}}+1\right)\left[\left(x^{\frac{1}{3}}\right)^2 - x^{\frac{1}{3}} + 1^2\right]} - \frac{\left(x^{\frac{1}{2}}+1\right)(x-1)}{x^{\frac{1}{2}}\left(x^{\frac{1}{2}}-1\right)\left(x^{\frac{1}{2}}+1\right)}\right]^{15}$$

$$= \left[\frac{\left(x^{\frac{1}{3}}+1\right)(x+1)}{(x+1)} - \frac{\left(x^{\frac{1}{2}}+1\right)(x-1)}{x^{\frac{1}{2}}(x-1)}\right]^{15} = \left[x^{\frac{1}{3}} + 1 - \frac{x^{\frac{1}{2}}+1}{x^{\frac{1}{2}}}\right]^{15}$$

$$= \left[x^{\frac{1}{3}} + 1 - 1 - x^{-\frac{1}{2}}\right]^{15} = \left[x^{\frac{1}{3}} - x^{-\frac{1}{2}}\right]^{15}$$

Let $(r+1)^{th}$ term be independent of x

$\therefore \quad T_{r+1} = {}^{15}C_r \left(x^{\frac{1}{3}}\right)^{15-r} \left(x^{-\frac{1}{2}}\right)^r = {}^{15}C_r . x^{\left(\frac{15-r}{3}-\frac{r}{2}\right)}$

$\therefore \quad \frac{15-r}{3}-\frac{r}{2}=0 \quad \therefore 30-5r=0 \quad \therefore r=6$

$\therefore$ constant term = ${}^{15}C_6$ = 5005 (2)

Q.80 Ans.:(2) neither reflexive nor transitive but symmetric

Explanation: Obviously the relation is not reflexive and transitive but it is symmetric, because

$x^2 + y^2 = 1 \quad \Rightarrow \quad y^2 + x^2 = 1$

$\therefore$ P is symmetric

$\therefore$ P is neither reflexive nor transitive but symmetric.

Q.81 Ans.:(4) – 20

Explanation: $\lim\limits_{x\to 2}\frac{f(4)-f(x^2)}{x-2}=\lim\limits_{x\to 2}\frac{f(4)-f(x^2)}{x^2-4}.(x+2)$

$=-\lim\limits_{x\to 2}\frac{f(x^2)-f(4)}{x^2-4}.(x+2)$ Let $x^2 - 4 = h$

$=-\left[\lim\limits_{h\to 0}\frac{f(4+h)-f(4)}{h}\right]\left[\lim\limits_{x\to 2}(x+2)\right]$ $\therefore x^2 = 4 + h$

$= -[f'(4)].[4]$ As $x \to 2$, $x^2 \to 4$

$= -[5][4] \quad (\therefore f'(4)=5)$ $\therefore h \to 0$

$= -20$

Q.82 Ans.:(1) 0

Explanation: for any real x,

$-1 \le \sin x \le 1$

$\therefore \quad -1 \le \sin\left(e^{\frac{1}{x}}\right) \le 1$

$\therefore \quad -x \le x.\sin\left(e^{\frac{1}{x}}\right) \le x$

$\lim\limits_{x\to 0} -x = 0 = \lim\limits_{x\to 0} x$

$\therefore$ By sandwitch rule,

$$\lim_{x\to 0} x \sin\left(e^{\frac{1}{x}}\right) = 0 \qquad (1)$$

Q.83 Ans.:(2) real and distinct of $h^2 > 9$

Explanation: $3x^2 + 2hxy + 3y^2 = 0$

$a = 3, h = h, b = 3$

$h^2 - ab = h^2 - 9$

For real and distinct lines $h^2 - 9 > 0$

i.e. $h^2 > 9$

Q.84 Ans.:(3) $(p \to q) \vee (q \to p)$

Explanation: Using truth table, we can easily prove that

$(p \to q) \vee (q \to p)$ is a tautology.

Q.85 Ans.: (2) 210 x 243

Explanation: When repetitions are allowed we have 5 x 5 = 25 choices for selection of 2 vowels out of 5.

a	a	e	a	i	a	o	a	u	a		
a	e	e	e	i	e	o	e	u	e		
a	i	e	i	i	i	o	i	u	i	25 ways	
a	o	e	o	i	o	o	o	u	o		
a	u	e	u	i	u	o	u	u	u		

Similarly for consonants when repetitions are allowed we have 21 x 21 ways to select 2 consonants.

$\therefore$ In all we have (5 x 5) x (21 x 21) = $(105)^2$ ways.

$\therefore$ Option (1) is correct.

Q.86 Ans.:(1) $x = \tan^{-1}\left(\sqrt{p/q}\right)$

Explanation: $y = \sin^p x.\cos^q(x)$

y is max. or min according as

$z = \log y = p \log \sin x + q \log \cos x$ is max. or min.

$$\frac{dz}{dx} = \frac{p}{\sin x}\cos x + \frac{q}{\cos x}(-\sin x) = 0$$

$\therefore$ $p \cot x - q \tan x = 0$ $\quad \tan^2 x = p/q$

$$x = \tan^{-1}\left(\sqrt{p/q}\right)$$

$\therefore \quad \dfrac{d^2z}{dx^2} = -p\,\text{cosec}^2x - q\sec^2 x$ which is clearly – ve when $x = \tan^{-1}\left(\sqrt{p/a}\right)$

Hence z is max. at $x = \tan^{-1}\left(\sqrt{p/a}\right)$

Q.87 Ans.:(1) 15

Explanation: we know that Q.D. $= \dfrac{5}{6} \times$ M.D.

$= \dfrac{5}{6} \times 12$

$= 10$

S.D. $= \dfrac{3}{2} \times$ Q.D.

$= \dfrac{3}{2} \times 10$

$= 15$

S.D. = 15

Q.88 Ans.: (2) (0, 1)

Explanation: function

$f(x) = ax^2 + bx + c$ is derivative of

$f(x) = \dfrac{ax^3}{3} + \dfrac{bx^2}{2} + cx + d$

$f(0) = d$

$f(1) = \dfrac{a}{3} + \dfrac{b}{2} + c + d$

$= \dfrac{2a + 3b + 6c}{6} + d$

$= \dfrac{0}{6} + d$

$= d$

Also f is cout and diff. on [0, 1] and (0, 1) resply

$\therefore$ By Rolle's Th^m

$\exists\ \lambda \in (0, 1)$ y.t. f'(λ) = 0 i.e. $a\lambda^2 + b\lambda + c = 0$

$\Rightarrow$ at least one root is in (0, 1).

Q.89 Ans.: (2) $\frac{3}{5}$

Explanation: $E_1 \rightarrow$ Bag contains 2w and 2 nonwhite

$E_2 \rightarrow$ Bag contains 3w and 1 nonwhite

$E_3 \rightarrow$ Bag contains all four are white

$A \rightarrow$ two white balls are drawn.

$$p(E_1)=\frac{1}{3},\ p(E_2)\frac{1}{3},\ p(E_3)=\frac{1}{3}$$

$$p\left(\frac{A}{E_1}\right)=\frac{{}^2C_2}{{}^4C_2}=\frac{1}{6}$$

$$p\left(\frac{A}{E_2}\right)=\frac{{}^3C_2}{{}^4C_2}=\frac{1}{2}$$

$$p\left(\frac{A}{E_3}\right)=\frac{{}^4C_2}{{}^4C_2}=1$$

Now, $$p\left(\frac{E_3}{A}\right)=\frac{p(E_3).p\left(\frac{A}{E_3}\right)}{p(E_1).p\left(\frac{A}{E_3}\right)+p(E_2).p\left(\frac{A}{E_2}\right)+p(E_3)p\left(\frac{A}{E_3}\right)}$$

$$=\frac{\frac{1}{3}x1}{\frac{1}{3}.\frac{1}{6}+\frac{1}{3}.\frac{1}{2}+\frac{1}{3}.1}$$

$$=\frac{1}{\frac{1}{6}+\frac{1}{2}+1}=\frac{6}{1+3+6}=\frac{6}{10}=\frac{3}{5}$$

Q.90 Ans.: (2) $\frac{1}{6}$

Explanation: Req. prob. = $p(1^{st}\text{ faulty})xp(2^{nd}\text{ being faulty when }1^{st}\text{ is faulty}).$

$$=\frac{2}{4}x\frac{1}{3}$$

$$=\frac{1}{6}$$