PHYSICS

SECTION-A

1.

**Answer: (b)**

**Solution:**

Spring forces does not change instantaneously thus for $m_1$ ; $a_1 = a_0$

For $m_2$ $F_{S_P} = m_2 a_2$ ....... (i) instantaneously after $F_2$ is withdrawn

Initially $F_{S_P} - F_2 - m_2 a_0 = 0$ $F_{S_P} \rightarrow$

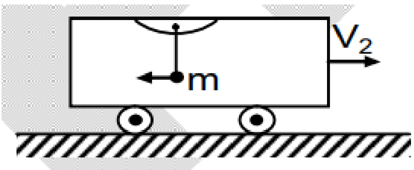
$\text{Fsp} = F_2 + m_2 a_0 - \text{(ii)From (i)and (ii)} a_2 = \frac{F_2}{m_2} + a_0$

2.

**Answer: (a)**

**Solution:**

$WD = \Delta K$




$$mgl = \frac{1}{2}\frac{m.6m}{m+6m}(V_1 + V_2)^2 - 0$$

$$\therefore V_1 + V_2 = \sqrt{\frac{7}{3}gl}$$

3.

**Answer: (a)**

**Solution:**

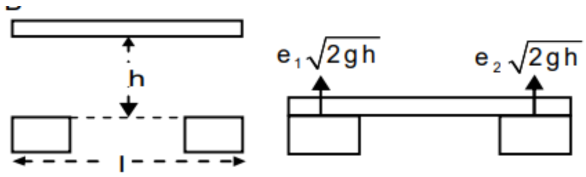
$$\tan 30^\circ \frac{eV \sin 60^\circ}{\tan 60^\circ}$$

$$e = \frac{\tan 30^\circ}{\tan 60^\circ} = \tan^2 30^\circ$$

**4.**

**Answer: (b)**

**Solution:**




$$V_{cm} = \frac{e_1 + e_2}{2}\sqrt{2gh}$$

$$h_{max} = \frac{(V_{cm})^2}{2g} = \frac{(e_1 + e_2)^2 h}{4}$$

**5.**

**Answer: (b)**

**Solution:**

$$\therefore \sin^3 \omega t = \frac{1}{4}(\sin \omega t - \sin 3\omega t)$$

**6.**

**Answer: (b)**

**Solution:**

Initial length (circumference) of the ring $= 2\pi r$

Final length (circumference) of the ring $= 2\pi R$

Change in length $= 2\pi R - 2\pi r$

$$\text{Strain} = \frac{\text{Change in length}}{\text{Original length}} = \frac{2\pi(R - r)}{2\pi r} = \frac{R - r}{r}$$

Now Young's modulus, $E = \frac{F/A}{l/L} = \frac{F/A}{(R-r)}$

$$\therefore F = AE\left(\frac{R - r}{r}\right)$$

**7.**

**Answer: (a)**

**Solution:**

$$V_0 = V_{ball} = \sqrt{2gR}$$

$$\int T.dt = -\frac{m}{2}(V - V_0) \quad \text{... (i)}$$

$$\int T.dt.R = \frac{1}{2}M.R^2.\frac{V}{R} \quad \text{... (ii)}$$

$$-\frac{M}{2}(V - V_0) = \frac{M}{2}V$$

$$2V = V_0 \Rightarrow V = \frac{V_0}{2} = \frac{\sqrt{2gR}}{2} = \sqrt{\frac{gR}{2}}$$

$$\omega = \frac{V}{R} = \sqrt{\frac{g}{2R}}$$

8.

**Answer: (d)**

**Solution:**

In the ideal case that we normally consider each collision transfers twice the magnitude of its normal momentum. On the face EFGH, it transfers only half of that.

9.

**Answer: (a)**

**Solution:**

Slope of $V - T$ graph is $\frac{dV}{dT} = \frac{nR}{P}$

10.

**Answer: (c)**

**Solution:**

Electric field is directed in the direction of fall of potential $\left[E = -\frac{dV}{dr}\right]$

11.

**Answer: (c)**

**Solution:**

$$E = \rho \frac{i}{A}$$

$$E = \frac{kr^2}{R} \frac{1}{\pi r^2}$$

$$E = \frac{ki}{\pi R}$$

**12.**

**Answer: (d)**

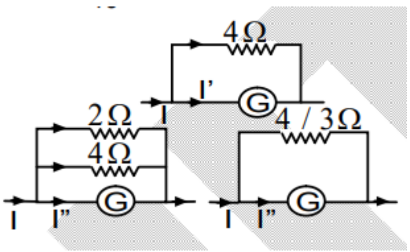
**Solution:**

$$l' = \frac{4}{4+G} l \Rightarrow \frac{4}{4+G} = \frac{1}{5} \text{ (given)where } G = 16\Omega$$

$$l" = \frac{4/3}{\frac{4}{3}+16}$$

$$l = \frac{1}{13}\ l$$

$$\Rightarrow l" = \frac{0.65}{13} = 0.05$$




**13.**

**Answer: (c)**

**Solution:**

Work done to form a bubble of radius R

$W_1 = 8\pi R^2 T_1$

Work done to form a bubble of radius 2R

$W_2 = 8\pi\ (2R)^2\ T_2 = 32\ \pi R^2 T_2 \qquad \therefore \frac{W_1}{W_2} = \frac{T_1}{4T_2}$

If surface tension of soap solution is same, then $W_2 = 4W_1$

But in the problem the temperature of solution is increased. So its surface tension decreases

$\therefore W_2 < 4W_1$

14.

**Answer: (c)**

**Solution:**

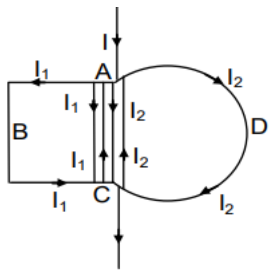
Least count in B is highest of all the measurements hence accuracy is least.

15.

**Answer: (b)**

**Solution:**

Introducing two equal and opposite current $l_1$ and $l_2$ between A & C




Force on ABCA closed loop zero

Force on ADCA closed loop zero

Force on Extra $l_1$ & $l_2$

$F = (l_1 + l_2)\, lB = 1\ell B$

16.

**Answer: (b)**

**Solution:**

Phase difference for current in inductor and capacitor is 180°

$i = i_L \sim i_C$

17.

**Answer: (b)**

**Solution:**

In conditions spectrum of X − ray the minimum wave length is given by $\lambda_{min} = \frac{hc}{eV}$ and the characteristic X − ray $\lambda \alpha \frac{1}{(Z-1)^2}$

18.

**Answer: (a)**

**Solution:**

$\lambda$longest$\Rightarrow E_{min}$

For Balmer $\lambda$ longest is for $n = 2 \to 3$

$\Rightarrow \lambda$ longest Balmer$>\lambda$ longest Lyman

19.

**Answer: (b)**

**Solution:**

For positive half cycle the junction diode is forward biased.

20.

**Answer: (c)**

**Solution:**

Flux coming out of the cube

$$\phi_1 = \frac{\lambda.a\sqrt{3}}{\varepsilon_0} \quad \ldots (i)$$

and from sphere

$$\phi_2 = \frac{\lambda.2a}{\varepsilon_0} \quad \ldots (ii)$$

**SECTION-B**

21.

**Answer: (274)**

**Solution:**

$VS = 4, MS = 2.7$

$= MS + VS \times LC$

$= 2.7 + 0.04 = 2.74$

**22.**

**Answer: (25)**

**Solution:**

Suppose in equilibrium wire PQ lies at a distance r above the wire AB Hence in equilibrium

$mg = Bil \Rightarrow mg = \frac{\mu_0}{4\pi}\left(\frac{2i}{r}\right) \times il$

$$\Rightarrow 10^{-3} \times 10 = 10^{-7} \times \frac{2 \times (50)^2}{r} = 0.5 \Rightarrow r = 25 \text{ mm}$$

**23.**

**Answer: (30)**

**Solution:**

The area of the $a - t$ graph gives the change in the velocity of the body. The body will acquire the maximum speed till this acceleration that is the maximum velocity will be at $t = 8$ sec

$$\therefore V_{max} = \left(\frac{8+4}{2}\right) \times 5 = 30$$

**24.**

**Answer: (75)**

**Solution:**

For normal incidence on second surface $r_2 = 0$

$\therefore r_1 = A$ and

$$\therefore \mu = \frac{\sin i}{\sin r}$$

For small angle $\mu = \frac{i}{r} = \frac{\theta}{A} \Rightarrow 1.5 = \frac{\theta}{5}\frac{n!}{r!9n-r)!}$

**25.**

**Answer: (14)**

**Solution:**

$\phi = 2eV$

$$\frac{hc}{\lambda_1} = 8eV \quad T_2 = 2T_1$$

If $l_1$ is the wavelength corresponding to maximum intensity at $T_1$ & $T_2$ at $T_2$; Then $\lambda_2 = \lambda_1 / 2$

(by Wein's displacement Law)

$$\frac{hc}{\lambda_2} = \frac{2hc}{\lambda_1} = 16\ \text{eV}$$

$$\phi = 2\text{eV} \ \therefore \text{K.E.}_{\text{max}} = \frac{hc}{\lambda} - \phi = 14\text{eV}$$

**26.**

**Answer: (10)**

**Solution:**

$$\text{Q} - \text{Value} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

**27.**

**Answer: (13)**

**Solution:**

$$i_L = \frac{50}{10 \times 10^3} = 5\text{mA}$$

$$i = \frac{140 - 50}{5 \times 10^3} = 18\text{mA}$$

$$\therefore i_Z = i - i_L = 13\text{mA}$$

**28.**

**Answer: (1200)**

**Solution:**

$$RT = 200V + 1$$

$$\Delta U = \left(\frac{R}{\gamma - 1}\right)(T_f - T_i) = 1\frac{R}{\frac{4}{3} - 1}(T_f - T_i)$$

$$= 3R\,(T_f - T_i) = 3 \times 200(V_f - V_i)$$

$$= 1200\text{J}$$

**29.**

**Answer: (1)**

**Solution:**

$\text{Thrust} = \rho a. v^2$

$= \rho a. 2gh = 10^3 \times 10^{-3} \times 2 \times 10 \times 50 \times 10^{-3}$

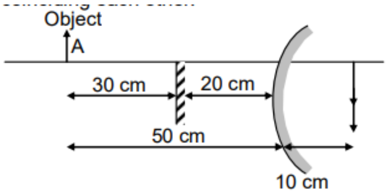
$= 1N$

**30.**

**Answer: (25)**

**Solution:**

Since there is no parallex, it means that both images (By plane mirror and convex mirror) coinciding each other.




According to property of plane mirror it will form image at a distance of 30 cm behind it. Hence for convex mirror $u = -50\text{ cm}, v = +10\text{ cm}$

By using $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{+10} + \frac{1}{-50} = \frac{4}{50}$

$\Rightarrow f = \frac{25}{2}\text{cm} \Rightarrow R = 2f = 25\text{cm}$

CHEMISTRY

SECTION-A

31.

Answer: (c)

Solution:

$$\lambda = \frac{h}{\sqrt{2mqV}}; q = 2 \times 1.06 \times 10^{-19} c$$

$V = V$ volts

$m = 4 \text{ amu} = 4 \times 1.67 \times 10^{-27} \text{kg}$

$$\left[\lambda = \frac{0.101}{\sqrt{v}} \text{A}^{\circ}\right]$$

32.

Answer: (d)

Solution:

Let aqueous V.P. be p mm of Hg

| Initial conditions | NTP conditions |
|---|---|
| $P_1(\text{dry gas}) = (750 - p)\text{mm}$ | $P_2 = 760 \text{ mm}$ |
| $V_1 + 100 \text{ mL}$ | $V_2 = 91.9 \text{ mL}$ |
| $T_1 = 15 + 273 = 288 \text{ K}$ | $T_1 = 273 \text{ K}$ |

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}, \frac{(750 - p)}{288} \times 100 = \frac{760 \times 91.9}{273}$$

$(750 - p) = 736.8$

$P = 13.2 \text{ mm}$

33.

Answer: (d)

Solution:

$$K_p = K_c(RT)^{\Delta n}; K_c = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$$

**34.**

**Answer: (a)**

**Solution:**

$CN^-$ is strong field ligand Greater the number of $CN^-$, more will be the strength of ligands more will be the value of $\Delta_o$ (crystal field splitting energy).

**35.**

**Answer: (d)**

**Solution:**

Decomposition of $N_2O$ on hot platinum is zero order reaction so unit rate constant

$= \text{mol L}^{-1}\text{Time}^{-1}$.

Acidic hydrolysis of ester is first order reaction, so unit of rate constant $= \text{Time}^{-1}$.

Alkaline hydrolysis of ester is second order reaction, so unit of rate constant

$= \text{mol}^{-1}\text{ L Time}^{-1}$.

Reduction of $FeCl_3$ by $SnCl_2$, is third order reaction, so unit of rate constant

$= \text{mol}^{-2}\text{ L}^2\text{Time}^{-1}$.

**36.**

**Answer: (d)**

**Solution:**

As in $X_3(YZ_4)_2$ the sum of all oxidation number is zero $+6 + 10 - 16 = 0$

**37.**

**Answer: (c)**

**Solution:**

The jump in I.P values is noticed during successive removal of electron when valence shell changes. As in 4 and 5 IP Values the difference is maximum so it is carbon.

38.

**Answer: (a)**

**Solution:**

(A) Increasing order of magnetic moment will be $d^1, d^3, d^4, d^5$. So this one is not correct

(B) as the oxidation state of metal increases acidic strength increases so this one is correctly matched

(C) Mn have highest oxidation state of +7

39.

**Answer: (c)**

**Solution:**

$$2K_2(HgI_4) + NH_4OH + 3NaOH \rightarrow \underset{\text{Nesseler'sreagent}}{I - Hg - O - Hg - NH_2} + 4KI + 3NaI + 3H_2O$$

40.

**Answer: (b)**

**Solution:**

The number of molecules with energy greater that the activation energy at $T_2$ is given by $Q + R$.

Total number of molecules is $P + Q$. The required fraction is $\frac{Q+R}{P+Q}$

41.

**Answer: (c)**

**Solution:**

Amidines (I) are most basic due equal resonating structure after protonation, amides are lest basic as lone pair on N atom are in conjugation with carbonyl group.

Secondary amines are more basic than primary amines.

42.

**Answer: (c)**

**Solution:**

$$R_f = \frac{\text{Distance travelled by substance}}{\text{Distance travelled by eluent}}$$

**For A:**

$$0.75 = \frac{\text{Distance travelled by substance A}}{8}$$

Distance travelled by substance A $= 6$ cm

**For B:**

$$0.50 = \frac{\text{Distance travelled by substance B}}{8}$$

Distance travelled by substance B $= 4$ cm

Difference in the height of A and B $= 6 - 4 = 2$ cm

**43.**

**Answer: (a)**

**Solution:**

Due to more stable carbocation

(I) $CH_3 - \overset{CH_3}{\underset{\underset{\oplus}{C}}{|}} - CH_3$

(II) $CH_3\overset{\oplus}{C}HCH_3$

(III) $CH_3\overset{\oplus}{C}H_2$

**44.**

**Answer: (d)**

**Solution:**

1 and 3 are same.

**45.**

**Answer: (b)**

**Solution:**

The tertiary alkyl halide undergoes elimination reaction to give alkenes

$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-X+NaOC_2H_5 \rightarrow \underset{\text{2−methyl propene}}{CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2}$$

46.

**Answer: (b)**

**Solution:**

HCl is not affected by peroxides so major product formed by E.A.R.

$$CH_3-CH=CH_2 \xrightarrow[\text{(Peroxode)}]{\text{HCl}} CH_3-\overset{+}{C}H-CH_3 \xrightarrow{Cl^{\ominus}} CH_3-\underset{\underset{Cl}{|}}{C}H-CH_3$$

47.

**Answer: (d)**

**Solution:**

$$Pl=\frac{pK_a\text{ of acidic group}+pK_a\text{ of basic group}}{2}=\frac{y+(14-x)}{2}$$

48.

**Answer: (d)**

**Solution:**

$Hg^{2+}+2e^-\rightarrow Hg \qquad \Delta G_1^{\circ}=-2F(0.85)$

$Hg+4I^-\rightarrow HgI_4^{2-}+2e^- \qquad \Delta G_2^{\circ}=-2F(0.05)$

So

$Hg+4I^-\rightarrow HgI_4^{2-}+2e^- \qquad \Delta G^{\circ}=-2F(0.90)$

$$0.90=\frac{0.06}{2}\log K_f$$

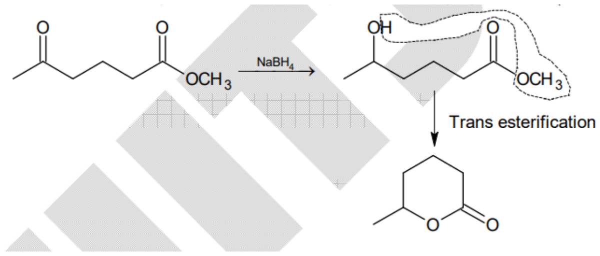
$K_f=1.0\times10^{30}$

49.

**Answer: (c)**

**Solution:**

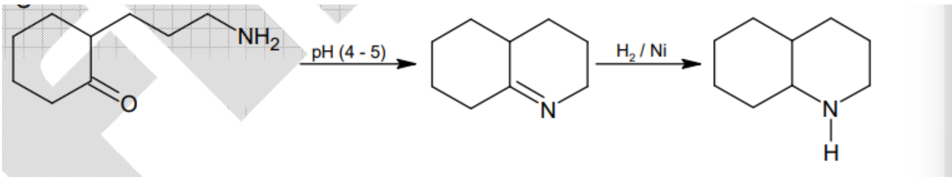
Reduction of ester group is not affected by weak reducing agent $NaBH_4$




**50.**

**Answer: (c)**

**Solution:**




**SECTION-B**

**51.**

**Answer: (2)**

**Solution:**

mole of HCl $= \frac{1}{100} \times 10^{-3} = 10^{-5}$mole

conc of HCl $= 10^{-5}$M

so pH $= 5$

change in pH $= 7 - 5 = 2$

**52.**

**Answer: (328)**

**Solution:**

Applying Hess's Law

$$\Delta_f H^{\circ} = \Delta_{sub}H + \frac{1}{2}\Delta_{diss}H + \text{I.E.} + \text{E.A} + \Delta_{lattice}H$$

$-617\ 161 + 520 + 77 + \text{E.(A)} + (-1047)$

$\text{E.(A)} = -167 + 289 = -328\ \text{kJ mol}^{-1}$

∴ electron affinity of fluorine

$= -328 \text{ kJ mol}^{-1}$

53.

**Answer: (9)**

**Solution:**

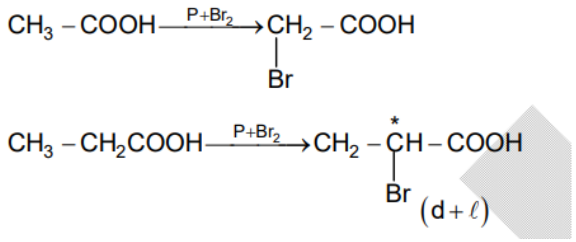
$$\text{pI} = \left(\frac{pK_{a_2} + pK_{a_3}}{2}\right) = \frac{8.0 + 10.0}{2} = 9.0$$

54.

**Answer: (3)**

**Solution:**

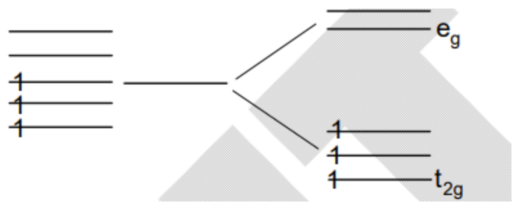
Formic acid and benzoic acid do not contain a H atoms so they cannot give HVZ reaction




55.

**Answer: (3)**

**Solution:**




$Cr^{3+}, 3d^3 n = 3$

56.

**Answer: (12)**

**Solution:**

II, III, IV, V, VII, VIII, IX, X, XI, XIII, XIV, XVI can show geometrical isomerism.

**57.**

**Answer: (550)**

**Solution:**

$\lambda^{\circ}(Ba(OH)_2) = \lambda^{\circ}(BaCl_2) + 2\lambda^{\circ}(NaOh) - 2\lambda^{\circ}(NaCl)$

$\lambda^{\circ}(Ba(OH)_2) = 300 + 2(250) - 2(125)$

$\lambda^{\circ}(Ba(OH)_2) = 300 + 500 - 250$

$\lambda^{\circ}(Ba(OH)_2) = 550 \text{ mho cm}^2\text{mol}^{-1}$

**58.**

**Answer: (12)**

**Solution:**

$$V_1 = \frac{2 \times 0.0821 \times 300}{8.21} = 6.0L$$

$$V_2 = \frac{2 \times 0.0821 \times 300}{2.73} = 18.0L$$

$W_{irr,isothermal} = -P_{ext} \times \Delta V = -1(18 - 6)$

$= -12 \text{ it} - \text{atm}$

**59.**

**Answer: (3)**

**Solution:**

Milli. moles of NaOH $= 30 \times 0.2 = 6$ m. m

m. m of $CH_3COOH = 50 \times 0.2 = 10$ m. m

Now:

$CH_3COOH + NaOh \rightarrow CH_3COONa + N_2O$

| | | |
|---|---|---|
| 10 | 6 | 0 |
| $10 - 6 = 0$ | $6 - 6 = 0$ | 6 |

$$pH = -\log(2 \times 10^{-5}) + \log\frac{6}{4} = 4.87$$

Suppose ‘v’ mL of NaOH is added then

$$\text{m.m of } CH_3COONa = (6 + v \times 0.2)$$

$$\text{m.m of } CH_3COOH = (4 - v \times 0.2)$$

$$5 = -\log(2 \times 10^{-5}) + \log\left(\frac{6 + 0.2v}{4 - 0.2v}\right)$$

$$0.3010 = \log\left(\frac{6 + 0.2v}{4 - 0.2v}\right)$$

So $\left(\frac{6+0.2v}{4-0.2v}\right) = 2 \Rightarrow v = 3.33\text{mL} = \frac{10}{3}\text{mL}$ So

$x = 3$

**60.**

**Answer: (1)**

**Solution:**

$$Na + O_2 \rightarrow Na_2O, Na_2O + \frac{1}{2}O_2 \rightarrow Na_2O_2$$

It exists as $2Na^+$ and $O_2^{2-}$ So oxidation state of O is $-1$.

**MATHEMATICS**

**SECTION-A**

**61.**

**Answer: (C)**

**Solution:**

$$y = \tan^{-1}\left(\frac{5x - x}{1 + 5x(x)}\right) + \tan^{-1}\left(\frac{x + \frac{2}{3}}{1 - \frac{2x}{3}}\right) = (\tan^{-1} 5x - \tan^{-1} x) + \left(\tan^{-1} x + \tan^{-1}\frac{2}{3}\right)$$

$$y' = \frac{5}{1 + 25x^2}$$

$\therefore a = 5$

**62.**

**Answer: (a)**

**Solution:**

$$\lim_{n\to\infty}\sum_{k=0}^{n}\frac{{}^{n}C_k}{n^k}\int_0^1\left[\lim_{n\to\infty}{}^{n}C_k\left(\frac{x}{n}\right)^k x^2\right]dx=\left[\lim_{n\to\infty}\left(1+\frac{x}{n}\right)^k x^2\right]dx$$

$$=\int_0^1 e^x x^2 dx=\int_0^1 e^x(x^2+2x)dx-2\int_0^1 e^x(x+1)dx+2\int_0^1 e^x dx$$

$$=e^x(x^2-2x+2)_0^1=e-2$$

**63.**

**Answer: (b)**

**Solution:**

(A) False because if $g(x)$ is $\sin(2\pi x)$.

(B) Take logarithm on both sides and differentiate once to get the expression.

(C) Obviously, false.

(D) Statement is correct for $f|x|$ but not for $f(x)$

**64.**

**Answer: (a)**

**Solution:**

Using limit of substitution, Put $\frac{x^n}{e^x}=t$.

Now, as $x\to\infty, \frac{x^n}{e^x}\to 0$

So, $\lim_{t\to 0}\frac{2^t-3^t}{t}$

**65.**

**Answer: (b)**

**Solution:**

$(f(x)-1)^2(f(x)-x^3)=0$

$\therefore f(x)=x^3$

$f'(x)=3x^2$

66.

**Answer: (c)**

**Solution:**

$$l = \int \frac{3(\tan x - 1)\sec^2 x}{(\tan x + 1)\sqrt{\tan^3 x + \tan^2 x + \tan x}} dx = 3\int \frac{(t-1)}{(t-1)\sqrt{t^3 + t^2 + t}} dt$$

$$= 3\int \frac{\left(1 - \frac{1}{t^2}\right)}{\left(t + \frac{1}{t} + 2\right)\sqrt{t + \frac{1}{t} + 1}} dt \text{ Let } t + \frac{1}{t} + 1z^2 \Rightarrow \left(1 - \frac{1}{t^2}\right) dt = 2zdz$$

67.

**Answer: (d)**

**Solution:**

$$\int \left(\frac{y+1}{y}\right) dy = \int e^x (\sin 2x - \cos^2 x) dx$$

$$\Rightarrow y + \ln y = -e^x \cos^2 x + c$$

68.

**Answer: (a)**

**Solution:**

$$y = f(x) = \begin{cases} 0 & \text{if } x < 0 \\ 2x^2 & \text{if } x \geq 0 \end{cases}$$

$\therefore$ f(x) is continuous and derivable

69.

**Answer: (b)**

**Solution:**

$$\cos 2\theta = \frac{1}{3} (\text{Given})$$

$$\therefore \frac{1 - \tan^2\theta}{1 + \tan^2\theta} = \frac{1}{3} \Rightarrow 3 - 3\tan^2\theta = 1 + \tan^2\theta$$

$\Rightarrow 4\tan^2\theta = 2 \text{ or } \tan^2\theta = \frac{1}{2} \Rightarrow \tan^8\theta = \frac{1}{16}$

$\Rightarrow 2\cos 2\alpha - 3\cos\alpha = 32 \cdot \left(\frac{1}{16}\right) = 2$

**70.**

**Answer: (b)**

**Solution:**

The difference of radius is equal to diameter of circle. Radius of given circle

$\Rightarrow (x + 1)^2 + (y + 2)^2 - 9$, is 3

$\therefore$ Difference $= 6$

**71.**

**Answer: (c)**

**Solution:**

$A = (2\alpha + 1, 3\alpha + 2, 4\alpha + 3)$

$B = (\beta + 2, 2\beta - 1, 3\beta - 2)$

$$\therefore \underset{(1)}{\frac{2\alpha - \beta - 1}{2}} = \underset{(2)}{\frac{3\alpha - 2\beta + 3}{1}} = \underset{(3)}{\frac{4\alpha - 3\beta + 5}{1}}$$

Solving (1) and (2) $\Rightarrow$ $4\alpha - 3\beta + 7 = 0$

Solving (2) and (3) $\Rightarrow$ $\alpha - \beta + 2 = 0$

$\alpha = -1, \beta = 1, A(-1, -1, -1); B(3, 1, 1)$

$AB = 2\sqrt{6}$

**72.**

**Answer: (a)**

**Solution:**

$2\vec{a} - 3\vec{b} + 6\vec{c} = \vec{0} \Rightarrow 2\vec{a} - 3\vec{b} = -6\vec{c} \Rightarrow \left|2\vec{a} - 3\vec{b}\right|^2 = 36|\vec{c}|^2$

$4a^2 + 9b^2 - 12\vec{a}.\vec{b} = 36c^2$

$$4a^2 + 9b^2 - 12.ab\cos\theta = 36c^2$$

$$16b^2 + 9b^2 - 12.2b^2\cos\theta = 36\frac{1}{4}b^2$$

$$25 - 24\cos\theta = 9 \Rightarrow \cos\theta = \frac{2}{3}$$

**73.**

**Answer: (a)**

**Solution:**

Use Polar coordinates.

**74.**

**Answer: (c)**

**Solution:**

Use basic concepts.

**75.**

**Answer: (d)**

**Solution:**

Hence required number of ways $\frac{{}^{n-6}C_4 \cdot n}{5} = 36$

Which is satisfied by n=12

**76.**

**Answer: (c)**

**Solution:**

Let $(1 + 3x + 2x^2)^6 = \sum_{k=0}^{12} a_k x^k$ ……. (i)

$(1 + 3x + 2x^2)^6 = (1 + 2x)^6(1 + x)^6$

Coefficient of $x^{12} = {}^6C_6 2^2 . {}^6C_6 = 2^6 = a_{12}$

Coefficient of $x^{12} = ({}^6C_6 2^6 . {}^6C_5) + ({}^6C_6 2^5 . {}^6C_6)$

$= (6 \times 2^6) + (6 \times 2^5) = 9 \times 2^6$

Put $x = 1$ and $-1$ in equation (i) and adding, we get

$$(1+3+2)^6 + (1-3+2)^6 = (a_0 + a_1 + a_2 + \cdots + a_{12}) + a_0 - a_1 + a_2 - a_3 + \cdots + a_{12})$$

$$\Rightarrow a_0 + a_2 + \cdots + a_{12} = \frac{6^6}{2} \Rightarrow \frac{\sum_{k=0}^{6} a_{2k}}{a_{12}} = \frac{3^6}{2}$$

**77.**

**Answer: (b)**

**Solution:**

$$\sum \alpha = 0; \sum \alpha\beta = -p; \alpha\beta\gamma = -1$$

$$|A+B+C| = \begin{vmatrix} \alpha^3+\beta^3+\gamma^3+4 & 0 & 0 \\ 0 & \alpha^3+\beta^3+\gamma^3+4 & 0 \\ 0 & 0 & \alpha^3+\beta^3+\gamma^3+4 \end{vmatrix}$$

$$= (\alpha^3+\beta^3+\gamma^3+4)^3 = 1$$

$$\alpha + \beta + \gamma = 0$$

$$\therefore \sum \alpha^3 = 3\alpha\beta\gamma = -3$$

**78.**

**Answer: (a)**

**Solution:**

Given question becomes

$$= \det.A^1 \cdot \det.\left(\operatorname{adj}\left(\frac{\operatorname{adj} B}{|B|}\right)\right) \cdot \det.\left(\operatorname{adj}\left(\frac{\operatorname{adj} B}{|B|}\right)\right)$$

$$= \frac{1}{|A|}|\operatorname{adj}(\operatorname{adi}B)| \cdot |\operatorname{adj}(\operatorname{adi}B)|$$

$$= \frac{1}{|A|} \cdot |B|^4(1)|A|^4 = 8$$

**79.**

**Answer: (a)**

**Solution:**

Assuming $\arg z_1 = \theta$ and $\arg z_2 = \theta + \alpha$

$$\frac{az_1}{bz_2} + \frac{bz_2}{az_1} = \frac{a|z_1|e^{i\theta}}{b|z_2|e^{i(\theta+\alpha)}} + \frac{b|z_2|e^{i\theta}}{a|z_1|e^{i\theta}} = e^{i\alpha} + e^{i\alpha} = 2\cos\alpha$$

**80.**

**Answer: ()**

**Solution:**

Use basic concepts.

**SECTION-B**

**81.**

**Answer: (743)**

**Solution:**

$(EM)^T = 20\ L$

Take transpose on both sides

$EM = 20\ l$

$(E + M)^T = 17\ (E - M)^T$

$E^T + M^T = 17\ (E^T - M^T)$

$16E^T = 18M^T$

Take transpose on both sides

$16E = 18M$

$$\Rightarrow E^2 = \frac{9}{8} EM\ \&\ M^2 = \frac{8}{9}\ EM$$

$$\therefore E^2 + M^2 = \left(\frac{9}{8} + \frac{8}{9}\right) EM = \frac{145}{72}\ 20l = \frac{725}{18} l$$

**82.**

**Answer: (7)**

**Solution:**

$$\int_1^4 x\left(x - f^{-1}(x)\right)dx = \int_3^5 g(y)\,(5-y)g'(y)dy = \left((5-y)\,\frac{g^2(y)}{2}\right)_3^5 + \int_3^5 \frac{g^2(y)}{2}dy$$

$$-2\cdot\frac{g^2(3)}{2} + \frac{9}{2} = \frac{7}{2}$$

Hence $2\int_1^4 x\left(x - f^{-1}(x)\right)dx = 7$

**83.**

**Answer: (7)**

**Solution:**

$$S_k = \int_0^1 x^2\,(1-x)^k dx = \int_0^1 (1-x)^2\,dx \quad \left(\text{use} = \int_a^b f(x)dx = \int_a^b f(a+b-x)dx\right)$$

Hence $\sum_{k=1}^{\infty}\int_0^1 x^2\,(1-x)^k dx = \int_0^1 (1-x)^2\ \underbrace{\sum_{k=1}^{\infty} x^k dx}_{\text{infinite G.P}}$

$$= \int_0^1 (1-x)^2\left(\frac{x}{1-x}\right)dx = \int_0^1 (x-x)^2\,dx = \frac{1}{2} - \frac{1}{3} = \frac{1}{6} \Rightarrow p+q = 7$$

**84.**

**Answer: (108)**

**Solution:**

$\vec{l} = x\,\vec{m} + y\,\vec{n} + z\,\vec{k}$

$\Rightarrow 1 = \frac{-1}{11}(x+y+z)$ $\quad$ (dot product with $\vec{l}$)

$x + y + z = -11$ $\quad$ ... (i)

$\frac{-1}{11} = x - \frac{1}{11}(y+z)$ $\quad$ (dot product with $\vec{m}$

$1 + 11m = y + z$ $\quad$ ... (2)

$\Rightarrow x = -1 \quad \Rightarrow y(\vec{n}\cdot\vec{k})z$ $\quad$ (dot product with $\vec{n}$ and $\vec{k}$)

$\Rightarrow y = z \Rightarrow \vec{l} + \vec{m} = y(\vec{n} + \vec{k})$

$$\Rightarrow 2 - \frac{2}{11} = 25\left(2 + 2\vec{n} \cdot \vec{k}\right) \Rightarrow 2 + 2\vec{n} \cdot \vec{k} = \frac{4}{55}$$

$$\Rightarrow \vec{n} \cdot \vec{k} = \frac{-53}{55}$$

85.

**Answer: (10)**

**Solution:**

Use basic concepts.

86.

**Answer: (4)**

**Solution:**

$$\lim_{x \to 0} \frac{\ln((\cos x)^a)}{x^b} = \lim_{x \to 0} \frac{a \ln(\cos x)}{x^b}$$

Now applying L' Hospital rule

$$\lim_{x \to 0} \frac{-a \tan x}{bx^{b-1}} = \lim_{x \to 0} \frac{\tan x}{x} \cdot \frac{-a}{b} \frac{1}{x^{b-2}} = \lim_{x \to 0} \frac{-a}{b} \frac{1}{x^{b-2}}$$

Now for limit to be finite

$b - 2 = 0\{0, -1, -2, -3, -4, \ldots.\}$

$b = \{2, 1, 0, -1, -2, -3, \ldots \ldots\}$

But b can only be $b = \{2, 1]$ as it is an outcome of a dice.

Now probability is

$$P = \frac{\text{No. of ways to select}'a'}{\text{Total no. of ways to select}'a'} \cdot \frac{\text{No. ofwaystose lect}'b'}{\text{Total no. of ways to select}'b'}$$

$$P = \frac{6}{2} \cdot \frac{2}{3} = \frac{1}{3} \Rightarrow p + q = 1 + 3 = 4$$

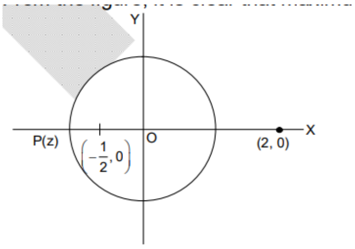
87.

**Answer: (36)**

**Solution:**

Locus of z is $x^2 + y^2 = 1$

From the figure, it is clear that maximum value of




$$2\left(|z_1 - 2| + \left|z_2 + \frac{1}{2}\right|\right) = 2 \times \frac{9}{2} = \lambda$$

$\therefore\ 4\lambda = 36l$

**88.**

**Answer: (19)**

**Solution:**

$f(1) = 5, f(2) = 8, f'(1) = 3$ and $f''(1) = 0$

$f(x) = (x-1)^3(x-2) + 3x + 2$

$f(3) = 8 + 9 + 2 = 19$

**89.**

**Answer: (3)**

**Solution:**

$$P(A) = ({}^nC_1 + {}^nC_2 + {}^nC_3 + \cdots + {}^nC_{n-1})\left(\frac{1}{2}\right)^n = \frac{2^n - 2}{2^n}$$

$$P(B) = P(0 \text{ girl or girl}) = ({}^nC_0 + {}^nC_1)\left(\frac{1}{2}\right)^n = \frac{n+1}{2^n}$$

$$P(A \cap B) = P(\text{exactly one girl}) = {}^nC_1 \times \left(\frac{1}{2}\right)^n$$

Now, $(P \cap B) = P(A)P(B)$

$$\frac{n}{2^n} = \frac{2^n - 2}{2^n}\left(\frac{n+1}{2^n}\right) \Rightarrow n = \frac{(2^n - 2)(n+1)}{2^n}$$

**90.**

**Answer: (0)**

**Solution:**

Since point of minima is negative therefore point of maxima is also negative. Hence, both roots $f'(x)$ must be negative and distinct. Sum of the roots $< 0$ and $D > 0$

Their intersection is$\phi$, hence no values of a.