Jai Mahakali Shikshan Sanstha's

AGNIHOTRI COLLEGE OF ENGINEERING (NAGTHANA)

Nagthana Road, Near Bypass Highway, Sindi (Meghe), Wardha (Maharashtra) 442001

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DETAILED SOLUTION OF MOCK-CET TEST PAPER - 01

(As Per MHT-CET Exam)

(Dated on 20/05/2020)

Q. 1]The frequencies for series limit of Balmer and Paschen series respectively are '$\nu 1$' and '$\nu 3$'. If frequency of first line of Balmer series is '$\nu 2$' then the relation between '$\nu 1$', '$\nu 2$', and '$\nu 3$' is

(A) $\nu 1 - \nu 2 = \nu 3$

(B)$\nu 1 + \nu 3 = \nu 2$

(C)$\nu 1 + \nu 2 = \nu 3$

(D)$\nu 1 - \nu 3 = 2\nu 1$

Sol^n:(A)

$$V = n\lambda,\ \frac{1}{\lambda} = \frac{n}{v}$$

$$\frac{1}{\lambda} = R\left(\frac{1}{P^2} - \frac{1}{n^2}\right)$$

$$\nu = Rc\left(\frac{1}{P^2} - \frac{1}{n^2}\right) \quad \text{series limit } n = \infty$$

$$\nu_2 = Rc\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = Rc\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$\nu_1 = Rc\left(\frac{1}{2^2}\right) = \frac{Rc}{4}$$

$$\nu_3 = Rc\left(\frac{1}{3^2}\right) = \frac{Rc}{9}$$

$$\therefore \quad \nu_1 - \nu_3 = Rc\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$\therefore \quad \nu_1 - \nu_3 = \nu_2$$

$$\therefore \quad \nu_1 - \nu_2 = \nu_3$$

Q. 2]When three capacitors of equal capacities are connected in parallel and one of the same capacity is connected in series with its combination. The resultant capacity is 3.75 μF. The capcity of each capacitor is

(A)5 μF

(B)6 μF

(C)7 μF

(D)8 μF

Sol^n:(A)

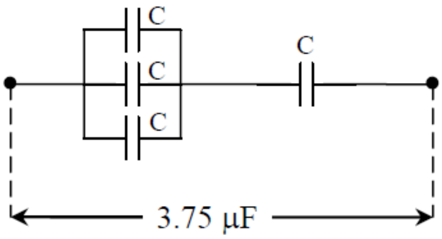
$$C_{eq} = \frac{3C \times C}{3C + C}$$

$$C_{eq} = \frac{3C^2}{4C}$$

$$C_{eq} = \frac{3C}{4}$$

$$\therefore \quad C = \frac{4C_{eq}}{3} = \frac{4 \times 3.75}{3}$$

$$\therefore \quad C = 4 \times 1.25 = 5.00\ \mu F$$



Q. 3]Sensitivity of moving coil galvanometer is 's'. If a shunt of $\left(\frac{1}{8}\right)^{th}$ of the resistance of galvanometer is connected to moving coil galvanometer, its sensitivity becomes

(A)$\frac{s}{3}$

(B)$\frac{s}{6}$

(C)$\frac{s}{9}$

(D)$\frac{s}{12}$

Sol^n:(C)

$$S = \frac{G}{8}, S = \frac{G}{n-1}$$

$$\frac{G}{8} = \frac{G}{n-1}$$

$$\therefore \quad 8 = n - 1$$

$$\therefore \quad n = 8 + 1 = 9$$

Since range of galvanometer in increased nine times its sensitivity reduces to $\frac{1}{9}$.

$$\therefore \quad S' = \frac{s}{9}$$

Q. 4]Two unknown resistances are connected in two gaps of a meter-bridge. The null point is obtained at 40 cm from left end. A 30 Ω resistance is connected in series with the smaller of the two resistances, the null point shifts by 20 cm to the right end. The value of smaller resistance in Ω is

(A)12

(B)24

(C)36

(D)48

Sol^{n}:(B)

$\ell_x = 40$ cm, $\ell_R = 60$ cm

$$\frac{x}{R} = \frac{\ell_x}{\ell_R} = \frac{40}{60} = \frac{2}{3} \qquad \dots (1)$$

$$\therefore \quad \frac{x+30}{R} = \frac{60}{40} = \frac{3}{2}$$

$$\therefore \quad \frac{x+30}{R} = \frac{3}{2}$$

$$\therefore \quad 2(X+30) \Rightarrow 3R$$

$$R = \frac{2(x+30)}{3} \qquad \dots (2)$$

From (1) & (2),

$$\frac{X}{2\frac{(x+30)}{3}} = \frac{2}{3}$$

$$\frac{3x}{2(x+30)} = \frac{2}{3}$$

$$9x = 4x + 120$$

$$5x = 120 \Rightarrow x = 24\ \Omega$$

Q. 5] InFraunhofer diffraction pattern, slit width is 0.2 mm and screen is at 2 m away from the lens. If wavelength of light used is 5000 Å then the distance between the first minimum on either side of the central maximum is (θ is small and measured in radian)

(A) $10^{-1}\ m$

(B) $10^{-2}\ m$

(C) $2 \times 10^{-2}\ m$

(D) $2 \times 10^{-1}\ m$

Sol^{n}: (B)

$a = 0.2 \times 10^{-3}$m, D = 2m

$\lambda = 5 \times 10^{-7}$ m

$$x = \frac{\lambda D}{a} = \frac{5 \times 10^{-7} \times 2}{0.2 \times 10^{-3}}$$

$$\therefore \quad x = \frac{5 \times 10^{-7}}{10^{-4}} = 5 \times 10^{-7+4}\ \text{m}$$

$$\therefore \quad x = 5 \times 10^{-3}\ \text{m}$$

Distance between 1st minima on either side

$$= 5 \times 10^{-3} + 5 \times 10^{-3}$$

$$= 10 \times 10^{-3} = 10^{-2}\ \text{m}$$

Q. 6]In series LCR circuit R = 18 Ω and impedance is 33 Ω. An r.m.s. voltage 220 V is applied across the circuit. The true power consumed in a.c. circuit is

(A)220 W

(B)400 W

(C)600 W

(D) 800 W

Sol^n:(D)

$$P = e_{rms}.i_{rms}.\cos\phi$$
$$= e_{rms}.\frac{e_{rms}}{z}.\frac{R}{z}$$
$$= \frac{220\times220\times18}{33\times33}$$
$$= \frac{20\times20\times18}{3\times3}$$
$$= 20\times20\times2$$
$$= 800\text{ W}$$

Q. 7]Two parallel plate air capacitors of same capacity 'C' are connected in series to a battery of emf 'E'. Then one of the capacitors is completely filled with dielectric material of constant 'K'. The change in the effective capacity of the series combination is

(A) $\frac{C}{2}\left[\frac{k-1}{k+1}\right]$

(A) $\frac{2}{C}\left[\frac{k-1}{k+1}\right]$

(A) $\frac{C}{2}\left[\frac{k+1}{k-1}\right]$

(A) $\frac{C}{2}\left[\frac{k-1}{k+1}\right]^2$

Sol^n:(A)

$$\frac{1}{C_1}=\frac{1}{C}+\frac{1}{C}=\frac{2}{C}\Rightarrow C_1=\frac{C}{2}$$
$$\frac{1}{C_2}=\frac{1}{C}+\frac{1}{KC}$$
$$\frac{1}{C_2}=\frac{1}{C}\left[1+\frac{1}{K}\right]$$
$$\therefore\ C_2=\frac{C}{\left(1+\frac{1}{K}\right)}=\frac{CK}{(K+1)}$$
$$\Delta C=\frac{CK}{(K+1)}-\frac{C}{2}=C\left[\frac{K}{K+1}-\frac{1}{2}\right]$$
$$=C\left[\frac{2K-K-1}{2(K+1)}\right]=\frac{C}{2}\left[\frac{K-1}{K+1}\right]$$

Q. 8]The polarising angle for transparent medium is 'θ', 'v' is the speed of light in that medium. Then the relation between 'θ' and 'v' is (c = velocity of light in air)

(A) $\theta = \tan^{-1}\left(\frac{v}{c}\right)$

(B) $\theta = \cot^{-1}\left(\frac{v}{c}\right)$

(C) $\theta = \sin^{-1}\left(\frac{v}{c}\right)$

(D) $\theta = \cos^{-1}\left(\frac{v}{c}\right)$

Sol^n:(B)

$$\tan\theta = \mu = \frac{C}{V}$$

$$\therefore \cot\theta = \frac{V}{C}$$

$$\therefore \theta = \cot^{-1}\left(\frac{V}{C}\right)$$

Q. 9]Two identical light waves having phase difference 'ϕ' propagate in same direction. When they superpose, the intensity of resultant wave is proportional to

(A) $\cos^2\emptyset$

(B) $\cos^2\frac{\emptyset}{2}$

(C) $\cos^2\frac{\emptyset}{3}$

(D) $\cos^2\frac{\emptyset}{4}$

Sol^n:(B)

For two identical light waves

$$I_R = 4I\cos^2\frac{\phi}{2}$$

$$\therefore I_R \propto \cos^2\frac{\phi}{2}$$

Q. 10]For a transistor, α_{dc} and β_{dc} are the current ratios, then the value of $\frac{\beta_{dc}-\alpha_{dc}}{\alpha_{dc}\cdot\beta_{dc}}$ is

(A) 1
(B) 1.5
(C) 2
(D) 2.5

Sol^n:(A)

$$\beta_{dc} = \frac{\alpha_{dc}}{1-\alpha_{dc}} \Rightarrow (1-\alpha_{dc}) = \frac{\alpha_{dc}}{\beta_{dc}}$$

$$\frac{\beta_{dc}-\alpha_{dc}}{\alpha_{dc}\cdot\beta_{dc}} = \frac{\beta_{dc}\left(1-\frac{\alpha_{dc}}{\beta_{dc}}\right)}{\alpha_{dc}\cdot\beta_{dc}}$$

$$= \frac{1-\frac{\alpha_{dc}}{\beta_{dc}}}{\alpha_{dc}} = \frac{1-(1-\alpha_{dc})}{\alpha_{dc}}$$

$$= \frac{1-1+\alpha_{dc}}{\alpha_{dc}} = 1$$

Q. 11] A radioactive element has rate of disintegration 10,000 disintegrations per minute at a particular instant. After four minutes it becomes 2500 disintegrations per minute. The decay constant per minute is

(A) $0.2\log_e^{2}$

(B) $0.5\log_e^{2}$

(C) $0.6\log_e^{2}$

(D) $0.8\log_e^{2}$

Sol^n:(B)

$$\frac{N}{N_0} = e^{-\lambda t}$$

$$\therefore \quad \frac{2500}{10000} = e^{-\lambda\times 4}$$

$$\therefore \quad \frac{1}{4} = e^{-4\lambda}$$

$$\therefore \quad e^{4\lambda} = 4$$

$$\therefore \quad 4\lambda = \log_e 4$$

$$\therefore \quad 4\lambda = \log_e 2^2$$

$$\therefore \quad 4\lambda = 2\log_e 2$$

$$\therefore \quad \lambda = \frac{2}{4}\log_e 2$$

$$\therefore \quad \lambda = 0.5\ \log_e 2$$

Q. 12] When the same monochromatic ray of light travels through glass slab and through water, the number of waves in glass slab of thickness 6 cm is same as in water column of height 7 cm. If refractive index of glass is 1.5 then refractive index of water is

(A) 1.258

(B) 1.269

(C) 1.286

(D) 1.310

Sol^n:(C)

No. of waves is glass slab = No. of waves in water column

$\therefore \quad \mu_g . h_g = \mu_w . h_w$

$$\therefore \quad \mu_w = \frac{\mu_g . h_g}{h_w} = \frac{1.5 \times 6}{7}$$

$$\therefore \quad \mu_w = \frac{9}{7} = 1.286$$

Q. 13] If the electron in hydrogen atom jumps from second Bohr orbit to ground state and difference between energies of the two states is radiated in the form of photons. If the work function of the material is 4.2 eV then stopping potential is

[Energy of electron in n^{th} orbit = $\frac{-13.6}{n^2} eV$]

(A) 2eV

(B) 4eV

(C) 6eV

(D) 8eV

Sol^n:(C)

$$E = \frac{13.6}{1} - \frac{13.6}{2^2}$$

$$E = 13.6 \left[\frac{4-1}{4}\right] = 13.6 \times \frac{3}{4}$$

$\therefore \quad E = 10.2 \text{ eV } (= h\nu)$

i.e. $h\nu = 10.2$ eV

$h\nu = \phi_0 + eV_s$

$\therefore \quad 10.2 \text{ eV} = 4.2 \text{ eV} + eV_s$

$\therefore \quad 6 \text{ eV} = eV_s$

$\therefore \quad V_s = 6V$

Q. 14] The magnetic moment of electron due to orbital motion is proportional to (n = principal quantum numbers)

(A) $\frac{1}{n^2}$

(B) $\frac{1}{n}$

(C) n^2

(D) n

Sol^n:(D)

Magnetic moment $(M_0) = \dfrac{e}{2m_0} \times L_0$

$\therefore \quad L_0 \propto n$

$\therefore \quad M_0 \propto n$

Q. 15]Photodiode is a device

(A) which is always operated in reverse bias

(B) which is always operated in forward bias

(C) in which photo current is independent of intersity of incident radiation

(D) which may be operated in forward or reverse bias

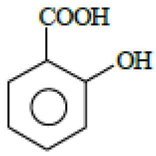
Sol^n:(A) Photodiode is a device always operated in reverse bias

MHT-CET

Subject : Chemistry Paper Set 1 (Solution)

Q.1 The acid which contains both –OH and –COOH groups is
(A) phthalic acid (B) adipic acid (C) glutaric acid (D) salicylic acid

Sol. (D)



Salicylic acid

Q.2 Identify the compound in which phosphorus exists in the oxidation state of +1.
(A) Phosphonic acid (H_3PO_3) (B) Phosphinic acid (H_3PO_2)
(C) Pyrophosphorus acid ($H_4P_2O_5$) (D) Orthophosphoric acid (H_3PO_4)

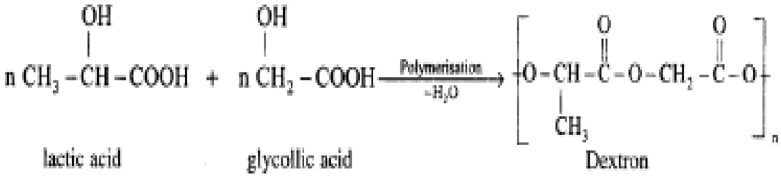
Sol. (B)
Factual

Q.3 Identify the weakest oxidising agent among the following.
(A) Li^+ (B) Na^+ (C) Cd^{2+} (D) I_2

Sol. (A)
It is strongest reducing agent.

Q.4 The monomers used in preparation of dextron are
(A) lactic acid and glycollic acid
(B) 3–Hydroxy butanoic acid and 3–Hydroxy pentanoic acid
(C) styrene and 1, 3–Butadiene
(D) hexamethylenediamine and adipic acid

Sol. (A)



Q.5 Which among the following compounds does not act as a reducing agent?
(A) H_2O (B) H_2S (C) H_2Se (D) H_2Te

Sol.. (A) Except H_2O, all hydrides of group 16 acts as reducing agent.

Q.6 Which of the following processes in **NOT** used to preserve the food?
(A) Irradiation (B) Addition of salts (C) Addition of heat (D) Hydration

Sol. (D)
Factual

Q.7 In case of substituted aniline the group which decreases the basic strength is
(A) $-OCH_3$ (B) $-CH_3$ (C) $-NH_2$ (D) $-C_6H_5$

Sol. (D)
$-C_6H_5$ is electron withdrawing group.

Q.8 (+) 2–Methylbutan–1–ol and (–) 2–Methylbutan–1–ol have different values for which property?
(A) Boiling point (B) Relative density (C) Refractive index (D) Specific rotation

Sol. (D)
Enantiomers of each other.

Q.9 Which among the following is **NOT** a mineral of iron?
(A) Haematite (B) Magnesite (C) Magnetite (D) Siderite

Sol. (B)
Magnesite – $MgCO_3$
It is a mineral of Magnesium.

Q.10 Nitration of which among the following compounds yields cyclonite?
(A) Formaldehyde (B) Benzaldehyde (C) Urotropine (D) Acetaldehyde ammonia

Sol. (C)
Factual
Urotropine when nitrated gives high explosive cyclonite.

Q.11 Which element among the following does form $P\pi$–$P\pi$ multiple bonds?
(A) Arsenic (B) Nitrogen (C) Phosphorus (D) Antimony

Sol. (B)
$N \equiv N$ N(7) –1s2 2s2 2p3

Q.12 Which of the following statements is incorrect in case of Hofmann bromamide degradation?

(A) Reaction is useful for decreasing length of carbon chain by one carbon atom
(B) It gives tertiary amine
(C) It gives primary amine
(D) Aqueous or alcoholic KOH is used with bromine

Sol. (B) It is used to obtain primary amine

Q.13 Which of the following statements is incorrect for pair of elements Zr – Hf?

(A) Both possess same number of valence electrons
(B) Both have identical atomic sizes
(C) Both have almost identical ionic radii
(D) Both of these belong to same period of periodic table

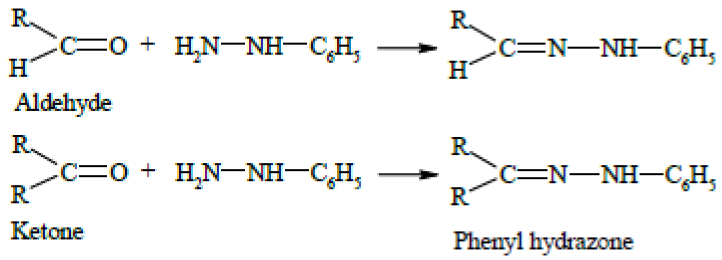
Sol. (D)

Zr–Hf are chemical twins and are present in period 5th and 6th respectively.

Q.14 Aldehydes or ketones when treated with $C_6H_5–NH–NH_2$, the product formed is

(A) semicarbazone (B) phenylhydrazone (C) hydrazone (D) oxime

Sol. (B)



Q.15 Solubility of which among the following solids in water changes slightly with temperature?

(A) KNO_3 (B) $NaNO_3$ (C) KBr (D) NaBr

Sol. (D Factual

MHT-CET Solution (Set - I)

Subject- Mathematics

1. The maximum value of $f(x) = \frac{\log x}{x}$ $(x \neq 0, x \neq 1)$ *is*

Ans - B

$$f(x) = \frac{\log x}{x}$$

$$f'(x) = \frac{x.\frac{1}{x} - \log x}{x^2} = \frac{1 - \log x}{x^2}$$

$$f'(x) = 0 \Rightarrow \frac{1 - \log x}{x^2} = 0$$

$$\log x = 1$$

$$x = e$$

$$\text{max. value } f(e) = \frac{\log e}{e} = \frac{1}{e}$$

2. $\int_0^1 x \tan^{-1} x \, dx =$

Ans - B

$$\underset{\text{(uv rule)}}{\int_0^1 x \tan^{-1} x dx} = \left[\tan^{-1} x \int x \, dx\right]_0^1 - \int_0^1 \left(\frac{d}{dx} \tan^{-1} x \int x \, dx\right) dx$$

$$= \left(\tan^{-1} x \cdot \frac{x^2}{2}\right)_0^1 - \int_0^1 \frac{1}{1+x^2} \cdot \frac{x^2}{2} dx$$

$$= \left(\frac{\pi}{4} \cdot \frac{1}{2} - 0\right) - \frac{1}{2}\int_0^1 \frac{1+x^2-1}{1+x^2} dx$$

$$= \frac{\pi}{8} - \frac{1}{2}\int_0^1 \left(1 - \frac{1}{1+x^2}\right) dx$$

$$= \frac{\pi}{8} - \frac{1}{2}\left[x - \tan^{-1} x\right]_0^1$$

$$= \frac{\pi}{8} - \frac{1}{2}\left[(1-0) - \left(\frac{\pi}{4} - 0\right)\right] = \frac{\pi}{8} - \frac{1}{2} + \frac{\pi}{8} = \frac{\pi}{4} - \frac{1}{2}$$

3. If lines represented by equation $px^2 - qy^2 = 0$ are distinct then

$pq > 0$ $\quad$ $pq < 0$ $\quad$ $pq = 0$ $\quad$ $p + q = 0$

The statement pattern $(\sim p \wedge q)$ is logically equivalent to

Ans – A

$px^2 - qy^2 = 0$

$a = p, b = -q, h = 0$

lines are real and distinct is $h^2 - ab > 0$

$\Rightarrow 0 + pq > 0$

$pq > 0$

4. The statement pattern $(\sim p \wedge q)$ is logically equivalent to

Ans – B

$(\sim p \wedge q)$ is logically equivalent to

$$
\begin{aligned}
A \rightarrow (p \vee q) \vee \sim p &= T \vee q = T \\
B \rightarrow (p \vee q) \wedge \sim p &= (p \wedge \sim p) \vee (q \wedge \sim p) && \ldots \text{ Distributive law} \\
&= F \vee (q \wedge \sim p) && \ldots \text{ Complementary law} \\
&= q \wedge \sim p && \ldots \text{ Identify law} \\
&= \sim p \wedge q && \ldots \text{ Commutative law}
\end{aligned}
$$

5. The inverse of matrix $\begin{bmatrix} 1 & 0 & 0 \\ 3 & 3 & 0 \\ 5 & 2 & -1 \end{bmatrix}$ is

Ans – B

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 3 & 0 \\ 5 & 2 & -1 \end{bmatrix} \qquad |A| = -3$$

$$A^{-1} = \frac{1}{|A|} \text{Adj } A$$

$$= \frac{1}{-3} \begin{bmatrix} -3 & 0 & 0 \\ 3 & -1 & 0 \\ -9 & -2 & 3 \end{bmatrix}$$

6. For a invertible matrix A if A (adj A)= $\begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$, then |A|=

Ans – C

$$A\ (\text{adj } A) = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix} = 10 \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = 10\ I$$

we know that $A\ (\text{adj } A) = |A|\ I$

a. $\Rightarrow\ |A| = 10$

7. The equation of line equally inclined to co-ordinate axes and passing through (-3, 2, -5) is

Ans – B

Equation of line passing through (x_1, y_1, z_1) and having d.c.s. ℓ, m, n is

$$\frac{x - x_1}{\ell} = \frac{y - y_1}{m} = \frac{z - z_1}{n}$$

Here $(x_1, y_1, z_1) \equiv (-3, 2, -5)$

Also line is equally inclined to co-ordinate axes.

$\therefore\ \ell = -1, m = 1, n = -1$

$\therefore$ Equation of line is $\dfrac{x + 3}{-1} = \dfrac{y - 2}{1} = \dfrac{z + 5}{-1}$

8. If $\int_0^{\pi/2} \log \cos x \, dx = \frac{\pi}{2} log\left(\frac{1}{2}\right)$, then $\int_0^{\pi/2} \log \sec x \, dx =$

Ans – D

$$\int_0^{\pi/2} \log \sec x dx = \int_0^{\pi/2} \log\left(\frac{1}{\cos x}\right)dx$$
$$= -\int_0^{\pi/2} \log(\cos x)dx$$
$$= -\frac{\pi}{2}\log(1/2) \quad \left(\log\left(\frac{1}{a}\right) = -\log a\right) \qquad = \frac{\pi}{2}\log 2$$

9. A boy tosses fair coin 3 times. If he gets Rs.2X for X heads then his expected gain equals to Rs…….

Ans – C

For x heads, he gets y = 2x

x	0	1	2	3
y	0	2	4	6
p(y)	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$

Expected gain = $\Sigma y_i p_i$

$$= 0\left(\frac{1}{8}\right) + 2\left(\frac{3}{8}\right) + 4\left(\frac{3}{8}\right) + 6\left(\frac{1}{8}\right) = \frac{6+12+6}{8} = 3$$

10. If the origin and the points P(2,3,4) , Q(1,2,3) and R(x, y, z) are co-planer then

Ans – C

O, P, Q, R are co–planar

$$\left[\overline{OR} \quad \overline{OP} \quad \overline{OQ}\right] = 0$$

$$\begin{vmatrix} x & y & z \\ 2 & 3 & 4 \\ 1 & 2 & 3 \end{vmatrix} = 0$$

$x(9-8) - y(6-4) + z(4-3) = 0$

$x - 2y + z = 0$

Alternative

Points P, Q satisfy equations given in option.

11. If vector $\bar{r}$ with d.c.s. l,m,n is equally inclined to the co-ordinate axes, then the total number of such vectors is

Ans – C

$$\overline{r} = |\overline{r}|\left(\pm\frac{1}{\sqrt{3}}\hat{i}\pm\frac{1}{\sqrt{3}}\hat{j}\pm\frac{1}{\sqrt{3}}\hat{k}\right)$$

For equally inclined to co–ordinate axes.

$$\alpha = \beta = \gamma$$
$$\ell = m = n$$
$$\ell^2 + m^2 + n^2 = 1$$
$$3\ell^2 = 1$$
$$\ell^2 = \frac{1}{3}$$

$$\ell = \pm\frac{1}{\sqrt{3}} = m = n \Rightarrow \ell\text{, m, n each has 2 choices.}$$

$$\therefore \quad \text{total lines} = 2^3$$

12. If $\int \frac{1}{(x^2+4)(x^2+9)}dx = A\tan^{-1}\frac{x}{2} + B\tan^{-1}\left(\frac{x}{3}\right) + C$ then $A - B =$

Ans – A

$$\frac{1}{AB} = \frac{1}{B-A}\left(\frac{1}{A}-\frac{1}{B}\right)$$
$$\int\frac{1}{(x^2+4)(x^2+9)}dx = \int\frac{1}{5}\left(\frac{1}{x^2+4}-\frac{1}{x^2+9}\right)dx$$
$$= \frac{1}{5}\left[\frac{1}{2}\tan^{-1}\frac{x}{2}-\frac{1}{3}\tan^{-1}\frac{x}{3}\right]+C$$
$$A = \frac{1}{10} \qquad B = -\frac{1}{15}$$
$$A - B = \frac{1}{10}+\frac{1}{15}=\frac{5}{30}=\frac{1}{6}$$

13. The solution of differential equation $\frac{dy}{dx} = \tan\left(\frac{y}{x}\right) + \frac{y}{x}$ is

Ans – B

$$\frac{dy}{dx} = \tan\left(\frac{y}{x}\right)+\left(\frac{y}{x}\right)$$

$$\frac{y}{x} = v$$
$$y = vx$$
$$\frac{dy}{dx} = v + x\frac{dv}{dx}$$

$\therefore$ the given equation becomes

$$v + x\frac{dv}{dx} = \tan v + v$$
$$\frac{1}{\tan v}dv = \frac{1}{x}dx$$
$$\int \cot v\, dv = \int \frac{1}{x}dx$$
$$\log|\sin v| = \log x + \log c$$
$$= \log(xc)$$
$$\sin v = xc$$
$$\sin\left(\frac{y}{x}\right) = xc$$

14. The number of principal solutions of $\tan 2\theta = 1$ is

Ans – B

$\tan 2\theta = 1$ (+ive)
1^{st} and 3^{rd} quadrant

15. If slopes of lines represented by $Kx^2 + 5xy + y^2 = 0$ differ by 1 then $K =$.

Ans – B

$kx^2 + 5xy + y^2 = 0$
$m_1 + m_2 = -5$, $m_1m_2 = k$, $m_1 - m_2 = 1$
$(m_1 - m_2)^2 = (m_1 + m_2)^2 - 4m_1m_2 \Rightarrow 1 = 25 - 4k \Rightarrow k = 6$