AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST TARGET - JEE - TEST - 25 R & B
SOLUTION Date 17-11-2019

[PHYSICS]

1. For dc, $R = \frac{V}{i} = \frac{100}{1} = 100\ \Omega$

For ac, $Z = \frac{V}{i} = \frac{100}{0.5} = 200\ \Omega$

$\because\ Z = \sqrt{R^2 + (\omega L)^2}$

$\Rightarrow\ 200 = \sqrt{(100)^2 + 4\pi^2(50)^2 L^2}$

$\therefore\ L = 0.55\ H$

2. This is because, when frequency ν is increased, the capacitive reactance $X_C = \frac{1}{2\pi\nu C}$ decreases and hence the current through the bulb increases

3. Current remains unchanged in R. However, it beccomes half in L, because reactance is doubled on doubling the frequency

4. The current of 1.6 A lags emf in phase by $\pi/2$. The current of 0.4 A leads emf in phase by $\pi/2$. So, these two currents are 180° out of phase with each other.

$\therefore$ Net current, $I_1 = (1.6 - 0.4)\ \text{A} = 1.2\ \text{A}$

$1.6 = \frac{E_v}{X_L}$ and $0.4 = \frac{E_v}{X_C}$

$\Rightarrow\ \frac{X_C}{X_L} = 4 \Rightarrow \frac{1}{\omega C \omega L} = 4$

$\Rightarrow\ \omega = \frac{1}{2\sqrt{LC}}$

$\Rightarrow\ f = \frac{\omega}{2\pi} = \frac{1}{4\pi\sqrt{LC}}$

5. If an ac source $E = E_0 \sin\omega t$ is applied across an inductance and capacitance in parallel, the current in inductance will lag the applied voltage while that across the capacitor will lead, and so,

$$I_L = \frac{E_0}{X_L}\sin\left(\omega t - \frac{\pi}{2}\right) = -0.8\sqrt{2}\cos\omega t$$

$$I_C = \frac{V}{X_C}\sin\left(\omega t + \frac{\pi}{2}\right) = 0.6\sqrt{2}\cos\omega t$$

So the current drawn from the source

$$I = I_L + I_C = -0.2\sqrt{2}\ \cos\ \omega t$$

$$I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{0.2\sqrt{2}}{\sqrt{2}} = 0.2\text{ A}$$

6. As resistance of the lamp

$$R = \frac{V_S^2}{P_0} = \frac{100^2}{50} = 200\ \Omega$$

The rms current $I = \frac{V}{R} = \frac{100}{200} = \frac{1}{2}$ A.

So when the lamp is put in series with a capacitance and run at 200 V ac, from $V = IZ$, we have

$$Z = \frac{V}{I} = \frac{200}{(1/2)} = 400\ \Omega$$

Now as in case of C–R circuit,

$$Z = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}$$

i.e., $R^2 + \left(\frac{1}{\omega C}\right)^2 = 160000$

or $\left(\frac{1}{\omega C}\right)^2 = 16\times10^4 - (200)^2 = 12\times10^4$

$$\frac{1}{\omega C} = \sqrt{12}\times10^2$$

$$C = \frac{1}{100\pi\times\sqrt{12}\times10^2}\text{ F}$$

$$= \frac{100}{\pi\sqrt{12}}\ \mu\text{F} = \frac{50}{\sqrt{3}} = 9.2\ \mu\text{F}$$

7. $$\cos\phi = \frac{R}{\sqrt{R^2 + \left(\frac{1}{\omega C} - \omega L\right)^2}}$$

Putting the values, $C = 500\ \mu$F

8. $X_L = X_C$ at resonance

$$\frac{X_L}{X_C} = 1 \text{ for both circuits.}$$

Impedance may be different if applied voltage is different.

9. Since $\cos\phi = \frac{R}{Z} = \frac{IR}{IZ} = \frac{8}{10} = \frac{4}{5}$

(Also cos ϕ can never be greater than 1)

Hence, (c) is wrong.

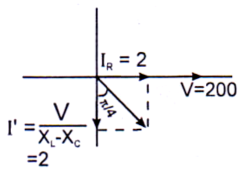
Also $IX_C > IX_L \Rightarrow X_C > X_L$

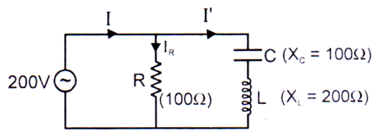
$\therefore$ Current will be leading.

In an *LCR* circuit,

$$V = \sqrt{(v_L - v_C)^2 + v_R^2} = \sqrt{(6-12)^2 + 8^2}$$

$V = 10$; which is less than voltage drop across capacitor.

10. 



$$I_R = \frac{V}{R} = \frac{200}{100} = 2A \quad I' = \frac{V}{X_L - X_C} = \frac{200}{100} = 2A$$

$$I = \sqrt{I_R^2 + I'^2} = 2\sqrt{2}Amp$$

11. The circuit will have inductive nature if

$$\omega > \frac{1}{\sqrt{LC}}\left(\omega L > \frac{1}{\omega C}\right)$$

Hence A is false. Also if circuit has inductive nature the current will lage behind voltage. Hence D is also false.

If $\omega = \frac{1}{\sqrt{LC}}\left(\omega L = \frac{1}{\omega C}\right)$ the circuit will have resistance nature. Hence B is false.

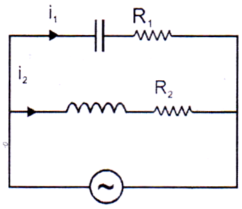
Power factor $\cos\phi = \frac{R}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)}} = 1$ it $\omega L = \frac{1}{\omega C}$. Hence C is true.

12. (i) $V = \frac{V_0}{T/4}t \qquad V = \frac{4V_0}{T}t$

$$\Rightarrow V_{rms} = \sqrt{< V^2 >} = \frac{4V_0}{T}\sqrt{< t >} = \frac{4V_0}{T}\left\{\frac{\int_0^{T/4} t^2 dt}{\int_0^{T/4} dt}\right\}^{1/2} = \frac{V_0}{\sqrt{3}}$$

13. $i_{1_{rms}} = \frac{E_{rms}}{\sqrt{X_C^2 + R_1^2}} = \frac{130}{13} = 10A$

$i_{2_{rms}} = \frac{E_{rms}}{\sqrt{X_L^2 + R_2^2}} = 13A$



Power dissipated = $i_{1rms}^2 R_1 + i_{2rms}^2 R_2 = 10^2 \times 5 + 13^2 \times 6$
= power delivered by battery
$= 1500 + 169 \times 6$
= 1514 watt

14. Resultant voltage = 200 volt
Since V_1 and V_3 are out of phase 180º, the resultant voltage is equal to V_2
$\therefore \quad V_2 = 200$ vlolt

15. The equivalent primary load is

$$R_1 = \left(\frac{N_1}{N_2}\right)^2 R_2 = \left(\frac{20}{1}\right)^1 (6.0) = 2400\Omega$$

Current in the primary coil

$$= \frac{240}{R_1} = \frac{240}{2400} = 0.1A$$

16. $X_C = \frac{1}{2\pi fC} = \frac{10^6}{2\pi 50 \times 500} = \frac{20}{11}\Omega$
$X_L = 2\pi fL = 2\pi \times 50 \times 10 \times 10^{-3} = p\Omega$
Since $X_L < X_C$, so inductive branch has less impendance, and so more current. Hence B_2 will be brighter.

17. Quality factor

$$= \frac{f_0}{f_2 - f_1} = \frac{600}{650 - 550} = \frac{600}{100} = 6$$

18. $E = E_0 \cos \omega t$
$\therefore \quad \omega = 50\,\pi$
$2\pi f = 50\,\pi \Rightarrow \quad f = 25$ Hz
In one cycle as current becomes zero twice.
Therefore, 50 times the current becomes zero in 1s.

19. here $R = X_L = X_C$
($\therefore$ voltage across them is same)
When capacitor is short circuited,

$$I = \frac{10}{(R^2 + X_L^2)^{1/2}} = \frac{10}{\sqrt{2}R}$$

$\therefore$ Potential drop across indeuctance = IX_L = IR = $10/\sqrt{2}V$

20. **(d) Gravitational force and magnetic force are equal in magnitude and opposite in direction.**

$$\Rightarrow \lambda Lg = \frac{\mu_0 I^2 L}{2\pi h} \Rightarrow h = \frac{\mu_0 I^2}{2\pi\lambda g}.$$

21. $|e| = N\left(\frac{\Delta B}{\Delta t}\right).A\cos\theta \;= 500 \times 1 \times (10 \times 10^{-2})^2 \cos 0 = 5V.$

22. Self inductance Where *n* is the number of turns per unit length and *N* is the total number of turns and $N = nl$
In the given question *n* is same. *A* is increased 4 times and *l* is increased 2 times and hence *L* will be increased 8 times.

23. In steady state current passing through solenoid

$$i = \frac{E}{R} = \frac{10}{10} = 1\,A$$

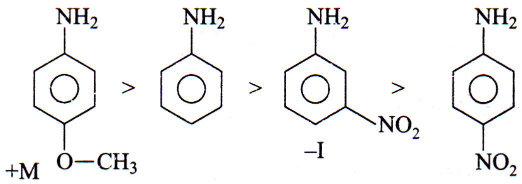
24. At resonance *LCR* series circuit behaves as pure resistive circuit. For resistive circuit $\phi = 0^o$

25. Transformers working with DC will have zero output.

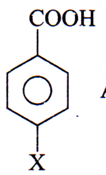
[CHEMISTRY]

26. EDG (+M increases stability)

27. EWG decreases basic strength
EDG increases basic strength



28.



Acidic strength $\propto \frac{1}{pK_a}$

EWG increases acidic strength

29. Due to –I effect and ortho effect.

30. Two Cl from same positions gives greater –I-effect than a single F from the same position hence.
$Cl_2CHCOOH$ is stronger acid than FCH_2COOH.

31. Ist structure is aromatic in all there examples and 2nd structure is not aromatic and resonance energy of aromatic compound is higher than non aromatic compound.

32. For resonance conjugation should be present as that conjugate site doesn't have π bond.

33. There are unpaired electrons, others have no unpaired electrons.

34. Rate of electrophilic substitution ∝ stability of arenium ion

35. A carboxylic acid is always stronger acid than phenol. However, between III and IV, III is more acidic as $-CH_3$ decreases acidic strength by +I effect. Between I and II, II is stronger acid as –Cl has net electron withdrawing effect.

36. I is least acidic due to the absence of any electron withdrawing group on ring. IV is most acidic due to the electron withdrawing resonance effect of $-NO_2$ from ortho-position, although intramolecular

H-bonding decreases acidic strength to some extent. III is less acidic than II due to the steric inhibition of resonance of $-NO_2$ by two adjacent methyl groups.

37. On the basis of stability of conjugate base due to electronic effects.

38. (c) In the present case, basicity parallels nucleophilicity. R_3C^- is the strongest base, hence strongest nucleophile. F^- is weakest base therefore weakest nucleophile. R_2N^- is stronger base and stronger nucleophile than RO^-.

39. As it doesn't obey Huckel's rule.

40. Mesomeric effect is applicable at ortho and para position

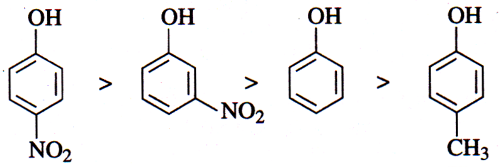
41. Vacant d orbital resonance

42. More stable carbocation due to delocalisation and hyperconjugation.

43. $-NO_2$ has greater electron withdrawing power than $-CN$ by resonance effect, hence IV is most stable followed by III. II is least stable as delocalisation of negative charge is opposed by electron donating resonance effect of methoxy group.

44. Carboxylic acids are stronger acid than $\overset{\oplus}{N}H_3$ in amino acid and $-\overset{\oplus}{N}H_3$ (Y). (Z) is more acidic than (Y) due to –I effect of (–COOH) group which is nearer to (Z) than (Y). Hence, the acidic order: X > Z > Y.

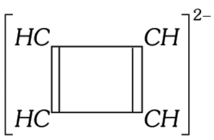
45. Any factor which stabilizes phenoxide ion makes the corresponding phenol more acidic.
$-NO_2$ is an electron-attracting group whereas $-CH_3$ is an electron-releasing group.
An electron-attracting substituent tends to disperse the negative charge of the phenoxide ion and thus, makes it more stable, which, in turn, increases the acid strength of phenol. The substituent in para position is more effective than in the meta-position, as the former involves a resonating structure bearing negative charge on the carbon attached to the electron-withdrawing substituent.
An electron-releasing substituent tends to intensify the negative charge of the phenoxide ion and thus makes it more unstable. which, in turn, decreases the acid strength of phenol. Hence, the order of acid strength is



(IV) (III) (I) (II)

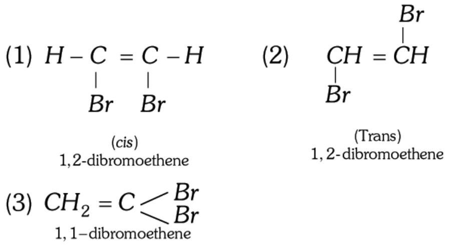
46. $CH_2 = CH_2$ both the carbon atoms are sp^2 hybridised.

47. Cyclobutadienyl anion $(C_4H_4)^{2-}$

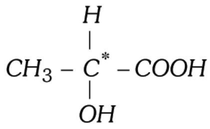


π electrons = 8.

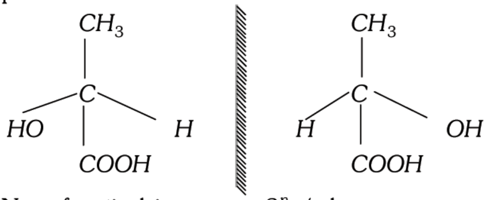
48. $C_2H_2Br_2$ has three isomers.



49.

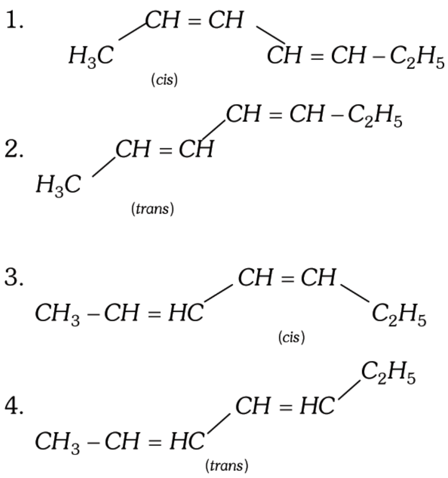


Only one chiral centre. Hence two optical isomers are possible.



No. of optical isomer $= 2^n$ (where n = no. of chiral carbon) $= 2^1 = 2$.

50. $\overset{1}{C}H_3-\overset{2}{C}H=\overset{3}{C}H-\overset{4}{C}H=\overset{5}{C}H-\overset{6,7}{C_2}H_5$



[MATHEMATICS]

51.

$\overline{AC} = \hat{i} + 2\hat{j} + 2\hat{k}$

So $\widehat{AC} = \dfrac{(\hat{i} + 2\hat{j} + 2\hat{k})}{3}$ and $\overline{AB} = 6\hat{i} - 2\hat{j} - 3\hat{k}$ so

$\Rightarrow \widehat{AB} = \dfrac{6i - 2\hat{j} - 3\hat{k}}{7}$

Vector along angle bisector = $\widehat{AC} + \widehat{AB}$

$= \dfrac{\hat{i} + 2\hat{j} + 2\hat{k}}{3} + \dfrac{6\hat{i} - 2\hat{j} - 3\hat{k}}{7} = \dfrac{25\hat{i} + 8\hat{j} + 5\hat{k}}{21}$

So D.R's of the bisector are <25, 8, 5>

52.

The point of intersection of $\dfrac{x-1}{2} = \dfrac{y-2}{3} = \dfrac{z-3}{4} = \lambda$

and $\dfrac{x-4}{5} = \dfrac{y-1}{2} = \dfrac{z}{1} = \mu$ will be given by $2\lambda + 1 = 5\mu + 4$,

$3\lambda + 2 = 2\mu + 1$, $4\lambda + 3 = \mu$

$\Rightarrow \lambda = \mu = -1$ and then point is $(-1, -1, -1)$

53.

D.R's of x-axis <1, 0, 0>; DR's of normal to plane are

<2, –3, 9>; $\sin\theta = \dfrac{2}{7} = \lambda$ (given)

$\Rightarrow \lambda = \dfrac{2}{7}$

54.

Mid point of (2, 3, 4) and (6, 7, 8) is (4, 5, 6) which satisfies $x + y + z - 15 = 0$

55.

Given $y(x + z) = 0$

So either $y = 0$ which is xz-plane or $x + z = 0$ which is a plane containing y-axis and inclined to x-axis at $-\pi/4$ and inclined to z-axis at $\pi/4$.But these planes are mutually perpendicular.

56.

The line $y = z = 0$ is x-axis which has D.R.'s <1, 0, 0>

Let the required plane which is parallel to x-axis be

P:$(\lambda + 2)x + (\lambda - 1)y + (\lambda + 3)z - (5\lambda + 1) = 0$

So the product of D.R.'s will be zero i.e., $\lambda + 2 = 0$ and the plane P will be P: $-3y + z + 9 = 0$ or $3y - z = 9$

57.

$A(a, 2, 3)$, $B(1, b, 2)$, $C(2, 1, c)$, $O(0, 0, 0)$

Given centroid at $G = (1,2,3) \equiv \left(\dfrac{a+3}{4}, \dfrac{b+3}{4}, \dfrac{c+5}{4}\right)$

$\Rightarrow a = 1, b = 5, c = 7$

Hence $a^2 + b^2 + c^2 = 75$

58.

Line segment joining (1, –1, 0) and (–1, 0, 1)

is $\vec{r} = -2\hat{i} + \hat{j} + \hat{k} \Rightarrow |\vec{r}| = \sqrt{6}$

The given plane is $2x + y + 6z - 1 = 0$

The required length is $d = \sqrt{|\vec{r}|^2 - (\vec{r}.\hat{n})^2}$

$= \sqrt{6 - \frac{9}{41}} = \sqrt{\frac{237}{41}}$

59.

D.R.'s of the line of intersection of $x + y + z = 0$ and

$2x + y + 4 = 0$ will be $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 1 \\ 2 & 1 & 0 \end{vmatrix} = -\hat{i} + 2\hat{j} - \hat{k}$

The required plane must be parallel to the vector obtained above. Also the sum of products of D.R's should vanish

This is fulfilled by $x - z + 4 = 0$

As (1) (1) + 0 (1) + (–1) (1) = 0

Also (–1)1 + 2 (0) + (–1) (–1) = 0

$\therefore$ $x - z + 4 = 0$ is the required plane

60.

A prism will be formed when all the three lines of intersection (by two planes taken each time) are parallel.

Now $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & -5 & 2 \\ 3 & -3 & \lambda \end{vmatrix} = (6 - 5\lambda)\hat{i} + (6 - 4\lambda)\hat{j} + 3\hat{k}$

$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 4 & -5 & 2 \\ 5 & -1 & -\lambda \end{vmatrix} = (5\lambda + 2)\hat{i} + (4\lambda + 10)\hat{j} + 21\hat{k}$

Comparing we get $\lambda = 1$ and D.R.'s = <1, 2, 3>

Using $\lambda = 1$ in the 3^{rd} combination for checking

$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -3 & 1 \\ 5 & -1 & -1 \end{vmatrix} = 4\hat{i} + 8\hat{j} + 12\hat{k} = 4(\hat{i} + 2\hat{j} + 3\hat{k})$ which is true

61.

$\begin{vmatrix} (1-x) & 1 & 1 \\ 1 & (1-y) & 1 \\ 1 & 1 & (1-z) \end{vmatrix} = 0$ gives

$(x - 1)(y - 1)(z - 1) = (x + y + z) - 1$

On simplification we get $xyz = xy + yz + zx$

$\Rightarrow \frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$

62.

Reflection of point (2, –1, 3) is given by

$$\frac{x-2}{3}=\frac{y+1}{-2}=\frac{z-3}{-1}=\frac{-2(6+2-3-9)}{9+4+1}$$

$$\Rightarrow \quad x=\frac{26}{7}, y=-\frac{15}{7}, z=\frac{17}{7}$$

63.

A general point on the line

$$L_1: \frac{x-1}{3}=\frac{y-2}{1}=\frac{z-3}{2}=\lambda \qquad \text{........(i)}$$

will be $(3\lambda + 1, \lambda + 2, 2\lambda + 3)$ and similarly on

$$L_2: \frac{x-3}{1}=\frac{y-1}{2}=\frac{x-2}{3}=\mu \qquad \text{..........(ii)}$$

will be $(\mu + 3, 2\mu + 1, 3\mu + 2)$

From (i) and (ii) we get $\lambda = \mu = 1$ and point of intersection is $P(4, 3, 5)$. The plane passing through $P(4, 3, 5)$ which is at maximum distance from origin will have normal along $\overrightarrow{OP}$ i.e., $\vec{n}=4\hat{i}+3\hat{j}+5\hat{k}$

Hence the plane will be $4(x-4)+3(y-3)+5(z-5)=0$

i.e., $4x + 3y + 5z = 50$

64.

Since yz-plane serves as a mirror

$\Rightarrow$ only angle with x-axis changes and it changes from α to $(180° - \alpha)$ so D.C's are $(-\cos\alpha, \cos\beta, \cos\gamma)$

65.

The normal to the plane has D.R.'s <1, 1, 1>

Hence the plane is $(x-a)+(y-a)+(z-a)=0$

i.e., $x + y + z = 3a$ as a result the intercepts on the co-ordinates axes are $3a$ each

$\Rightarrow$ Sum of reciprocals $=\frac{1}{3a}\times 3=\frac{1}{a}$

66.

The line is $L: \frac{x-11}{10}=\frac{y+2}{-4}=\frac{z+8}{-11}$ and the point $P(2,-1,5)$. Unit vector along the line L is $\widehat{AB}=\frac{10\hat{i}-4\hat{j}-11\hat{k}}{\sqrt{237}}$

and $\vec{r}=\overrightarrow{AP}=-9\hat{i}+\hat{j}+13\hat{k}$

so Length of perpendicular $=\sqrt{\vec{r}^2-(\vec{r}.\widehat{AB})^2}$

$=\sqrt{251-237}=\sqrt{14}$ units

Foot of perpendicular $B=(11\hat{i}-2\hat{j}-8\hat{k})+(\vec{r}.\widehat{AB})\widehat{AB}$

$=11\hat{i}-2\hat{j}-8\hat{k}+\frac{-237}{\sqrt{237}}.\left(\frac{10\hat{i}-4\hat{j}-11\hat{k}}{\sqrt{237}}\right)$

$=\hat{i}+2\hat{j}+3\hat{k}=(1,2,3)$

67.

A general point on the line from (1, –2, 3) with D.R.'s <2, 3 –6> is $(2d+1, 3d-2, -6d+3)$

This will lie on the plane $x - y + z - 5 = 0$

i.e., $2d+1-3d+2-6d+3-5=0$ gives $d=\frac{1}{7}$ units.

68.

The equation of xy-plane is $z = 0$. The points $P_1(a, b, c)$ and $P_2(-a, -c, -b)$. The required ratio is $\frac{-c}{(-b)} = c:b$

69.

Given $O(0,0,0); A(1,2,1); B(2,1,3); C(-1,1,2)$ $\overline{OA}\times\overline{OB}$ gives normal $\vec{n}_1$ to plane OAB

$$\therefore \quad \vec{n}_1 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 1 \\ 2 & 1 & 3 \end{vmatrix} = 5\hat{i} - \hat{j} - 3\hat{k}$$

70.

Let $P_1 = 2x + 5y + 3z = 0$

$P_2 = x - y + 4z = 2$

$P_3 = 7y - 5z = -4$

Observe that only P_1 passes through origin so these planes can not be at equal distance from origin.

$$\Delta = \begin{vmatrix} 2 & -5 & 3 \\ 1 & -1 & 4 \\ 0 & 7 & 5 \end{vmatrix}$$

$$= \Delta_x = \begin{vmatrix} 0 & 5 & 3 \\ 2 & -1 & 4 \\ -4 & 7 & -5 \end{vmatrix} = 0; \Delta_y = \begin{vmatrix} 2 & 0 & 3 \\ 1 & 2 & 4 \\ 0 & -4 & -5 \end{vmatrix} = 0$$

$$\Delta_z = \begin{vmatrix} 2 & 5 & 0 \\ 1 & -1 & 2 \\ 0 & 7 & -4 \end{vmatrix} = 0 \quad (\text{As } R_1 - 2R_2 = R_3)$$

$\therefore$ planes meet in a line

Aliter: $P_1 - 2P_2 = P_3$

$\because$ $(2x + 5y + 3z) + (-2)(x - y + 4z - 2) = (7y - 5z + 4)$

$\Rightarrow$ plane pan thugh a line

71.

Given $\vec{r}_1 = (1+2\lambda)\vec{a} + (\lambda - 2)\vec{b}$

$\vec{r}_2 = (2+\mu)\vec{a} + (2\mu - 1)\vec{b}$

Which shows that $\vec{r}_1 = \vec{r}_2$ for $\lambda = -\mu = \frac{1}{3}$

Then $\vec{r}_1 = \frac{5}{3}\vec{a} - \frac{5}{3}\vec{b} = \frac{5}{3}(\vec{a} - \vec{b}) = \frac{k}{3}(\vec{a} - \vec{b})$

Hence $k = 5$

72. since $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1 \Rightarrow \Sigma \sin^2\alpha = 3 - 1 = 2$

73. Find angle between the lines *PQ* and *RS*, we get that neither $PQ \,||\, RS$ nor $PQ \perp RS$. Also $PQ \neq RS$.

74. Planes are perpendicular, if $6 - 6 + 2k = 0 \Rightarrow k = 0$.

75. Required distance = $\left|\frac{6-18+8+11}{7}\right| = 1$