AVIRAL
JEE | NEET | FOUNDATIONS

FINAL TEST SERIES JEE -2020
TEST-06 ANSWER KEY
Test Date :30-12-2019

[PHYSICS]

1. $\frac{1}{2}mv^2 = eV_0 = 1.68\text{ eV}$

or $h\nu = \frac{hc}{\lambda} = \frac{1240\text{eVnm}}{400\text{nm}} = 3.1\text{eV}$

or $3.1\text{ eV} = W_0 + 1.68\text{ eV}$

$W_0 = 1.42\text{ eV}$

2. f = R/2 by formula

$u = f\left(1 - \frac{1}{m}\right) = 17.5\left(1 - \frac{1}{2.5}\right) = 10.5\text{cm}$

3. App. depth =

$\frac{h}{3\mu_1} + \frac{h}{3\mu_2} + \frac{h}{3\mu_3} = \frac{h}{3}\left(\frac{1}{\mu_1} + \frac{1}{\mu_2} + \frac{1}{\mu_3}\right)$

4. **A**

5. **C**

6. Distance between first and

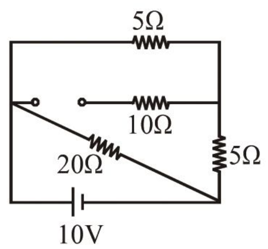
sixth minima = $\frac{5\lambda D}{a}$

$\Rightarrow \frac{5 \times 5 \times 10^{-7} \times 0.5}{a} = 0.5 \times 10^{-3}$

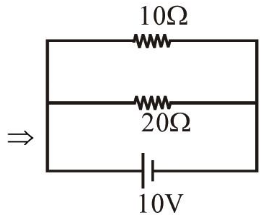
$\Rightarrow a = 2.5\text{ mm}$

7. **A**

8.

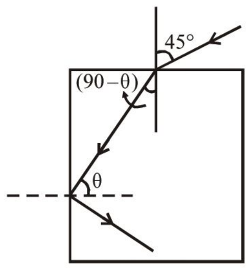


$\Rightarrow$



$i = \frac{10}{\text{Req}} = \frac{10}{20/3} = 1.5\text{A}$

9.



$1 \times \sin 45° = \mu \times \sin(90 - \theta)$

$\frac{1}{\sqrt{2}} = \mu \cos\theta \Rightarrow \cos\theta = \frac{1}{\sqrt{2}\mu}$

$\sin\theta \geq \frac{1}{\mu}$

$\Rightarrow \sqrt{1-\cos^2\theta} \geq \frac{1}{\mu}$

$\Rightarrow \sqrt{1-\frac{1}{2\mu^2}} \geq \frac{1}{\mu} \Rightarrow \mu \geq \sqrt{\frac{3}{2}}$

10. $\because \frac{x}{D} = \frac{\Delta}{d} \Rightarrow x = \frac{\Delta D}{d}$

$d_1 = \frac{7\lambda_1 D}{d}; d_2 = \frac{7\lambda_2 D}{d}$

$\frac{d_1}{d_2} = \frac{\lambda_1}{\lambda_2}$

11. Image moves away from lens with non-uniform acceleration.

12. Momentum of the recoiled hydrogen atom

= momentum of the emitted photon

$= \frac{h\nu}{c} = \frac{h}{\lambda} = hR\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$

$= 6.6 \times 10^{-34} \times 10^{+7}\left(\frac{1}{1} - \frac{1}{16}\right)$

$= 6.5 \times 10^{-27}$ kg-m s^{-1}

13. Transistor as an amplifier

$V_{out} = \beta \frac{R_L}{R_i} \times V_{in}$

$2 = 100 \times \frac{2\times10^3}{1\times10^3} \times V_{in}$

$V_{in} = 10$ mV

14. $f = -6$ $u = -18$ $h = 2$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$v = -4.5$

$h' = h\left(\frac{-v}{u}\right) = 2 \times -\left(\frac{-4.5}{18}\right) = 0.50$ m

image height = 0.50 m

15. $\delta = i + e - A$

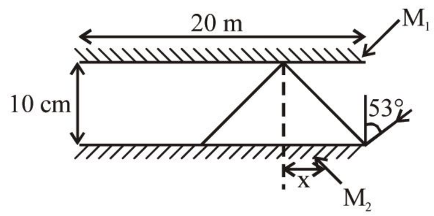
$\delta = 2i - A$

$\delta = 2\left(\frac{3}{4}A\right) - A$

$\delta = \frac{A}{2}$ $\because A = 60°$

$\therefore \delta = 30°$

16. After each reflection it covers a distance x along the mirror



$\frac{x}{d} = \tan 53°$

$\Rightarrow$ $x = d \tan 53°$

$= 10 \times \frac{4}{3}$ cm

Total no. of reflections

$= \frac{20}{10\times\frac{4}{3}} \times 100 = 150$

17. $u = -x \quad v = 3x$

$3x + x + 80$

$4x = 80 \Rightarrow x = 20$

$u = -20 \quad v = 60$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{60} - \frac{1}{20} = \frac{1}{f}$$

$f = -30$ cm

18. $\tan c = \dfrac{5}{9}$

$$\sin c = \frac{1}{\mu} = \frac{5}{\sqrt{106}}$$

$$\mu = \frac{\sqrt{106}}{5}$$

19. Apply snell's law

$\mu_g \sin i = 1 \sin 90^\circ$

$$\mu_g = \frac{1}{\sin i}$$

20. For incident surface

$$\sin c = \frac{1}{\mu} = \frac{1}{\sqrt{2}}$$

$c = 45^\circ$

then after T.I.R.

$$\sin c = \frac{\sqrt{3}}{2} \Rightarrow c = 60^\circ$$

21. **5**

22. **5**

23. **6**

24. **2**

25. **5**

[CHEMISTRY]

26. (3) Hydroboration followed by oxidation of alkene produces primary alcohols

27. (3) Etard reaction uses CrO_2Cl_2 as oxidising agent

28. (1)

29. (3) Fact

30. (1) Option (1) is not possible becuase α carbon involves in aldolcondensation

31. (1) Bromine water oxidises aldehyde group of glucose into carboxylic group

32. (2) Nitrobenzene first converted into nitroso benzene which finally get reduced into n-phenyl hydroxylamine by the action of zinc again

33. (3) In this reaction benzene added with hydrocyanic acid & friedal craft's catalyst $ZnCl_2$ to form benzen diazonium chloride which futher hydrolysis produces aldehyde

34. (1) x is sodium phenoxide which further combine with chloroethane to give ethoxy benzene

35. (d)

36. (1)

37. (4)

38. (3) A is cis-alkene and B is tran-alkene melting point of trans is more than cis

39. (2) B product form in accourdance with anti Markownikoff's rule C is allylic substitution in presence of NBS

40. It is test of amide linkage.

41. (3) Fact

42. (1) Fact

43. (1) Fact

44. Glucose and Mannose are Epimer's of each other

45. (4) Fact

46. **9**

47. **5**

48. **6**

49. **4**

50. **5**

[MATHEMATICS]

51. (d) $|\mathbf{c}| = 1 + \alpha^2 + \beta^2 = 3 \Rightarrow \alpha^2 + \beta^2 = 2$

Since $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$ are linearly dependent.

Hence, $\begin{vmatrix} 1 & 1 & 1 \\ 4 & 3 & 4 \\ 1 & \alpha & \beta \end{vmatrix} = 1 - \beta = 0 \Rightarrow \beta = 1$

$\therefore\ \alpha^2 = 1 \Rightarrow \alpha = \pm 1$.

52. (d) $(2\mathbf{a} + 3\mathbf{b} - 5\mathbf{c}).(4\mathbf{a} - 6\mathbf{b} + 10\mathbf{c})$

$= 8\mathbf{a}.\mathbf{a} - 18\mathbf{b}.\mathbf{b} - 50\mathbf{c}.\mathbf{c} - 12\mathbf{a}.\mathbf{b} + 20\mathbf{a}.\mathbf{c}$

$+12\mathbf{b}.\mathbf{a} + 30\mathbf{b}.\mathbf{c} - 20\mathbf{c}.\mathbf{a} + 30\mathbf{c}.\mathbf{b}$

$= 8a^2 - 18b^2 - 50c^2 + 60\mathbf{c}.\mathbf{b}$

$= 32 - 72 - 200 + 60.|\mathbf{b}|.|\mathbf{c}|\cos 60^\circ = -120.$

53. (d) Let the vector be $x\,\mathbf{i} + y\,\mathbf{j}$

$\therefore \cos 45^o = \dfrac{x+y}{\sqrt{2}\sqrt{x^2+y^2}} \Rightarrow 1 = \dfrac{x+y}{\sqrt{x^2+y^2}}$

$\Rightarrow x + y = \sqrt{x^2+y^2}$ also $\sqrt{x^2+y^2} = 1 \Rightarrow x + y = 1$

Again $\cos 60^o = \dfrac{3x-4y}{5} \Rightarrow \dfrac{5}{2} = 3x - 4y$

$5 = 6x - 8y$ .....(i)

$1 = x + y$ .....(ii)

$\Rightarrow$ No value in the given options set satisfies the above relations. Thus (d) is correct.

54. (b) $\mathbf{c} = \mathbf{a} \times \mathbf{b} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 3 & -5 & 0 \\ 6 & 3 & 0 \end{vmatrix} = \mathbf{i}(0) - \mathbf{j}(0) + \mathbf{k}(9+30) = 39\mathbf{k}$

Now, $|\mathbf{a}| = \sqrt{9+25} = \sqrt{34}$

$|\mathbf{b}| = \sqrt{36+9} = \sqrt{45}$

$|\mathbf{c}| = \sqrt{(39)^2} = 39.$

55. (c) $(\mathbf{a} + \mathbf{b} + \mathbf{c}).[(\mathbf{a} + \mathbf{b}) \times (\mathbf{a} + \mathbf{c})]$

$= (\mathbf{a} + \mathbf{b} + \mathbf{c}).(\mathbf{a} \times \mathbf{a} + \mathbf{a} \times \mathbf{c} + \mathbf{b} \times \mathbf{a} + \mathbf{b} \times \mathbf{c})$

$= (\mathbf{a} + \mathbf{b} + \mathbf{c}).(\mathbf{a} \times \mathbf{c} + \mathbf{b} \times \mathbf{a} + \mathbf{b} \times \mathbf{c})$

$= [\mathbf{a}\,\mathbf{a}\,\mathbf{c}] + [\mathbf{a}\,\mathbf{b}\,\mathbf{a}] + [\mathbf{a}\,\mathbf{b}\,\mathbf{c}] + [\mathbf{b}\,\mathbf{a}\,\mathbf{c}] + [\mathbf{b}\,\mathbf{b}\,\mathbf{a}]$

$+[\mathbf{b}\,\mathbf{b}\,\mathbf{c}] + [\mathbf{c}\,\mathbf{a}\,\mathbf{c}] + [\mathbf{c}\,\mathbf{b}\,\mathbf{a}] + [\mathbf{c}\,\mathbf{b}\,\mathbf{c}]$

$= -[\mathbf{a}\,\mathbf{b}\,\mathbf{c}]$.

56.

(c) $\mathbf{V}\times\mathbf{W}=\begin{vmatrix}\mathbf{i} & \mathbf{j} & \mathbf{k}\\ 2 & 1 & -1\\ 1 & 0 & 3\end{vmatrix}=3\mathbf{i}-7\mathbf{j}-\mathbf{k}$

But $\mathbf{U}$ is a unit vector, $\therefore$ $\mathbf{U}=\dfrac{3\mathbf{i}-7\mathbf{j}-\mathbf{k}}{\sqrt{59}}$

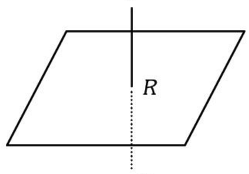
Hence, $[\mathbf{U}\,\mathbf{V}\,\mathbf{W}]=\dfrac{3^2+7^2+1^2}{\sqrt{59}}=\sqrt{59}$.

57. (c) Angle between line and normal to plane is $\cos\left(\dfrac{\pi}{2}-\theta\right)=\dfrac{1\times 2+2(-1)+2\sqrt{\lambda}}{3\times\sqrt{5+\lambda}}$, where θ is the angle between line and plane

$\Rightarrow \sin\theta=\dfrac{1\times 2+2\times(-1)+2\sqrt{\lambda}}{3\times\sqrt{5+\lambda}}\Rightarrow\dfrac{1}{3}=\dfrac{2\sqrt{\lambda}}{3\sqrt{5+\lambda}}$

$\Rightarrow\dfrac{1}{3}=\dfrac{2\sqrt{\lambda}}{3\sqrt{5+\lambda}}\Rightarrow\lambda=\dfrac{5}{3}$.

58. (a) Let Q be image of the point $P(5,4,6)$ in the given plane, then PQ is normal to the plane. The direction ratios of PQ are 1,1,2. Since PQ passes through (5,4, 6) and has direction ratio 1,1,2;



Therefore, equation of PQ is

$\dfrac{x-5}{1}=\dfrac{y-4}{1}=\dfrac{z-6}{2}=r$, (say)

$\therefore\ x=r+5, y=r+4, z=2r+6$

So, co-ordinates of Q be $(r+5, r+4, 2r+6)$

Let R be the mid point of PQ then co-ordinates of R are

$\left(\dfrac{r+5+5}{2},\dfrac{r+4+4}{2},\dfrac{2r+6+6}{2}\right)$

i.e., $\left(\dfrac{r+10}{2},\dfrac{r+8}{2},\dfrac{2r+12}{2}\right)$

Since R lies on the plane

$\therefore\ \dfrac{r+10}{2}+\dfrac{r+8}{2}+2\left(\dfrac{2r+12}{2}\right)-15=0$

$\Rightarrow r+10+r+8+4r+24-30=0$

$\Rightarrow 6r+12=0\Rightarrow r=-2$

So, co-ordinates of Q are (3, 2, 2).

Trick : From option (a) , midpoint of (3, 2, 2) and (5, 4, 6) satisfies the equation of given plane.

59. (b) Let side of the cube = a

Then OG, BE and AD, CF will be four diagonals.

d.r.'s of $OG = a, a, a = 1, 1, 1$

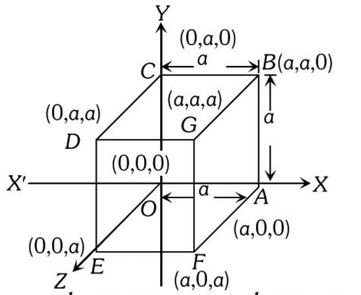
d.r.'s of $BE = -a, -a, a = 1, 1, -1$

d.r.'s of $AD = -a, a, a = -1, 1, 1$

d.r.'s of $CF = a, -a, a = 1, -1, 1$

Let d.r.'s of line be l, m, n.

Therefore angle between line and diagonal



$$\cos\alpha = \frac{l+m+n}{\sqrt{3}}, \cos\beta = \frac{l+m-n}{\sqrt{3}},$$

$$\cos\gamma = \frac{-l+m+n}{\sqrt{3}}, \cos\delta = \frac{l-m+n}{\sqrt{3}}$$

$$\Rightarrow \cos^2\alpha + \cos^2\beta + \cos^2\gamma + \cos^2\delta$$

$$= \frac{1}{3}[(l+m+n)^2 + (l+m-n)^2 + (-l+m+n)^2 + (l-m+n)^2]$$

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

60. (c) Area of $\Delta ABC = \frac{1}{2}\sqrt{a^2b^2 + b^2c^2 + c^2a^2}$

$$\Delta = \frac{1}{2}\sqrt{4\times 9 + 9\times 16 + 16\times 4} = \frac{1}{2}\sqrt{244} = \sqrt{61}.$$

61. (a) The equation of plane, in which the line $\frac{x-5}{4} = \frac{y-7}{4} = \frac{z+3}{-5}$ lies, is

$A(x-5) + B(y-7) + C(z+3) = 0$ ……(i)

Where $4A + 4B - 5C = 0$ ……(ii)

Also, since line $\frac{x-8}{7} = \frac{y-4}{1} = \frac{z-5}{3}$ lies in this plane

$\therefore\ 7A + B + 3C = 0$ ……(iii)

By (ii) and (iii), we get $\frac{A}{17} = \frac{B}{-47} = \frac{C}{-24}$

$\therefore$ The required plane is

$17(x-5) - 47(y-7) + (-24)(z+3) = 0$

$\Rightarrow\ 17x - 47y - 24z + 172 = 0.$

62. (a) Let λ, μ and λ', μ' be the numbers of heads and tails thrown by A and B respectively, so that $\lambda + \lambda' = n+1$ and $\mu + \mu' = n$.

The required probability P is the probability of the inequality $\lambda > \mu$.. The probability $1-P$ of the opposite event $\lambda \le \mu$ is at the same time the probability of the inequality $\lambda' > \mu'$ *i.e.,* $1-P$ is the probability that A will throw more tails than B.

[**Reason :** $\lambda \le \mu \Rightarrow n+1-\lambda' \le n-\mu'$

$\Rightarrow 1-\lambda' \le -\mu' \Rightarrow \lambda' - 1 \ge \mu' \Rightarrow \lambda' \ge \mu' + 1 > \mu'$]

By reason of symmetry $1-P = P$ or $P = \frac{1}{2}$.

63. (a) For each toss there are four choices :

(i) A gets head, B gets head, (ii) A gets tail, B gets head,

(iii) A gets head, B gets tail (iv) A gets tail, B gets tail.

Thus exhaustive number of ways $= 4^{50}$.

Out of the four choices listed above (iv) is not favourable to the required event in a toss.

Therefore favourable number of cases is 3^{50}.

Hence the required probability $= \left(\frac{3}{4}\right)^{50}$.

64. (c) The number is divisible by 4 if last two digits are 12, 24, 32 and 52. Remaining three places can be filled by 3! ways.

$\therefore$ Favouable cases $= 3! \times 4$

Required probability $= \frac{3! \times 4}{5!} = \frac{1}{5}$.

65. (a) We are given $P(E \cap F) = \frac{1}{12}$ and $P(\overline{E} \cap \overline{F}) = \frac{1}{2}$

$\Rightarrow P(E).P(F) = \frac{1}{12}$ .....(i)

and $P(\overline{E}).P(\overline{F}) = \frac{1}{2}$ .....(ii)

$\Rightarrow \{(1-P(E)\}\ \{(1-P)(F)\} = \frac{1}{2}$

$\Rightarrow 1 + P(E)P(F) - P(E) - P(F) = \frac{1}{2}$

$\Rightarrow 1 + \frac{1}{12} - [P(E) + P(F)] = \frac{1}{2}$

$\Rightarrow P(E) + P(F) = \frac{7}{12}$ .....(iii)

On solving (i) and (iii), we get

$P(E) = \frac{1}{3}, \frac{1}{4}$ and $P(F) = \frac{1}{4}, \frac{1}{3}$.

66. (d) Let A denotes the event that a sum of 5 occurs, B the event that a sum of 7 occurs and C the event that neither a sum of 5 nor a sum of 7 occurs, we have $P(A)=\frac{4}{36}$, $P(B)=\frac{6}{36}$ and $P(C)=\frac{26}{36}=\frac{13}{18}$

Thus $P(A$ occurs before $B)$

$=P[A \text{ or } (C\cap A) \text{ or } (C\cap C\cap A) \text{ or } \ldots\ldots\ldots]$

$=P(A)+P(C\cap A)+P(C\cap C\cap A)+\ldots\ldots$

$=P(A)+P(C).P(A)+P(C)^2P(A)+\ldots\ldots$

$$=\frac{P(A)}{1-P(C)}, \text{[by G.P.]}=\frac{\frac{1}{9}}{1-\frac{13}{18}}=\frac{2}{3}.$$

67. (c) Required probability

$=P(\text{less than } 7)+P(\text{odd})+P(\text{both})-P(7\cap\text{odd})$

$-P(7\cap\text{both})-P(\text{odd}\cap\text{both})+P(\text{odd}\cap 7\cap\text{both})$

But $P(\text{both})=P(7\cap\text{odd})=P(7\cap\text{both})=P(odd\cap\text{both})$

$=P(\text{odd}\cap 7\cap\text{both})$

Therefore required probability

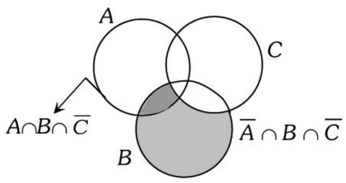
$=P(\text{Less than } 7)+P(\text{odd})-P(7\cap\text{odd})$

$P(\text{odd})=\frac{18}{36}=\frac{1}{2}$

$P(\text{less than } 7)=\frac{15}{36}=\frac{5}{12}$, $P(\text{both})=\frac{6}{36}=\frac{1}{6}$

Hence required probability $=\frac{5}{12}+\frac{1}{2}-\frac{2}{12}=\frac{9}{12}=\frac{3}{4}.$

68. (a) From Venn diagram, we can see that



$P(B\cap C)=P(B)-P(A\cap B\cap\overline{C})-P(\overline{A}\cap B\cap\overline{C})$

$=\frac{3}{4}-\frac{1}{3}-\frac{1}{3}=\frac{1}{12}.$

69 (b) Let A_1 be the event that the black card is lost, A_2 be the event that red card is lost and let E be the event that first 13 cards examined are red.

Then the required probability $=P\left(\frac{A_1}{E}\right)$.

We have $P(A_1)=P(A_2)=\frac{1}{2}$; as black and red cards were intially equal in number.

Also, $P\left(\frac{E}{A_1}\right)=\frac{{}^{26}C_{13}}{{}^{51}C_{13}}$ and $P\left(\frac{E}{A_2}\right)=\frac{{}^{25}C_{13}}{{}^{51}C_{13}}$

The required probability $= P\left(\frac{A_1}{E}\right)$

$$= \frac{P(E/A_1)P(A_1)}{P(E/A_1)P(A_1) + P(E/A_2)P(A_2)}$$

$$= \frac{\frac{1}{2}\cdot\frac{^{26}C_{13}}{^{51}C_{13}}}{\frac{1}{2}\cdot\frac{^{26}C_{13}}{^{51}C_{13}} + \frac{1}{2}\cdot\frac{^{25}C_{13}}{^{51}C_{13}}} = \frac{2}{3}.$$

70. (a) The man will be one step away from the starting point if (i) either he is one step ahead or (ii) one step behind the starting point.

$\therefore$ The required probability $= P(i) + P(ii)$

The man will be one step ahead at the end of eleven steps if he moves six steps forward and five steps backward. The probability of this event $= {}^{11}C_6(0.4)^6(0.6)^5$.

The man will be one step behind at the end of eleven steps if he moves six steps backward and five steps forward.

The probability of this event$= {}^{11}C_6(0.6)^6(0.4)^5$.

Hence the required probability

$= {}^{11}C_6(0.4)^6(0.6)^5 + {}^{11}C_6(0.6)^6(0.4)^5$

$= {}^{11}C_6(0.4)^5(0.6)^5(0.4+0.6) = {}^{11}C_6(0.24)^5$.

71

(a) Since $(1, a, a^2)$, $(1, b, b^2)$ and $(1, c, c^2)$ are non-coplanar, therefore $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} \neq 0 = \Delta\,(\text{say})$

and $\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix} = \begin{vmatrix} a & a^2 & 1 \\ b & b^2 & 1 \\ c & c^2 & 1 \end{vmatrix} + \begin{vmatrix} a & a^2 & a^3 \\ b & b^2 & b^3 \\ c & c^2 & c^3 \end{vmatrix} = 0$

$\Rightarrow \Delta + abc\,\Delta = 0$

$\Rightarrow \Delta(abc+1) = 0 \Rightarrow abc = -1.$

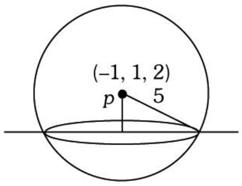
72.

(b) Let the equation of plane be $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$, where $= \frac{1}{\sqrt{\sum\left(\frac{1}{a^2}\right)}}$ or $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}=1$ ......(i)

Now according to equation, $x=\frac{a}{3}, y=\frac{b}{3}, z=\frac{c}{3}$

Put the values of x, y, z in (i), we get the locus of the centroid of the triangle $\frac{1}{x^2}+\frac{1}{y^2}+\frac{1}{z^2}=9$, *i.e.*, $k=9$.

73. (c) $p = \dfrac{-1+2+4+7}{\sqrt{1+4+4}} = \dfrac{12}{3} = 4$



$\therefore\ r = \sqrt{25-16} = 3.$

74. Obviously the line and the plane are parallel, so to find the distance between the line and the plane, take any point on the line *i.e.*, (1, – 2, 1). Now the perpendicular distance of the point (1, – 2, 1) from the plane will be the required distance.

Hence distance $= \left|\dfrac{2(1)+2(-2)-1(1)-6}{\sqrt{2^2+2^2+1^2}}\right| = \dfrac{9}{\sqrt{9}} = 3$.

75. (a) $\mathbf{a}.\mathbf{c} = 1$ and $\mathbf{b}.\mathbf{c} = 1$

Given that $(\mathbf{a}\times\mathbf{b})\times\mathbf{c} = (\mathbf{c}.\mathbf{a})\mathbf{b} - (\mathbf{c}.\mathbf{b})\mathbf{a} = \mu\mathbf{b} + \lambda\mathbf{a}$

where $\mu = \mathbf{c}.\mathbf{a} = 1,\ \lambda = -(\mathbf{c}.\mathbf{b}) = -1$

$\Rightarrow \mu + \lambda = 1 - 1 = 0$.