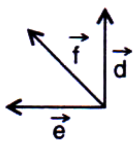
AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST MEDICAL PLUS -03 TEST - 03 RAJPUR SOLUTION Date 04-08-2019

[PHYSICS]

1. From figure, $\vec{d} + \vec{e} = \vec{f}$



2. If $\vec{C}$ is resultant of $\vec{A}$ and $\vec{B}$, then

$$|\vec{C}| = \sqrt{A^2 + B^2 + 2AB\cos 120^\circ}$$

$$|\vec{C}| = \sqrt{A^2 + B^2 - AB} \qquad \left[\text{As } \cos 120^\circ = -\frac{1}{2}\right]$$

Similarly,

$$|\vec{A} - \vec{B}| = \sqrt{A^2 + B^2 - 2AB\cos 120^\circ}$$

$$= \sqrt{A^2 + B^2 + AB}$$

$$|\vec{A} - \vec{B}| > C$$

3. Magnitude of component of $\vec{A}$ along $\vec{B} = \dfrac{\vec{A}\cdot\vec{B}}{|\vec{B}|}$

$$= \frac{(2\hat{i} + 3\hat{j})\cdot(\hat{i} + \hat{j})}{\sqrt{2}}$$

$$= \frac{2+3}{\sqrt{2}} = \frac{5}{\sqrt{2}}.$$

4.

5.

6. When tow vectors are paralel to each other, their cross product is zero.

$$\vec{A} \times \vec{C} = 0$$

$\therefore$ $\vec{A}$ and $\vec{C}$ are parallel to each other.

7. $|\vec{A} \times \vec{B}| = \sqrt{3}\,\vec{A}\cdot\vec{B}$

$\therefore$ $AB\sin\theta = \sqrt{3}\,AB\cos\theta$

or $\tan\theta = \sqrt{3}$ or $\theta = 60^\circ$

$$|\vec{A} + \vec{B}| = (A^2 + B^2 + 2AB\cos 60^\circ)^{1/2}$$

$$= (A^2 + B^2 + AB)^{1/2}$$

8. The sum of two vectors is $\vec{R} = \vec{A} + \vec{B}$. The difference of two vectors is $\vec{R}' = \vec{A} - \vec{B}$. Since, $\vec{R}$ and $\vec{R}'$ are at right angles, therefore, their dot product is zero.

i.e, $\vec{R} \cdot \vec{R}' = 0$ or $(\vec{A} + \vec{B}) \cdot (\vec{A} - \vec{B}) = 0$

or $\vec{A} \cdot \vec{A} - \vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{A} - \vec{B} \cdot \vec{B} = 0$

or $A^2 - \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{B} - B^2 = 0$

or $A^2 - B^2 = 0$

or $A = B.$

9.
$$+5\hat{k} = -a\hat{k}$$
$$a = -5$$

10. $|\vec{A} \times \vec{B}| = \sqrt{3}(\vec{A} \cdot \vec{B})$

$\therefore$ $AB \sin\theta = \sqrt{3}\ AB \cos\theta$

or $\tan\theta = \sqrt{3}$ or $\theta = \tan^{-1}\sqrt{3} = 60^\circ$.

11.
$$\vec{a} = 2\hat{i} + 3\hat{j} + 8\hat{k}$$
$$\vec{b} = 4\hat{j} - 4\hat{i} + \alpha\hat{k}$$

If $\vec{a}$ is $\perp$ to $\vec{b}$, then $\vec{a} \cdot \vec{b} = 0$

or $(2\hat{i} + 3\hat{j} + 8\hat{k}) \cdot (-4\hat{i} + 4\hat{j} + \alpha\hat{k}) = 0$

or $(-8 + 12 + 8\alpha) = 0$

or $\alpha = -\frac{1}{2}.$

12. $\vec{S} = \vec{F}_1 + \vec{F}_2$ and $\vec{D} = \vec{F}_1 - \vec{F}_2$

As two vectors are perpendicular to each other, hence $\vec{S} \cdot \vec{D} = 0$

or $(\vec{F}_1 + \vec{F}_2) \cdot (\vec{F}_1 - \vec{F}_2) = 0$

or $(\vec{F}_1)^2 - (\vec{F}_2)^2 = 0$

or $|\vec{F}_1|^2 - |\vec{F}_2|^2 = 0$

or $|\vec{F}_1|^2 = |\vec{F}_2|^2$

or $|\vec{F}_1| = |\vec{F}_2|.$

13.

14. Given first vector (P) = A
Second vector (Q) = A

resultant vector $(R) = A$

Now, $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$

$A = \sqrt{A^2 + A^2 + 2A^2\cos\theta}$

or $A = \sqrt{2A^2(1+\cos\theta)}$

or $A^2 = 2A^2(1+\cos\theta)$

or $\cos\theta = -\frac{1}{2}$

or $\theta = 120°$.

15. $\vec{P}$ is perpendicular to $\vec{Q}\times\vec{P}$. The dot product of perpendicular vector is zero.

16. $\cos\theta = \frac{\vec{A}.\vec{B}}{AB} = \frac{2(-3)+3\times 0+1\times 6}{\sqrt{14}\times\sqrt{45}}$

$\therefore$ $\theta = 90°$

17. $|\vec{A}+\vec{B}| = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

and $|\vec{A}-\vec{B}| = \sqrt{A^2 + (-B)^2 + 2A(-B)\cos\theta}$

Now, $\sqrt{A^2 + B^2 + 2AB\cos\theta}$

$= \sqrt{A^2 + (-B)^2 + 2A(-B)\cos\theta}$

or $A^2 + B^2 + 2AB\cos\theta = A^2 + B^2 - 2AB\cos\theta$

$4AB\cos\theta = 0$, *i.e.*, $\theta = \frac{\pi}{2} = 90°$.

18.

$\vec{A}\cdot\vec{B} = AB\cos\theta$

$|\vec{A}\times\vec{B}| = AB\sin\theta$

As $\vec{A}\cdot\vec{B} = |\vec{A}\times\vec{B}|$

or $AB\cos\theta = AB\sin\theta$

or $\tan\theta = 1$, $\theta = 45°$.

19. $\vec{C} = \vec{A} + \vec{B}$ gives;

$C^2 = A^2 + B^2 + 2AB\cos\theta$

But $C^2 = A^2 + B^2$

$\therefore$ $2AB\cos\theta = 0$

or $\cos\theta = 0$, $\theta = \frac{\pi}{2}$.

20. Here, $\vec{A} = \vec{B} + \vec{C}$

Let angle between $\vec{B}$ and $\vec{C}$ be θ ; then

$$A^2 = B^2 + C^2 + 2BC\cos\theta$$

$$(5)^2 = 4^2 + 3^2 + 2(4)(3)\cos\theta$$

or $0 = 24\cos\theta, \quad \theta = \frac{\pi}{2}$

In the right angled triangle, let the angle between $\vec{A}$ and $\vec{C}$ be α.

$\therefore \quad \cos\alpha = \frac{C}{A} = \frac{3}{5}$

$\therefore \quad \alpha = \cos^{-1}(3/5)$.

21. $R^2 = P^2 + Q^2 + 2PQ\cos\theta$

Here, $|\vec{R}| = |\vec{Q}| = |\vec{P}|$

$\therefore \quad P^2 = P^2 + P^2 + 2PP\cos\theta$

or $P^2 = 2P^2 + 2P^2\cos\theta$

or $P^2 = 2P^2(1 + \cos\theta)$

or $\frac{1}{2} = 1 + \cos\theta$

or $\cos\theta = -\frac{1}{2} \quad \therefore \theta = 120°$.

22. $|\vec{F}| = \sqrt{6^2 + 8^2 + 10^2} = \sqrt{200}$

$= 10\sqrt{2}\text{N}$

Hence, $m = \frac{F}{a} = \frac{10\sqrt{2}\text{ N}}{1} = 10\sqrt{2}$ kg.

23. $\vec{\tau} = \vec{r} \times \vec{F}$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 7 & 3 & 1 \\ -3 & 1 & 5 \end{vmatrix} = \hat{i}(15-1) - \hat{j}(35+3) + \hat{k}(7+9)$$

$= 14\hat{i} - 38\hat{j} + 16\hat{k}$.

24. Here, $P^2 + Q^2 = R^2$

$(5)^2 + (12)^2 = (13)^2$

$\therefore$ Angle between P and $Q = 90°$, if α is the angle between Q and R; then $\cos\alpha = \left(\frac{12}{13}\right)$.

25. $(0.5)^2 + (0.8)^2 + C^2 = 1$

$C^2 = 1 - (0.5)^2 - (0.8)^2 = 1 - 0.25 - 0.64$

$= 1 - 0.89 = 0.11$

$\therefore \quad C = \sqrt{0.11}$

26. Component of $\vec{A}$ along

$= (A\cos\theta)\hat{B}(\vec{A}.\hat{B})\hat{B} = \frac{(\vec{A}.\vec{B})\vec{B}}{B^2}$

$\vec{A}.\vec{B} = (3\hat{i}+4\hat{j}).(\hat{i}+\hat{j}) = 7$

$\vec{B} = \hat{i}+\hat{j}$

or $B^2 = 2$

27. Actually $\vec{P}+\vec{Q}$ and $\vec{P}-\vec{Q}$ represent the two diagonals of the parallelogram whose any two concurrent side are represented by $\vec{P}$ and $\vec{Q}$. The angle between the diagonals can have any value between 0º and 180º

28. If $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$, the two vectors $\vec{A}$ and $\vec{B}$ must be perpendicular to each other.

29. Here, $\vec{A}+\vec{B} = -\vec{C}$

Hence, $|\vec{A}+\vec{B}| = |-\vec{C}| = |\vec{C}|$

30. The dot product of two vectors cannot be equal to the dot product of their unit vectors.

31. Two vectors of equal magnitude and directed in opposite directions give zero resultant.

33. For normal vectors, $\vec{A}.\vec{B} = 0$. This is the case with the vector in option (c)

$(\hat{i}A\cos\theta + \hat{j}A\sin\theta).(\hat{i}B\sin\theta - \hat{j}B\cos\theta) = AB\sin\theta\cos\theta - AB\sin\theta\cos\theta = 0$

34. Components of water depend on the choice of coordinate system.

35. Vector perpendicular to $\hat{i}+\hat{j}$ is $\hat{i}-\hat{j}$.

Here $\vec{A} = 3\hat{i}+4\hat{j}$ and $\vec{B} = \hat{i}-\hat{j}$

$\therefore$ $\vec{A}.\vec{B} = 3-4 = -1$

$\vec{B} = \hat{i}-\hat{j}$

and $B^2 = 2$

36. $C = \left[A^2 + B^2 + 2AB\cos\frac{2\pi}{3}\right]^{1/2}$

$= \left[A^2 + B^2 + 2A\left(-\frac{1}{2}\right)\right]^{1/2} = A = B$

37. $\vec{A}\times\vec{B}$ is directed opposite to $\vec{B}\times\vec{A}$.

38. Projection of $\vec{A}$ on y-axis is given by $\vec{A}.\hat{j}$. Here, $(3\hat{i}+4\hat{k}).\hat{j} = 0$

39. Projection of $\vec{A}$ on $\vec{B}$ is the dot product of $\vec{A}$ and the unit vector along $\vec{B}$.

40. Any one of them is equally possible. Hence, none of the given options is necessarily valid.

41. $\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta} = \frac{\sin\theta}{\frac{A}{B}+\cos\theta}$ and $\tan\beta = \frac{A\sin\theta}{B + A\cos\theta} = \frac{\sin\theta}{\frac{B}{A}+\cos\theta}$

$\therefore$ $\alpha < \beta$ when $\frac{A}{B} > 1$

This will make $\frac{B}{A} < 1$

42. $\tan\beta = \frac{B\sin\theta}{A + B\cos\theta}$

or $\tan 90^{o} = -\frac{B\sin\theta}{A + B\cos\theta}$

$\therefore$ A + B cosθ = 0

or $\theta = \cos^{-1}\left(-\frac{A}{B}\right)$

43. $\vec{A} = A\hat{A}$

$\therefore$ $\Delta\vec{A} = (\Delta A)\hat{A} + (\Delta\hat{A})A$

When $\Delta\hat{A} = 0$

Then $\Delta\vec{A} = (\Delta A)\hat{A} = (\Delta|\vec{A}|)\hat{A}$

$\therefore$ $|\Delta\vec{A}| = \Delta|\hat{A}|$

44. $\Delta\vec{A} = -\vec{A} - \vec{A} = -2\vec{A}$

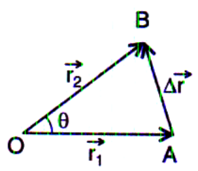
Now as $|\vec{A}| = |-\vec{A}|$

$\therefore$ $\Delta|\vec{A}| = 0^{o}$ ·

45. $\vec{\Delta r} = \vec{r}_2 = \vec{r}_1$, (where $r_2 = r_1 = r$)

Hence, $\Delta r = \sqrt{r_2^2 + r_1^2 - 2r_2r_1\cos\theta}$

$= 2r\sin\frac{\theta}{2}$



[CHEMISTRY]

46.

Mass of an electron = 9.108×10^{-31} kg

Number of electrons in 1 kg $= \frac{1}{9.108 \times 10^{-31}}$

Number of moles of electrons in 1 kg

$= \frac{1}{9.108 \times 10^{-31} \times 6.023 \times 10^{23}} = \frac{\mathbf{1 \times 10^{8}}}{\mathbf{9.108 \times 6.023}}$

47.

(a) $10\text{ g }O_2 = \frac{6.023\times10^{23}\times10}{32}$ **molecules**

(b) $15\text{ L }H_2 = \frac{6.023\times10^{23}\times15}{22.4}$ **molecules (Largest)**

(c) $5\text{ L }N_2 = \frac{6.023\times10^{23}\times5}{22.4}$ **molecules**

(d) $0.5\text{ g }H_2 = \frac{6.023\times10^{23}\times0.5}{2}$ **molecules**

48.

Number of electrons involved in the redox reaction is five.
Therefore, equivalent weight is **M/5**.

49.

Concentration of $Na_2CO_3 = \frac{25.3}{250}\times1000 = 101.2\ g\ L^{-1}$

$= \frac{101.2}{106}\text{ mol L}^{-1} = 0.9547\text{ mol L}^{-1}$

$\therefore$ Conc. of Na^+ ion $= 2\times0.9547 =$ **1.91M**

Conc. of CO_3^{2-} ion **= 0.955 M**

50.

$44\ g\ CO_2 = 1\text{ mol} = 6.02\times10^{23}$ molecules

$48\ g\ O_2 = \frac{48}{32} = 1.5\text{ mol} = 1.5\times6.02\times10^{23}$ molecules

$8\ g\ H_2 = \frac{8}{2} = 4\text{ mol} = 4\times6.02\times10^{23}$ molecules

$64\ g\ SO_2 = \frac{64}{32} = 2\text{ mol} = 2\times6.02\times10^{23}$ molecules

$\therefore$ 8 g H_2 has maximum number of molecules.

51.

Number of moles in 0.018 g water $= \frac{0.018}{18} = 1\times10^{-3}$ moles

$\therefore$ Number of molecules in 10^{-3} moles $= N_A\times10^{-3}$.

$= 6.022\times10^{23}\times10^{-3} =$ **6.022×10^{20}**

52.

$$\underset{\substack{1\text{ mol}\\100\ g}}{CaCO_3} + 2HCl \longrightarrow CaCl_2 + H_2O + \underset{\substack{1\text{ mol}\\6.023\times10^{23}\\\text{molecules}}}{CO_2}$$

Thus, 100 g of pure $CaCO_3$ gives 1 mol or 6.023×10^{23} molecules

1 mg or 10^{-3} g of pure $CaCO_3$ gives .

53.

$$\underset{\text{(Original)}}{M_1V_1} = \underset{\text{(Diluted)}}{M_2V_2}$$

$5\times1 = M_2\times10$

$M_2 = \frac{5}{10} = 0.5\text{ M} =$ **1N** [$\because$ H_2SO_4 is a dibasic acid]

54.

Let the mass of oxygen be x g and that of nitrogen be $4x$ g

Number of molecules of $O_2 = \frac{x}{32} \times N_A$

Number of molecules of $N_2 = \frac{4x}{28} \times N_A$

Ratio of the number of molecules $= \frac{x}{32} : \frac{4x}{28}$

or $\frac{x}{32} : \frac{x}{7}$ or **7 : 32**

55.

$$\underset{1 \text{ mol}}{MCO_3} \xrightarrow{\Delta} MO + \underset{\substack{1 \text{ mol} \\ \text{or } 22400 \text{ mL of } CO_2 \text{ at STP}}}{CO_2}$$

448 cc of CO_2 is given by metal carbonate = 2 g

22400 cc of CO_2 is given by metal carbonate

$$= \frac{2}{448} \times 22400 \ g = 100 \ g$$

$\therefore$ Mol mass of $MCO_3 = 100$

or $M + 60 = 100$ or atomic mass of metal $= 100 - 60 = 40$

Eq. mass of metal $= \frac{40}{2} = \mathbf{20}$

56.

The given configuration represents the ground state of Cr.

57.

Angular momentum $= \sqrt{l(l+1)} \frac{h}{2\pi}$

For s-orbital, $l = 0$

$\therefore$ Angular momentum = **zero**

58.

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34} \text{kg } m^2 \ s^{-1}}{65 \times 10^{-3} \text{kg} \times ms^{-1}} = \mathbf{1.02 \times 10^{-33} \ m}$$

59.

The third line from the red end corresponds to yellow region, *i.e.*, $n_2 = \mathbf{5.}$

Thus, transition will be from n_2 (= 5) to n_1 (< 5).

60.

$E_1 = -2.18 \times 10^{-18}$ J atom^{-1}

$$E_4 = \frac{-2.18 \times 10^{-18}}{4} \text{ J atom}^{-1}$$

$$v = \frac{E_4 - E_1}{h} = \frac{2.18 \times 10^{-18}}{6.625 \times 10^{-34}} \left(1 - \frac{1}{16}\right)$$

$$= \frac{2.18 \times 10^{-18}}{6.625 \times 10^{-34}} \times 0.9375 = \mathbf{3.08 \times 10^{15} \ s^{-1}}$$

61.

$$E_2 = \frac{E_1}{(2)^2}; \quad \therefore E_1 = -328 \times 4 = -1312 \text{ kJ mol}^{-1}$$

$$E_4 = -\frac{1312}{(4)^2} = \mathbf{-82 \text{ kJ mol}^{-1}}$$

65.

$$\text{K.E.} = \frac{1}{2} mv^2$$

$$v^2 = \frac{2 \times \text{K.E.}}{m} ; v = \sqrt{\frac{2 \times \text{K.E.}}{m}}$$

$$\lambda = \frac{h}{mv} = \frac{h}{m} \times \sqrt{\frac{m}{2 \times \text{K.E.}}}$$

$$= \frac{h}{\sqrt{m \times 2 \times \text{K.E.}}} = \frac{6.625 \times 10^{-34}}{\sqrt{1 \times 2 \times 0.5}} = \mathbf{6.625 \times 10^{-34}}\ \boldsymbol{m}$$

66.

For H-like particles,

$$r_n = \frac{a_0 n^2}{Z} = \frac{0.59\ \text{Å} \times (3)^2}{2}\ [n = 3, Z = 2 \text{ for He}^+]$$

$$= \mathbf{2.38\ Å}$$

68. By law of conservation of momentum

$$0 = m_1\vec{v_1} + m_2\vec{v_2} \Rightarrow m_1\vec{v_1} = -m_2\vec{v_2}$$

–*ve* sign indicates that both he particles are moving in opposite direction. Now de-Broglie wavelengths

$$\lambda_1 = \frac{h}{m_1v_1} \text{ and } \lambda_2 = \frac{h}{m_2v_2} ; \therefore \frac{\lambda_1}{\lambda_2} = \frac{m_2v_2}{m_1v_1} = 1$$

69. $\lambda_{\text{photon}} = \frac{hc}{E}$ and $\lambda_{\text{proton}} = \frac{h}{\sqrt{2mE}}$

$$\Rightarrow \frac{\lambda_{\text{photon}}}{\lambda_{\text{electron}}} = c\sqrt{\frac{2m}{E}} \Rightarrow \frac{\lambda_{\text{photon}}}{\lambda_{\text{electron}}} \propto \frac{1}{\sqrt{E}}$$

70. Photo current (*i*) directly proportional to light intensity (*I*) falling on a photosensitive plate. $\Rightarrow i \propto I$

71. According to Einstein's equation

$$hn = W_0 + K_{max} \Rightarrow V_0 = \left(\frac{h}{e}\right)\nu - \frac{W_0}{e}$$

This is the equation of straight line having positive slope (*h*/*e*) and intercept on $-V_0$ axis, equals to $\frac{W_0}{e}$

72. Stopping potential does not depend upon intensity of incident light (*I*).

74. By using $\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$