JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS

CLASS :- 11^{th} **PAPER CODE :- CWT-2**

CHAPTER :- BASIC MATHS & VECTOR

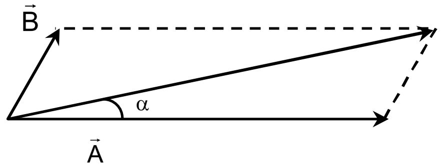
ANSWER KEY

1.	(C)	**2.**	(B)	**3.**	(D)	**4.**	(A)	**5.**	(A)	**6.**	(A)	**7.**	(D)
8.	(A)	**9.**	(A)	**10.**	(B)	**11.**	(B)	**12.**	(C)	**13.**	(B)	**14.**	(A)
15.	(A)	**16.**	(B)	**17.**	(C)	**18.**	(D)	**19.**	(B)	**20.**	(A)	**21.**	16
22.	10	**23.**	12	**24.**	18	**25.**	12	**26.**	10	**27.**	14	**28.**	15
29.	15	**30.**	16										

SOLUTIONS

1. (C)

Sol. If is clear from the diagram that angle made by resultant is smaller with vector of greater magnitude.



2. (B)

3. (D)

Sol. $9° = 9 \times \frac{\pi}{180} = \left(\frac{\pi}{20}\right)$

4. (A)

Sol. $f(x) = \sqrt{3}\ \sin x + \cos x$

$f'(x) = \sqrt{3}\cos x - \sin x = 0$

$\tan x = \sqrt{3} \quad \Rightarrow \quad x = 60^o$

$f(x) = \sqrt{3}\sin 60^o + \cos 60^o = 2.$

5. (A)

Sol. Unit vector in the direction of $\vec{A}$

$\hat{A} = \frac{\vec{A}}{|\vec{A}|} = \frac{2\hat{i}+2\hat{j}-\hat{k}}{3}$ ∴

Velocity , $\vec{V} = 12\hat{A} = 8\hat{i}+8\hat{j}-4\hat{k}$

6. (A)

Sol. $\int \frac{1}{6x+2}dx = \frac{\ell n(6x+2)}{6}\Big|_0^1 = \frac{\ell n(8)-\ell n(2)}{6}$

$= \frac{2\ell n2}{6} = \frac{1}{3}(\ell n2)$

7. (D)

8. (A)

Sol. Let 3x + 5 = u. 3dx = du.

$\int \frac{du}{3u} = \frac{1}{3}\ell nu + C$

$= \frac{1}{3}\ell n\ (3x+5) + C$

$= \ell n\ (3x+5)^{1/3} + C$

9. (A)

Sol. $\vec{A} = 4\hat{i} + 6\hat{j}$

$\vec{A}+\vec{B} = 10\hat{i}+9\hat{j}$

$\vec{B} = (\vec{A}+\vec{B}) - \vec{A}$

$= 10\hat{i}+9\hat{j}-4\hat{i}-6\hat{j} = 6\hat{i}+3\hat{j}$

$|\vec{B}| = \sqrt{6^2+3^2} = \sqrt{45}$.

$\vec{B}.\vec{B} = |\vec{B}|^2 = (\sqrt{45})^2 = 45$

10. (B)

Sol. $\theta = \cos^{-1}\frac{(6\hat{i}+3\hat{j})(\hat{i})}{\sqrt{45}}$

$\theta = \cos^{-1}\left(\frac{6}{\sqrt{45}}\right)$

$= \cos^{-1}\left(\frac{6}{3\sqrt{5}}\right) = \cos^{-1}\left(\frac{2}{\sqrt{5}}\right)$

$= \tan^{-1}\left(\frac{1}{2}\right)$

11. (B)

Sol. (A) $|\vec{A}+\vec{B}| = A^2 + B^2 + 2AB\cos\theta$

$A^2 = A^2 + A^2 + 2A^2\cos\theta \quad \cos\theta = -\frac{1}{2},\ \theta =$ 120

(B) $F_1 \sim F_2 \le R \le F_1 + F_2$

Here $F_1 \sim F_2 = 4$ and $F_1 + F_2 = 12$

(C) $\cos\theta = \frac{\vec{A}\ .\ \vec{B}}{|A||B|} = \frac{0}{2\sqrt{2}\times 3} = 0 \quad \theta = 90^o$

(D) $\vec{A}+\vec{B} = 2\hat{i}+\hat{j}+3\hat{k}$

$|\vec{A}+\vec{B}| = \sqrt{2^2+1+3^2} = \sqrt{14}$

12. (C)

Sol. $|a| - |b| \le |\vec{a}+\vec{b}| \le |a| + |b|$

13. (B)

Sol. $\vec{r} = t^2\hat{i} + (t^3 - 2t)\hat{j}, \vec{v} = \frac{d\vec{r}}{dt} = 2t\hat{i} + (3t^2 - 2)\hat{j}$

$\vec{a} = \frac{d\vec{v}}{dt} = 2\hat{i} + (6t)\hat{j}$

$\vec{a}.\vec{v} = [2\hat{i} + 6t\hat{j}].[2t\hat{i} + (3t^2 - 2)\hat{j}]$

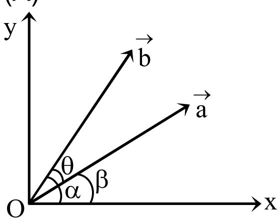
$= 4t + 6t(3t^2 - 2) = 0$

$4t + 18t^3 - 12t = 0 \quad \Rightarrow 18t^3 - 8t = 0$

$18t^3 = 8t, 9t^2 = 4, t^2 = 4/9, t = \pm 2/3 \quad t = 2/3$ s

14. (A)

Sol.



$\tan\beta = \frac{1}{\sqrt{3}}$

$\Rightarrow \quad \beta = 30^\circ$

$\therefore \quad \alpha = \theta + \beta = 53^\circ$

$\therefore \quad \vec{b} = 10\cos 53\,\hat{i} + 10\sin 53\,\hat{j} = 6\,\hat{i} + 8\,\hat{j}$

$\therefore \vec{a} + \vec{b} = (6 + \sqrt{3})\,\hat{i} + 9\,\hat{j}$

15. (A)

Sol. $2^\circ = \frac{\pi}{90}$ rad

$x = \sin\frac{\pi}{90}\cos\frac{\pi}{90}$

$\sin\frac{\pi}{90} \approx \frac{\pi}{90} \qquad \cos\frac{\pi}{90} \approx 1$

$x = \frac{\pi}{90}$

16. (B)

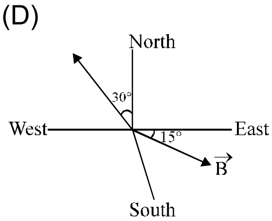
Sol. t = 6 to 8 sec, x is decreasing and slope is constant

17. (C)

Sol. sum of three non coplanar vectors can not be zero

18. (D)

Sol.



The direction of resultant must lie in between smaller angle between $\vec{A}$ and $\vec{B}$.

There fore resultant in south direction is not possible.

19. (B)

Sol. The displacement is $\vec{d}$ = ([3, 2, 4] – [2, 1, 3]) m = [1, 1, 1] m.

Then $\vec{F}\cdot\vec{d}$ = [(1)(1) + (–2)(1) + (0)(1)]N.m

= –1 J.

20. (A)

Sol. Unit vector in the direction of velocity = u sin t vector along the given vector

$\therefore \hat{v} = \frac{-4\hat{i} + 3\hat{j}}{\sqrt{(4)^2 + (3)^2}}$

$\vec{v} = |\vec{v}|\,\hat{v} = 10\left(\frac{-4}{5}\hat{i} + \frac{3}{5}\hat{j}\right) = -8\hat{i} + 6\hat{j}$ m/s

21. 16

Sol. $\int_0^2 (3x^2)\ dx = 8$

$\int_2^6 y\ dx = 0$

Total area = 8 + 0 = 8

22. 10

Sol. $f\{f(x)\} = -\frac{1}{x}$

$f\left\{f\left(-\frac{1}{10}\right)\right\} = 10.$

23. 12

Sol. $f(x) = 24\sin^2 x$

$f'(x) = 24(2\sin x\cos x) = 24\sin(2x)$

$f'(\pi/12) = 24\sin\left(\frac{\pi}{6}\right) = 12.$

24. 18

Sol. $P = xy = (60 - 2y)y = 60y - 2y^2$

$\frac{dP}{dy} = 60 - 4y = 0$

$\Rightarrow y = 15$

$\frac{d^2P}{dy^2} = -4 < 0$

$\Rightarrow$ y = 15 is a point of maxima, therefore

$P_{max} = (60 - 2 \times 15)15$

$= \quad 450 = 18 \times 25$

$\Rightarrow n = 18$

25. 12

Sol. $\int_0^{\pi/4} \sin^2 y = \int_0^{\pi/4} \sin^2 x \, dx$

$I = 24 \int_0^{\pi/4} (\cos^2 x - \sin^2 x) \, dx$

$= 24 \int_0^{\pi/4} (\cos 2x) \, dx$

$= 24 \left(\frac{\sin(2x)}{2} \Big|_0^{\pi/4} \right) = \frac{24}{2} \times (1-0) = 12$

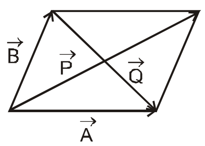
26. 10

Sol. $\vec{P} = \vec{A} + \vec{B}$ & $\vec{Q} = \vec{A} - \vec{B}$

$\vec{P} \times \vec{Q} = (\vec{A} + \vec{B}) \times (\vec{A} - \vec{B})$

$= = - \vec{A} \times \vec{B} + \vec{B} \times \vec{A}$

$\vec{B} \times \vec{A} = \frac{\vec{P} \times \vec{Q}}{2} = \frac{1}{2} \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & 1 \\ 1 & -1 & -1 \end{vmatrix}$



$= \frac{1}{2} \left[4\hat{j} - 4\hat{k} \right] = 2\hat{j} - 2\hat{k}$

$=$ Area $= |\vec{B} \times \vec{A}| = 2\sqrt{2}$

x = 10

27. 14

Sol. $v \propto r^2$ and $v \propto h$

$\Rightarrow \quad v \propto r^2 h \Rightarrow \quad v = kr^2 h$

when v = 770, r = 7 and h = 15

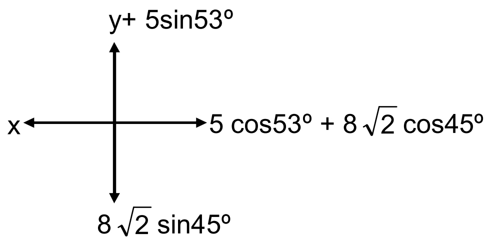
$k = \frac{V}{r^2 h} = \frac{770}{49 \times 10} = \frac{1}{3}\left(\frac{22}{7}\right)$

So, $V = \frac{1}{3}\left(\frac{22}{7}\right) r^2 h$

$132 = \frac{1}{3} \times \frac{22}{7} \times 9 \times h \quad \Rightarrow h = 14$ cm

28. 15

Sol.



$\sum Fx = 0$

x = 5 cos53° + $8\sqrt{2}$ cos45°

$\sum Fy = 0$

y + 5 sin53° = $8\sqrt{2}$ sin45°

From (1) & (2)

x = 3 + 8 = 11

y = 4

x + y = 11 + 4 = 15

29. 15

Sol. $\int_0^{\pi/2} 3\sin(2x)dx = 3\left[-\frac{\cos 2x}{2}\right]_0^{\pi/2}$ = [–(–1) + 1] = 3.

30. 16 units

Sol. $A_x = 2$

$A_y = 2\sqrt{3}$

$A = \sqrt{Ax^2 + Ay^2} = \sqrt{4+12} = 4$