Product of Vectors

1. If $\vec{A}$ and $\vec{B}$ are two vectors, then the wrong statement out of the following is

(1) $\vec{A}.\vec{B}=\vec{B}.\vec{A}$ (2) $\vec{A}+\vec{B}=\vec{B}+\vec{A}$

(3) $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$ (4) $\vec{A}\times\vec{B}=-\vec{B}\times\vec{A}$

2. Choose the wrong statement.

(1) Three vectors of different magnitudes may be combined to give a zero resultant.

(2) Two vectors of different magnitudes can be combined to give a zero resultant.

(3) The product of a scalar and a vector is a vector quantity.

(4) All of these.

3. Three vectors $\vec{A},\vec{B}$ and $\vec{C}$ satisfy the relation $\vec{A}.\vec{B}=0$ and $\vec{A}.\vec{B}=0$. The vector $\vec{A}$ is parallel to

(1) $\vec{B}$ (2) $\vec{C}$ (3) $\vec{B}.\vec{C}$ (4) $\vec{B}\times\vec{C}$

4. Two vectors $\vec{A}$ and $\vec{B}$ are such that $\vec{A}+\vec{B}=\vec{C}$ and $\vec{A}^2+\vec{B}^2=\vec{C}^2$. Which of the following statements is correct?

(1) $\vec{B}$ and $\vec{A}$ are parallel (2) $\vec{A}$ is perpendicular to $\vec{B}$

(3) $\vec{A}$ and $\vec{B}$ are equal in magnitude (4) None of these

5. Which of the following is true?

(1) $|\vec{A}+\vec{B}|\leq|\vec{A}|-|\vec{B}|$ (2) $|\vec{A}-\vec{B}|\geq|\vec{A}|-|\vec{B}|$

(3) Both of these (4) None of these

6. Choose the false statement.

1) Scalar product and vector product obey commutative law.

2) Scalar product does not obey distributive law where as vector product obeys commutative law.

3) Scalar product and vector product obey associative law.

4) All the above.

7. $(\bar{A}+\bar{B})$ x $(\bar{A}-\bar{B})$ **is**

1) $(\bar{A}^2-\bar{B}^2)$ 2) $2\overline{AB}$ 3) $2(\bar{A}\times\bar{B})$ 4) $2(\bar{B}\times\bar{A})$

8. If ℓ_1, m_1, n_1 **and** ℓ_2, m_2, n_2 **are the direction cosines of two vectors and** θ **is the angle between them, then the value of cos** θ **is**

1) $\ell_1\ell_2 + m_1m_2 + n_1n_2$ 2) $\ell_1m_1 + m_1n_1 + n_1\ell_1$

3) $\ell_2m_2 + m_2n_2 + n_2l_2$ 4) $m_1\ell_2 + \ell_2m_2 + n_1m_2$

9. The angle between $(\vec{A}\times\vec{B})$ **and** $(\vec{B}\times\vec{A})$ **is (in radian)**

1) $\pi/2$ 2) π 3) $\pi/4$ 4) zero

10. If none of the vectors $\vec{A}, \vec{B}$ **and** $\vec{C}$ **are zero and if** $\vec{A}\times\vec{B}=0$ **and** $\vec{B}\times\vec{C}=0$ **the value of** $\vec{A}\times\vec{C}$ **is**

1) Unity 2) Zero 3) B^2 4) AC $\cos\theta$

11. Which of the following vector identities is/are false?

a) $\vec{A}.\vec{B}=\vec{B}.\vec{A}$ **b)** $\vec{A}.\vec{B}=-\vec{B}.\vec{A}$ **c)** $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$ **d)** $\vec{A}\times\vec{B}=-\vec{B}\times\vec{A}$

1) Both b & c 2) Only a 3) Both c & d 4) Both a & b

12. (A): Torque is a pseudo vector.

(R): The cross product of two polar vectors is a pseudo vector.

(1) A is true, R is true and R is the correct explanation of A.

(2) A is true, R is true but R is not the orrect explanation of A.

(3) A is true, R is false.

(4) Both A and R are false.

13. Arrange the magnitude of cross products in the decreasing order.

a) $\vec{A}$ **and** $\vec{B}$ **making angle Zero**

b) $\vec{A}$ **and** $\vec{B}$ **making angle** 30^0

c) $\vec{A}$ **and** $\vec{B}$ **making angle** 120^0

1) a, b, c 2) b, c, a 3) c, a, b 4) c, b, a

14. (A): $\vec{A} x \vec{B} = \vec{C}$ **where** $\vec{C}$ **is a vector normal to both** $\vec{A}$ **and** $\vec{B}$.

(R): Direction of cross product obeys right hand thumb rule .

(1) A is true, R is true and R is the correct explanation of A.

(2) A is true, R is true but R is not the orrect explanation of A.

(3) A is true, R is false.

(4) Both A and R are false.

15. (A): The cross product of a polar vector with an axial vector is a polar vector.

(R): A polar vector changes its sign under inversion of coordinates while an axial vector does not. Therefore, the product will not change its sign.

(1) A is true, R is true and R is the correct explanation of A.

(2) A is true, R is true but R is not the orrect explanation of A.

(3) A is true, R is false.

(4) Both A and R are false.

16. (A): If $\vec{A}+\vec{B}+\vec{C}=0$ **then** $\vec{A}\times\vec{B}=\vec{B}\times\vec{C}=\vec{C}\times\vec{A}$.

(R): The vector sum of three vectors can never be zero.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A).

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

17. Match the following.

(a) Angle between $\bar{a}$ and $\bar{b}$ (e) 0^o if $\bar{a} = -3\bar{b}$

(b) Angle between $\bar{a}$ and $\bar{b}$ (f) 90^o $|\bar{a}.\bar{b}| = |\bar{a} \times \bar{b}|$

(c) Angle between $\bar{a}$ and $\bar{b}$ (g) 180^o if $|\bar{a} + \bar{b}| = |\bar{a}|\,|\bar{b}|$

(d) Angle between $\bar{a}$ and $\bar{b}$ if (h) 45^o $|\bar{a} + \bar{b}| = |\bar{a} - \bar{b}|$

(1) a-g, b-h, c-e, d-f (2) a-g, b-h, c-f, d-e (3) a-e, b-h, c-f, d-e (4) a-e, b-h, c-f, d-g

18. Match the following.

a) $\bar{i}.(\bar{j} \times \bar{k}) + \bar{j}.(\bar{k} \times \bar{i}) + \bar{k}(\bar{i} \times \bar{j}) =$ **e) 0**

b) $(\bar{i}.\bar{i}) + (\bar{i} \times \bar{i}) =$ **f) 1**

c) $(\bar{A}.\bar{B})(\bar{A} \times \bar{B}) + (\bar{B}.\bar{A})(\bar{B} \times \bar{A}) =$ **g) 3**

d) $(\bar{i} + \bar{j}).(2\bar{i} + 2\bar{k}) =$ **h) 2**

(1) a-e, b-f, c-g, d-h (2) a-g, b-h, c-f, d-e (3) a-g, b-f, c-e, d-h (4) a-f, b-g, c-h, d-e

19. Match the following.

a) Work **e)** $\vec{r} \times \vec{F}$

b) Power **f)** $\vec{F}.\bar{s}$

c) Linear velocity **g)** $\vec{F}.\vec{v}$

d) Torque **h)** $\vec{\omega} \times \vec{r}$

(1) a-g, b-h, c-f, d-e (2) a-f, b-g, c-e, d-h

(3) a-f, b-g, c-h, d-e (4) a-g, b-f, c-e, d-h

20. Which of the following vector identifies is/are false?

a) $\vec{A}.\vec{B} = \bar{B}.\bar{A}$ b) $\vec{A}.\vec{B} = -\bar{B}.\bar{A}$

c) $\bar{A} \times \bar{B} = \bar{B} \times \bar{A}$ d) $\bar{A} \times \bar{B} = -\bar{B} \times \bar{A}$

(1) Both b & c (2) Only a

(3) Both c & d (4) Both a & b

21. Match the following.

a) Addition of vectors	**e) Relative velocity**
b) Dot product	**f) Resultant velocity**
c) Cross product	**g) Work done**
d) Subtraction of vectors	**h) Torque**

The correct match is

1) $a \to e; b \to f; c \to g; d \to h$ 2) $a \to h; b \to g; c \to f; d \to e$

3) $a \to f; b \to g; c \to h; d \to e$ 4) $a \to g; b \to h; c \to e; d \to f$

22. Match the following.

a) Current strength, Pressure	**e) Vectors**
b) Distance, workdone	**f) Scalars**
c) Force, torque	**g) Possesses direction but not vectors**
d) Component of Vector, smaller value of angular displacement	**h) Scalar and vector**

The correct match is

1) $a \to e; b \to f; c \to g; d \to h$ 2) $a \to h; b \to g; c \to f; d \to e$

3) $a \to g; b \to e; c \to f; d \to h$ 4) $a \to g; b \to f; c \to e; d \to h$

23. Match the following: (Angle between $\vec{A}$ & $\vec{B}$).

a) $\vec{A}-\vec{B}=\vec{C}$ and A – B = C

b) $\vec{A}+\vec{B}=\vec{C}$ and A – B = C

c) $\vec{A}-\vec{B}=\vec{C}$ and $A^2 + B^2 = C^2$

d) $\vec{A}+\vec{B}=\vec{C}$ and A = B = C

e) π

f) $2\pi/3$

g) 0

h) $\pi/2$

1) a-g, b-h, c-f, d-e

2) a-h, b-e, c-f, d-g

3) a-f, b-e, c-h, d-g

4) a-g, b-e, c-h, d-f

23. If $\vec{A}=2i+3j$ and $\vec{B}=2j+3k$ the component of $\vec{B}$ along $\vec{A}$ is

1) 6 2) $\frac{1}{6}$ 3) $\frac{6}{13}$ 4) $\frac{6}{\sqrt{13}}$

24. The component of $\vec{A}$ along $\vec{B}$ is $\sqrt{3}$ times that of the component of $\vec{B}$ along $\vec{A}$. Then A : B is

1) $1:\sqrt{3}$ 2) $\sqrt{3}:1$ 3) $2:\sqrt{3}$ 4) $\sqrt{3}:2$

25. If θ is the angle between unit vectors $\vec{A}$ and $\vec{B}$, then $\frac{(1-\vec{A}.\vec{B})}{(1+\vec{A}.\vec{B})}$ is equal to

1) $\tan^2(\theta/2)$ 2) $\sin^2(\theta/2)$ 3) $\cot^2(\theta/2)$ 4) $\cos^2(\theta/2)$

26. A force $\vec{F}=4\hat{i}-5\hat{j}+3\hat{k}$ is acting at a point $\vec{r}_1=\hat{i}+2\hat{j}+3\hat{k}$. The torque acting about a point $\vec{r}_2=3\hat{i}-2\hat{j}-3\hat{k}$ is

(1) $42\hat{i}+30\hat{j}-6\hat{k}$ (2) $42\hat{i}+30\hat{j}+6\hat{k}$ (3) $42\hat{i}-30\hat{j}+6\hat{k}$ (4) None

27. The vectors $3\hat{i}-2\hat{j}+\hat{k}$ and $2\hat{i}+6\hat{j}+c\hat{k}$ are perpendicular when

(1) c=6 (2) c=1 (3) c=3 (4) c=8

28. A vector $\vec{A}$ points vertically upward and $\vec{B}$ points towards North. The vector product $\vec{A}\times\vec{B}$ is

(1) Zero (2) Along West (3) Along East (4) Vertically downward

29. A particle of mass m is projected with a velocity V making an angle of 45^0 with the horizontal. The magnitude of the angular momentum of the particle about the point of projection, when the particle is at its maximum height is

(1) Zero (2) $\frac{mV^2}{4\sqrt{2g}}$ (3) $\frac{mV^3}{\sqrt{2g}}$ (4) $m\sqrt{2gh^3}$

Key

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

Hints

23. Component of $\bar{B}$ day $\bar{A}$

$= B\cos\theta$

$= \frac{\bar{A}.\bar{B}}{A}$

$= \frac{6}{\sqrt{4+9}} = \frac{6}{\sqrt{13}}$

24. $(A\cos\theta) = \sqrt{3}(B\cos\theta)$

$\frac{A}{B} = \frac{\sqrt{3}}{1} = \sqrt{3}:1$

25. $\left(\frac{1-\bar{A}.\bar{B}}{1+\bar{A}.\bar{B}}\right) = \frac{1-\cos\theta}{1+\cos\theta} = \frac{\sin^2\theta/2}{\cos^2\theta/2} = Tan^2\frac{\theta}{2}$

26. $\vec{T} = (\vec{r}_1 - \vec{r}_2) \times \vec{F}$

$\Rightarrow (-2\vec{i} + 4\vec{j} + 6\vec{k}) \times (4\vec{i} - 5\vec{j} + 3\vec{k})$

$= 42\vec{i} + 30\vec{j} - 6\vec{k}$

27. Since the vectors are perpendicular

$(3\hat{i} - 2\hat{j} + \hat{k}).(2\hat{i} - 6\hat{j} + c\hat{k}) = 0$

Or 3 x 2 - 2 x 6 + c x 1 = 0 or c = 6

29. The linear momentum at the highest point of the path = m Vcos45^0.

$= \frac{mV}{\sqrt{2}}$

Now, maximum height attained

$= \frac{V^2 \sin^2 45}{2g} = \frac{V^2}{4g}$

$\therefore$ Angular momentum $= \frac{mV}{\sqrt{2}} . \frac{V^2}{4g} = \frac{mV^3}{4\sqrt{2}g}$