EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 07

Time: 30 minutes | Maximum marks: 25

Name: _____ Class: _____ Date: _____

1. There are 25 questions. Each has exactly one correct answer: choose A, B, C or D.
2. Each correct answer carries 1 mark. There is no negative marking.
3. The key sheet and worked solutions are at the end of this test.

1. The unit vector in the direction of $2\bar{i} - 6\bar{j} + 3\bar{k}$ is

A. $-2\bar{i} + 6\bar{j} - 3\bar{k}$ **B.** $\frac{2}{7}\bar{i} - \frac{6}{7}\bar{j} + \frac{3}{7}\bar{k}$
C. $\frac{2}{49}\bar{i} - \frac{6}{49}\bar{j} + \frac{3}{49}\bar{k}$ **D.** $-\frac{2}{7}\bar{i} + \frac{6}{7}\bar{j} - \frac{3}{7}\bar{k}$

2. Among displacement, velocity, energy and weight, the scalar quantity is

A. weight **B.** velocity **C.** energy **D.** displacement

3. $\overline{DN} + \overline{NF} + \overline{FE} + \overline{EL} =$

A. $\overline{LD}$ **B.** $\overline{DE}$ **C.** $\bar{0}$ **D.** $\overline{DL}$

4. If $(\bar{a}, \bar{b}) = 110^\circ$, then $(-\bar{a}, -2\bar{b}) =$

A. 110° **B.** 0° **C.** 70° **D.** 20°

5. If $|\bar{a}| = 4$, then $|3\bar{a}| =$

A. $\frac{4}{3}$ **B.** 7 **C.** -12 **D.** 12

6. If $\bar{r} = -3\bar{i} - 5\bar{j} + 2\bar{k}$, then $|\bar{r}| =$

A. $\sqrt{6}$ **B.** $\sqrt{38}$ **C.** 6 **D.** 38

7. The direction cosines of $2\bar{i} - 6\bar{j} - 9\bar{k}$ are

A. $(2, -6, -9)$ **B.** $(\frac{2}{11}, -\frac{6}{11}, -\frac{9}{11})$
C. $(\frac{2}{121}, -\frac{6}{121}, -\frac{9}{121})$ **D.** $(\frac{2}{17}, -\frac{6}{17}, -\frac{9}{17})$

8. A vector makes angles 120° and 120° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma =$

A. 60° **B.** 90° **C.** 45° **D.** 30°

9. The vectors $p\bar{i} + 12\bar{j} - 18\bar{k}$ and $-6\bar{i} - 4\bar{j} + 6\bar{k}$ are collinear when $p =$

A. 2 **B.** 19 **C.** -18 **D.** 18

10. The points $A(-3, 2, 3)$, $B(-1, 5, 1)$ and $C(p, 14, -5)$ are collinear when $p =$

A. 8 **B.** -11 **C.** 11 **D.** 5

11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(2x - y - 12)\bar{a} + (-2x - 3y + 4)\bar{b} = \bar{0}$, then

A. $x = 5,\ y = 2$ **B.** $x = 5,\ y = -2$ **C.** $x = -5,\ y = 2$ **D.** $x = -2,\ y = 5$

12. The vectors $-3\bar{i} - \bar{j} + \bar{k}$, $-2\bar{i} + 2\bar{j} + \bar{k}$ and $p\bar{i} + \bar{j} + 2\bar{k}$ are coplanar when $p =$

A. -6 **B.** -4 **C.** -5 **D.** 5

13. If the determinant of the components of three vectors is 0, the vectors are

A. linearly independent **B.** mutually perpendicular

C. non-coplanar **D.** coplanar

14. The point dividing the join of $A(-5, 0, 3)$ and $B(-2, 3, 6)$ internally in the ratio $1 : 2$ is

A. $(-8, -3, 0)$ **B.** $(-\frac{7}{2}, \frac{3}{2}, \frac{9}{2})$

C. $(-3, 2, 5)$ **D.** $(-4, 1, 4)$

15. The point dividing the join of $A(5, -5, -2)$ and $B(-5, 6, 4)$ externally in the ratio $3 : 2$ is

A. $(0, \frac{1}{2}, 1)$ **B.** $(-1, \frac{8}{5}, \frac{8}{5})$

C. $(-25, 28, 16)$ **D.** $(25, -27, -14)$

16. The centroid of the triangle with vertices $(0, -1, 5)$, $(2, -2, -1)$ and $(1, -3, 5)$ is

A. $(1, -2, 3)$ **B.** $(\frac{3}{2}, -3, \frac{9}{2})$

C. $(3, -6, 9)$ **D.** $(\frac{3}{4}, -\frac{3}{2}, \frac{9}{4})$

17. The centroid of triangle ABC is $(4, -2, 4)$, $A = (-3, 3, 0)$ and $B = (3, 1, -5)$. Then $C =$

A. $(12, -10, 17)$ **B.** $(4, -6, 9)$ **C.** $(8, -8, 13)$ **D.** $(12, -2, 7)$

18. The point of the line $\bar{r} = (2\bar{i} + \bar{j} - 2\bar{k}) + t(-\bar{i} + 2\bar{j} - 4\bar{k})$ given by $t = 2$ is

A. $(4, -3, 6)$ **B.** $(3, 4, -8)$ **C.** $(1, 3, -6)$ **D.** $(0, 5, -10)$

19. Direction ratios of the line $\frac{x-1}{2} = \frac{y}{1} = \frac{z-2}{-3}$ are

A. $(1, 0, 2)$ **B.** $(2, 1, -3)$ **C.** $(-2, -1, 3)$ **D.** $(-1, 0, -2)$

20. The vector equation of the plane through the point $-\bar{i} - 2\bar{j}$ parallel to $\bar{i} + 4\bar{j} - 3\bar{k}$ and $-2\bar{i} + 3\bar{j} + 2\bar{k}$ is

A. $\bar{r} = (-\bar{i} - 2\bar{j}) + s(\bar{i} + 4\bar{j} - 3\bar{k}) + t(-2\bar{i} + 3\bar{j} + 2\bar{k})$

B. $\bar{r} = s(-\bar{i} - 2\bar{j}) + t(\bar{i} + 4\bar{j} - 3\bar{k}) + -2\bar{i} + 3\bar{j} + 2\bar{k}$

C. $\bar{r} = (1 - s - t)(-\bar{i} - 2\bar{j}) + s(\bar{i} + 4\bar{j} - 3\bar{k}) + t(-2\bar{i} + 3\bar{j} + 2\bar{k})$

D. $\bar{r} = (-\bar{i} - 2\bar{j}) + t(\bar{i} + 4\bar{j} - 3\bar{k} + -2\bar{i} + 3\bar{j} + 2\bar{k})$

21. A vector along the internal bisector of the angle between $-9\bar{i} + 8\bar{j} - 12\bar{k}$ and $12\bar{i} + 4\bar{j} - 3\bar{k}$ is

A. $\frac{3}{2}\bar{i} + 6\bar{j} - \frac{15}{2}\bar{k}$

B. $3\bar{i} + 12\bar{j} - 15\bar{k}$

C. $\frac{87}{221}\bar{i} + \frac{172}{221}\bar{j} - \frac{207}{221}\bar{k}$

D. $-\frac{321}{221}\bar{i} + \frac{36}{221}\bar{j} - \frac{105}{221}\bar{k}$

22. $ABCDEF$ is a regular hexagon with centre O, $\overline{AB} = \bar{a}$ and $\overline{BC} = \bar{b}$. Then $\overline{BC} =$

A. $\bar{b}$ **B.** $-\bar{b}$ **C.** $\bar{a} + \bar{b}$ **D.** $\bar{a}$

23. If $\overline{OA} = \bar{a}$, $\overline{OB} = \bar{b}$ and $\overline{OC} = -\frac{1}{3}\bar{a} + \frac{1}{5}\bar{b}$, then C lies

A. outside the triangle, inside $\angle OBA$ (beyond OA)

B. outside the triangle, inside $\angle OAB$ (beyond OB)

C. outside the triangle, inside $\angle AOB$ (beyond AB)

D. inside triangle OAB

24. When the axes are rotated about the x-axis through 90°, the new components of $(3, -1, 1)$ are

A. $(-1, -1, 3)$ **B.** $(3, -1, 1)$ **C.** $(3, 1, 1)$ **D.** $(3, -1, -1)$

25. Lines through a point P and the vertices of triangle ABC meet BC, CA, AB at D, E, F, with $\frac{BD}{DC} = 2$, $\frac{CE}{EA} = \frac{2}{3}$. Then $\frac{AF}{FB} =$

A. $\frac{3}{4}$ **B.** $\frac{4}{3}$ **C.** 3 **D.** $-\frac{3}{4}$

Key sheet

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

Solutions

1. The unit vector in the direction of $2\bar{i} - 6\bar{j} + 3\bar{k}$ is

$|\bar{a}| = \sqrt{4 + 36 + 9} = 7$

$\frac{\bar{a}}{|\bar{a}|} = \frac{2}{7}\bar{i} - \frac{6}{7}\bar{j} + \frac{3}{7}\bar{k}$

Ans: (B) $\frac{2}{7}\bar{i} - \frac{6}{7}\bar{j} + \frac{3}{7}\bar{k}$

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2. Among displacement, velocity, energy and weight, the scalar quantity is

A scalar has magnitude only; a vector has magnitude and direction.

So the scalar quantity here is energy.

Ans: (C) energy

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3. $\overline{DN} + \overline{NF} + \overline{FE} + \overline{EL} =$

Each vector starts where the previous one ends (triangle law).

So the sum is $\overline{DL}$.

Ans: (D) $\overline{DL}$

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4. If $(\bar{a}, \bar{b}) = 110^\circ$, then $(-\bar{a}, -2\bar{b}) =$

-1 and -2 have the same signs.

So the angle is 110°.

Ans: (A) 110°

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5. If $|\bar{a}| = 4$, then $|3\bar{a}| =$

$|m\bar{a}| = |m|\,|\bar{a}|$

$= 3 \times 4 = 12$

Ans: (D) 12

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6. If $\bar{r} = -3\bar{i} - 5\bar{j} + 2\bar{k}$, then $|\bar{r}| =$

$|\bar{r}| = \sqrt{9 + 25 + 4}$

$= \sqrt{38}$

Ans: (B) $\sqrt{38}$

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7. The direction cosines of $2\bar{i} - 6\bar{j} - 9\bar{k}$ are

$r = \sqrt{4 + 36 + 81} = 11$

Direction cosines $= (\frac{2}{11}, -\frac{6}{11}, -\frac{9}{11})$.

Ans: (B) $(\frac{2}{11}, -\frac{6}{11}, -\frac{9}{11})$

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8. A vector makes angles 120° and 120° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma =$

$\cos^2\gamma = 1 - \cos^2 120^\circ - \cos^2 120^\circ = \frac{1}{2}$

$\Rightarrow \gamma = 45^\circ$

Ans: (C) 45°

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9. The vectors $p\bar{i} + 12\bar{j} - 18\bar{k}$ and $-6\bar{i} - 4\bar{j} + 6\bar{k}$ are collinear when $p =$

$\frac{12}{-4} = \frac{p}{-6}$

$p = 18$

Ans: (D) 18

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10. The points $A(-3, 2, 3)$, $B(-1, 5, 1)$ and $C(p, 14, -5)$ are collinear when $p =$

$\overline{AC} = 4\,\overline{AB}$

$p - (-3) = 4 \times 2 \Rightarrow p = 5$

Ans: (D) 5

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11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(2x - y - 12)\bar{a} + (-2x - 3y + 4)\bar{b} = \bar{0}$, then

Non-collinear $\bar{a}, \bar{b}$: both coefficients must be zero.

$2x - y - 12 = 0,\ -2x - 3y + 4 = 0 \Rightarrow x = 5,\ y = -2$

Ans: (B) $x = 5,\ y = -2$

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12. The vectors $-3\bar{i} - \bar{j} + \bar{k}$, $-2\bar{i} + 2\bar{j} + \bar{k}$ and $p\bar{i} + \bar{j} + 2\bar{k}$ are coplanar when $p =$

$$\begin{vmatrix} -3 & -1 & 1 \\ -2 & 2 & 1 \\ p & 1 & 2 \end{vmatrix} = 0$$

$-3p - 15 = 0 \Rightarrow p = -5$

Ans: (C) -5

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13. If the determinant of the components of three vectors is 0, the vectors are

This is one of the standard results on linear dependence.

The answer is: coplanar.

Ans: (D) coplanar

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14. The point dividing the join of $A(-5, 0, 3)$ and $B(-2, 3, 6)$ internally in the ratio $1 : 2$ is

$\frac{m\bar{b} + n\bar{a}}{m+n} = \frac{1(-2,3,6) + 2(-5,0,3)}{3}$

$= (-4, 1, 4)$

Ans: (D) $(-4, 1, 4)$

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15. The point dividing the join of $A(5, -5, -2)$ and $B(-5, 6, 4)$ externally in the ratio $3 : 2$ is

$\frac{m\bar{b} - n\bar{a}}{m-n} = \frac{3(-5,6,4) - 2(5,-5,-2)}{1}$

$= (-25, 28, 16)$

Ans: (C) $(-25, 28, 16)$

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16. The centroid of the triangle with vertices $(0, -1, 5)$, $(2, -2, -1)$ and $(1, -3, 5)$ is

$G = \frac{\bar{a} + \bar{b} + \bar{c}}{3} = \frac{(3, -6, 9)}{3}$

$= (1, -2, 3)$

Ans: (A) $(1, -2, 3)$

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17. The centroid of triangle ABC is $(4,-2,4)$, $A=(-3,3,0)$ and $B=(3,1,-5)$. Then $C=$

$\bar{c}=3\bar{g}-\bar{a}-\bar{b}$

$=(12,-10,17)$

Ans: (A) $(12,-10,17)$

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18. The point of the line $\bar{r}=(2\bar{i}+\bar{j}-2\bar{k})+t(-\bar{i}+2\bar{j}-4\bar{k})$ given by $t=2$ is

$\bar{r}=(2,1,-2)+2(-1,2,-4)$

$=(0,5,-10)$

Ans: (D) $(0,5,-10)$

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19. Direction ratios of the line $\frac{x-1}{2}=\frac{y}{1}=\frac{z-2}{-3}$ are

In $\frac{x-x_1}{a}=\frac{y-y_1}{b}=\frac{z-z_1}{c}$ the denominators are direction ratios.

So they are $(2,1,-3)$.

Ans: (B) $(2,1,-3)$

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20. The vector equation of the plane through the point $-\bar{i}-2\bar{j}$ parallel to $\bar{i}+4\bar{j}-3\bar{k}$ and $-2\bar{i}+3\bar{j}+2\bar{k}$ is

Through $\bar{a}$ parallel to $\bar{b}$ and $\bar{c}$: $\bar{r}=\bar{a}+s\bar{b}+t\bar{c}$.

Ans: (A) $\bar{r}=(-\bar{i}-2\bar{j})+s(\bar{i}+4\bar{j}-3\bar{k})+t(-2\bar{i}+3\bar{j}+2\bar{k})$

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21. A vector along the internal bisector of the angle between $-9\bar{i}+8\bar{j}-12\bar{k}$ and $12\bar{i}+4\bar{j}-3\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|}+\frac{\bar{b}}{|b|}=\frac{1}{17}(-9\bar{i}+8\bar{j}-12\bar{k})+\frac{1}{13}(12\bar{i}+4\bar{j}-3\bar{k})$

$=\frac{87}{221}\bar{i}+\frac{172}{221}\bar{j}-\frac{207}{221}\bar{k}$

Ans: (C) $\frac{87}{221}\bar{i}+\frac{172}{221}\bar{j}-\frac{207}{221}\bar{k}$

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22. $ABCDEF$ is a regular hexagon with centre O, $\overline{AB}=\bar{a}$ and $\overline{BC}=\bar{b}$. Then $\overline{BC}=$

With A as origin: $B=\bar{a}$, $C=\bar{a}+\bar{b}$, $D=2\bar{b}$, $E=2\bar{b}-\bar{a}$, $F=\bar{b}-\bar{a}$, $O=\bar{b}$.

$\overline{BC}=\bar{b}$

Ans: (A) $\bar{b}$

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23. If $\overline{OA}=\bar{a}$, $\overline{OB}=\bar{b}$ and $\overline{OC}=-\frac{1}{3}\bar{a}+\frac{1}{5}\bar{b}$, then C lies

$p=-\frac{1}{3},\ q=\frac{1}{5},\ p+q=-\frac{2}{15}$

So C lies outside the triangle, inside $\angle OAB$ (beyond OB).

Ans: (B) outside the triangle, inside $\angle OAB$ (beyond OB)

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24. When the axes are rotated about the x-axis through 90°, the new components of $(3,-1,1)$ are

About the x-axis: $(a_1,\ a_2\cos\alpha+a_3\sin\alpha,\ -a_2\sin\alpha+a_3\cos\alpha)$.

With $\alpha=90^\circ$ this gives $(3,1,1)$.

Ans: (C) $(3,1,1)$

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25. Lines through a point P and the vertices of triangle ABC meet BC, CA, AB at D, E, F, with $\frac{BD}{DC} = 2$, $\frac{CE}{EA} = \frac{2}{3}$. Then $\frac{AF}{FB} =$

Ceva: $\frac{BD}{DC} \cdot \frac{CE}{EA} \cdot \frac{AF}{FB} = 1$

$\frac{AF}{FB} = \frac{3}{4}$

Ans: (A) $\frac{3}{4}$
