EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 05

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 vector of magnitude 7 in the direction of $-3\bar{i} - 4\bar{j} - 12\bar{k}$ is

A. $-\frac{21}{13}\bar{i} - \frac{28}{13}\bar{j} - \frac{84}{13}\bar{k}$ **B.** $-21\bar{i} - 28\bar{j} - 84\bar{k}$

C. $-\frac{3}{13}\bar{i} - \frac{4}{13}\bar{j} - \frac{12}{13}\bar{k}$ **D.** $\frac{21}{13}\bar{i} + \frac{28}{13}\bar{j} + \frac{84}{13}\bar{k}$

2. The unit vector in the direction of $12\bar{i} + 16\bar{j} - 15\bar{k}$ is

A. $\frac{12}{625}\bar{i} + \frac{16}{625}\bar{j} - \frac{3}{125}\bar{k}$ **B.** $\frac{12}{13}\bar{i} + \frac{16}{13}\bar{j} - \frac{15}{13}\bar{k}$

C. $\frac{12}{25}\bar{i} + \frac{16}{25}\bar{j} - \frac{3}{5}\bar{k}$ **D.** $-\frac{12}{25}\bar{i} - \frac{16}{25}\bar{j} + \frac{3}{5}\bar{k}$

3. If $\overline{OA} = -4\bar{i} + 5\bar{j}$ and $\overline{OB} = \bar{i} - 2\bar{j} + 4\bar{k}$, then $\overline{AB} =$

A. $-\frac{3}{2}\bar{i} + \frac{3}{2}\bar{j} + 2\bar{k}$ **B.** $-3\bar{i} + 3\bar{j} + 4\bar{k}$

C. $-5\bar{i} + 7\bar{j} - 4\bar{k}$ **D.** $5\bar{i} - 7\bar{j} + 4\bar{k}$

4. If $(\bar{a}, \bar{b}) = 15^\circ$, then $(6\bar{a}, 5\bar{b}) =$

A. 15° **B.** 0° **C.** 75° **D.** 165°

5. If $|\bar{a}| = 3$, then $|7\bar{a}| =$

A. 10 **B.** 21 **C.** -21 **D.** $\frac{3}{7}$

6. The position vector of the point $P(-2, -3, 0)$ is

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

7. If $l = -\frac{19}{21}$ and $m = -\frac{4}{21}$ are two direction cosines of a line, then $n =$

A. $\pm\frac{64}{441}$ **B.** $\pm\frac{8}{21}$ **C.** $\frac{44}{21}$ **D.** $\frac{29}{21}$

8. The direction cosines of $3\bar{i} - 4\bar{k}$ are

A. $(\frac{3}{7}, 0, -\frac{4}{7})$ **B.** $(3, 0, -4)$

C. $(\frac{3}{25}, 0, -\frac{4}{25})$ **D.** $(\frac{3}{5}, 0, -\frac{4}{5})$

9. The vectors $p\bar{i} + 12\bar{j} - 6\bar{k}$ and $-5\bar{i} - 6\bar{j} + 3\bar{k}$ are collinear when $p =$

A. 10 **B.** 11 **C.** -10 **D.** $\frac{5}{2}$

10. The points $A(-1, 4, 5)$, $B(-2, 3, 5)$ and $C(p, 0, 5)$ are collinear when $p =$

A. 3 **B.** -5 **C.** -3 **D.** -4

11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(-2x+3y+25)\bar{a}+(-x+2y+15)\bar{b}=\bar{0}$, then

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

12. The vectors $3\bar{i}-2\bar{j}+\bar{k}$, $-3\bar{i}+3\bar{j}-2\bar{k}$ and $-12\bar{i}+p\bar{j}-6\bar{k}$ are coplanar when $p=$

A. -10 **B.** 9 **C.** 11 **D.** 10

13. A subset of a linearly independent system of vectors is

A. always the null vector **B.** linearly independent

C. always collinear **D.** linearly dependent

14. The point dividing the join of $A(-4,6,-4)$ and $B(5,-3,-4)$ internally in the ratio $2:1$ is

A. $(2,0,-4)$ **B.** $(-1,3,-4)$

C. $(\frac{1}{2},\frac{3}{2},-4)$ **D.** $(14,-12,-4)$

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

A. $(-\frac{4}{5},1,\frac{3}{5})$ **B.** $(-6,1,24)$

C. $(4,1,-21)$ **D.** $(-1,1,\frac{3}{2})$

16. The centroid of the triangle with vertices $(-5,1,4)$, $(0,4,-5)$ and $(5,4,-5)$ is

A. $(0,\frac{9}{2},-3)$ **B.** $(0,\frac{9}{4},-\frac{3}{2})$

C. $(0,3,-2)$ **D.** $(0,9,-6)$

17. The centroid of triangle ABC is $(1,-2,1)$, $A=(1,0,1)$ and $B=(5,6,3)$. Then $C=$

A. $(-4,-10,-2)$ **B.** $(-3,-12,-1)$ **C.** $(9,0,7)$ **D.** $(-5,-8,-3)$

18. The line through $A(1,-1,3)$ and $B(3,-4,1)$ is

A. $\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z-3}{-2}$ **B.** $\frac{x-1}{3}=\frac{y+1}{-4}=\frac{z-3}{1}$

C. $\frac{x-2}{1}=\frac{y+3}{-1}=\frac{z+2}{3}$ **D.** $\frac{x+1}{2}=\frac{y-1}{-3}=\frac{z+3}{-2}$

19. The point of the line $\bar{r}=(4\bar{i}+5\bar{j}+\bar{k})+t(-\bar{i}-\bar{j}-4\bar{k})$ given by $t=4$ is

A. $(15,19,0)$ **B.** $(0,1,-15)$ **C.** $(3,4,-3)$ **D.** $(8,9,17)$

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

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

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

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

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

21. A vector along the internal bisector of the angle between $-15\bar{i}+8\bar{k}$ and $-12\bar{i}-16\bar{j}+15\bar{k}$ is

A. $-\frac{579}{425}\bar{i}-\frac{16}{25}\bar{j}+\frac{91}{85}\bar{k}$ **B.** $-\frac{171}{425}\bar{i}+\frac{16}{25}\bar{j}-\frac{11}{85}\bar{k}$

C. $-27\bar{i}-16\bar{j}+23\bar{k}$ **D.** $-\frac{27}{2}\bar{i}-8\bar{j}+\frac{23}{2}\bar{k}$

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

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

23. If $\overline{OA} = \bar{a}$, $\overline{OB} = \bar{b}$ and $\overline{OC} = \frac{3}{4}\bar{a} + \frac{5}{3}\bar{b}$, then C lies

A. inside triangle OAB

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

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

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

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

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

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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 $\frac{BD}{DC} = \frac{3}{4}$, $\frac{CE}{EA} = 2$. Then $\frac{AF}{FB} =$

A. $-\frac{2}{3}$ **B.** $\frac{3}{8}$ **C.** $\frac{2}{3}$ **D.** $\frac{3}{2}$

Key sheet

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

Solutions

1. The vector of magnitude 7 in the direction of $-3\bar{i} - 4\bar{j} - 12\bar{k}$ is

$|\bar{a}| = 13$

$\frac{7\bar{a}}{|\bar{a}|} = -\frac{21}{13}\bar{i} - \frac{28}{13}\bar{j} - \frac{84}{13}\bar{k}$

Ans: (A) $-\frac{21}{13}\bar{i} - \frac{28}{13}\bar{j} - \frac{84}{13}\bar{k}$

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2. The unit vector in the direction of $12\bar{i} + 16\bar{j} - 15\bar{k}$ is

$|\bar{a}| = \sqrt{144 + 256 + 225} = 25$

$\frac{\bar{a}}{|\bar{a}|} = \frac{12}{25}\bar{i} + \frac{16}{25}\bar{j} - \frac{3}{5}\bar{k}$

Ans: (C) $\frac{12}{25}\bar{i} + \frac{16}{25}\bar{j} - \frac{3}{5}\bar{k}$

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3. If $\overline{OA} = -4\bar{i} + 5\bar{j}$ and $\overline{OB} = \bar{i} - 2\bar{j} + 4\bar{k}$, then $\overline{AB} =$

$\overline{AB} = \overline{OB} - \overline{OA}$

$= 5\bar{i} - 7\bar{j} + 4\bar{k}$

Ans: (D) $5\bar{i} - 7\bar{j} + 4\bar{k}$

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4. If $(\bar{a}, \bar{b}) = 15^\circ$, then $(6\bar{a}, 5\bar{b}) =$

6 and 5 have the same signs.

So the angle is 15°.

Ans: (A) 15°

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5. If $|\bar{a}| = 3$, then $|7\bar{a}| =$

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

$= 7 \times 3 = 21$

Ans: (B) 21

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6. The position vector of the point $P(-2, -3, 0)$ is

$P(x, y, z) \Rightarrow \overline{OP} = x\bar{i} + y\bar{j} + z\bar{k}$

$= -2\bar{i} - 3\bar{j}$

Ans: (C) $-2\bar{i} - 3\bar{j}$

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7. If $l = -\frac{19}{21}$ and $m = -\frac{4}{21}$ are two direction cosines of a line, then $n =$

$l^2 + m^2 + n^2 = 1$

$n^2 = 1 - \frac{361}{441} - \frac{16}{441} = \frac{64}{441} \Rightarrow n = \pm\frac{8}{21}$

Ans: (B) $\pm\frac{8}{21}$

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8. The direction cosines of $3\bar{i} - 4\bar{k}$ are

$r = \sqrt{9 + 0 + 16} = 5$

Direction cosines $= (\frac{3}{5}, 0, -\frac{4}{5})$.

Ans: (D) $(\frac{3}{5}, 0, -\frac{4}{5})$

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9. The vectors $p\bar{i} + 12\bar{j} - 6\bar{k}$ and $-5\bar{i} - 6\bar{j} + 3\bar{k}$ are collinear when $p =$

$\frac{12}{-6} = \frac{p}{-5}$

$p = 10$

Ans: (A) 10

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10. The points $A(-1, 4, 5)$, $B(-2, 3, 5)$ and $C(p, 0, 5)$ are collinear when $p =$

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

$p - (-1) = 4 \times (-1) \Rightarrow p = -5$

Ans: (B) -5

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11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(-2x + 3y + 25)\bar{a} + (-x + 2y + 15)\bar{b} = \bar{0}$, then

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

$-2x + 3y + 25 = 0,\ -x + 2y + 15 = 0 \Rightarrow x = 5,\ y = -5$

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

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12. The vectors $3\bar{i} - 2\bar{j} + \bar{k}$, $-3\bar{i} + 3\bar{j} - 2\bar{k}$ and $-12\bar{i} + p\bar{j} - 6\bar{k}$ are coplanar when $p =$

$$\begin{vmatrix} 3 & -2 & 1 \\ -3 & 3 & -2 \\ -12 & p & -6 \end{vmatrix} = 0$$

$3p - 30 = 0 \Rightarrow p = 10$

Ans: (D) 10

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13. A subset of a linearly independent system of vectors is

This is one of the standard results on linear dependence.

The answer is: linearly independent.

Ans: (B) linearly independent

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14. The point dividing the join of $A(-4, 6, -4)$ and $B(5, -3, -4)$ internally in the ratio $2 : 1$ is

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

$= (2, 0, -4)$

Ans: (A) $(2, 0, -4)$

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

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

$= (4, 1, -21)$

Ans: (C) $(4, 1, -21)$

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16. The centroid of the triangle with vertices $(-5, 1, 4)$, $(0, 4, -5)$ and $(5, 4, -5)$ is

$G = \frac{\bar{a} + \bar{b} + \bar{c}}{3} = \frac{(0,9,-6)}{3}$

$= (0, 3, -2)$

Ans: (C) $(0, 3, -2)$

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17. The centroid of triangle ABC is $(1,-2,1)$, $A=(1,0,1)$ and $B=(5,6,3)$. Then $C=$

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

$=(-3,-12,-1)$

Ans: (B) $(-3,-12,-1)$

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18. The line through $A(1,-1,3)$ and $B(3,-4,1)$ is

$\overline{AB}=(2,-3,-2)$

Line: $\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z-3}{-2}$

Ans: (A) $\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z-3}{-2}$

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19. The point of the line $\bar{r}=(4\bar{i}+5\bar{j}+\bar{k})+t(-\bar{i}-\bar{j}-4\bar{k})$ given by $t=4$ is

$\bar{r}=(4,5,1)+4(-1,-1,-4)$

$=(0,1,-15)$

Ans: (B) $(0,1,-15)$

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

Through three points: $\bar{r}=(1-s-t)\bar{a}+s\bar{b}+t\bar{c}$.

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

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21. A vector along the internal bisector of the angle between $-15\bar{i}+8\bar{k}$ and $-12\bar{i}-16\bar{j}+15\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|}+\frac{\bar{b}}{|\bar{b}|}=\frac{1}{17}(-15\bar{i}+8\bar{k})+\frac{1}{25}(-12\bar{i}-16\bar{j}+15\bar{k})$

$=-\frac{579}{425}\bar{i}-\frac{16}{25}\bar{j}+\frac{91}{85}\bar{k}$

Ans: (A) $-\frac{579}{425}\bar{i}-\frac{16}{25}\bar{j}+\frac{91}{85}\bar{k}$

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

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

$\overline{OE}=-\bar{a}+\bar{b}$

Ans: (B) $-\bar{a}+\bar{b}$

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23. If $\overline{OA}=\bar{a}$, $\overline{OB}=\bar{b}$ and $\overline{OC}=\frac{3}{4}\bar{a}+\frac{5}{3}\bar{b}$, then C lies

$p=\frac{3}{4},\ q=\frac{5}{3},\ p+q=\frac{29}{12}$

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

Ans: (D) outside the triangle, inside $\angle AOB$ (beyond AB)

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

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

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

Ans: (D) $(-3,1,1)$

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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 $\frac{BD}{DC} = \frac{3}{4}$, $\frac{CE}{EA} = 2$. Then $\frac{AF}{FB} =$

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

$\frac{AF}{FB} = \frac{2}{3}$

Ans: (C) $\frac{2}{3}$
