EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 08

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 75 in the direction of $10\bar{i} - 11\bar{j} + 2\bar{k}$ is

A. $\frac{2}{3}\bar{i} - \frac{11}{15}\bar{j} + \frac{2}{15}\bar{k}$ **B.** $750\bar{i} - 825\bar{j} + 150\bar{k}$

C. $50\bar{i} - 55\bar{j} + 10\bar{k}$ **D.** $-50\bar{i} + 55\bar{j} - 10\bar{k}$

2. The unit vector in the direction of $15\bar{i} - 8\bar{j}$ is

A. $-\frac{15}{17}\bar{i} + \frac{8}{17}\bar{j}$ **B.** $\frac{15}{289}\bar{i} - \frac{8}{289}\bar{j}$

C. $\frac{15}{17}\bar{i} - \frac{8}{17}\bar{j}$ **D.** $\frac{15}{7}\bar{i} - \frac{8}{7}\bar{j}$

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

A. $-\bar{i} - 6\bar{j} - 5\bar{k}$ **B.** $\bar{i} + 6\bar{j} + 5\bar{k}$

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

4. If $(\bar{a}, \bar{b}) = 15^\circ$, then $(-\bar{a}, 2\bar{b}) =$

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

5. If $|\bar{a}| = 5$, then $|-2\bar{a}| =$

A. 10 **B.** -10 **C.** $\frac{5}{2}$ **D.** 7

6. The position vector of the point $P(-1, 3, -1)$ is

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

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

7. If $l = \frac{8}{9}$ and $m = \frac{4}{9}$ are two direction cosines of a line, then $n =$

A. $-\frac{1}{3}$ **B.** $\frac{10}{9}$ **C.** $\pm\frac{1}{81}$ **D.** $\pm\frac{1}{9}$

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

A. $(0, -\frac{3}{25}, \frac{4}{25})$ **B.** $(0, -3, 4)$

C. $(0, -\frac{3}{7}, \frac{4}{7})$ **D.** $(0, -\frac{3}{5}, \frac{4}{5})$

9. The vectors $6\bar{i} + p\bar{j} + 15\bar{k}$ and $2\bar{i} + 2\bar{j} + 5\bar{k}$ are collinear when $p =$

A. -6 **B.** 6 **C.** $\frac{2}{3}$ **D.** 7

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

A. 2 **B.** 3 **C.** -1 **D.** 1

11. If $12\bar{i}+20\bar{j}=x(\bar{i}+3\bar{j})+y(2\bar{i}+2\bar{j})$, then

A. $x=-4,\ y=4$ **B.** $x=-4,\ y=-4$ **C.** $x=4,\ y=-4$ **D.** $x=4,\ y=4$

12. The vectors $-2\bar{i}-2\bar{j}$, $3\bar{i}-2\bar{j}+3\bar{k}$ and $p\bar{i}+4\bar{j}-3\bar{k}$ are coplanar when $p=$

A. 0 **B.** 1 **C.** -2 **D.** -1

13. Any two non-collinear vectors are

A. parallel **B.** linearly dependent

C. linearly independent **D.** of equal length

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

A. $(\frac{5}{2},-\frac{3}{2},5)$ **B.** $(3,-1,5)$

C. $(-22,-26,5)$ **D.** $(2,-2,5)$

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

A. $(-8,2,-7)$ **B.** $(1,5,8)$

C. $(-\frac{7}{2},\frac{7}{2},\frac{1}{2})$ **D.** $(-3,\frac{11}{3},\frac{4}{3})$

16. The centroid of the tetrahedron with vertices $(3,-3,3)$, $(6,0,2)$, $(2,0,2)$ and $(1,3,1)$ is

A. $(3,0,2)$ **B.** $(4,0,\frac{8}{3})$ **C.** $(12,0,8)$ **D.** $(6,0,4)$

17. The centroid of tetrahedron $ABCD$ is $(2,4,0)$, and $A=(-3,0,5)$, $B=(4,-4,-1)$, $C=(1,6,0)$. Then $D=$

A. $(6,14,-4)$ **B.** $(4,10,-4)$ **C.** $(10,18,4)$ **D.** $(0,2,-4)$

18. The line through $A(0,2,4)$ and $B(-4,-1,7)$ is

A. $\frac{x+4}{0}=\frac{y+3}{2}=\frac{z-3}{4}$ **B.** $\frac{x}{-4}=\frac{y-2}{-1}=\frac{z-4}{7}$

C. $\frac{x}{-4}=\frac{y+2}{-3}=\frac{z+4}{3}$ **D.** $\frac{x}{-4}=\frac{y-2}{-3}=\frac{z-4}{3}$

19. The point of the line $\bar{r}=(-3\bar{i}-3\bar{j}+3\bar{k})+t(3\bar{i}+3\bar{j}+\bar{k})$ given by $t=-2$ is

A. $(0,0,4)$ **B.** $(-9,-9,1)$ **C.** $(3,3,5)$ **D.** $(9,9,-5)$

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

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

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

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

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

21. A vector along the internal bisector of the angle between $-8\bar{i}+15\bar{j}$ and $-8\bar{i}-\bar{j}+4\bar{k}$ is

A. $-16\bar{i}+14\bar{j}+4\bar{k}$ **B.** $\frac{64}{153}\bar{i}+\frac{152}{153}\bar{j}-\frac{4}{9}\bar{k}$

C. $-\frac{208}{153}\bar{i}+\frac{118}{153}\bar{j}+\frac{4}{9}\bar{k}$ **D.** $-8\bar{i}+7\bar{j}+2\bar{k}$

22. The orthocentre of the triangle with vertices $(0, 3, -4)$, $(0, 3, -2)$ and $(0, 5, -4)$ is

A. $(0, \frac{11}{3}, -\frac{10}{3})$ **B.** $(0, 3, -4)$

C. $(0, 3, -2)$ **D.** $(0, 4, -3)$

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23. In parallelogram $ABCD$, $\overline{AC} = 4\bar{i} - \bar{j} + 2\bar{k}$ and $\overline{BD} = 4\bar{i} + 3\bar{j} - 2\bar{k}$. Then $\overline{AB} =$

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

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24. When the axes are rotated about the y-axis through 90°, the new components of $(3, 1, 0)$ are

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

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25. A transversal cuts BC, CA, AB of triangle ABC at D, E, F with signed ratios $\frac{BD}{DC} = -\frac{3}{4}$, $\frac{CE}{EA} = \frac{3}{5}$. Then $\frac{AF}{FB} =$

A. $-\frac{20}{9}$ **B.** $-\frac{9}{20}$ **C.** $\frac{9}{20}$ **D.** $\frac{20}{9}$

Key sheet

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

Solutions

1. The vector of magnitude 75 in the direction of $10\bar{i} - 11\bar{j} + 2\bar{k}$ is

$|\bar{a}| = 15$

$\frac{75\,\bar{a}}{|\bar{a}|} = 50\bar{i} - 55\bar{j} + 10\bar{k}$

Ans: (C) $50\bar{i} - 55\bar{j} + 10\bar{k}$

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2. The unit vector in the direction of $15\bar{i} - 8\bar{j}$ is

$|\bar{a}| = \sqrt{225 + 64 + 0} = 17$

$\frac{\bar{a}}{|\bar{a}|} = \frac{15}{17}\bar{i} - \frac{8}{17}\bar{j}$

Ans: (C) $\frac{15}{17}\bar{i} - \frac{8}{17}\bar{j}$

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

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

$= -\bar{i} - 6\bar{j} - 5\bar{k}$

Ans: (A) $-\bar{i} - 6\bar{j} - 5\bar{k}$

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4. If $(\bar{a}, \bar{b}) = 15^\circ$, then $(-\bar{a}, 2\bar{b}) =$

-1 and 2 have opposite signs.

So the angle is $180^\circ - 15^\circ = 165^\circ$.

Ans: (B) 165°

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5. If $|\bar{a}| = 5$, then $|-2\bar{a}| =$

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

$= 2 \times 5 = 10$

Ans: (A) 10

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6. The position vector of the point $P(-1, 3, -1)$ is

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

$= -\bar{i} + 3\bar{j} - \bar{k}$

Ans: (A) $-\bar{i} + 3\bar{j} - \bar{k}$

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7. If $l = \frac{8}{9}$ and $m = \frac{4}{9}$ are two direction cosines of a line, then $n =$

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

$n^2 = 1 - \frac{64}{81} - \frac{16}{81} = \frac{1}{81} \Rightarrow n = \pm\frac{1}{9}$

Ans: (D) $\pm\frac{1}{9}$

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

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

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

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

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9. The vectors $6\bar{i} + p\bar{j} + 15\bar{k}$ and $2\bar{i} + 2\bar{j} + 5\bar{k}$ are collinear when $p =$

$\frac{15}{5} = \frac{p}{2}$

$p = 6$

Ans: (B) 6

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

$\overline{AC} = -1\,\overline{AB}$

$p - (1) = -1 \times (-2) \Rightarrow p = 3$

Ans: (B) 3

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11. If $12\bar{i} + 20\bar{j} = x(\bar{i} + 3\bar{j}) + y(2\bar{i} + 2\bar{j})$, then

Compare the coefficients of $\bar{i}$ and $\bar{j}$:

$x + 2y = 12,\ 3x + 2y = 20 \Rightarrow x = 4,\ y = 4$

Ans: (D) $x = 4,\ y = 4$

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12. The vectors $-2\bar{i} - 2\bar{j}$, $3\bar{i} - 2\bar{j} + 3\bar{k}$ and $p\bar{i} + 4\bar{j} - 3\bar{k}$ are coplanar when $p =$

$$\begin{vmatrix} -2 & -2 & 0 \\ 3 & -2 & 3 \\ p & 4 & -3 \end{vmatrix} = 0$$

$-6p - 6 = 0 \Rightarrow p = -1$

Ans: (D) -1

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13. Any two non-collinear vectors are

This is one of the standard results on linear dependence.

The answer is: linearly independent.

Ans: (C) linearly independent

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

$\frac{m\bar{b} + n\bar{a}}{m+n} = \frac{3(6,2,5) + 4(-1,-5,5)}{7}$

$= (2, -2, 5)$

Ans: (D) $(2, -2, 5)$

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

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

$= (1, 5, 8)$

Ans: (B) $(1, 5, 8)$

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16. The centroid of the tetrahedron with vertices $(3, -3, 3)$, $(6, 0, 2)$, $(2, 0, 2)$ and $(1, 3, 1)$ is

$\frac{\bar{a} + \bar{b} + \bar{c} + \bar{d}}{4} = \frac{(12,0,8)}{4}$

$= (3, 0, 2)$

Ans: (A) $(3, 0, 2)$

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17. The centroid of tetrahedron $ABCD$ is $(2,4,0)$, and $A=(-3,0,5)$, $B=(4,-4,-1)$, $C=(1,6,0)$. Then $D=$

$\bar{d}=4\bar{g}-\bar{a}-\bar{b}-\bar{c}$

$=(6,14,-4)$

Ans: (A) $(6,14,-4)$

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18. The line through $A(0,2,4)$ and $B(-4,-1,7)$ is

$\overline{AB}=(-4,-3,3)$

Line: $\frac{x}{-4}=\frac{y-2}{-3}=\frac{z-4}{3}$

Ans: (D) $\frac{x}{-4}=\frac{y-2}{-3}=\frac{z-4}{3}$

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19. The point of the line $\bar{r}=(-3\bar{i}-3\bar{j}+3\bar{k})+t(3\bar{i}+3\bar{j}+\bar{k})$ given by $t=-2$ is

$\bar{r}=(-3,-3,3)+-2(3,3,1)$

$=(-9,-9,1)$

Ans: (B) $(-9,-9,1)$

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

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

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

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21. A vector along the internal bisector of the angle between $-8\bar{i}+15\bar{j}$ and $-8\bar{i}-\bar{j}+4\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|}+\frac{\bar{b}}{|\bar{b}|}=\frac{1}{17}(-8\bar{i}+15\bar{j})+\frac{1}{9}(-8\bar{i}-\bar{j}+4\bar{k})$

$=-\frac{208}{153}\bar{i}+\frac{118}{153}\bar{j}+\frac{4}{9}\bar{k}$

Ans: (C) $-\frac{208}{153}\bar{i}+\frac{118}{153}\bar{j}+\frac{4}{9}\bar{k}$

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22. The orthocentre of the triangle with vertices $(0,3,-4)$, $(0,3,-2)$ and $(0,5,-4)$ is

$\overline{AB}$ is along $\bar{k}$ and $\overline{AC}$ along $\bar{j}$, so the right angle is at A.

The orthocentre of a right angled triangle is the right angled vertex $(0,3,-4)$.

Ans: (B) $(0,3,-4)$

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23. In parallelogram $ABCD$, $\overline{AC}=4\bar{i}-\bar{j}+2\bar{k}$ and $\overline{BD}=4\bar{i}+3\bar{j}-2\bar{k}$. Then $\overline{AB}=$

$\overline{AB}=\frac{\overline{AC}-\overline{BD}}{2}$

$=-2\bar{j}+2\bar{k}$

Ans: (C) $-2\bar{j}+2\bar{k}$

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24. When the axes are rotated about the y-axis through 90°, the new components of $(3,1,0)$ 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 $(0,1,3)$.

Ans: (A) $(0,1,3)$

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25. A transversal cuts BC, CA, AB of triangle ABC at D, E, F with signed ratios $\frac{BD}{DC} = -\frac{3}{4}$, $\frac{CE}{EA} = \frac{3}{5}$. Then $\frac{AF}{FB} =$

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

$\frac{AF}{FB} = \frac{20}{9}$

Ans: (D) $\frac{20}{9}$