EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 06

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. Among length, velocity, displacement and force, the scalar quantity is

A. force **B.** length **C.** displacement **D.** velocity

2. The vector of magnitude 6 in the direction of $-12\bar{i} - \bar{j} - 12\bar{k}$ is

A. $\frac{72}{17}\bar{i} + \frac{6}{17}\bar{j} + \frac{72}{17}\bar{k}$ **B.** $-\frac{12}{17}\bar{i} - \frac{1}{17}\bar{j} - \frac{12}{17}\bar{k}$

C. $-72\bar{i} - 6\bar{j} - 72\bar{k}$ **D.** $-\frac{72}{17}\bar{i} - \frac{6}{17}\bar{j} - \frac{72}{17}\bar{k}$

3. If $|\bar{a}| = 11$ and $|\bar{b}| = 8$, the least possible value of $|\bar{a} - \bar{b}|$ is

A. 19 **B.** $\sqrt{185}$ **C.** 0 **D.** 3

4. If $(\bar{a}, \bar{b}) = 40^\circ$, then $(-5\bar{a}, -5\bar{b}) =$

A. 140° **B.** 0° **C.** 40° **D.** 50°

5. If $|\bar{a}| = 7$, then $|-6\bar{a}| =$

A. $\frac{7}{6}$ **B.** 13 **C.** -42 **D.** 42

6. The scalar components of $5\bar{i} - 5\bar{j} - 6\bar{k}$ along the x, y and z axes are

A. $-6, -5, 5$ **B.** $5, -5, -6$ **C.** $-5, 5, 6$ **D.** $5, 5, 6$

7. A vector makes angles 45° and 60° 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°

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

A. $\frac{2}{3}$ **B.** $\pm\frac{4}{9}$ **C.** $\frac{13}{9}$ **D.** $\pm\frac{16}{81}$

9. The vectors $-12\bar{i} - 4\bar{j} + p\bar{k}$ and $-6\bar{i} - 2\bar{j} - 4\bar{k}$ are collinear when $p =$

A. -8 **B.** -7 **C.** 8 **D.** -2

10. The points $A(-2, 5, 2)$, $B(0, 6, 1)$ and $C(-6, p, 4)$ are collinear when $p =$

A. -7 **B.** -2 **C.** 7 **D.** 3

11. If $-8\bar{i} - 10\bar{j} = x(-2\bar{i} - 2\bar{j}) + y(2\bar{i} + 4\bar{j})$, then

A. $x = 3,\ y = 1$ **B.** $x = -3,\ y = 1$ **C.** $x = 3,\ y = -1$ **D.** $x = -1,\ y = 3$

12. The vectors $3\bar{i} - 3\bar{j} - 2\bar{k}$, $-2\bar{i} + \bar{j} - 2\bar{k}$ and $-4\bar{i} + 5\bar{j} + p\bar{k}$ are coplanar when $p =$

A. 6 **B.** -6 **C.** 5 **D.** 7

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13. A superset of a linearly dependent system of vectors is

A. linearly independent **B.** always non-coplanar

C. always orthonormal **D.** linearly dependent

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14. The point dividing the join of $A(0, -2, 5)$ and $B(-3, 4, -1)$ internally in the ratio $2 : 1$ is

A. $(-1, 0, 3)$ **B.** $(-2, 2, 1)$ **C.** $(-\frac{3}{2}, 1, 2)$ **D.** $(-6, 10, -7)$

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

A. $(-12, -7, -1)$ **B.** $(9, 5, -7)$

C. $(-\frac{3}{2}, -1, -4)$ **D.** $(-\frac{8}{3}, -\frac{5}{3}, -\frac{11}{3})$

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16. The centroid of the tetrahedron with vertices $(-2, -4, 4)$, $(-4, 5, 0)$, $(1, -3, 3)$ and $(5, 6, 1)$ is

A. $(0, \frac{4}{3}, \frac{8}{3})$ **B.** $(0, 1, 2)$

C. $(0, 4, 8)$ **D.** $(0, 2, 4)$

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

A. $(1, 7, -9)$ **B.** $(13, 13, -3)$ **C.** $(9, 11, -5)$ **D.** $(19, 3, 19)$

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

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

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19. The line through $A(-3, 3, -1)$ and $B(-2, 4, -2)$ is

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

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

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20. On the plane $\bar{r} = (1 - s - t)(-3\bar{i} + \bar{j} - 3\bar{k}) + s(\bar{j} + \bar{k}) + t(3\bar{i} - \bar{j} + \bar{k})$, the point with $s = 1$, $t = 2$ is

A. $(12, -3, 9)$ **B.** $(-18, 5, -15)$ **C.** $(6, -1, 3)$ **D.** $(3, 0, 0)$

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21. A vector along the internal bisector of the angle between $8\bar{i} + 9\bar{j} - 12\bar{k}$ and $-8\bar{i} + 4\bar{j} + 19\bar{k}$ is

A. $13\bar{j} + 7\bar{k}$

B. $\frac{13}{2}\bar{j} + \frac{7}{2}\bar{k}$

C. $\frac{304}{357}\bar{i} + \frac{121}{357}\bar{j} - \frac{575}{357}\bar{k}$

D. $\frac{32}{357}\bar{i} + \frac{257}{357}\bar{j} + \frac{71}{357}\bar{k}$

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22. The circumcentre of the triangle with vertices $(-3, 1, 5)$, $(-3, 1, 10)$ and $(-3, 3, 5)$ is

A. $(-3, 2, 5)$ **B.** $(-3, 2, \frac{15}{2})$

C. $(-3, \frac{5}{3}, \frac{20}{3})$ **D.** $(-3, 1, 5)$

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

A. $2\bar{i} - 2\bar{k}$ **B.** $-2\bar{i} + 2\bar{k}$

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

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24. When the axes are rotated about the z-axis through 45°, the new components of $(3, 4, 5)$ are

A. $(3, \frac{9\sqrt{2}}{2}, \frac{\sqrt{2}}{2})$ **B.** $(-\frac{\sqrt{2}}{2}, \frac{7\sqrt{2}}{2}, 5)$

C. $(\frac{7\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 5)$ **D.** $(\frac{\sqrt{2}}{2}, -\frac{7\sqrt{2}}{2}, 5)$

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25. A transversal cuts BC, CA, AB of triangle ABC at D, E, F with signed ratios $\frac{BD}{DC} = -\frac{1}{3}$, $\frac{CE}{EA} = \frac{4}{5}$. Then $\frac{AF}{FB} =$

A. $-\frac{4}{15}$ **B.** $-\frac{15}{4}$ **C.** $\frac{15}{4}$ **D.** $\frac{4}{15}$

Key sheet

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

Solutions

1. Among length, velocity, displacement and force, the scalar quantity is

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

So the scalar quantity here is length.

Ans: (B) length

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2. The vector of magnitude 6 in the direction of $-12\bar{i}-\bar{j}-12\bar{k}$ is

$|\bar{a}|=17$

$\frac{6\,\bar{a}}{|\bar{a}|}=-\frac{72}{17}\bar{i}-\frac{6}{17}\bar{j}-\frac{72}{17}\bar{k}$

Ans: (D) $-\frac{72}{17}\bar{i}-\frac{6}{17}\bar{j}-\frac{72}{17}\bar{k}$

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3. If $|\bar{a}|=11$ and $|\bar{b}|=8$, the least possible value of $|\bar{a}-\bar{b}|$ is

$|\bar{a}-\bar{b}|\geq\big||\bar{a}|-|\bar{b}|\big|$

$=|11-8|=3$

Ans: (D) 3

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4. If $(\bar{a},\bar{b})=40^\circ$, then $(-5\bar{a},-5\bar{b})=$

-5 and -5 have the same signs.

So the angle is 40°.

Ans: (C) 40°

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5. If $|\bar{a}|=7$, then $|-6\bar{a}|=$

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

$=6\times7=42$

Ans: (D) 42

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6. The scalar components of $5\bar{i}-5\bar{j}-6\bar{k}$ along the x, y and z axes are

For $x\bar{i}+y\bar{j}+z\bar{k}$ the scalar components are x, y, z.

Here they are $5, -5, -6$.

Ans: (B) $5, -5, -6$

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7. A vector makes angles 45° and 60° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma=$

$\cos^2\gamma=1-\cos^2 45^\circ-\cos^2 60^\circ=\frac{1}{4}$

$\Rightarrow\gamma=60^\circ$

Ans: (A) 60°

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

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

$n^2=1-\frac{49}{81}-\frac{16}{81}=\frac{16}{81}\Rightarrow n=\pm\frac{4}{9}$

Ans: (B) $\pm\frac{4}{9}$

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9. The vectors $-12\bar{i} - 4\bar{j} + p\bar{k}$ and $-6\bar{i} - 2\bar{j} - 4\bar{k}$ are collinear when $p =$

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

$p = -8$

Ans: (A) -8

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10. The points $A(-2, 5, 2)$, $B(0, 6, 1)$ and $C(-6, p, 4)$ are collinear when $p =$

$\overline{AC} = -2\,\overline{AB}$

$p - (5) = -2 \times 1 \Rightarrow p = 3$

Ans: (D) 3

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11. If $-8\bar{i} - 10\bar{j} = x(-2\bar{i} - 2\bar{j}) + y(2\bar{i} + 4\bar{j})$, then

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

$-2x + 2y = -8,\ -2x + 4y = -10 \Rightarrow x = 3,\ y = -1$

Ans: (C) $x = 3,\ y = -1$

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12. The vectors $3\bar{i} - 3\bar{j} - 2\bar{k}$, $-2\bar{i} + \bar{j} - 2\bar{k}$ and $-4\bar{i} + 5\bar{j} + p\bar{k}$ are coplanar when $p =$

$$\begin{vmatrix} 3 & -3 & -2 \\ -2 & 1 & -2 \\ -4 & 5 & p \end{vmatrix} = 0$$

$18 - 3p = 0 \Rightarrow p = 6$

Ans: (A) 6

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13. A superset of a linearly dependent system of vectors is

This is one of the standard results on linear dependence.

The answer is: linearly dependent.

Ans: (D) linearly dependent

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14. The point dividing the join of $A(0, -2, 5)$ and $B(-3, 4, -1)$ internally in the ratio $2 : 1$ is

$\frac{m\bar{b} + n\bar{a}}{m+n} = \frac{2(-3,4,-1) + 1(0,-2,5)}{3}$

$= (-2, 2, 1)$

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

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

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

$= (-12, -7, -1)$

Ans: (A) $(-12, -7, -1)$

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16. The centroid of the tetrahedron with vertices $(-2, -4, 4)$, $(-4, 5, 0)$, $(1, -3, 3)$ and $(5, 6, 1)$ is

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

$= (0, 1, 2)$

Ans: (B) $(0, 1, 2)$

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

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

$= (13, 13, -3)$

Ans: (B) $(13, 13, -3)$

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18. Direction ratios of the line $\frac{x-3}{3} = \frac{y-1}{-1} = \frac{z+2}{-3}$ 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 $(3, -1, -3)$.

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

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19. The line through $A(-3, 3, -1)$ and $B(-2, 4, -2)$ is

$\overline{AB} = (1, 1, -1)$

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

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

---

20. On the plane $\bar{r} = (1 - s - t)(-3\bar{i} + \bar{j} - 3\bar{k}) + s(\bar{j} + \bar{k}) + t(3\bar{i} - \bar{j} + \bar{k})$, the point with $s = 1$, $t = 2$ is

$1 - s - t = -2$

$\bar{r} = -2(-3, 1, -3) + 1(0, 1, 1) + 2(3, -1, 1) = (12, -3, 9)$

Ans: (A) $(12, -3, 9)$

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21. A vector along the internal bisector of the angle between $8\bar{i} + 9\bar{j} - 12\bar{k}$ and $-8\bar{i} + 4\bar{j} + 19\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|} + \frac{\bar{b}}{|\bar{b}|} = \frac{1}{17}(8\bar{i} + 9\bar{j} - 12\bar{k}) + \frac{1}{21}(-8\bar{i} + 4\bar{j} + 19\bar{k})$

$= \frac{32}{357}\bar{i} + \frac{257}{357}\bar{j} + \frac{71}{357}\bar{k}$

Ans: (D) $\frac{32}{357}\bar{i} + \frac{257}{357}\bar{j} + \frac{71}{357}\bar{k}$

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22. The circumcentre of the triangle with vertices $(-3, 1, 5)$, $(-3, 1, 10)$ and $(-3, 3, 5)$ is

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

Circumcentre = midpoint of the hypotenuse BC = $(-3, 2, \frac{15}{2})$.

Ans: (B) $(-3, 2, \frac{15}{2})$

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

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

$= 2\bar{i} - 2\bar{k}$

Ans: (A) $2\bar{i} - 2\bar{k}$

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24. When the axes are rotated about the z-axis through 45°, the new components of $(3, 4, 5)$ are

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

With $\alpha = 45^\circ$ this gives $(\frac{7\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 5)$.

Ans: (C) $(\frac{7\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, 5)$

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25. A transversal cuts BC, CA, AB of triangle ABC at D, E, F with signed ratios $\frac{BD}{DC} = -\frac{1}{3}$, $\frac{CE}{EA} = \frac{4}{5}$. Then $\frac{AF}{FB} =$

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

$\frac{AF}{FB} = \frac{15}{4}$

Ans: (C) $\frac{15}{4}$