EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 04

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 $6\bar{j} - 8\bar{k}$ is

A. $-\frac{3}{5}\bar{j} + \frac{4}{5}\bar{k}$ **B.** $-3\bar{j} + 4\bar{k}$

C. $\frac{3}{50}\bar{j} - \frac{2}{25}\bar{k}$ **D.** $\frac{3}{5}\bar{j} - \frac{4}{5}\bar{k}$

2. Among mass, force, density and volume, the vector quantity is

A. mass **B.** density **C.** volume **D.** force

3. $\overline{QL} + \overline{LH} + \overline{HF} =$

A. $\bar{0}$ **B.** $\overline{QH}$ **C.** $\overline{QF}$ **D.** $\overline{FQ}$

4. If $(\bar{a}, \bar{b}) = 50^\circ$, then $(6\bar{a}, 3\bar{b}) =$

A. 50° **B.** 130° **C.** 40° **D.** 0°

5. If $|\bar{a}| = 2$, then $|7\bar{a}| =$

A. 14 **B.** 9 **C.** $\frac{2}{7}$ **D.** -14

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

A. 14 **B.** $\sqrt{14}$ **C.** 2 **D.** $\sqrt{2}$

7. The direction cosines of $15\bar{i} - 8\bar{k}$ are

A. $(\frac{15}{17}, 0, -\frac{8}{17})$ **B.** $(\frac{15}{289}, 0, -\frac{8}{289})$

C. $(15, 0, -8)$ **D.** $(\frac{15}{23}, 0, -\frac{8}{23})$

8. A vector makes angles 30° and 90° 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 $-2\bar{i} + p\bar{j} - 8\bar{k}$ and $\bar{i} - 2\bar{j} + 4\bar{k}$ are collinear when $p =$

A. 5 **B.** 1 **C.** -4 **D.** 4

10. The points $A(-2, -2, 1)$, $B(0, 0, 3)$ and $C(p, 4, 7)$ are collinear when $p =$

A. 6 **B.** -8 **C.** 8 **D.** 4

11. If $11\bar{i} - 6\bar{j} = x(-2\bar{i} + 3\bar{j}) + y(\bar{i} + 2\bar{j})$, then

A. $x = 3,\ y = -4$ **B.** $x = -4,\ y = -3$ **C.** $x = -4,\ y = 3$ **D.** $x = 4,\ y = -3$

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

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

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13. If $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar and $x\bar{a} + y\bar{b} + z\bar{c} = \bar{0}$, then

A. $x = y = z = 0$ **B.** $x = y = z$, not necessarily 0

C. $x = y = z = 1$ **D.** $x + y + z = 0$ only

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

A. $(-4, -\frac{2}{3}, 2)$ **B.** $(-4, 2, 2)$ **C.** $(-4, 5, 2)$ **D.** $(-4, \frac{7}{2}, 2)$

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

A. $(5, 11, 3)$ **B.** $(2, \frac{7}{2}, \frac{3}{2})$

C. $(-1, -4, 0)$ **D.** $(\frac{5}{3}, \frac{8}{3}, \frac{4}{3})$

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

A. $(\frac{4}{3}, \frac{8}{3}, -\frac{4}{3})$ **B.** $(4, 8, -4)$

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

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

A. $(-2, 2, -2)$ **B.** $(-1, 4, -1)$ **C.** $(9, 12, 9)$ **D.** $(-4, -2, -4)$

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18. The point of the line $\bar{r} = (-3\bar{i} - 4\bar{j} - 4\bar{k}) + t(-2\bar{i} + 4\bar{j} + 4\bar{k})$ given by $t = 3$ is

A. $(3, -16, -16)$ **B.** $(-11, -8, -8)$ **C.** $(-5, 0, 0)$ **D.** $(-9, 8, 8)$

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

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

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

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

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

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

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

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21. A vector along the internal bisector of the angle between $-10\bar{i} - 11\bar{j} - 2\bar{k}$ and $-4\bar{i} + 3\bar{j} + 12\bar{k}$ is

A. $-14\bar{i} - 8\bar{j} + 10\bar{k}$ **B.** $-\frac{14}{39}\bar{i} - \frac{188}{195}\bar{j} - \frac{206}{195}\bar{k}$

C. $-\frac{38}{39}\bar{i} - \frac{98}{195}\bar{j} + \frac{154}{195}\bar{k}$ **D.** $-7\bar{i} - 4\bar{j} + 5\bar{k}$

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22. The orthocentre of the triangle with vertices $(2, 4, -4)$, $(2, 4, 1)$ and $(2, 9, -4)$ is

A. $(2, \frac{13}{2}, -\frac{3}{2})$ **B.** $(2, 4, 1)$

C. $(2, \frac{17}{3}, -\frac{7}{3})$ **D.** $(2, 4, -4)$

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

A. $-6\bar{i} - 4\bar{j} - 4\bar{k}$ **B.** $-3\bar{i} - 2\bar{j} - 2\bar{k}$

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

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24. When the axes are rotated about the x-axis through 60°, the new components of $(-2, -1, 0)$ are

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

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

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

A. $\frac{1}{3}$ **B.** $-\frac{1}{3}$ **C.** 3 **D.** -3

Key sheet

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

Solutions

1. The unit vector in the direction of $6\bar{j} - 8\bar{k}$ is

$|\bar{a}| = \sqrt{0 + 36 + 64} = 10$

$\frac{\bar{a}}{|\bar{a}|} = \frac{3}{5}\bar{j} - \frac{4}{5}\bar{k}$

Ans: (D) $\frac{3}{5}\bar{j} - \frac{4}{5}\bar{k}$

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2. Among mass, force, density and volume, the vector quantity is

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

So the vector quantity here is force.

Ans: (D) force

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3. $\overline{QL} + \overline{LH} + \overline{HF} =$

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

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

Ans: (C) $\overline{QF}$

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4. If $(\bar{a}, \bar{b}) = 50^\circ$, then $(6\bar{a}, 3\bar{b}) =$

6 and 3 have the same signs.

So the angle is 50°.

Ans: (A) 50°

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5. If $|\bar{a}| = 2$, then $|7\bar{a}| =$

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

$= 7 \times 2 = 14$

Ans: (A) 14

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

$|\bar{r}| = \sqrt{1 + 9 + 4}$

$= \sqrt{14}$

Ans: (B) $\sqrt{14}$

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7. The direction cosines of $15\bar{i} - 8\bar{k}$ are

$r = \sqrt{225 + 0 + 64} = 17$

Direction cosines $= (\frac{15}{17}, 0, -\frac{8}{17})$.

Ans: (A) $(\frac{15}{17}, 0, -\frac{8}{17})$

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8. A vector makes angles 30° and 90° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma =$

$\cos^2\gamma = 1 - \cos^2 30^\circ - \cos^2 90^\circ = \frac{1}{4}$

$\Rightarrow \gamma = 60^\circ$

Ans: (A) 60°

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9. The vectors $-2\bar{i} + p\bar{j} - 8\bar{k}$ and $\bar{i} - 2\bar{j} + 4\bar{k}$ are collinear when $p =$

$\frac{-8}{4} = \frac{p}{-2}$

$p = 4$

Ans: (D) 4

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10. The points $A(-2, -2, 1)$, $B(0, 0, 3)$ and $C(p, 4, 7)$ are collinear when $p =$

$\overline{AC} = 3\,\overline{AB}$

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

Ans: (D) 4

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11. If $11\bar{i} - 6\bar{j} = x(-2\bar{i} + 3\bar{j}) + y(\bar{i} + 2\bar{j})$, then

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

$-2x + y = 11,\ 3x + 2y = -6 \Rightarrow x = -4,\ y = 3$

Ans: (C) $x = -4,\ y = 3$

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

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

$-6p - 24 = 0 \Rightarrow p = -4$

Ans: (C) -4

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13. If $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar and $x\bar{a} + y\bar{b} + z\bar{c} = \bar{0}$, then

This is one of the standard results on linear dependence.

The answer is: $x = y = z = 0$.

Ans: (A) $x = y = z = 0$

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

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

$= (-4, 2, 2)$

Ans: (B) $(-4, 2, 2)$

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

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

$= (-1, -4, 0)$

Ans: (C) $(-1, -4, 0)$

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

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

$= (1, 2, -1)$

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

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

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

$= (-1, 4, -1)$

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

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18. The point of the line $\bar{r} = (-3\bar{i} - 4\bar{j} - 4\bar{k}) + t(-2\bar{i} + 4\bar{j} + 4\bar{k})$ given by $t = 3$ is

$\bar{r} = (-3, -4, -4) + 3(-2, 4, 4)$

$= (-9, 8, 8)$

Ans: (D) $(-9, 8, 8)$

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

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

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

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

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

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21. A vector along the internal bisector of the angle between $-10\bar{i} - 11\bar{j} - 2\bar{k}$ and $-4\bar{i} + 3\bar{j} + 12\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|} + \frac{\bar{b}}{|\bar{b}|} = \frac{1}{15}(-10\bar{i} - 11\bar{j} - 2\bar{k}) + \frac{1}{13}(-4\bar{i} + 3\bar{j} + 12\bar{k})$

$= -\frac{38}{39}\bar{i} - \frac{98}{195}\bar{j} + \frac{154}{195}\bar{k}$

Ans: (C) $-\frac{38}{39}\bar{i} - \frac{98}{195}\bar{j} + \frac{154}{195}\bar{k}$

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22. The orthocentre of the triangle with vertices $(2, 4, -4)$, $(2, 4, 1)$ and $(2, 9, -4)$ 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 $(2, 4, -4)$.

Ans: (D) $(2, 4, -4)$

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

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

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

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

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24. When the axes are rotated about the x-axis through 60°, the new components of $(-2, -1, 0)$ are

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

With $\alpha = 60^\circ$ this gives $(-2, -\frac{1}{2}, \frac{\sqrt{3}}{2})$.

Ans: (B) $(-2, -\frac{1}{2}, \frac{\sqrt{3}}{2})$

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

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

$\frac{AF}{FB} = \frac{1}{3}$

Ans: (A) $\frac{1}{3}$