EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 10

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 $12\bar{i} + 5\bar{j}$ is

A. $\frac{12}{17}\bar{i} + \frac{5}{17}\bar{j}$ **B.** $\frac{12}{169}\bar{i} + \frac{5}{169}\bar{j}$
C. $-\frac{12}{13}\bar{i} - \frac{5}{13}\bar{j}$ **D.** $\frac{12}{13}\bar{i} + \frac{5}{13}\bar{j}$

2. Among weight, work, acceleration and momentum, the scalar quantity is

A. momentum **B.** weight **C.** acceleration **D.** work

3. $\overline{EC} + \overline{CM} + \overline{ML} =$

A. $\overline{EL}$ **B.** $\overline{LE}$ **C.** $\bar{0}$ **D.** $\overline{EM}$

4. If $(\bar{a}, \bar{b}) = 160^\circ$, then $(6\bar{a}, -2\bar{b}) =$

A. 160° **B.** 70° **C.** 0° **D.** 20°

5. If $|\bar{a}| = 3$, then $|-6\bar{a}| =$

A. $\frac{1}{2}$ **B.** 18 **C.** -18 **D.** 9

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

A. $\sqrt{30}$ **B.** 30 **C.** 2 **D.** $\sqrt{2}$

7. The direction cosines of $-6\bar{j} - 8\bar{k}$ are

A. $(0, -\frac{3}{5}, -\frac{4}{5})$ **B.** $(0, -\frac{3}{50}, -\frac{2}{25})$
C. $(0, -\frac{3}{7}, -\frac{4}{7})$ **D.** $(0, -6, -8)$

8. A vector makes angles 45° and 90° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma =$

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

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

A. -9 **B.** 10 **C.** 9 **D.** 1

10. The points $A(-3, -3, -3)$, $B(-5, -5, -6)$ and $C(p, 1, 3)$ are collinear when $p =$

A. 7 **B.** 1 **C.** 4 **D.** -7

11. If $-10\bar{i} - 6\bar{j} = x(4\bar{i} + \bar{j}) + y(2\bar{i} + 4\bar{j})$, then

A. $x = -1,\ y = -2$ **B.** $x = 2,\ y = 1$ **C.** $x = -2,\ y = 1$ **D.** $x = -2,\ y = -1$

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

A. 2 **B.** 3 **C.** 4 **D.** -3

13. Any three coplanar vectors are

A. linearly independent **B.** orthonormal

C. linearly dependent **D.** non-coplanar

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

A. $(-10, 0, 6)$ **B.** $(-1, \frac{9}{2}, 6)$ **C.** $(-2, 4, 6)$ **D.** $(0, 5, 6)$

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

A. $(-\frac{4}{3}, 0, \frac{8}{3})$ **B.** $(7, 10, -9)$

C. $(-\frac{1}{2}, 1, \frac{3}{2})$ **D.** $(-8, -8, 12)$

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

A. $(-1, -1, 1)$ **B.** $(-4, -4, 4)$

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

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

A. $(5, 13, 1)$ **B.** $(-10, -3, 4)$ **C.** $(-13, 3, 7)$ **D.** $(-12, 1, 6)$

18. The point of the line $\bar{r} = (-\bar{i} + 4\bar{j} + 5\bar{k}) + t(-3\bar{i} + \bar{j} - \bar{k})$ given by $t = 2$ is

A. $(-7, 6, 3)$ **B.** $(5, 2, 7)$ **C.** $(-5, 9, 9)$ **D.** $(-4, 5, 4)$

19. Direction ratios of the line $\frac{x+1}{1} = \frac{y-1}{-1} = \frac{z-4}{-3}$ are

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

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

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

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

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

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

21. A vector along the internal bisector of the angle between $-5\bar{i} - 12\bar{j}$ and $6\bar{i} - 9\bar{j} - 2\bar{k}$ is

A. $\frac{23}{143}\bar{i} - \frac{249}{143}\bar{j} - \frac{2}{11}\bar{k}$ **B.** $\bar{i} - 21\bar{j} - 2\bar{k}$

C. $\frac{1}{2}\bar{i} - \frac{21}{2}\bar{j} - \bar{k}$ **D.** $-\frac{133}{143}\bar{i} - \frac{15}{143}\bar{j} + \frac{2}{11}\bar{k}$

22. The circumcentre of the triangle with vertices $(-4, 5, -4)$, $(-4, 5, 1)$ and $(-4, 1, -4)$ is

A. $(-4, 3, -4)$ **B.** $(-4, 5, -4)$

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

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23. In parallelogram $ABCD$, $\overline{AC} = 3\bar{i} - 5\bar{j} - 5\bar{k}$ and $\overline{BD} = -5\bar{i} + \bar{j} - 3\bar{k}$. Then $\overline{BC} =$

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

C. $-\bar{i} - 2\bar{j} - 4\bar{k}$ **D.** $-2\bar{i} - 4\bar{j} - 8\bar{k}$

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24. When the axes are rotated about the x-axis through 90°, the new components of $(4, 1, -4)$ are

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

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

A. $-\frac{15}{16}$ **B.** $\frac{15}{16}$ **C.** $-\frac{16}{15}$ **D.** $\frac{16}{15}$

Key sheet

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

Solutions

1. The unit vector in the direction of $12\bar{i} + 5\bar{j}$ is

$|\bar{a}| = \sqrt{144 + 25 + 0} = 13$

$\frac{\bar{a}}{|\bar{a}|} = \frac{12}{13}\bar{i} + \frac{5}{13}\bar{j}$

Ans: (D) $\frac{12}{13}\bar{i} + \frac{5}{13}\bar{j}$

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2. Among weight, work, acceleration and momentum, the scalar quantity is

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

So the scalar quantity here is work.

Ans: (D) work

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3. $\overline{EC} + \overline{CM} + \overline{ML} =$

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

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

Ans: (A) $\overline{EL}$

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4. If $(\bar{a}, \bar{b}) = 160^\circ$, then $(6\bar{a}, -2\bar{b}) =$

6 and -2 have opposite signs.

So the angle is $180^\circ - 160^\circ = 20^\circ$.

Ans: (D) 20°

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5. If $|\bar{a}| = 3$, then $|-6\bar{a}| =$

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

$= 6 \times 3 = 18$

Ans: (B) 18

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

$|\bar{r}| = \sqrt{25 + 1 + 4}$

$= \sqrt{30}$

Ans: (A) $\sqrt{30}$

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7. The direction cosines of $-6\bar{j} - 8\bar{k}$ are

$r = \sqrt{0 + 36 + 64} = 10$

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

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

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8. A vector makes angles 45° and 90° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma =$

$\cos^2\gamma = 1 - \cos^2 45^\circ - \cos^2 90^\circ = \frac{1}{2}$

$\Rightarrow \gamma = 45^\circ$

Ans: (B) 45°

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

$\frac{9}{3} = \frac{p}{3}$

$p = 9$

Ans: (C) 9

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10. The points $A(-3, -3, -3)$, $B(-5, -5, -6)$ and $C(p, 1, 3)$ are collinear when $p =$

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

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

Ans: (B) 1

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11. If $-10\bar{i} - 6\bar{j} = x(4\bar{i} + \bar{j}) + y(2\bar{i} + 4\bar{j})$, then

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

$4x + 2y = -10,\ x + 4y = -6 \Rightarrow x = -2,\ y = -1$

Ans: (D) $x = -2,\ y = -1$

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

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

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

Ans: (B) 3

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13. Any three coplanar vectors are

This is one of the standard results on linear dependence.

The answer is: linearly dependent.

Ans: (C) linearly dependent

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

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

$= (-2, 4, 6)$

Ans: (C) $(-2, 4, 6)$

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

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

$= (-8, -8, 12)$

Ans: (D) $(-8, -8, 12)$

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

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

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

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

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

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

$= (-13, 3, 7)$

Ans: (C) $(-13, 3, 7)$

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18. The point of the line $\bar{r} = (-\bar{i} + 4\bar{j} + 5\bar{k}) + t(-3\bar{i} + \bar{j} - \bar{k})$ given by $t = 2$ is

$\bar{r} = (-1, 4, 5) + 2(-3, 1, -1)$

$= (-7, 6, 3)$

Ans: (A) $(-7, 6, 3)$

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19. Direction ratios of the line $\frac{x+1}{1} = \frac{y-1}{-1} = \frac{z-4}{-3}$ 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 $(1, -1, -3)$.

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

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

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

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

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21. A vector along the internal bisector of the angle between $-5\bar{i} - 12\bar{j}$ and $6\bar{i} - 9\bar{j} - 2\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|} + \frac{\bar{b}}{|\bar{b}|} = \frac{1}{13}(-5\bar{i} - 12\bar{j}) + \frac{1}{11}(6\bar{i} - 9\bar{j} - 2\bar{k})$

$= \frac{23}{143}\bar{i} - \frac{249}{143}\bar{j} - \frac{2}{11}\bar{k}$

Ans: (A) $\frac{23}{143}\bar{i} - \frac{249}{143}\bar{j} - \frac{2}{11}\bar{k}$

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22. The circumcentre of the triangle with vertices $(-4, 5, -4)$, $(-4, 5, 1)$ and $(-4, 1, -4)$ 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 = $(-4, 3, -\frac{3}{2})$.

Ans: (D) $(-4, 3, -\frac{3}{2})$

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23. In parallelogram $ABCD$, $\overline{AC} = 3\bar{i} - 5\bar{j} - 5\bar{k}$ and $\overline{BD} = -5\bar{i} + \bar{j} - 3\bar{k}$. Then $\overline{BC} =$

$\overline{BC} = \frac{\overline{AC} + \overline{BD}}{2}$

$= -\bar{i} - 2\bar{j} - 4\bar{k}$

Ans: (C) $-\bar{i} - 2\bar{j} - 4\bar{k}$

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24. When the axes are rotated about the x-axis through 90°, the new components of $(4, 1, -4)$ 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 $(4, -4, -1)$.

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

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

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

$\frac{AF}{FB} = \frac{15}{16}$

Ans: (B) $\frac{15}{16}$