EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 01

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 $-8\bar{i} + 9\bar{j} - 12\bar{k}$ is

A. $-\frac{8}{289}\bar{i} + \frac{9}{289}\bar{j} - \frac{12}{289}\bar{k}$ **B.** $\frac{8}{11}\bar{i} - \frac{9}{11}\bar{j} + \frac{12}{11}\bar{k}$

C. $-\frac{8}{17}\bar{i} + \frac{9}{17}\bar{j} - \frac{12}{17}\bar{k}$ **D.** $\frac{8}{17}\bar{i} - \frac{9}{17}\bar{j} + \frac{12}{17}\bar{k}$

2. Among time, acceleration, velocity and force, the scalar quantity is

A. acceleration **B.** time **C.** force **D.** velocity

3. $\overline{NR} + \overline{RM} + \overline{MD} + \overline{DP} =$

A. $\bar{0}$ **B.** $\overline{NP}$ **C.** $\overline{PN}$ **D.** $\overline{ND}$

4. If $(\bar{a}, \bar{b}) = 35^\circ$, then $(5\bar{a}, -3\bar{b}) =$

A. 55° **B.** 0° **C.** 35° **D.** 145°

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

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

6. If $\bar{r} = -6\bar{i} - 4\bar{j} - \bar{k}$, then $|\bar{r}| =$

A. 53 **B.** $\sqrt{53}$ **C.** 11 **D.** $\sqrt{11}$

7. The direction cosines of $15\bar{i} - 16\bar{j} + 12\bar{k}$ are

A. $(\frac{3}{5}, -\frac{16}{25}, \frac{12}{25})$ **B.** $(\frac{15}{43}, -\frac{16}{43}, \frac{12}{43})$

C. $(15, -16, 12)$ **D.** $(\frac{3}{125}, -\frac{16}{625}, \frac{12}{625})$

8. A vector makes angles 90° and 120° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma =$

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

9. The vectors $18\bar{i} + 12\bar{j} + p\bar{k}$ and $6\bar{i} + 4\bar{j} + \bar{k}$ are collinear when $p =$

A. -3 **B.** 4 **C.** 3 **D.** $\frac{1}{3}$

10. The points $A(-1, -4, 5)$, $B(-4, -6, 7)$ and $C(p, -12, 13)$ are collinear when $p =$

A. -13 **B.** -12 **C.** 11 **D.** -11

11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(-3x - y + 5)\bar{a} + (-2x + 2y + 14)\bar{b} = \bar{0}$, then

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

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12. The vectors $3\bar{i} - \bar{j} - 2\bar{k}$, $-\bar{i} - \bar{j} - 3\bar{k}$ and $8\bar{i} + p\bar{k}$ are coplanar when $p =$

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

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13. Any four vectors in space are always

A. linearly independent **B.** collinear

C. mutually perpendicular **D.** linearly dependent

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

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

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

A. $(25, -24, -7)$ **B.** $(0, 1, -\frac{24}{7})$

C. $(\frac{1}{2}, \frac{1}{2}, -\frac{7}{2})$ **D.** $(-24, 25, 0)$

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

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

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

A. $(-3, 8, -1)$ **B.** $(-3, 4, 7)$ **C.** $(-1, 4, -3)$ **D.** $(-2, 6, -2)$

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

A. $(6, -10, 8)$ **B.** $(-12, 8, 2)$ **C.** $(-6, 2, 4)$ **D.** $(-12, 0, 14)$

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19. Direction ratios of the line $\frac{x+4}{-1} = \frac{y+1}{2} = \frac{z-3}{-4}$ are

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

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

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

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

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

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

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21. A vector along the internal bisector of the angle between $-5\bar{i} - 12\bar{k}$ and $4\bar{i} - 4\bar{j} - 7\bar{k}$ is

A. $-\frac{97}{117}\bar{i} + \frac{4}{9}\bar{j} - \frac{17}{117}\bar{k}$ **B.** $-\bar{i} - 4\bar{j} - 19\bar{k}$

C. $\frac{7}{117}\bar{i} - \frac{4}{9}\bar{j} - \frac{199}{117}\bar{k}$ **D.** $-\frac{1}{2}\bar{i} - 2\bar{j} - \frac{19}{2}\bar{k}$

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

A. $-\bar{b}$ **B.** $\bar{a} + \bar{b}$ **C.** $-\bar{a} - 2\bar{b}$ **D.** $-\bar{a} - \bar{b}$

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23. If $\overline{OA} = \bar{a}$, $\overline{OB} = \bar{b}$ and $\overline{OC} = \frac{1}{4}\bar{a} + \frac{5}{3}\bar{b}$, then C lies

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

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

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

D. inside triangle OAB

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24. When the axes are rotated about the z-axis through 90°, the new components of $(-4, 5, -4)$ are

A. $(5, 4, -4)$ **B.** $(-4, -4, -5)$ **C.** $(-5, -4, -4)$ **D.** $(-4, 5, -4)$

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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 $\frac{BD}{DC} = 4$, $\frac{CE}{EA} = \frac{4}{5}$. Then $\frac{AF}{FB} =$

A. $-\frac{5}{16}$ **B.** $\frac{16}{5}$ **C.** $\frac{5}{16}$ **D.** 5

Key sheet

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

Solutions

1. The unit vector in the direction of $-8\bar{i}+9\bar{j}-12\bar{k}$ is

$|\bar{a}|=\sqrt{64+81+144}=17$

$\frac{\bar{a}}{|\bar{a}|}=-\frac{8}{17}\bar{i}+\frac{9}{17}\bar{j}-\frac{12}{17}\bar{k}$

Ans: (C) $-\frac{8}{17}\bar{i}+\frac{9}{17}\bar{j}-\frac{12}{17}\bar{k}$

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2. Among time, acceleration, velocity and force, the scalar quantity is

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

So the scalar quantity here is time.

Ans: (B) time

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3. $\overline{NR}+\overline{RM}+\overline{MD}+\overline{DP}=$

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

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

Ans: (B) $\overline{NP}$

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4. If $(\bar{a},\bar{b})=35^\circ$, then $(5\bar{a},-3\bar{b})=$

5 and -3 have opposite signs.

So the angle is $180^\circ-35^\circ=145^\circ$.

Ans: (D) 145°

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

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

$=6\times 7=42$

Ans: (B) 42

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6. If $\bar{r}=-6\bar{i}-4\bar{j}-\bar{k}$, then $|\bar{r}|=$

$|\bar{r}|=\sqrt{36+16+1}$

$=\sqrt{53}$

Ans: (B) $\sqrt{53}$

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7. The direction cosines of $15\bar{i}-16\bar{j}+12\bar{k}$ are

$r=\sqrt{225+256+144}=25$

Direction cosines $=(\frac{3}{5},-\frac{16}{25},\frac{12}{25})$.

Ans: (A) $(\frac{3}{5},-\frac{16}{25},\frac{12}{25})$

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8. A vector makes angles 90° and 120° with the x and y axes, and an acute angle γ with the z axis. Then $\gamma=$

$\cos^2\gamma=1-\cos^2 90^\circ-\cos^2 120^\circ=\frac{3}{4}$

$\Rightarrow\gamma=30^\circ$

Ans: (D) 30°

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9. The vectors $18\bar{i}+12\bar{j}+p\bar{k}$ and $6\bar{i}+4\bar{j}+\bar{k}$ are collinear when $p=$

$\frac{18}{6}=\frac{p}{1}$

$p=3$

Ans: (C) 3

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10. The points $A(-1,-4,5)$, $B(-4,-6,7)$ and $C(p,-12,13)$ are collinear when $p=$

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

$p-(-1)=4\times(-3)\Rightarrow p=-13$

Ans: (A) -13

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11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(-3x-y+5)\bar{a}+(-2x+2y+14)\bar{b}=\bar{0}$, then

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

$-3x-y+5=0,\ -2x+2y+14=0\Rightarrow x=3,\ y=-4$

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

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12. The vectors $3\bar{i}-\bar{j}-2\bar{k}$, $-\bar{i}-\bar{j}-3\bar{k}$ and $8\bar{i}+p\bar{k}$ are coplanar when $p=$

$$\begin{vmatrix}3&-1&-2\\-1&-1&-3\\8&0&p\end{vmatrix}=0$$

$8-4p=0\Rightarrow p=2$

Ans: (A) 2

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13. Any four vectors in space are always

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 $A(3,1,2)$ and $B(3,-3,6)$ internally in the ratio $3:1$ is

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

$=(3,-2,5)$

Ans: (C) $(3,-2,5)$

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

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

$=(-24,25,0)$

Ans: (D) $(-24,25,0)$

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

$G=\frac{\bar{a}+\bar{b}+\bar{c}}{3}=\frac{(-6,0,12)}{3}$

$=(-2,0,4)$

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

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

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

$= (-3, 8, -1)$

Ans: (A) $(-3, 8, -1)$

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

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

$= (-12, 8, 2)$

Ans: (B) $(-12, 8, 2)$

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19. Direction ratios of the line $\frac{x+4}{-1} = \frac{y+1}{2} = \frac{z-3}{-4}$ 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 $(-1, 2, -4)$.

Ans: (D) $(-1, 2, -4)$

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

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

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

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21. A vector along the internal bisector of the angle between $-5\bar{i} - 12\bar{k}$ and $4\bar{i} - 4\bar{j} - 7\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|} + \frac{\bar{b}}{|\bar{b}|} = \frac{1}{13}(-5\bar{i} - 12\bar{k}) + \frac{1}{9}(4\bar{i} - 4\bar{j} - 7\bar{k})$

$= \frac{7}{117}\bar{i} - \frac{4}{9}\bar{j} - \frac{199}{117}\bar{k}$

Ans: (C) $\frac{7}{117}\bar{i} - \frac{4}{9}\bar{j} - \frac{199}{117}\bar{k}$

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

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

$\overline{CA} = -\bar{a} - \bar{b}$

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

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23. If $\overline{OA} = \bar{a}$, $\overline{OB} = \bar{b}$ and $\overline{OC} = \frac{1}{4}\bar{a} + \frac{5}{3}\bar{b}$, then C lies

$p = \frac{1}{4}$, $q = \frac{5}{3}$, $p + q = \frac{23}{12}$

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

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

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24. When the axes are rotated about the z-axis through 90°, the new components of $(-4, 5, -4)$ are

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

With $\alpha = 90^\circ$ this gives $(5, 4, -4)$.

Ans: (A) $(5, 4, -4)$

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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 $\frac{BD}{DC} = 4$, $\frac{CE}{EA} = \frac{4}{5}$. Then $\frac{AF}{FB} =$

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

$\frac{AF}{FB} = \frac{5}{16}$

Ans: (C) $\frac{5}{16}$
