EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 02

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 5 in the direction of $-4\bar{i} + 12\bar{j} + 3\bar{k}$ is

A. $-\frac{4}{13}\bar{i} + \frac{12}{13}\bar{j} + \frac{3}{13}\bar{k}$ **B.** $-\frac{20}{13}\bar{i} + \frac{60}{13}\bar{j} + \frac{15}{13}\bar{k}$

C. $-20\bar{i} + 60\bar{j} + 15\bar{k}$ **D.** $\frac{20}{13}\bar{i} - \frac{60}{13}\bar{j} - \frac{15}{13}\bar{k}$

2. The unit vector in the direction of $-7\bar{i} + 6\bar{j} - 6\bar{k}$ is

A. $\bar{i} - \frac{6}{7}\bar{j} + \frac{6}{7}\bar{k}$ **B.** $\frac{7}{11}\bar{i} - \frac{6}{11}\bar{j} + \frac{6}{11}\bar{k}$

C. $-\frac{7}{11}\bar{i} + \frac{6}{11}\bar{j} - \frac{6}{11}\bar{k}$ **D.** $-\frac{7}{121}\bar{i} + \frac{6}{121}\bar{j} - \frac{6}{121}\bar{k}$

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

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

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

4. If $(\bar{a}, \bar{b}) = 140^\circ$, then $(-3\bar{a}, 2\bar{b}) =$

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

5. If $|\bar{a}| = 5$, then $|4\bar{a}| =$

A. 9 **B.** 20 **C.** $\frac{5}{4}$ **D.** -20

6. The position vector of the point $P(4, -2, 1)$ is

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

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

7. If $l = \frac{3}{7}$ and $m = -\frac{6}{7}$ are two direction cosines of a line, then $n =$

A. $\frac{9}{7}$ **B.** $\frac{10}{7}$ **C.** $\pm\frac{4}{49}$ **D.** $\pm\frac{2}{7}$

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

A. $(-\frac{12}{25}, \frac{1}{25}, -\frac{12}{25})$ **B.** $(-\frac{12}{289}, \frac{1}{289}, -\frac{12}{289})$

C. $(-\frac{12}{17}, \frac{1}{17}, -\frac{12}{17})$ **D.** $(-12, 1, -12)$

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

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

10. The points $A(1,-1,-1)$, $B(1,2,1)$ and $C(1,11,p)$ are collinear when $p=$

A. 7 **B.** -9 **C.** 9 **D.** 8

11. If $9\bar{i}-5\bar{j}=x(3\bar{i}-3\bar{j})+y(-\bar{j})$, then

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

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

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

13. Two collinear vectors are always

A. perpendicular **B.** linearly dependent

C. unit vectors **D.** linearly independent

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

A. $(-1,1,-3)$ **B.** $(-1,-1,-4)$ **C.** $(-1,9,1)$ **D.** $(-1,0,-\frac{7}{2})$

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

A. $(0,3,5)$ **B.** $(-2,-1,7)$

C. $(2,7,3)$ **D.** $(\frac{1}{2},4,\frac{9}{2})$

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

A. $(2,0,8)$ **B.** $(\frac{4}{3},0,\frac{16}{3})$

C. $(1,0,4)$ **D.** $(4,0,16)$

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

A. $(9,1,-2)$ **B.** $(13,0,-2)$ **C.** $(19,-8,2)$ **D.** $(1,3,-2)$

18. The line through $A(-4,4,-4)$ and $B(-6,0,-6)$ is

A. $\frac{x+4}{-6}=\frac{y-4}{0}=\frac{z+4}{-6}$ **B.** $\frac{x+4}{-2}=\frac{y-4}{-4}=\frac{z+4}{-2}$

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

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

A. $(6,7,5)$ **B.** $(5,4,3)$ **C.** $(-7,1,0)$ **D.** $(9,5,4)$

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

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

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

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

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

21. A vector along the internal bisector of the angle between $-6\bar{i}+8\bar{k}$ and $-12\bar{i}-15\bar{j}+16\bar{k}$ is

A. $-\frac{27}{25}\bar{i}-\frac{3}{5}\bar{j}+\frac{36}{25}\bar{k}$ **B.** $-\frac{3}{25}\bar{i}+\frac{3}{5}\bar{j}+\frac{4}{25}\bar{k}$

C. $-9\bar{i}-\frac{15}{2}\bar{j}+12\bar{k}$ **D.** $-18\bar{i}-15\bar{j}+24\bar{k}$

22. The circumcentre of the triangle with vertices $(-2, 0, 1)$, $(-2, 0, -5)$ and $(-2, 6, 1)$ is

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

23. In parallelogram $ABCD$, $\overline{AC} = 5\bar{i} - 5\bar{j} + 7\bar{k}$ and $\overline{BD} = \bar{i} + 3\bar{j} - \bar{k}$. Then $\overline{AB} =$

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

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

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

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

25. A transversal cuts BC, CA, AB of triangle ABC at D, E, F with signed ratios $\frac{BD}{DC} = -\frac{4}{5}$, $\frac{CE}{EA} = \frac{2}{5}$. Then $\frac{AF}{FB} =$

A. $-\frac{25}{8}$ **B.** $\frac{25}{8}$ **C.** $\frac{8}{25}$ **D.** $-\frac{8}{25}$

Key sheet

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

Solutions

1. The vector of magnitude 5 in the direction of $-4\bar{i}+12\bar{j}+3\bar{k}$ is

$|\bar{a}|=13$

$\frac{5\,\bar{a}}{|\bar{a}|}=-\frac{20}{13}\bar{i}+\frac{60}{13}\bar{j}+\frac{15}{13}\bar{k}$

Ans: (B) $-\frac{20}{13}\bar{i}+\frac{60}{13}\bar{j}+\frac{15}{13}\bar{k}$

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2. The unit vector in the direction of $-7\bar{i}+6\bar{j}-6\bar{k}$ is

$|\bar{a}|=\sqrt{49+36+36}=11$

$\frac{\bar{a}}{|\bar{a}|}=-\frac{7}{11}\bar{i}+\frac{6}{11}\bar{j}-\frac{6}{11}\bar{k}$

Ans: (C) $-\frac{7}{11}\bar{i}+\frac{6}{11}\bar{j}-\frac{6}{11}\bar{k}$

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

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

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

Ans: (D) $3\bar{i}+\bar{k}$

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4. If $(\bar{a},\bar{b})=140^\circ$, then $(-3\bar{a},2\bar{b})=$

-3 and 2 have opposite signs.

So the angle is $180^\circ-140^\circ=40^\circ$.

Ans: (A) 40°

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5. If $|\bar{a}|=5$, then $|4\bar{a}|=$

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

$=4\times5=20$

Ans: (B) 20

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6. The position vector of the point $P(4,-2,1)$ is

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

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

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

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7. If $l=\frac{3}{7}$ and $m=-\frac{6}{7}$ are two direction cosines of a line, then $n=$

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

$n^2=1-\frac{9}{49}-\frac{36}{49}=\frac{4}{49}\Rightarrow n=\pm\frac{2}{7}$

Ans: (D) $\pm\frac{2}{7}$

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

$r=\sqrt{144+1+144}=17$

Direction cosines $=(-\frac{12}{17},\frac{1}{17},-\frac{12}{17})$.

Ans: (C) $(-\frac{12}{17},\frac{1}{17},-\frac{12}{17})$

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

$\frac{-12}{4}=\frac{p}{-2}$

$p=6$

Ans: (A) 6

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10. The points $A(1,-1,-1)$, $B(1,2,1)$ and $C(1,11,p)$ are collinear when $p=$

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

$p-(-1)=4\times 2\Rightarrow p=7$

Ans: (A) 7

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11. If $9\bar{i}-5\bar{j}=x(3\bar{i}-3\bar{j})+y(-\bar{j})$, then

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

$3x=9,\ -3x-y=-5\Rightarrow x=3,\ y=-4$

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

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

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

$3-3p=0\Rightarrow p=1$

Ans: (A) 1

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13. Two collinear vectors are always

This is one of the standard results on linear dependence.

The answer is: linearly dependent.

Ans: (B) linearly dependent

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

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

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

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

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

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

$=(2,7,3)$

Ans: (C) $(2,7,3)$

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

$\frac{\bar{a}+\bar{b}+\bar{c}+\bar{d}}{4}=\frac{(4,0,16)}{4}$

$=(1,0,4)$

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

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

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

$=(13,0,-2)$

Ans: (B) $(13,0,-2)$

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18. The line through $A(-4,4,-4)$ and $B(-6,0,-6)$ is

$\overline{AB}=(-2,-4,-2)$

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

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

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

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

$=(9,5,4)$

Ans: (D) $(9,5,4)$

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

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

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

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21. A vector along the internal bisector of the angle between $-6\bar{i}+8\bar{k}$ and $-12\bar{i}-15\bar{j}+16\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|}+\frac{\bar{b}}{|\bar{b}|}=\frac{1}{10}(-6\bar{i}+8\bar{k})+\frac{1}{25}(-12\bar{i}-15\bar{j}+16\bar{k})$

$=-\frac{27}{25}\bar{i}-\frac{3}{5}\bar{j}+\frac{36}{25}\bar{k}$

Ans: (A) $-\frac{27}{25}\bar{i}-\frac{3}{5}\bar{j}+\frac{36}{25}\bar{k}$

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22. The circumcentre of the triangle with vertices $(-2,0,1)$, $(-2,0,-5)$ and $(-2,6,1)$ 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 = $(-2,3,-2)$.

Ans: (D) $(-2,3,-2)$

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23. In parallelogram $ABCD$, $\overline{AC}=5\bar{i}-5\bar{j}+7\bar{k}$ and $\overline{BD}=\bar{i}+3\bar{j}-\bar{k}$. Then $\overline{AB}=$

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

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

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

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

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

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25. A transversal cuts BC, CA, AB of triangle ABC at D, E, F with signed ratios $\frac{BD}{DC} = -\frac{4}{5}$, $\frac{CE}{EA} = \frac{2}{5}$. Then $\frac{AF}{FB} =$

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

$\frac{AF}{FB} = \frac{25}{8}$

Ans: (B) $\frac{25}{8}$