EXPRESSWALA ACADEMY

Maths 1A: Addition of Vectors

MCQ Test, Set 09

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 velocity, force, weight and temperature, the scalar quantity is

A. force **B.** weight **C.** temperature **D.** velocity

2. The vector of magnitude 45 in the direction of $11\bar{i} + 10\bar{j} + 2\bar{k}$ is

A. $33\bar{i} + 30\bar{j} + 6\bar{k}$ **B.** $495\bar{i} + 450\bar{j} + 90\bar{k}$

C. $-33\bar{i} - 30\bar{j} - 6\bar{k}$ **D.** $\frac{11}{15}\bar{i} + \frac{2}{3}\bar{j} + \frac{2}{15}\bar{k}$

3. If $|\bar{a}| = 10$ and $|\bar{b}| = 13$, the greatest possible value of $|\bar{a} + \bar{b}|$ is

A. 13 **B.** 23 **C.** 3 **D.** $\sqrt{269}$

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

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

5. If $|\bar{a}| = 9$, then $|-2\bar{a}| =$

A. 18 **B.** 11 **C.** -18 **D.** $\frac{9}{2}$

6. The scalar components of $3\bar{i} - 6\bar{j} + \bar{k}$ along the x, y and z axes are

A. $3, 6, 1$ **B.** $3, -6, 1$ **C.** $-3, 6, -1$ **D.** $1, -6, 3$

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

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

8. If $l = \frac{20}{21}$ and $m = -\frac{5}{21}$ are two direction cosines of a line, then $n =$

A. $\pm\frac{16}{441}$ **B.** $\frac{2}{7}$ **C.** $\pm\frac{4}{21}$ **D.** $\frac{25}{21}$

9. The vectors $-3\bar{i} - 18\bar{j} + p\bar{k}$ and $\bar{i} + 6\bar{j} - 2\bar{k}$ are collinear when $p =$

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

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

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

11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(-3x + 2y - 17)\bar{a} + (-x + y - 6)\bar{b} = \bar{0}$, then

A. $x = 1,\ y = -5$ **B.** $x = 5,\ y = -1$ **C.** $x = -5,\ y = 1$ **D.** $x = -5,\ y = -1$

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

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

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13. If the determinant of the components of three vectors is not 0, the vectors are

A. collinear **B.** linearly dependent

C. linearly independent **D.** coplanar

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

A. $(-2,4,0)$ **B.** $(-1,4,1)$ **C.** $(-10,4,-8)$ **D.** $(0,4,2)$

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

A. $(\frac{10}{3},-\frac{8}{3},-2)$ **B.** $(\frac{7}{2},-3,-1)$

C. $(2,0,-10)$ **D.** $(5,-6,8)$

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

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

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

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

A. $(7,14,-3)$ **B.** $(4,11,-6)$ **C.** $(1,8,-9)$ **D.** $(11,4,21)$

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

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

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19. The line through $A(-2,1,0)$ and $B(-1,0,-1)$ is

A. $\frac{x+2}{-1}=\frac{y-1}{0}=\frac{z}{-1}$ **B.** $\frac{x+2}{1}=\frac{y-1}{-1}=\frac{z}{-1}$

C. $\frac{x-2}{1}=\frac{y+1}{-1}=\frac{z}{-1}$ **D.** $\frac{x-1}{-2}=\frac{y+1}{1}=\frac{z+1}{0}$

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20. On the plane $\bar{r}=(1-s-t)(-\bar{i}+3\bar{j}+2\bar{k})+s(4\bar{i}-2\bar{j})+t(\bar{i}+3\bar{j}+2\bar{k})$, the point with $s=2$, $t=-1$ is

A. $(8,-10,-4)$ **B.** $(7,-7,-2)$ **C.** $(6,-4,0)$ **D.** $(-9,13,6)$

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21. A vector along the internal bisector of the angle between $19\bar{i}+4\bar{j}-8\bar{k}$ and $2\bar{i}-3\bar{j}+6\bar{k}$ is

A. $\frac{25}{21}\bar{i}-\frac{5}{21}\bar{j}+\frac{10}{21}\bar{k}$ **B.** $\frac{13}{21}\bar{i}+\frac{13}{21}\bar{j}-\frac{26}{21}\bar{k}$

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

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

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

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23. If $\overline{OA}=\bar{a}$, $\overline{OB}=\bar{b}$ and $\overline{OC}=\frac{2}{3}\bar{a}+\frac{1}{2}\bar{b}$, then C lies

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

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

C. inside triangle OAB

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

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24. When the axes are rotated about the x-axis through 30°, the new components of $(0, -2, -4)$ are

A. $(0, -2\sqrt{3} - 1, -2 + \sqrt{3})$ **B.** $(0, -2 - \sqrt{3}, 1 - 2\sqrt{3})$

C. $(2, -2, -2\sqrt{3})$ **D.** $(0, 2 - \sqrt{3}, -2\sqrt{3} - 1)$

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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 $\frac{BD}{DC} = \frac{4}{5}$, $\frac{CE}{EA} = \frac{1}{2}$. Then $\frac{AF}{FB} =$

A. $-\frac{5}{2}$ **B.** $\frac{5}{2}$ **C.** $\frac{2}{5}$ **D.** $\frac{8}{5}$

Key sheet

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

Solutions

1. Among velocity, force, weight and temperature, the scalar quantity is

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

So the scalar quantity here is temperature.

Ans: (C) temperature

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2. The vector of magnitude 45 in the direction of $11\bar{i} + 10\bar{j} + 2\bar{k}$ is

$|\bar{a}| = 15$

$\frac{45\,\bar{a}}{|\bar{a}|} = 33\bar{i} + 30\bar{j} + 6\bar{k}$

Ans: (A) $33\bar{i} + 30\bar{j} + 6\bar{k}$

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3. If $|\bar{a}| = 10$ and $|\bar{b}| = 13$, the greatest possible value of $|\bar{a} + \bar{b}|$ is

$|\bar{a} + \bar{b}| \le |\bar{a}| + |\bar{b}| = 23$

Equality holds for like vectors.

Ans: (B) 23

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

4 and -6 have opposite signs.

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

Ans: (A) 20°

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5. If $|\bar{a}| = 9$, then $|-2\bar{a}| =$

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

$= 2 \times 9 = 18$

Ans: (A) 18

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6. The scalar components of $3\bar{i} - 6\bar{j} + \bar{k}$ 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 $3, -6, 1$.

Ans: (B) $3, -6, 1$

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

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

$\Rightarrow \gamma = 60^\circ$

Ans: (D) 60°

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8. If $l = \frac{20}{21}$ and $m = -\frac{5}{21}$ are two direction cosines of a line, then $n =$

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

$n^2 = 1 - \frac{400}{441} - \frac{25}{441} = \frac{16}{441} \Rightarrow n = \pm\frac{4}{21}$

Ans: (C) $\pm\frac{4}{21}$

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9. The vectors $-3\bar{i} - 18\bar{j} + p\bar{k}$ and $\bar{i} + 6\bar{j} - 2\bar{k}$ are collinear when $p =$

$\frac{-3}{1} = \frac{p}{-2}$

$p = 6$

Ans: (D) 6

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

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

$p - (-2) = 2 \times (-3) \Rightarrow p = -8$

Ans: (C) -8

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11. If $\bar{a}$ and $\bar{b}$ are non-collinear and $(-3x + 2y - 17)\bar{a} + (-x + y - 6)\bar{b} = \bar{0}$, then

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

$-3x + 2y - 17 = 0,\ -x + y - 6 = 0 \Rightarrow x = -5,\ y = 1$

Ans: (C) $x = -5,\ y = 1$

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

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

$6p = 0 \Rightarrow p = 0$

Ans: (B) 0

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13. If the determinant of the components of three vectors is not 0, the vectors are

This is one of the standard results on linear dependence.

The answer is: linearly independent.

Ans: (C) linearly independent

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

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

$= (-2, 4, 0)$

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

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

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

$= (2, 0, -10)$

Ans: (C) $(2, 0, -10)$

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

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

$= (0, 1, -2)$

Ans: (D) $(0, 1, -2)$

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

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

$=(7,14,-3)$

Ans: (A) $(7,14,-3)$

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

Ans: (D) $(4,-3,-4)$

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19. The line through $A(-2,1,0)$ and $B(-1,0,-1)$ is

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

Line: $\frac{x+2}{1}=\frac{y-1}{-1}=\frac{z}{-1}$

Ans: (B) $\frac{x+2}{1}=\frac{y-1}{-1}=\frac{z}{-1}$

---

20. On the plane $\bar{r}=(1-s-t)(-\bar{i}+3\bar{j}+2\bar{k})+s(4\bar{i}-2\bar{j})+t(\bar{i}+3\bar{j}+2\bar{k})$, the point with $s=2$, $t=-1$ is

$1-s-t=0$

$\bar{r}=0(-1,3,2)+2(4,-2,0)+-1(1,3,2)=(7,-7,-2)$

Ans: (B) $(7,-7,-2)$

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21. A vector along the internal bisector of the angle between $19\bar{i}+4\bar{j}-8\bar{k}$ and $2\bar{i}-3\bar{j}+6\bar{k}$ is

$\frac{\bar{a}}{|\bar{a}|}+\frac{\bar{b}}{|\bar{b}|}=\frac{1}{21}(19\bar{i}+4\bar{j}-8\bar{k})+\frac{1}{7}(2\bar{i}-3\bar{j}+6\bar{k})$

$=\frac{25}{21}\bar{i}-\frac{5}{21}\bar{j}+\frac{10}{21}\bar{k}$

Ans: (A) $\frac{25}{21}\bar{i}-\frac{5}{21}\bar{j}+\frac{10}{21}\bar{k}$

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

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

$\overline{BF}=-2\bar{a}+\bar{b}$

Ans: (D) $-2\bar{a}+\bar{b}$

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23. If $\overline{OA}=\bar{a}$, $\overline{OB}=\bar{b}$ and $\overline{OC}=\frac{2}{3}\bar{a}+\frac{1}{2}\bar{b}$, then C lies

$p=\frac{2}{3}$, $q=\frac{1}{2}$, $p+q=\frac{7}{6}$

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

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

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24. When the axes are rotated about the x-axis through 30°, the new components of $(0,-2,-4)$ are

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

With $\alpha=30^\circ$ this gives $(0,-2-\sqrt{3},1-2\sqrt{3})$.

Ans: (B) $(0,-2-\sqrt{3},1-2\sqrt{3})$

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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 $\frac{BD}{DC} = \frac{4}{5}$, $\frac{CE}{EA} = \frac{1}{2}$. Then $\frac{AF}{FB} =$

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

$\frac{AF}{FB} = \frac{5}{2}$

Ans: (B) $\frac{5}{2}$
