

# JC1 H2 Mathematics (9758) Term 4 Revision Topical Quick Check Chapter 5 Vectors Chapter 6 3D Vector Geometry

## 1 CJC Promo 9758/2022/Q9

Relative to the origin *O*, the position vectors of points *A*, *B* and *C* are **a**, **b** and **c** respectively, where **b** is a unit vector. It is given that **b** and **b** – **a** are perpendicular and *C* lies on *AB* such that AC:CB = 3:1.

(i) Show that 
$$|\mathbf{a}| = \sec \theta$$
, where  $\theta$  is the angle between  $\mathbf{a}$  and  $\mathbf{b}$ . [3]

By expressing **c** in terms of **a** and **b**,

(ii) find the value of  $|\mathbf{c} \cdot \mathbf{b}|$  and state the geometrical interpretation of  $|\mathbf{c} \cdot \mathbf{b}|$ , [4]

(iii) find the value of 
$$\frac{|\mathbf{b} \times \mathbf{c}|}{|\mathbf{a} \times \mathbf{b}|}$$
. [2]

## 2 ACJC Promo 9758/2022/Q5

The line L has vector equation

$$L: \mathbf{r} = \begin{pmatrix} 6\\0\\1 \end{pmatrix} + \lambda \begin{pmatrix} -2\\1\\-1 \end{pmatrix}, \ \lambda \in \mathbb{R} .$$

- (i) Find the position vector of the point N, the foot of perpendicular from the point A with coordinates (3, 6, 1) to the line L. [3]
- (ii) Find the position vector of the point A', the reflection of point A in the line L. [2]
- (iii) Find the coordinates of the points on the line *L* that are  $3\sqrt{3}$  units away from point *A*. [2]

[3]

### 3 JPJC Promo 9758/2022/Q13

The planes 
$$P_1$$
 and  $P_2$  have equations  $\mathbf{r} = \begin{pmatrix} 4 \\ -1 \\ 3 \end{pmatrix} + s \begin{pmatrix} 3 \\ -1 \\ 7 \end{pmatrix} + t \begin{pmatrix} 1 \\ -3 \\ 12 \end{pmatrix}$  and  $x + 3y = 1$ 

respectively, where s and t are parameters.

- (i) Find the line of intersection of  $P_1$  and  $P_2$ . [3]
- (ii) Find the acute angle between  $P_1$  and  $P_2$ . [2]

The point *A* has position vector  $5\mathbf{i} - 4\mathbf{j} + 15\mathbf{k}$  and the point *B* has position vector  $\mathbf{i} - 2\mathbf{k}$ .

- (iii) Find the foot of perpendicular from A to  $P_2$ .
- (iv) Find the length of projection of AB onto  $P_2$ . [3]

#### 4 TMJC Promo 9758/2022/Q10



Fig. 1 shows a rectangular prism. Fig. 2 shows the prism with a removed part that was cut along the plane *ABFE*. The resulting object has a base *ABCD*, a top *EFGH*, a side *CDHG*, and a slanted side *ABFE*. The following information is given.

The top *EFGH* is a part of the plane with equation 4x + y - z = -6.

The base *ABCD* is a part of the plane with equation 4x + y - z = 7.

The slanted side *ABFE* is a part of the plane with equation 3x + 4y + 9z = 15.

- (i) Find the acute angle between the base and the slanted side. [2]
- (ii) Find the height of the object, measured in the direction perpendicular to the base.

[3]

(iii) Find a vector equation of the line of intersection between the base and the slanted side.

Point S with coordinates (2,11,12) lies on CD.

- (iv) Find the position vector of the foot of the perpendicular from point *S* to the line found in part (iii). [3]
- **(v)**



Fig. 3

A part of the object is to be further removed so that the remaining object is now symmetrical about a plane p that is parallel to CD. Fig. 3 shows the remaining object after the removal. Find the cartesian equation of p. [4]