Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. In particular, solutions found from a graphic display calculator should be supported by suitable working, for example if graphs are used to find a solution, you should sketch these as part of your answer. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

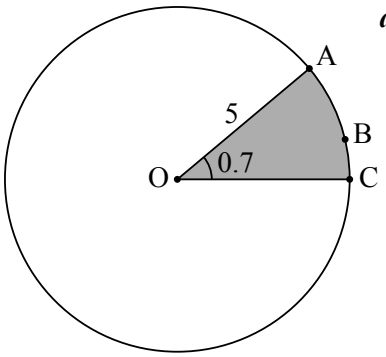
SECTION A

*Answer **all** questions in the boxes provided. Working may be continued below the lines if necessary.*

1. *[Maximum mark: 6]*

The following diagram shows a circle with centre O and radius 5 cm.

diagram not to scale



The points A, B and C lie on the circumference of the circle, and $A\hat{O}C = 0.7$ radians.

(a) (i) Find the length of the arc ABC.

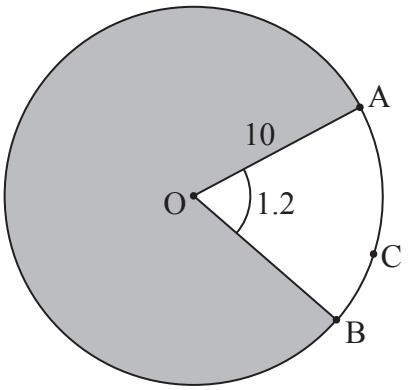
(ii) Find the perimeter of the shaded sector. *[4]*

(b) Find the area of the shaded sector. *[2]*

(This question continues on the following page)

2. [Maximum mark: 5]

The following diagram shows a circle with centre O and a radius of $10\,\text{cm}$. Points A, B and C lie on the circle.



Angle AOB is 1.2 radians.

(a) Find the length of arc ACB. [2]

(b) Find the perimeter of the shaded region. [3]

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3. *[Maximum mark: 7]*

The following diagram shows a circle with centre O and radius 8 cm.

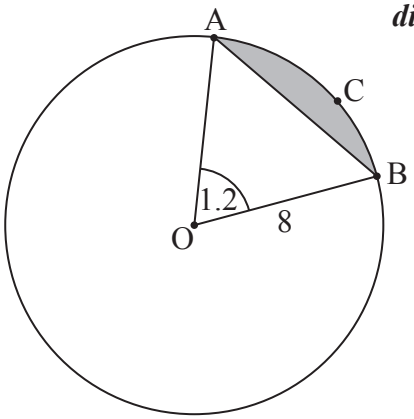

diagram not to scale

The points A, B and C are on the circumference of the circle, and $\hat{AOB} = 1.2$ radians.

(a) Find the length of arc ACB. *[2]*

(b) Find AB. *[3]*

(c) Hence, find the perimeter of the shaded segment ABC. *[2]*

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5. *[Maximum mark: 7]*

In triangle ABC, $AB = 6\,\text{cm}$ and $AC = 8\,\text{cm}$. The area of the triangle is $16\,\text{cm}^2$.

(a) Find the two possible values for $\hat{A}$. *[4]*

(b) Given that $\hat{A}$ is obtuse, find BC. *[3]*

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5. [Maximum mark: 7]

Given that $\sin x = \frac{3}{4}$, where x is an obtuse angle, find the value of

(a) $\cos x$; [4]

(b) $\cos 2x$. [3]

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*Do **NOT** write solutions on this page.*

10. *[Maximum mark: 15]*

The sides of a square are 16 cm in length. The midpoints of the sides of this square are joined to form a new square and four triangles (diagram 1). The process is repeated twice, as shown in diagrams 2 and 3.

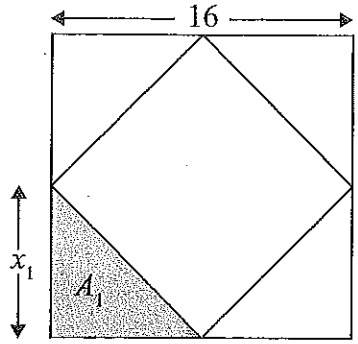


diagram 1

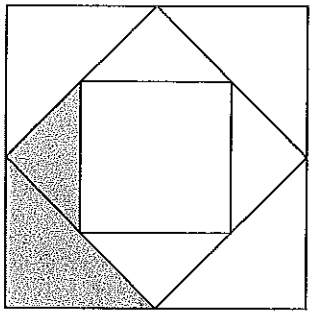


diagram 2

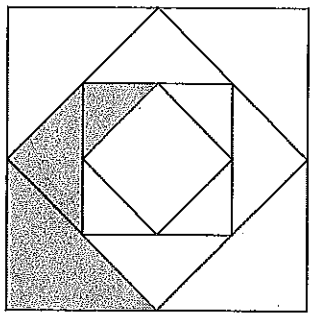


diagram 3

Let x_n denote the length of one of the equal sides of each new triangle.
Let A_n denote the area of each new triangle.

(a) The following table gives the values of x_n and A_n, for $1 \leq n \leq 3$. **Copy** and complete the table. *(Do **not** write on this page.)* *[4]*

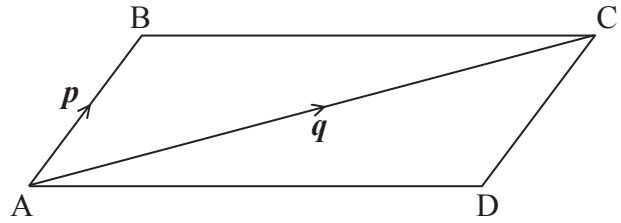
n	1	2	3
x_n	8		4
A_n	32	16	

(b) The process described above is repeated. Find A_6. *[4]*

(c) Consider an initial square of side length k cm. The process described above is repeated indefinitely. The total area of the shaded regions is $k\text{cm}^2$. Find the value of k. *[7]*

2. [Maximum mark: 7]

The following diagram shows the parallelogram ABCD.



Let $\vec{AB} = \boldsymbol{p}$ and $\vec{AC} = \boldsymbol{q}$. Find each of the following vectors in terms of $\boldsymbol{p}$ and/or $\boldsymbol{q}$.

(a) $\vec{CB}$ [2]

(b) $\vec{CD}$ [2]

(c) $\vec{DB}$ [3]

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Do **not** write solutions on this page.

Section B

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

8. [Maximum mark: 16]

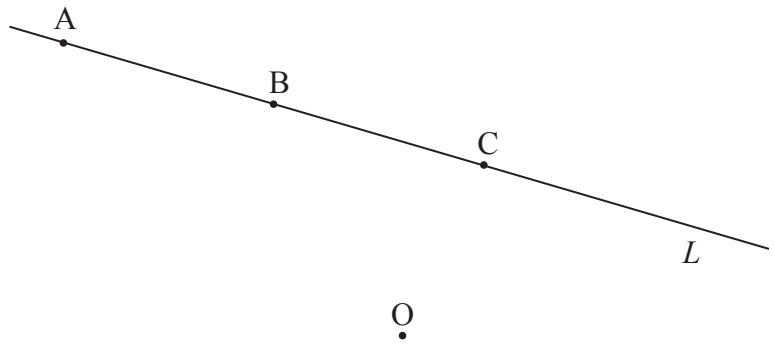
A line L passes through points $\mathrm{A}(-2, 4, 3)$ and $\mathrm{B}(-1, 3, 1)$.

(a) (i) Show that $\vec{\mathrm{AB}} = \begin{pmatrix} 1 \\ -1 \\ -2 \end{pmatrix}$.

(ii) Find $\left|\vec{\mathrm{AB}}\right|$. [3]

(b) Find a vector equation for L. [2]

The following diagram shows the line L and the origin O. The point C also lies on L.



Point C has position vector $\begin{pmatrix} 0 \\ y \\ -1 \end{pmatrix}$.

(c) Show that $y = 2$. [4]

(d) (i) Find $\vec{\mathrm{OC}} \bullet \vec{\mathrm{AB}}$.

(ii) Hence, write down the size of the angle between OC and L. [3]

(e) Hence or otherwise, find the area of triangle OAB. [4]

Do **not** write solutions on this page.

9. [Maximum mark: 15]

Let P and Q have coordinates $(1, 0, 2)$ and $(-11, 8, m)$ respectively.

(a) Express $\overrightarrow{PQ}$ in terms of m. [2]

Let $\boldsymbol{a}$ and $\boldsymbol{b}$ be perpendicular vectors, where $\boldsymbol{a} = \begin{pmatrix} 1 \\ 1 \\ n \end{pmatrix}$ and $\boldsymbol{b} = \begin{pmatrix} -3 \\ 2 \\ 1 \end{pmatrix}$.

(b) Find n. [4]

(c) Given that $\overrightarrow{PQ}$ is parallel to $\boldsymbol{b}$,

(i) express $\overrightarrow{PQ}$ in terms of $\boldsymbol{b}$;

(ii) hence find m. [5]

In part (d), distance is in metres, time is in seconds.

(d) A particle moves along a straight line through Q so that its position is given by $\boldsymbol{r} = \boldsymbol{c} + t\boldsymbol{a}$.

(i) Write down a possible vector $\boldsymbol{c}$.

(ii) Find the speed of the particle. [4]

Do **not** write solutions on this page.

9. [Maximum mark: 15]

A line L_1 passes through the points $\mathrm{A}(0, -3, 1)$ and $\mathrm{B}(-2, 5, 3)$.

(a) (i) Show that $\vec{\mathrm{AB}} = \begin{pmatrix} -2 \\ 8 \\ 2 \end{pmatrix}$.

(ii) Write down a vector equation for L_1. [3]

A line L_2 has equation $\boldsymbol{r} = \begin{pmatrix} -1 \\ 7 \\ -4 \end{pmatrix} + s\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$. The lines L_1 and L_2 intersect at a point C.

(b) Show that the coordinates of C are $(-1, 1, 2)$. [5]

(c) A point D lies on line L_2 so that $\left|\vec{\mathrm{CD}}\right| = \sqrt{18}$ and $\vec{\mathrm{CA}} \bullet \vec{\mathrm{CD}} = -9$. Find $\mathrm{A\hat{C}D}$. [7]