1 The diagram shows a regular octagon *ABCDEFGH*.

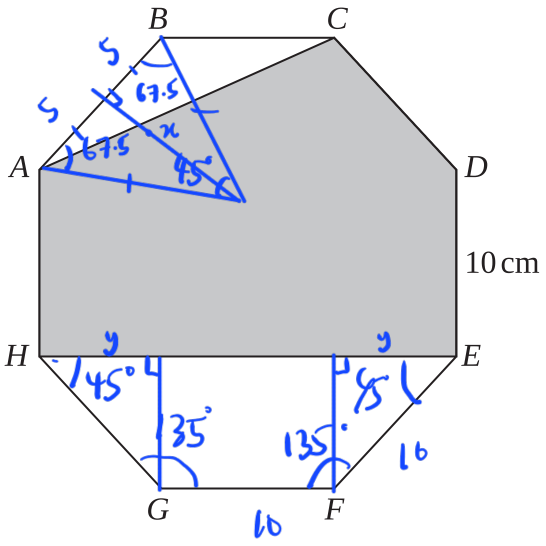


Diagram **NOT** accurately drawn

Each side of the octagon has length 10 cm.

Find the area of the shaded region *ACDEH*.
Give your answer correct to the nearest cm²

interior angle of octagon : $\frac{(8-2)}{8} \times 180° = 135°$ (1)

split octagon into 8 triangles

Find x : $x = 5 \tan 67.5° = 12.07106...$

Area of triangle $= \frac{1}{2} \times 10 \times 12.07106... = 60.355...$

Total area of octagon = 8 × 1 area of triangle

Area of octagon $= 8 \times 60.355...$
$= 482.84...$ (1)

Area of triangle ABC : $\frac{1}{2} \times 10 \times 10 \times \sin 135° = 25\sqrt{2} = 35.355...$ (1)

Find y : $y = 10 \cos 45° = 5\sqrt{2}$

Length of HE : $2 \times 5\sqrt{2} + 10 = 10\sqrt{2} + 10$ (1)

Area of trapezium : $\frac{1}{2} \times (10\sqrt{2} + 10 + 10) \times 10 \sin 45°$

$= 120.71...$ (1)

Area of shaded region = Area of octagon − area of triangle ABC − Area of trapezium

Area of shaded region = 482.84 … − 35.355 … − 120.71 …

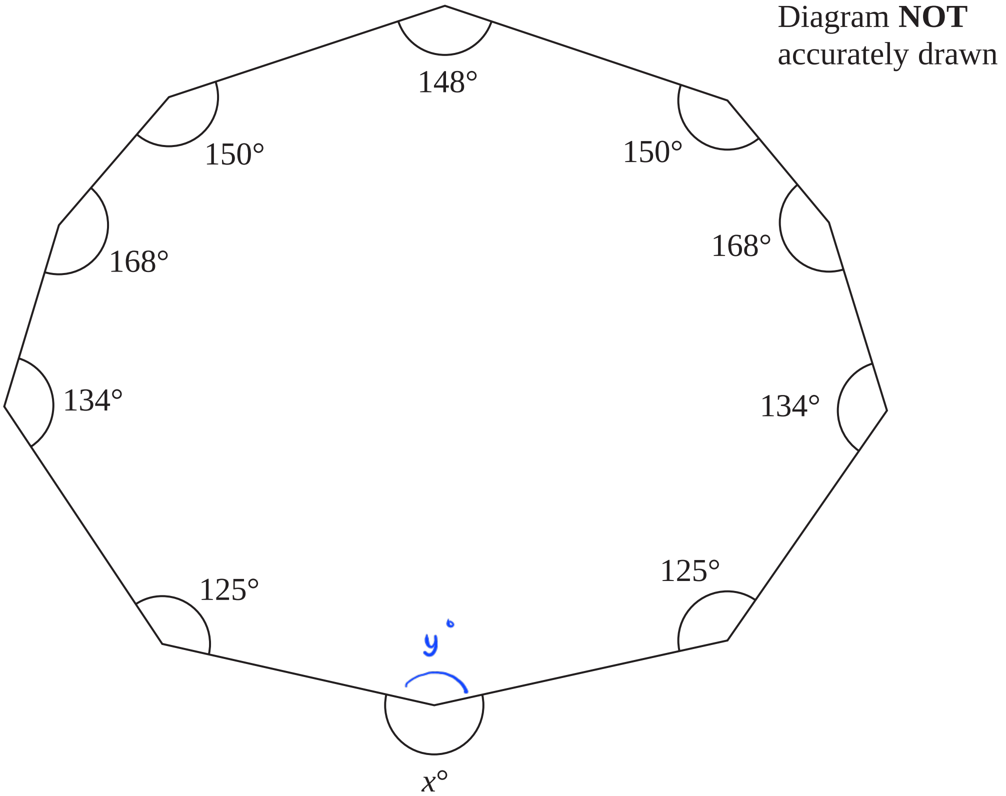
= 326.77 …

= 327 cm^2 (nearest cm^2) (1)

327 cm^2

(Total for Question 1 is 6 marks)

2 Here is a 10-sided polygon.



Work out the value of *x*.

angle inside polygon : $(n-2) \times 180^\circ$

$= (10-2) \times 180^\circ = 1440^\circ$ (1)

$125^\circ + 134^\circ + 168^\circ + 150^\circ + 148^\circ + 150^\circ + 168^\circ + 134^\circ + 125^\circ + y^\circ = 1440^\circ$

$y^\circ = 1440^\circ - 1302^\circ$

$= 138^\circ$ (1)

$\therefore x^\circ = 360^\circ - y^\circ$

$= 360^\circ - 138^\circ$ (1)

$= 222^\circ$ (1)

x = 222°

(Total for Question 2 is 4 marks)

3 The diagram shows two congruent isosceles triangles and parts of two congruent regular polygons, **X** and **Y**.

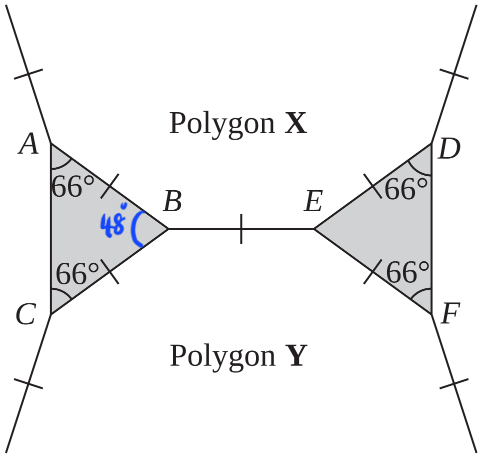


Diagram **NOT** accurately drawn

The two regular polygons each have n sides.

Work out the value of n.

angle ABC = $180° - 66° - 66°$
$= 48°$ (1)

Half of angle ABC = exterior angle of polygon X and Y
$= \frac{1}{2} \times 48° = 24°$

Exterior angle of polygon = $\frac{360°}{\text{no. of sides}}$

$24° = \frac{360°}{n}$

$n = \frac{360°}{24°}$ (1)

$= 15$ (1)

$n =$ 15

(Total for Question 3 is 3 marks)

4 The diagram shows parallelogram *EFGH*.

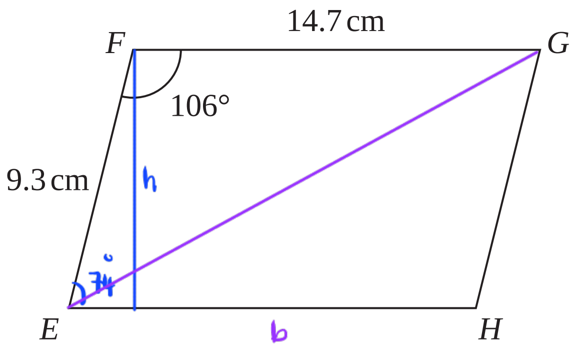


Diagram **NOT** accurately drawn

EF = 9.3 cm
FG = 14.7 cm
Angle *EFG* = 106°

Area of parallelogram : b × h

(a) Work out the area of the parallelogram.
Give your answer correct to 3 significant figures.

angle FEH = 180° − 106° = 74°

$\sin 74° = \frac{h}{9.3}$

$h = 9.3 \sin 74°$ ①

$= 8.94$ cm

Area of parallelogram : $8.94 \times 14.7 = 131 \text{ cm}^2$ ①

131 .... cm^2

(2)

(b) Work out the length of the diagonal *EG* of the parallelogram.
Give your answer correct to 3 significant figures.

By using cosine rule :

$EG^2 = EF^2 + FG^2 - 2 \times EF \times FG \times \cos 106°$

$= 9.3^2 + 14.7^2 - 2(9.3)(14.7) \cos 106°$ ①

$= 86.49 + 216.09 + 75.36$

$= 377.94$ ①

$EG = \sqrt{377.94}$

$= 19.4$ cm ①

19.4 .... cm

(3)

(Total for Question 4 is 5 marks)

5 The diagram shows a regular pentagon, *ABCDE*, a regular hexagon, *CFGHID*, and a quadrilateral, *EDIJ*.

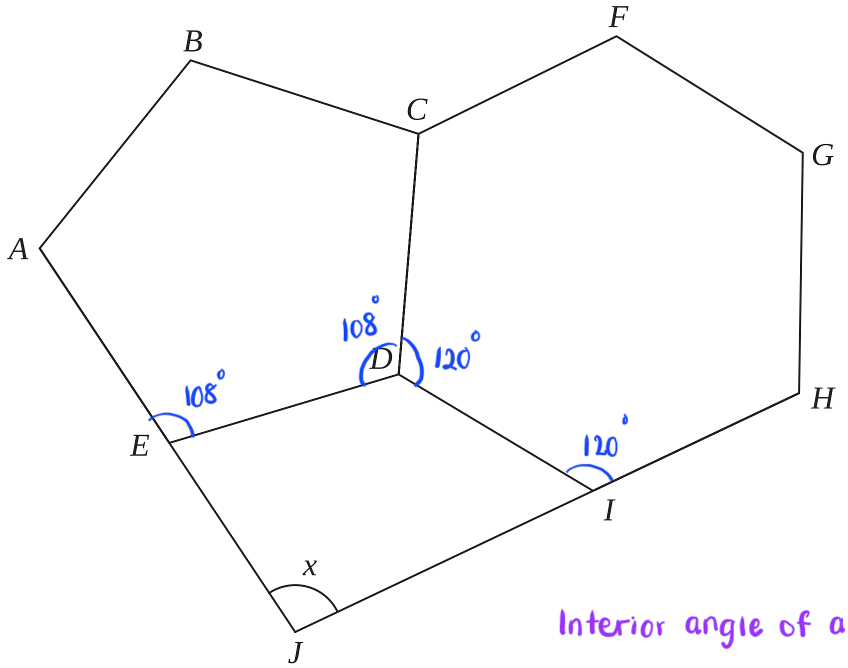


Diagram **NOT** accurately drawn

Interior angle of a polygon:

$$\frac{n-2}{n} \times 180°$$

where n = number of sides

AEJ and *HIJ* are straight lines.

Work out the size of the angle marked *x*.
Show your working clearly.

Finding interior angle of a pentagon:

$$\frac{5-2}{5} \times 180° = 108° \quad (1)$$

Finding interior angle of a hexagon:

$$\frac{6-2}{6} \times 180° = 120° \quad (1)$$

angle JED = 180° − 108° = 72°

angle EDI = 360° − 108° − 120° = 132° (1)

angle DIJ = 180° − 120° = 60°

x° = 360° − 72° − 132° − 60° (1)

= 96° (1)

96 °

(Total for Question 5 is 5 marks)

6

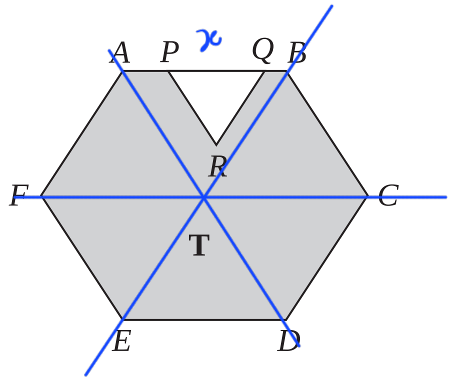


Diagram **NOT** accurately drawn

The diagram shows a shaded region **T** formed by removing an equilateral triangle PQR from a regular hexagon $ABCDEF$.

The points P and Q lie on AB such that $AB = 1.5 \times PQ$

Given that the area of region **T** is $72\sqrt{3}$ cm²

work out the length of PQ.

$AB = x$

Area of one triangle in hexagon $= \frac{1}{2} ab \sin C$

$= \frac{1}{2} x^2 \sin 60°$

$= \frac{\sqrt{3}}{4} x^2$ (1)

Area of hexagon $= 6 \times \frac{\sqrt{3} x^2}{4}$

$= \frac{3\sqrt{3}}{2} x^2$ (1)

Area of PQR $= \frac{1}{2} ab \sin C$

$= \frac{1}{2} \left(\frac{2}{3} x\right)^2 \sin 60°$

$= \frac{\sqrt{3}}{9} x^2$

Area of shaded region $= \left(\frac{3\sqrt{3}}{2} - \frac{\sqrt{3}}{9}\right) x^2$

$72\sqrt{3} = \frac{25\sqrt{3}}{18} x^2$ (1)

$x^2 = \frac{18 \times 72\sqrt{3}}{25\sqrt{3}}$

$= \frac{1296}{25}$

$x = \sqrt{\frac{1296}{25}}$

$x = \frac{36}{5}$

$PQ = \frac{2}{3} AB$

$= \frac{2}{3} \times \frac{36}{5}$

$= \frac{24}{5}$

$= 4.8$ (1)

4.8 .... cm

(Total for Question 6 is 4 marks)

7 The diagram shows triangle *ABP* inside the regular hexagon *ABCDEF*

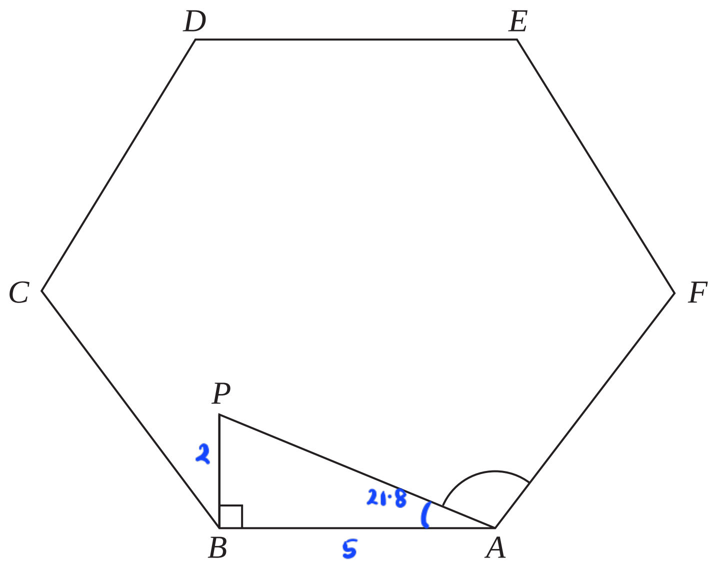


Diagram **NOT** accurately drawn

AB = 5 cm   *BP* = 2 cm   Angle *ABP* = 90°

Work out the size of angle *PAF*
Give your answer correct to 3 significant figures.

Internal angle of hexagon $= \frac{6-2}{6} \times 180°$

$= \frac{4}{6} \times 180°$

$= 120°$ (1)

$\tan BAP = \frac{2}{5}$ (1)

$BAP = \tan^{-1} \frac{2}{5}$ (1)

$= 21.8°$

angle PAF $= 120° - 21.8°$ (1)

$= 98.2°$ (1)

98.2 °

(Total for Question 7 is 5 marks)

8 The diagram shows a regular octagon *ABCDEFGH* and a regular pentagon *ABIJK*

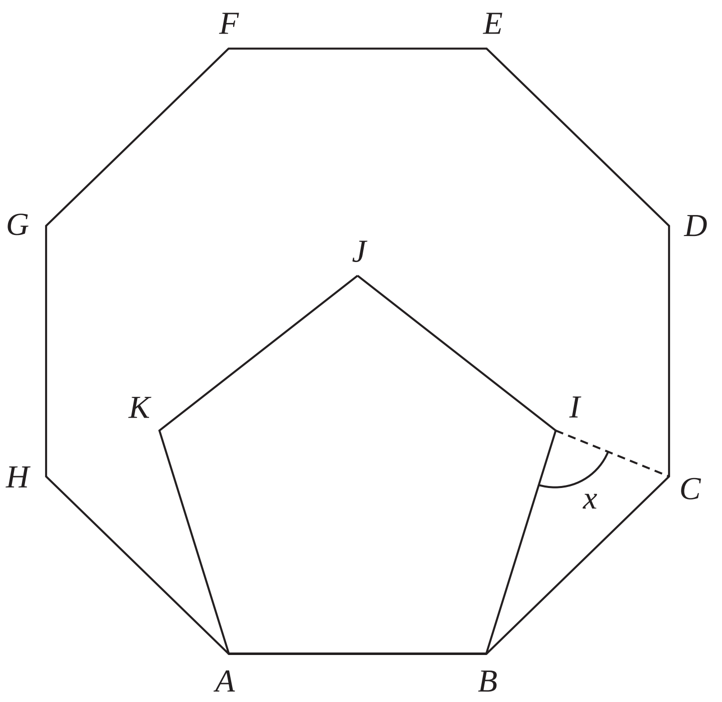


Diagram **NOT** accurately drawn

Work out the size of the angle x

Interior angle :

octagon : $180° - (360 \div 8) = 135°$ (1)

pentagon : $180° - (360 \div 5) = 108°$

$IBC = 135° - 108°$ (1)

$= 27°$

since BCI is isosceles,

$x = \dfrac{180° - 27°}{2}$ (1)

$= 76.5°$ (1)

76.5 °

(Total for Question 8 is 4 marks)

9 The diagram shows a regular 10-sided polygon, *ABCDEFGHIJ*

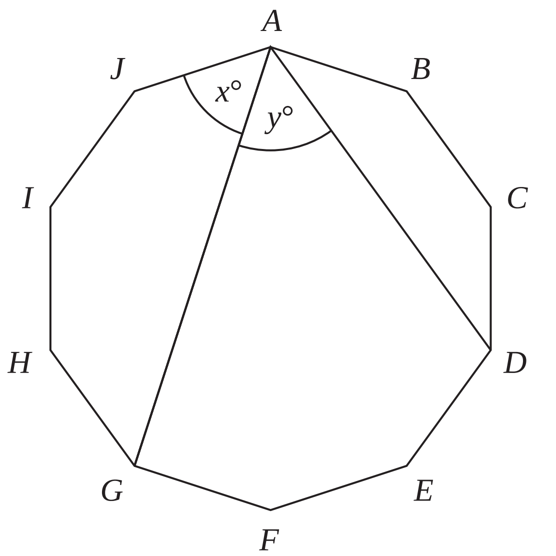


Diagram **NOT** accurately drawn

Show that $x = y$

Interior angle : $\frac{(10-2)\times180^\circ}{10} = 144^\circ$ (1)

$x = \frac{540^\circ - 3(144^\circ)}{2} = 54^\circ$ (1)

$B\hat{A}D = \frac{360^\circ - 2(144^\circ)}{2} = 36^\circ$ (1)

$y = 90^\circ - 36^\circ$

$= 54^\circ$ (1)

$\therefore y = x$

(Total for Question 9 is 4 marks)

10

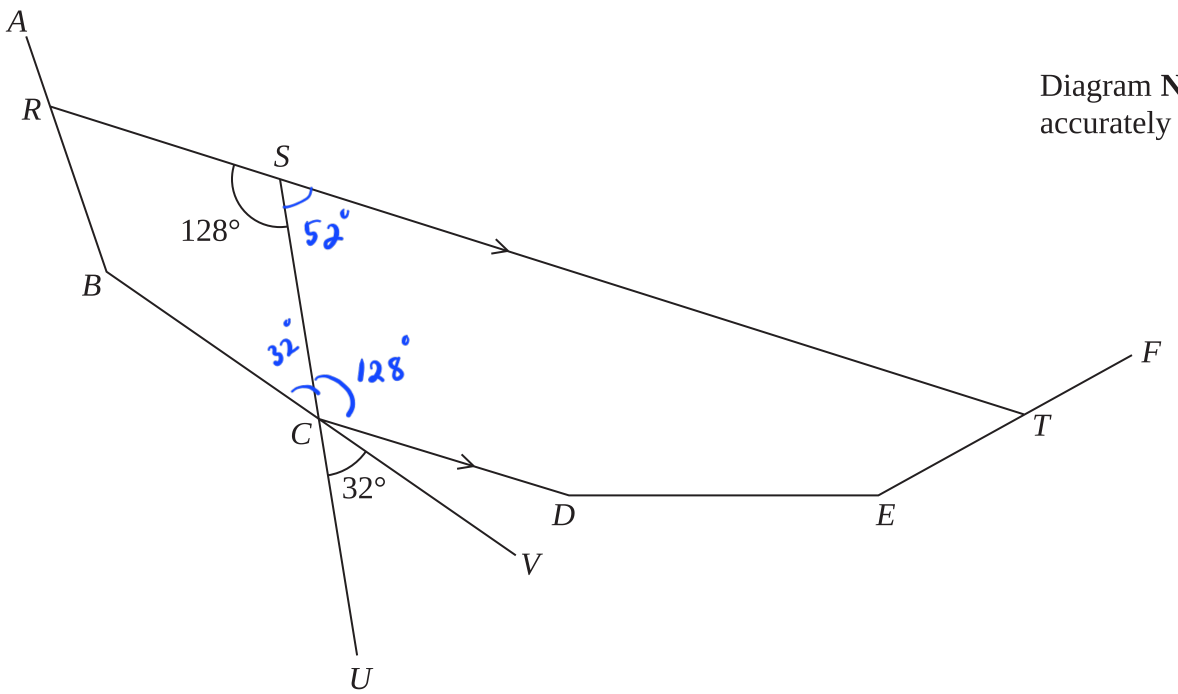


Diagram **NOT** accurately drawn

AB, *BC*, *CD*, *DE* and *EF* are five sides of a regular polygon.

RST, *SCU* and *BCV* are straight lines.
RST is parallel to *CD*
Angle *RSC* = 128°
Angle *UCV* = 32°

Work out how many sides the polygon has.
Show your working clearly.

BCS = UCV = 32°

SCD = RSC = 128° (1)

TSC = 180° − 128° = 52°

interior angle = 128° + 32° = 160° (1)

180 (n − 2) = 160 n (1)

180 n − 360 = 160 n

20 n = 360

n = 18 (1)

18

(Total for Question 10 is 4 marks)

11 The diagram shows a pentagon.

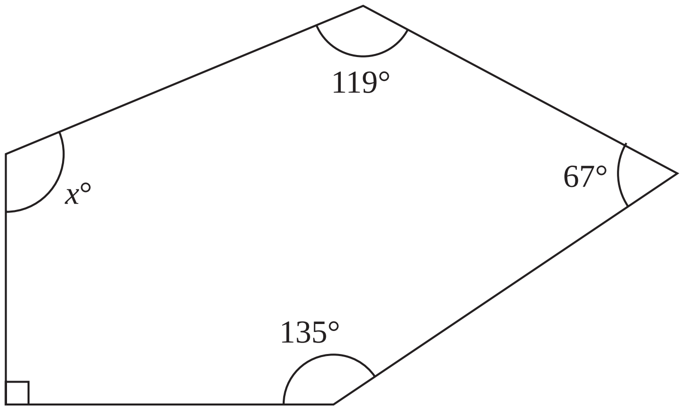


Diagram **NOT** accurately drawn

Work out the value of x

Total angle : $3 \times 180^\circ = 540^\circ$ (1)

$540 - 90 - 135 - 67 - 119$ (1)

$= 540 - 411$

$= 129$ (1)

$x =$ 129

(Total for Question 11 is 3 marks)

12

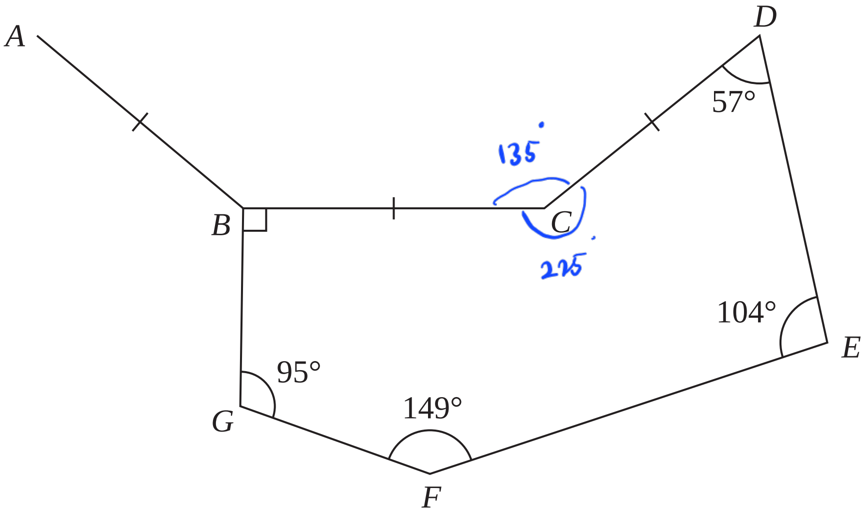


Diagram **NOT** accurately drawn

BCDEFG is a hexagon.
AB, *BC* and *CD* are three sides of a regular *n*-sided polygon.

Calculate the value of *n*
Show your working clearly.

sum of Interior angle of hexagon : $(6-2) \times 180° = 720°$ (1)

angle BCD (large) $= 720° - 90° - 95° - 149° - 104° - 57°$
$= 225°$ (1)

angle BCD (small) $= 360° - 225°$
$= 135°$ (1)

$$\frac{180(n-2)}{n} = 135°$$

$180n - 360° = 135n$

$180n - 135n = 360$

$45n = 360$

$n = \frac{360}{45} = 8$ (1)

$n =$ 8

(Total for Question 12 is 4 marks)

13 The diagram shows two circles with centre *O* and a regular pentagon *ABCDE*

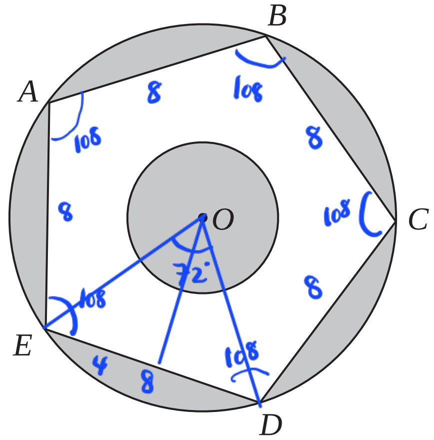


Diagram **NOT** accurately drawn

A, *B*, *C*, *D* and *E* are points on the larger circle.
The pentagon has sides of length 8 cm.

The diagram is shaded such that

shaded area = unshaded area

Work out the radius of the smaller circle.
Give your answer correct to 3 significant figures.

pentagon angle $= \frac{180 \times 3}{5} = 108°$

angle EOD $= 180 - 54 - 54$
$= 72°$

height of triangle : $\tan 54 = \frac{\text{height}}{4}$

$= 4 \tan 54 = 5.505 \ldots$ (1)

$\frac{\text{length OE}}{\sin 54°} = \frac{8}{\sin 72}$

$OE = \frac{8 \sin 54}{\sin 72} = 6.805 \ldots$ = radius of large circle

Area of whole diagram $= \pi \times 6.805^2 = 145.489 \ldots$ (1)

Area of pentagon $= 5 \times \frac{1}{2} \times 8 \times 5.505 \ldots = 110.11$ (1)

Shaded area = unshaded area

$145.489 - 110.11 + \pi r^2 = 110.11 - \pi r^2$ (1)

$2\pi r^2 = 74.731\ldots$ (1)

$r^2 = 11.89\ldots$

$r = 3.45$ (3 s.f.) (1)

3.45 cm

(Total for Question 13 is 6 marks)

14 Here is a 9-sided regular polygon *ABCDEFGHJ*, with centre *O*

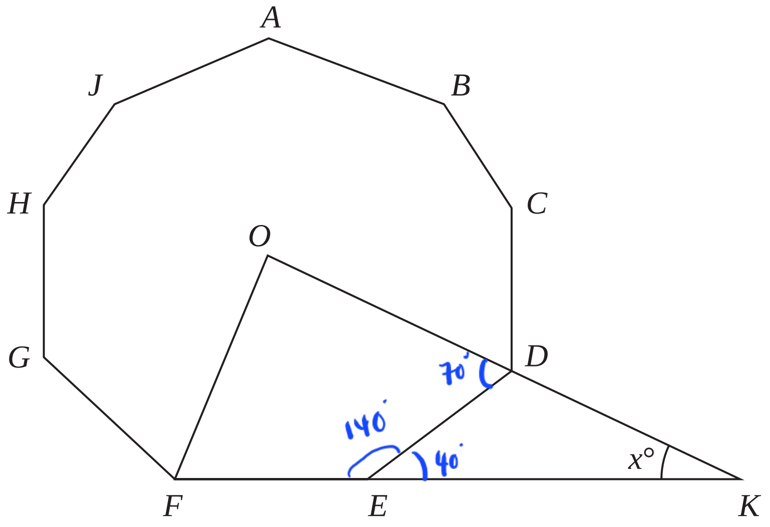


Diagram **NOT** accurately drawn

ODK and *FEK* are straight lines.

Work out the value of *x*

interior angle of polygon $= \dfrac{(9-2)(180)}{9} = 140°$ (1)

$DEK = 180° - 140° = 40°$

$EDK = 180° - \left(\dfrac{140}{2}\right) = 110°$ (1)

$x = 180° - 110° - 40°$

$= 30°$ (1)

$x = $ 30

(Total for Question 14 is 3 marks)