1 The diagram shows parallelogram *EFGH*.

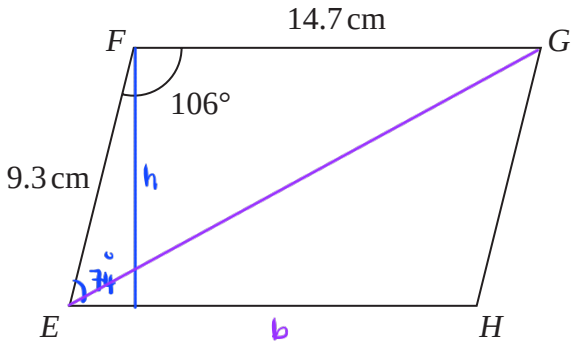

Diagram **NOT** accurately drawn

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 = $180^\circ - 106^\circ = 74^\circ$

$\sin 74^\circ = \frac{h}{9.3}$

$h = 9.3 \sin 74^\circ$ (1)

$= 8.94$ cm

Area of parallelogram : $8.94 \times 14.7 = 131\ cm^2$ (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 :

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

$= 9.3^2 + 14.7^2 - 2(9.3)(14.7) \cos 106^\circ$ (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 1 is 5 marks)

2 Here is a right-angled triangle.

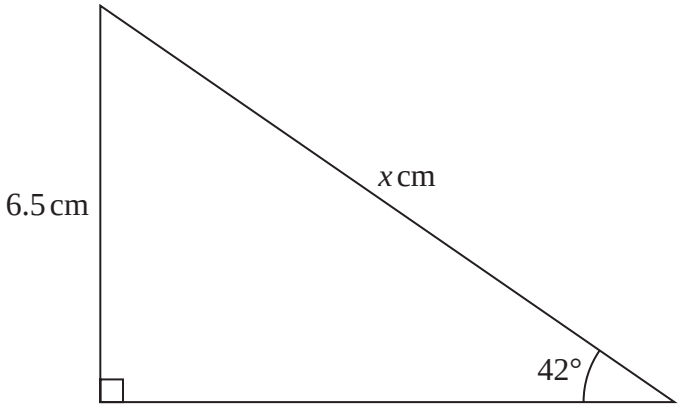

Diagram **NOT** accurately drawn

Work out the value of x.
Give your answer correct to one decimal place.

By using sine rule :

$$\frac{x}{\sin 90^\circ} = \frac{6.5}{\sin 42^\circ} \quad (1)$$

$$x = \frac{6.5}{0.669} \quad (1)$$

$$= 9.7 \quad (1)$$

$x =$ 9.7

(Total for Question 2 is 3 marks)

3

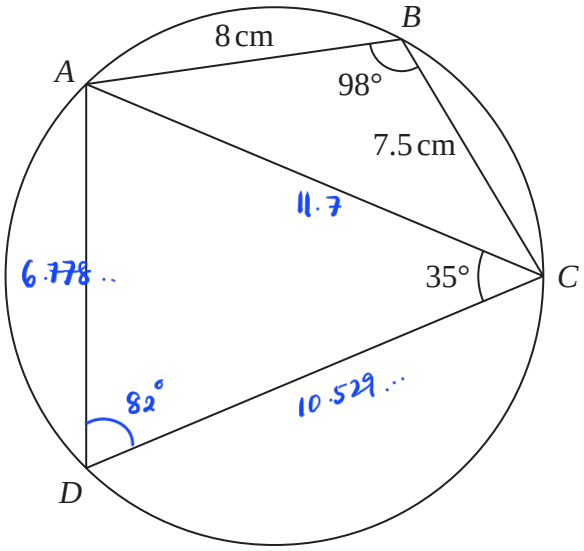

Diagram **NOT** accurately drawn

ABCD is a quadrilateral where *A*, *B*, *C* and *D* are points on a circle.

AB = 8 cm
BC = 7.5 cm
Angle *ABC* = 98°
Angle *ACD* = 35°

Work out the perimeter of quadrilateral *ABCD*.
Give your answer correct to one decimal place.

angle ADC = $180^\circ - 98^\circ$
= 82° (1)

By using cosine rule :

$AC^2 = 8^2 + 7.5^2 - 2(8)(7.5)\cos 98^\circ$
$AC^2 = 136.95\ldots$ (1)
$AC = 11.702\ldots$ (1)

By using sine rule :

$$\frac{AD}{\sin 35^\circ} = \frac{11.702\ldots}{\sin 82^\circ}$$

$$AD = \frac{11.702\ldots}{\sin 82^\circ} \times \sin 35^\circ$$
$= 6.778\ldots$ (1)

angle DAC $= 180^\circ - 82^\circ - 35^\circ$

$= 63^\circ$

By using sine rule :

$$\frac{DC}{\sin 63^\circ} = \frac{6.778\ldots}{\sin 35^\circ}$$

$$DC = \frac{6.778\ldots}{\sin 35^\circ} \times \sin 63^\circ$$

$= 10.529\ldots$ (1)

Perimeter of ABCD $= 8 + 7.5 + 10.529\ldots + 6.778\ldots$

$= 32.8$ cm (1)

32.8 ..... cm

(Total for Question 3 is 6 marks)

4 The diagram shows the positions of three ships, *A*, *B* and *C*.

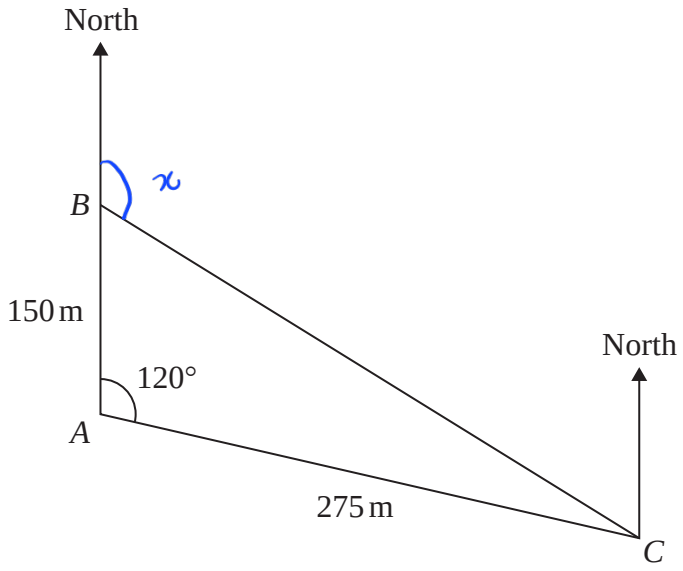

Diagram **NOT** accurately drawn

Ship *B* is due north of ship *A*.

The bearing of ship *C* from ship *A* is 120°

Calculate the bearing of ship *C* from ship *B*.
Give your answer correct to the nearest degree.

$a^2 = b^2 + c^2 - 2bc\cos A$

$BC^2 = (150)^2 + (275)^2 - 2(150)(275)\cos 120°$

$= 139375$ (1)

$BC = \sqrt{139375}$

$= 373.329\ldots$ (1)

$\frac{\sin ABC}{275} = \frac{\sin 120}{373.329\ldots}$ (1)

$\sin \angle ABC = 0.6379\ldots$

$\angle ABC = \sin^{-1}(0.6379\ldots)$

$= 39.6\ldots°$ (1)

$x = 180° - 39.6°$

$= 140.4°$

$\approx 140°$ (1)

140 °

(Total for Question 4 is 5 marks)

5 The diagram shows a sector OBC of a circle with centre O and radius $(6 + x)$ cm.

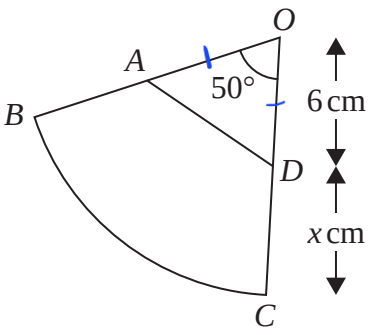

Diagram **NOT** accurately drawn

A is the point on OB and D is the point on OC such that $OA = OD = 6$ cm

Angle $BOC = 50°$

Given that

the perimeter of sector $OBC = 2 \times$ the perimeter of triangle OAD

find the value of x.
Give your answer correct to 3 significant figures.

$a^2 = b^2 + c^2 - 2bc \cos A$

$AD^2 = 6^2 + 6^2 - 2(6)(6) \cos 50°$

$= 25.719\ldots$

$AD = \sqrt{25.719\ldots}$

$= 5.0714\ldots$ (1)

perimeter of triangle $OAD = 12 + 5.0714\ldots$

$= 17.0714\ldots$ (1)

arc $BC = \frac{50°}{360°} \times 2\pi(6+x)$

$= \frac{5\pi}{18}(6+x)$ (1)

perimeter of sector $OBC = \frac{5\pi}{18}(6+x) + 2(6+x)$

$= \frac{5\pi}{18}(6+x) + 12 + 2x$

perimeter of sector OBC = 2x perimeter of triangle OAD

$\frac{5\pi}{18}(6+x) + 12 + 2x = 2 \times 17.0714..$ (1)

$\frac{5}{3}\pi + \frac{5\pi}{18}x + 12 + 2x = 34.1428$

$\frac{5\pi}{18}x + 2x = 34.1428 - 12 - \frac{5}{3}\pi$ (1)

$x\left(\frac{5\pi}{18} + 2\right) = 16.9068...$

$x = 5.89$ (3sf) (1)

$x =$ 5.89

(Total for Question 5 is 6 marks)

6 Here is triangle *ABC*

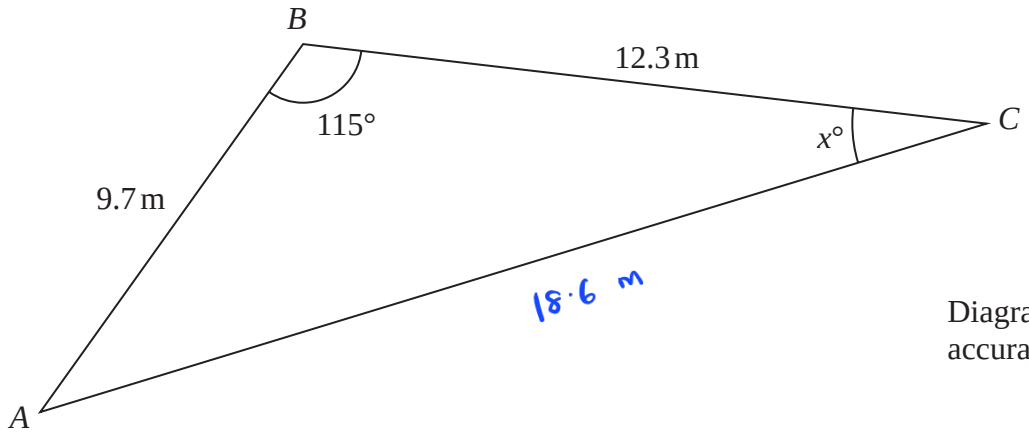

Diagram **NOT** accurately drawn

Work out the value of x
Give your answer correct to 3 significant figures.

$AC^2 = 9.7^2 + 12.3^2 - 2(9.7)(12.3)\cos 115$ (1)

$AC^2 = 346.2$

$AC = \sqrt{346.2} = 18.6$ m (1)

$\frac{\sin x}{9.7} = \frac{\sin 115^\circ}{18.6}$ (1)

$\sin x = \frac{\sin 115^\circ}{18.6} \times 9.7$

$\sin x = 0.47..$ (1)

$x = \sin^{-1} 0.47..$

$= 28.2$ (1)

$x =$ 28.2

(Total for Question 6 is 5 marks)

7 The diagram shows quadrilateral *ABCD*

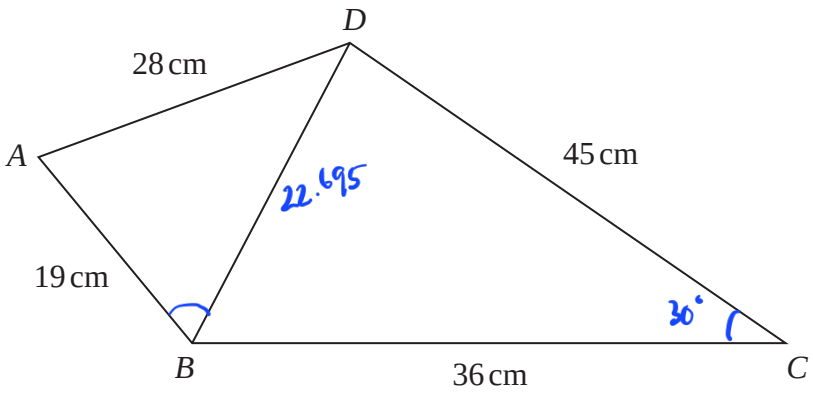

Diagram **NOT** accurately drawn

The angle *BCD* is acute.

Given that the area of triangle *BCD* = 405 cm^2

work out the size of angle *ABD*
Give your answer correct to one decimal place.

$\frac{1}{2} \times 36 \times 45 \times \sin C = 405$ (1)

$\sin C = \frac{405 \times 2}{36 \times 45}$

$C = \sin^{-1} \frac{405 \times 2}{36 \times 45}$

$C = 30°$ (1)

$BD = \sqrt{45^2 + 36^2 - 2 \times 45 \times 36 \times \cos 30°}$ (1)

$= \sqrt{3321 - 3240 \cos 30°}$

$= \sqrt{515.077\ldots}$

$= 22.695$

$28^2 = 19^2 + 22.695^2 - 2(19)(22.695) \cos ABD$

$\cos ABD = -\left(\frac{28^2 - 19^2 - 22.695^2}{2(19)(22.695)}\right)$ (1)

$ABD = 83.9°$ (1)

83.9 °

(Total for Question 7 is 5 marks)

8 The diagram shows triangle *ABC*

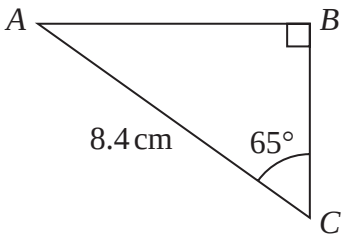

Diagram **NOT** accurately drawn

Work out the length of the side *AB*
Give your answer correct to 3 significant figures.

$$\frac{AB}{\sin 65^\circ} = \frac{8.4}{\sin 90^\circ} \quad (1)$$

$$AB = \frac{8.4}{\sin 90^\circ} \times \sin 65^\circ \quad (1)$$

$$= 7.61 \quad (1)$$

7.61 ..... cm

(Total for Question 8 is 3 marks)

9 The diagram shows triangle *PQR*

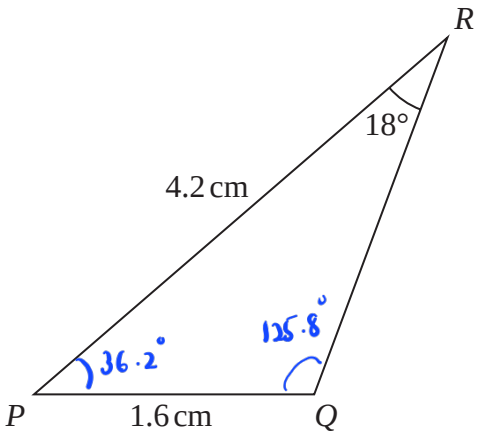

Diagram **NOT** accurately drawn

PQ = 1.6 cm *PR* = 4.2 cm Angle *PRQ* = 18°

Given that angle *PQR* is obtuse,

work out the area of triangle *PQR*
Give your answer correct to 3 significant figures.

$\frac{\sin PQR}{4.2} = \frac{\sin 18}{1.6}$ (1)

$\angle PQR = \sin^{-1}\left(\frac{\sin 18}{1.6}(4.2)\right)$

$= 54.2^\circ$ (acute) (1)

$\angle PQR = 180^\circ - 54.2^\circ = 125.8^\circ$ (obtuse) (1)

$\angle QPR = 180^\circ - 125.8^\circ - 18^\circ = 36.2^\circ$

(1)

Area $= \frac{1}{2} \times 4.2 \times 1.6 \times \sin 36.2^\circ$ (1)

$= 1.98$ (1)

1.98 ..... cm^2

(Total for Question 9 is 6 marks)

10 *AEC* and *BED* are chords of a circle.

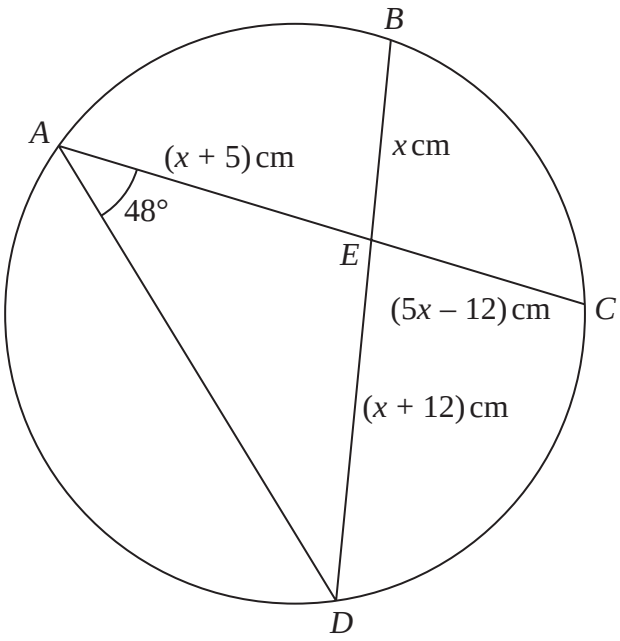

Diagram **NOT** accurately drawn

$AE = (x + 5)$ cm $\quad BE = x$ cm $\quad CE = (5x – 12)$ cm $\quad DE = (x + 12)$ cm

Angle $DAE = 48°$

Work out the size of angle *ADE*
Give your answer correct to one decimal place.

$(x+5)(5x-12) = x(x+12)$ (1)

$5x^2 - 12x + 25x - 60 = x^2 + 12x$

$4x^2 + x - 60 = 0$ (1)

$(4x - 15)(x+4) = 0$ (1)

$x = \frac{15}{4} = 3.75$ cm

$AE = 3.75 + 5 = 8.75$

$ED = 3.75 + 12 = 15.75$

$$\frac{\sin ADE}{8.75} = \frac{\sin 48^\circ}{15.75}$$

$ADE = \sin^{-1}\dfrac{\sin 48^\circ (8.75)}{15.75}$ (1)

$= 24.4$ (1)

24.4 °

(Total for Question 10 is 5 marks)

11 Here is a shape formed from two triangles *ABC* and *CDE*
ACD and *BCE* are straight lines.

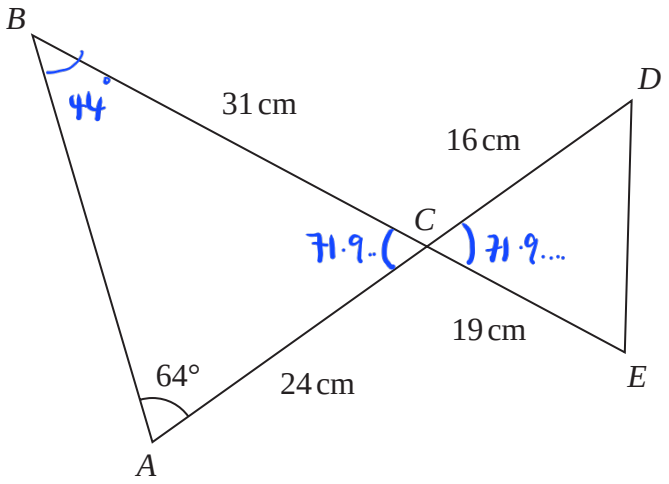

Diagram **NOT** accurately drawn

AC = 24 cm *BC* = 31 cm *CE* = 19 cm *CD* = 16 cm

Angle *BAC* = 64°

Work out the length of *DE*
Give your answer correct to 3 significant figures.

$$\frac{\sin ABC}{24} = \frac{\sin 64}{31} \quad (1)$$

$$ABC = \sin^{-1}\left(\frac{\sin 64}{31} \times 24\right)$$

$$= 44.... \quad (1)$$

$$BCA = 180 - 44... - 64 \quad (1)$$

$$= 71.9...$$

$$DE^2 = 16^2 + 19^2 - 16(19)\cos 71.9^\circ \quad (1)$$

$$DE = \sqrt{617 - 181.8...}$$

$$= 20.7 \quad (1)$$

20.7 ..... cm

(Total for Question 11 is 5 marks)

12 Here is a triangle *ABC*

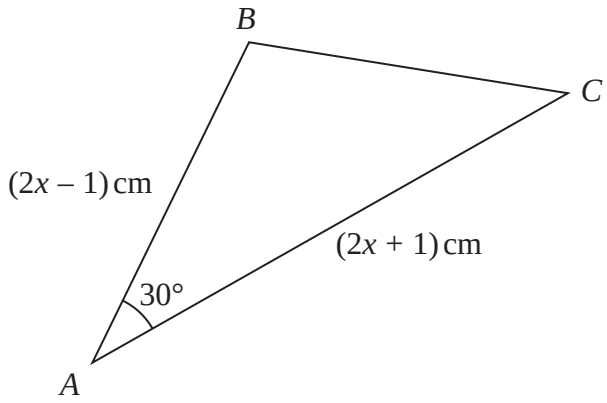

Diagram **NOT** accurately drawn

The area of the triangle is $(x^2 + x - 3.75)\,\text{cm}^2$

Find the size of the largest angle in triangle *ABC*
Give your answer correct to the nearest degree.

$\frac{1}{2}(2x-1)(2x+1)\sin 30^\circ = x^2 + x - 3.75$ (1)

$\frac{1}{4}(4x^2 - 1) = x^2 + x - 3.75$

$x^2 - 0.25 = x^2 + x - 3.75$

$x = -0.25 + 3.75$

$= 3.5$ (1)

$AB = 2(3.5) - 1 = 6$ cm

$AC = 2(3.5) + 1 = 8$ cm

since AC > AB, largest angle is ABC.

$BC^2 = 6^2 + 8^2 - 2(6)(8)\cos 30^\circ$

$= 16.8615\ldots$ (1)

$BC = \sqrt{16.8615\ldots} = 4.10628\ldots$

$$\frac{\sin ABC}{8} = \frac{\sin 30^\circ}{4.10628\ldots}$$ (1)

$\sin ABC = 0.974\ldots$

$ABC = \sin^{-1} 0.974\ldots$ (1)

$= 103^\circ$ (1)

103 °

(Total for Question 12 is 6 marks)

13 The diagram shows a triangle *ABC* and a flagpole *BF*

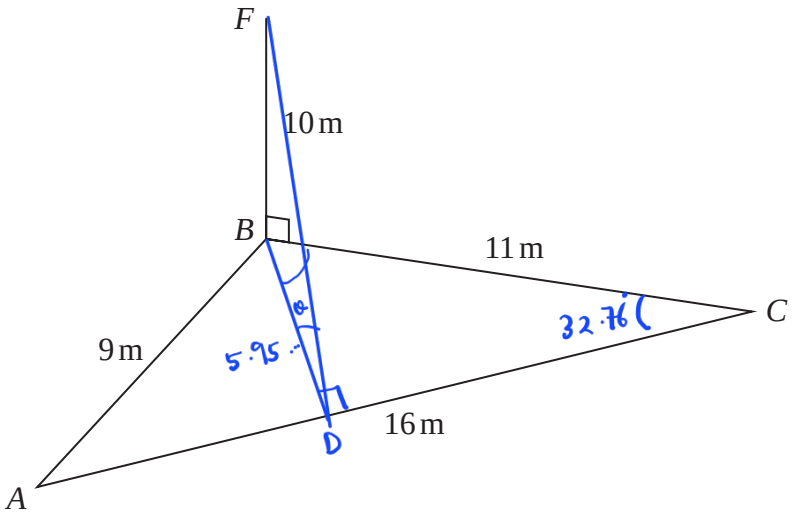

Diagram **NOT** accurately drawn

A, *B* and *C* are points on horizontal ground.

BF is vertical.

$AB = 9\,\text{m}$ $BC = 11\,\text{m}$ $AC = 16\,\text{m}$ $BF = 10\,\text{m}$

D is the point on *AC* such that angle *BDC* = 90°

Work out the size of the angle of elevation of the point *F* from the point *D*
Give your answer correct to one decimal place.

$9^2 = 11^2 + 16^2 - 2(11)(16)\cos BCA$ (1)

$\dfrac{9^2 - 11^2 - 16^2}{-2(11)(16)} = \cos BCA$

$BCA = 32.763\ldots$ (1)

$\dfrac{BD}{\sin 32.763..} = \dfrac{11}{\sin 90}$

$BD = 11 \sin 32.763$

$= 5.95\ldots$ (1)

$\tan FDB = \dfrac{10}{5.95\ldots}$ (1)

$FDB = \tan^{-1}\dfrac{10}{5.95\ldots} = 59.2$ (1)

59.2 °

(Total for Question 13 is 5 marks)