1.

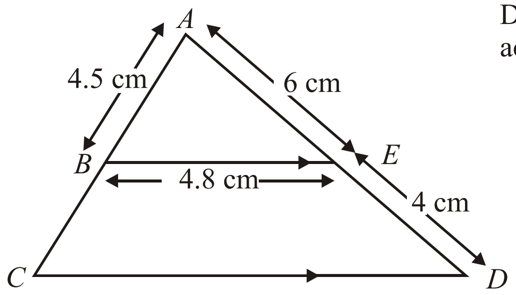


Diagram **NOT** accurately drawn

BE is parallel to *CD*.
AE = 6 cm, *ED* = 4 cm, *AB* = 4.5 cm, *BE* = 4.8 cm.

(a) Calculate the length of *CD*.

.......................cm
(2)

(b) Calculate the perimeter of the trapezium *EBCD*.

.......................cm
(2)
(Total 4 marks)

2.

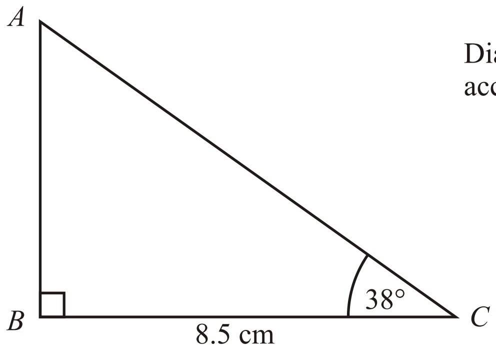


Diagram **NOT** accurately drawn

The diagram shows triangle ABC.
$BC = 8.5$ cm.
Angle $ABC = 90°$.
Angle $ACB = 38°$.

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

.... cm
(Total 3 marks)

3.

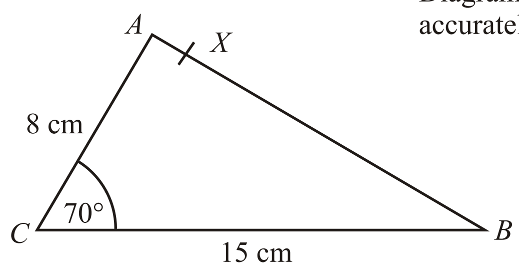


Diagram **NOT** accurately drawn

In triangle ABC,
$AC = 8$ cm,
$CB = 15$ cm,
Angle $ACB = 70°$.

(a) Calculate the area of triangle *ABC*.
Give your answer correct to 3 significant figures.

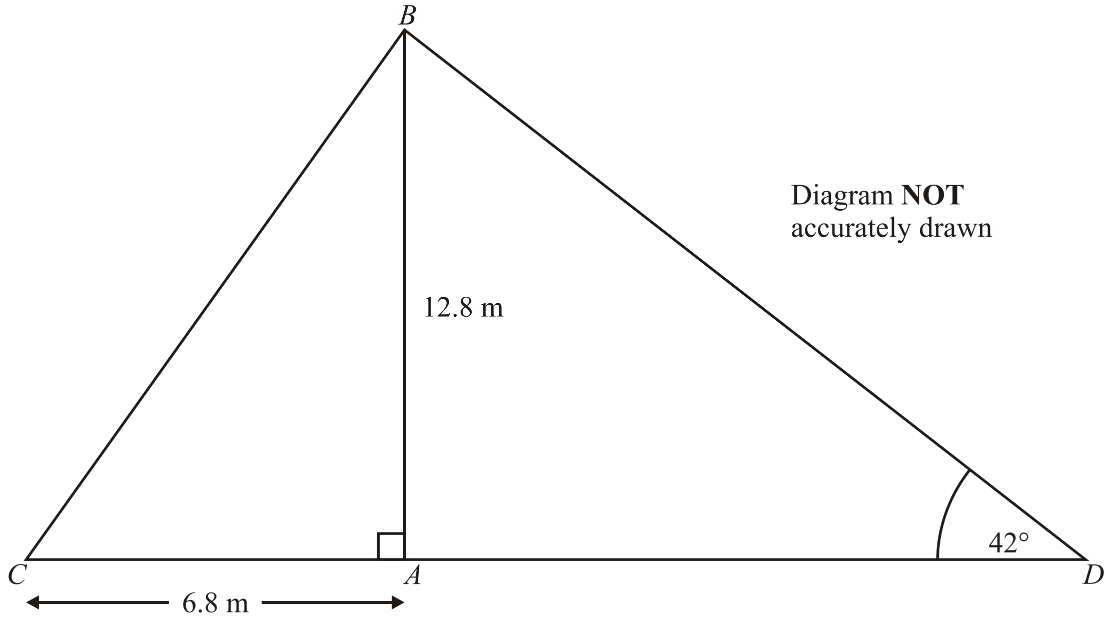
.... cm^2
(2)

X is the point on *AB* such that angle *CXB* = 90°.

(b) Calculate the length of *CX*.
Give your answer correct to 3 significant figures.

.... cm
(4)
(Total 6 marks)

4. The diagram represents a vertical flagpole, AB.
The flagpole is supported by two ropes, BC and BD, fixed to the horizontal ground at C and at D.



AB = 12.8 m.
AC = 6.8 m.
Angle BDA = 42°.

(a) Calculate the size of angle BCA.
Give your answer correct to 3 significant figures.

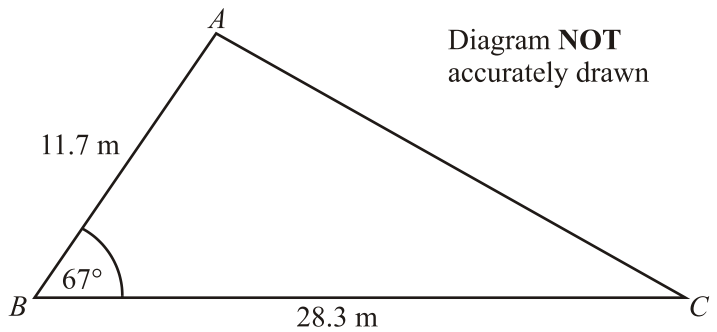
..............................°

(3)

(b) Calculate the length of the rope BD.
Give your answer correct to 3 significant figures.

………………………… m
(3)
(Total 6 marks)

5.



$AB = 11.7$ m.
$BC = 28.3$ m.
Angle $ABC = 67°$.

(a) Calculate the area of the triangle ABC.
Give your answer correct to 3 significant figures.

………………………… m^2
(2)

(b) Calculate the length of AC.
Give your answer correct to 3 significant figures.

………………………….. m

(3)

(Total 5 marks)

6. The depth, D metres, of the water at the end of a jetty in the afternoon can be modelled by this formula

$$D = 5.5 + A \sin 30(t - k)°$$

where

t hours is the number of hours after midday,
A and k are constants.

Yesterday the low tide was at 3 p.m.
The depth of water at low tide was 3.5 m.

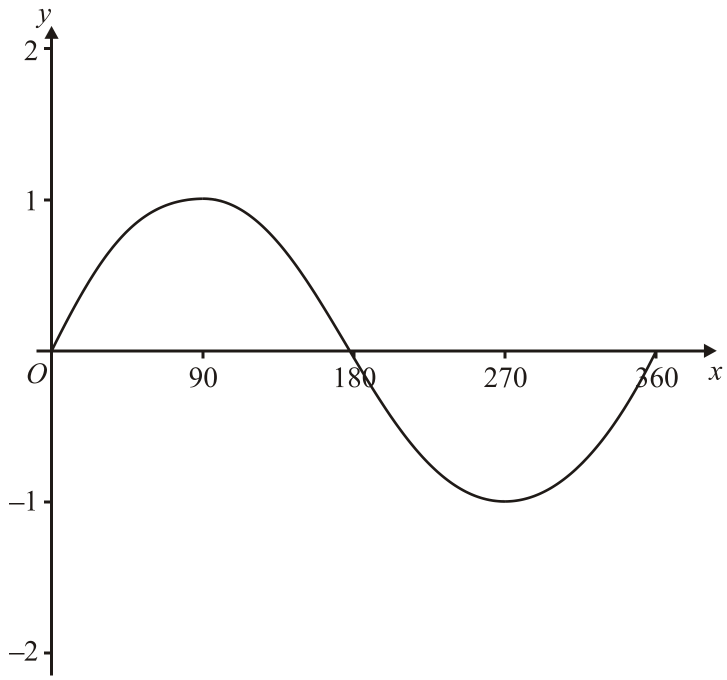
Find the value of A and k.

A = ...

k = ...

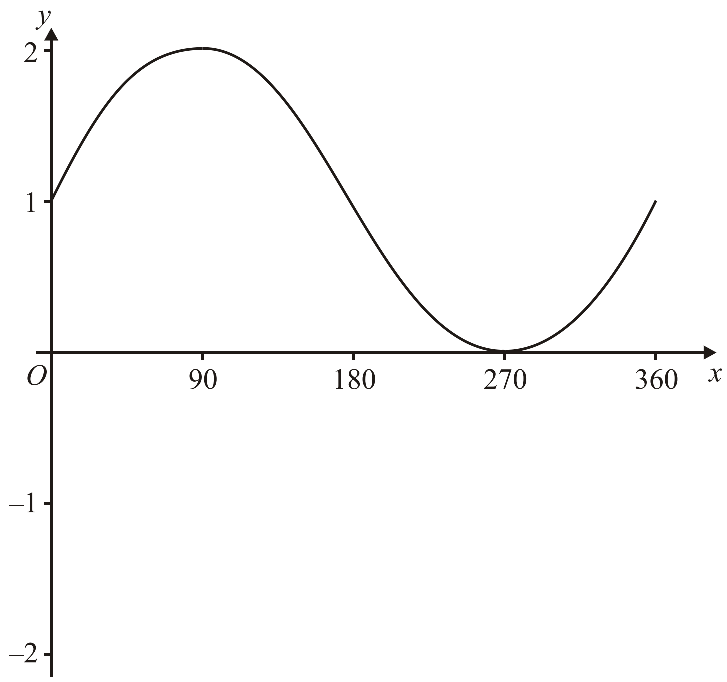
(Total 4 marks)

7. A sketch of the curve $y = \sin x°$ for $0 \le x \le 360$ is shown below.



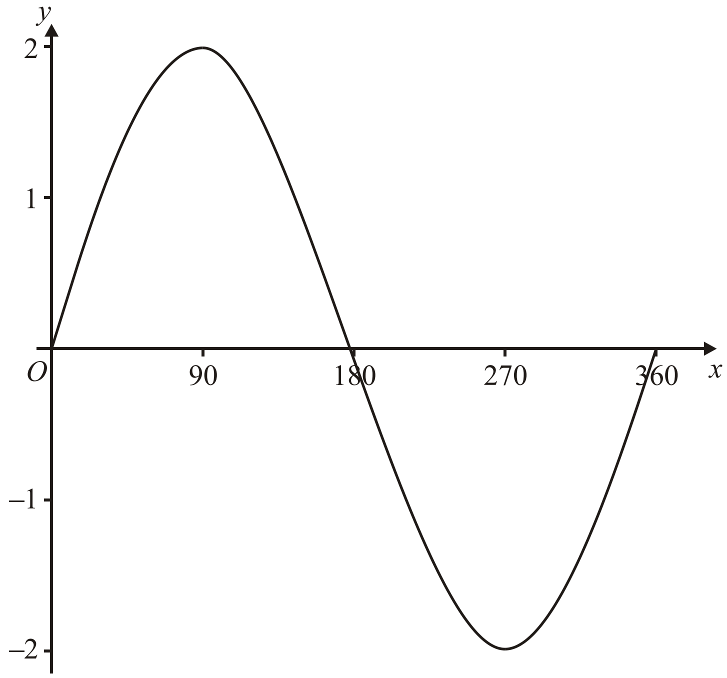
(a) Using the sketch above, or otherwise, find the equation of each of the following two curves.

(i)



(i) Equation y = ...

(ii)



(ii) Equation y = ...

(2)

(b) Describe fully the sequence of two transformations that maps the graph of $y = \sin x°$ onto the graph of $y = 3 \sin 2x°$

....

....

....

....

(3)

(Total 5 marks)

8.

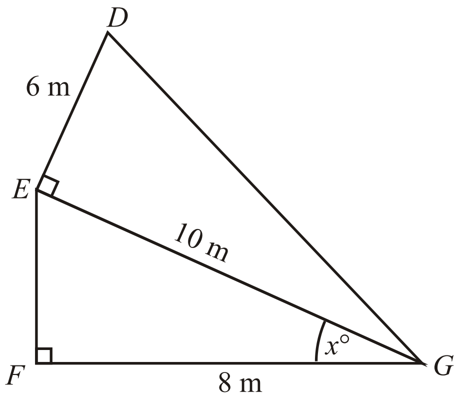


Diagram **NOT** accurately drawn

DE = 6m.
EG = 10 m.
FG = 8 m.
Angle DEG = 90°. Angle EFG = 90°.

(a) Calculate the length of DG.
Give your answer correct to 3 significant figures.

.... m
(3)

(b) Calculate the size of the angle marked x°.
Give your answer correct to one decimal place.

..........................°
(3)
(Total 6 marks)

9.

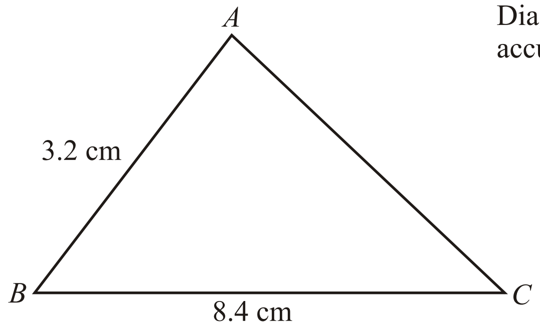


Diagram **NOT** accurately drawn

$AB = 3.2$ cm
$BC = 8.4$ cm

The area of triangle *ABC* is 10 cm^2.

Calculate the perimeter of triangle *ABC*.
Give your answer correct to three significant figures.

.... cm
(Total 6 marks)

10.

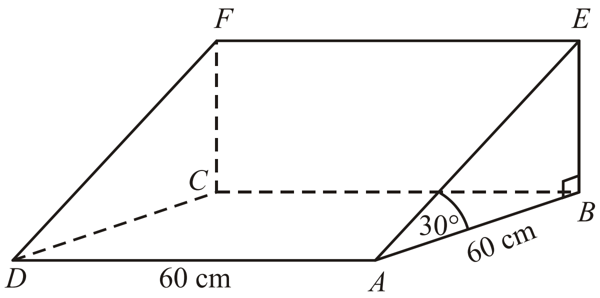


Diagram **NOT** accurately drawn

The diagram represents a prism.
AEFD is a rectangle.
ABCD is a square.

EB and *FC* are perpendicular to plane *ABCD.*

$AB = 60$ cm.
$AD = 60$ cm.
Angle $ABE = 90°$.
Angle $BAE = 30°$.

Calculate the size of the angle that the line *DE* makes with the plane *ABCD.*
Give your answer correct to 1 decimal place.

..........................°

(Total 4 marks)

11.

$$y = \sqrt{\frac{r + t\sin x°}{r - t\sin x°}}$$

$r = 8.8$
$t = 7.2$
$x = 40$

Calculate the value of y. Give your answer correct to 3 significant figures.

$y =$ ....

(Total 3 marks)

12.

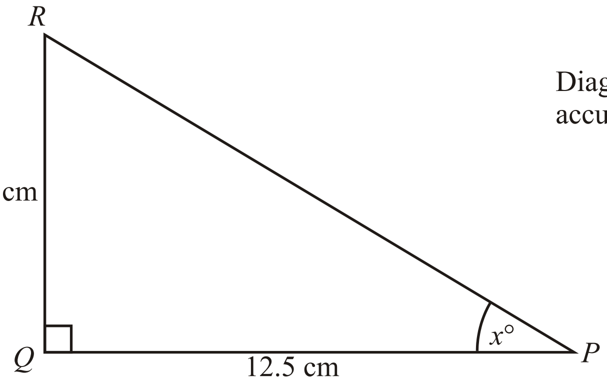


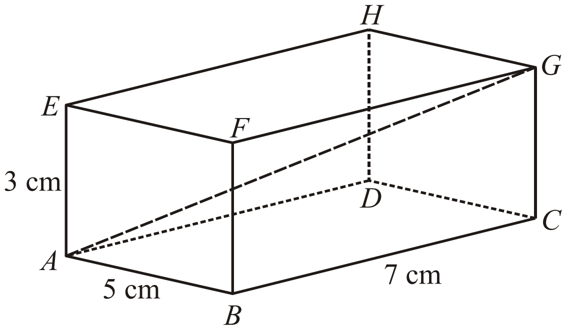
Diagram **NOT** accurately drawn

PQR is a triangle.
Angle *PQR* = 90°.
PQ = 12.5 cm.
QR = 5 cm.

Calculate the value of *x*.
Give your answer correct to 1 decimal place.

....
(Total 3 marks)

13.



The diagram represents a cuboid *ABCDEFGH*.

AB = 5 cm.
BC = 7 cm.
AE = 3 cm.

(a) Calculate the length of AG.
Give your answer correct to 3 significant figures.

.... cm
(2)

(b) Calculate the size of the angle between *AG* and the face *ABCD*.
Give your answer correct to 1 decimal place.

....°

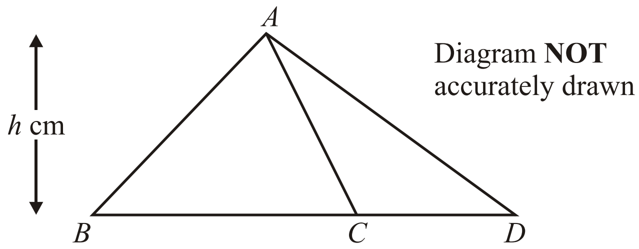
(2)
(Total 4 marks)

14. In triangle *PQR*,
PQ = 10 cm.
QR = 12 cm.
Angle *PQR* = 45°.

(a) Calculate the area of triangle *PQR*.
Give your answer correct to 3 significant figures.

.... cm^2

(2)



The diagram shows triangle ABC and triangle ACD.
BCD is a straight line.
The perpendicular distance from A to the line BCD is h cm.

(b) Explain why $\dfrac{\text{area of triangle } ABC}{\text{area of triangle } ACD} = \dfrac{BC}{CD}$

(2)

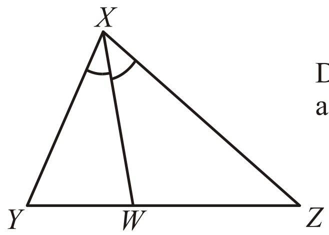


Diagram **NOT** accurately drawn

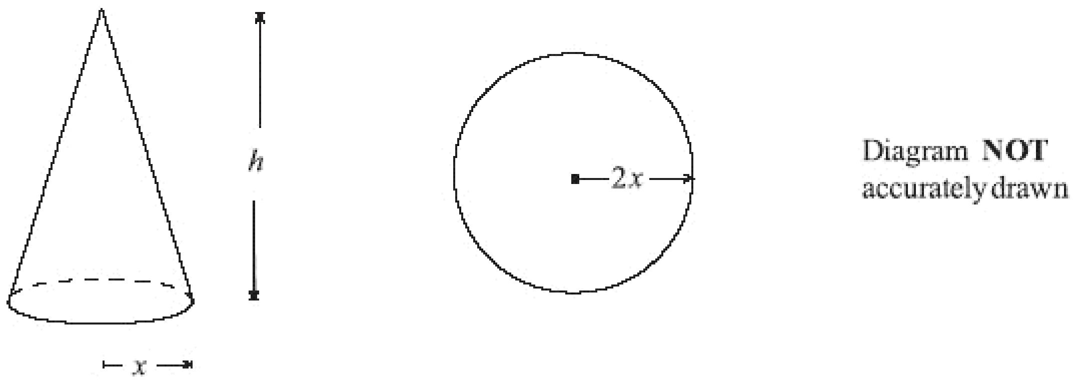
The diagram shows triangle XYZ.
W is the point on YZ such that angle YXW = angle WXZ.

(c) Using expressions for the area of triangle YXW and the area of triangle WXZ, or otherwise, show that

$$\frac{XY}{XZ} = \frac{YW}{WZ}$$

(3)
(Total 7 marks)

15.



The radius of the base of a cone is x cm and its height is h cm.

The radius of a sphere is $2x$ cm.

The volume of the cone and the volume of the sphere are equal.

Express h in terms of x.

Give your answer in its simplest form.

h = ………………..

(Total 3 marks)

16. A lighthouse, *L,* is 3.2 km due West of a port, *P*.
A ship, *S*, is 1.9 km due North of the lighthouse, *L*.

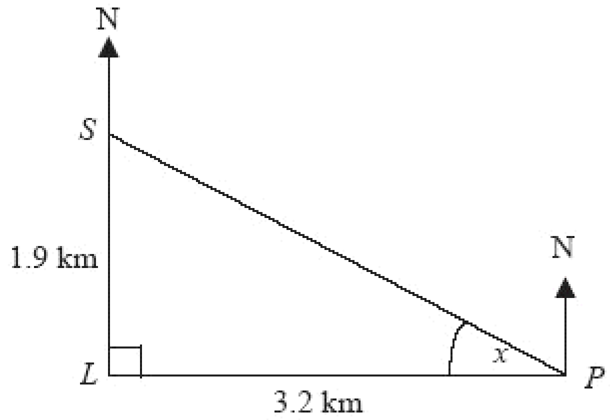


Diagram **NOT** accurately drawn

(a) Calculate the size of the angle marked *x*.
Give your answer correct to 3 significant figures.

x = ……………….. °

(3)

(b) Find the bearing of the port, *P*, from the ship, *S*.
Give your answer correct to 3 significant figures.

…………………... °

(1)
(Total 4 marks)

17.

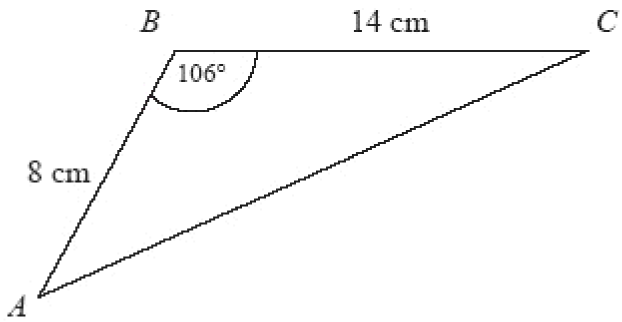


Diagram **NOT** accurately drawn

ABC is a triangle.

$AB = 8$ cm

$BC = 14$ cm

Angle $ABC = 106°$

Calculate the area of the triangle.

Give your answer correct to 3 significant figures.

………………..cm^2

(Total 3 marks)

18. The diagram shows a pyramid. The apex of the pyramid is V.

Each of the sloping edges is of length 6 cm.

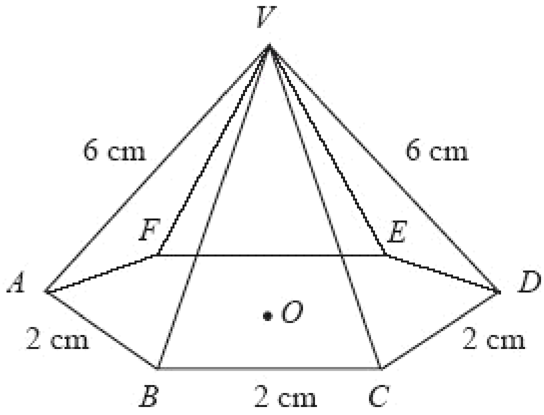


Diagram **NOT** accurately drawn

The base of the pyramid is a regular hexagon with sides of length 2 cm.

O is the centre of the base.

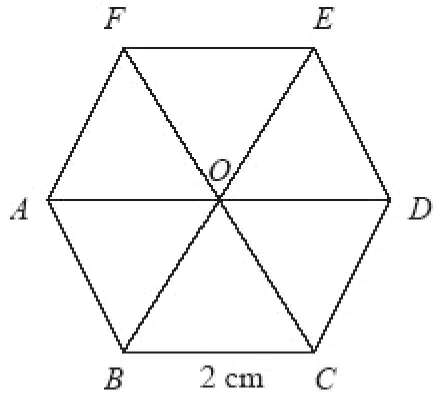


Diagram **NOT** accurately drawn

(a) Calculate the height of V above the base of the pyramid.
Give your answer correct to 3 significant figures.

………………..cm
(2)

(b) Calculate the size of angle DVA.
Give your answer correct to 3 significant figures.

………………..$^{\circ}$
(3)

(c) Calculate the size of angle AVC.
Give your answer correct to 3 significant figures.

………………….. °

(4)
(Total 9 marks)

19. The diagram shows some of the markings on a baseball field.

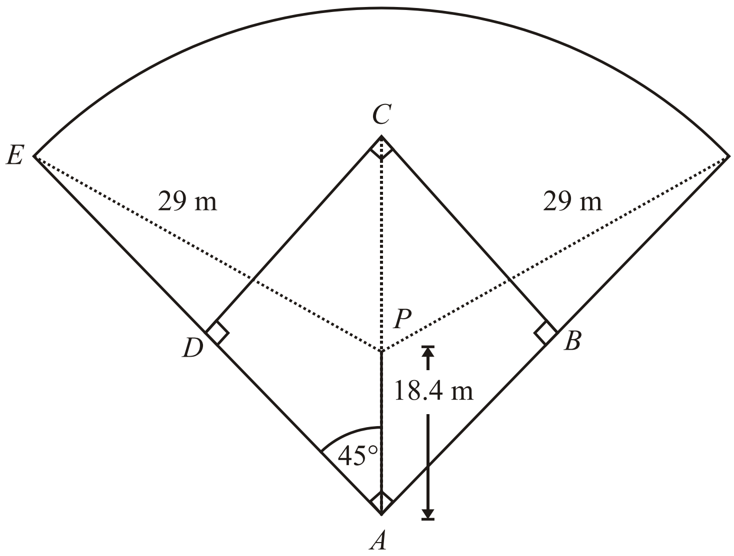


Diagram **NOT** accurately drawn

ABCD is a square.
AC is a diagonal of *ABCD*.
P is a point on *AC*.
ADE and *ABF* are straight lines.

AP = 18.4 m.
Angle *PAE* = 45°.

EF is an arc of the circle, centre *P* and radius 29 m.

(a) By considering triangle *PAE*, calculate the size of angle *AEP*.
Give your answer correct to 3 significant figures.

.... °
(3)

(b) Calculate the length of the arc EF.
Give your answer correct to 3 significant figures.

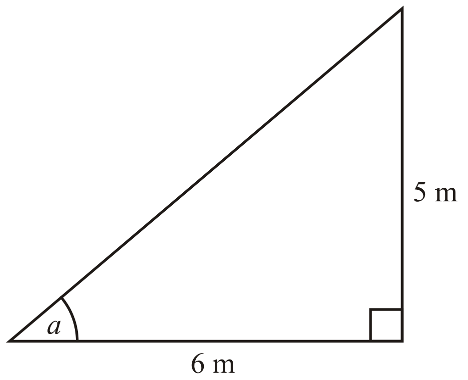
.... m

(4)

(Total 7 marks)

20. (a) Calculate the size of angle a in this right-angled triangle.
Give your answer correct to 3 significant figures.

Diagram **NOT** accurately drawn

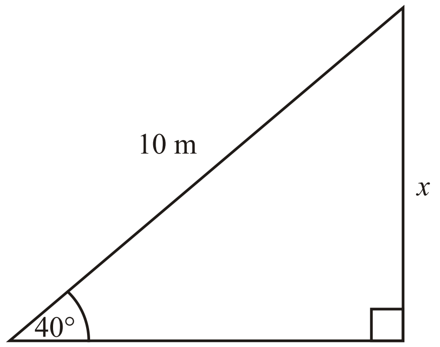


.....................................°

(3)

(b) Calculate the length of the side x in this right-angled triangle.
Give your answer correct to 3 significant figures.

Diagram **NOT** accurately drawn

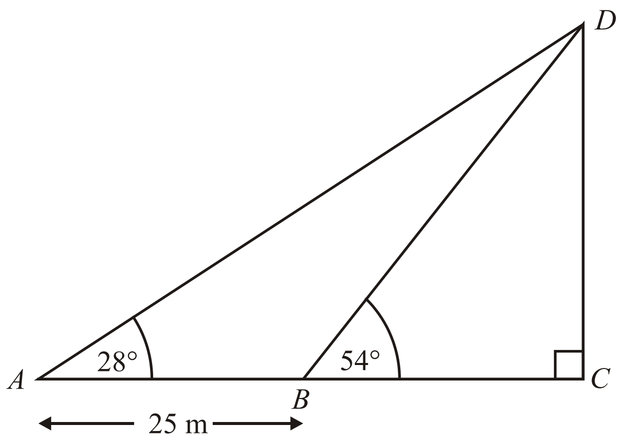


.... cm

(3)
(Total 6 marks)

21.

Diagram **NOT** accurately drawn



The diagram shows a vertical tower DC on horizontal ground ABC.
ABC is a straight line.

The angle of elevation of D from A is 28°.
The angle of elevation of D from B is 54°.

AB = 25 m.

Calculate the height of the tower.
Give your answer correct to 3 significant figures.

.... m
(Total 5 marks)

22.

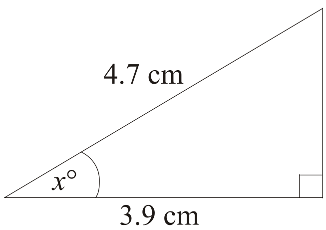


Diagram **NOT** accurately drawn

Work out the value of x.
Give your answer correct to 1 decimal place.

x = ...
(Total 3 marks)

23.

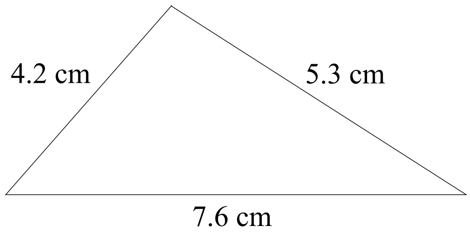


Diagram **NOT** accurately drawn

The lengths of the sides of a triangle are 4.2 cm, 5.3 cm and 7.6 cm.

(a) Calculate the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.

....................................°

(3)

(b) Calculate the area of the triangle.
Give your answer correct to 3 significant figures.

.... cm^2

(3)
(Total 6 marks)

24.

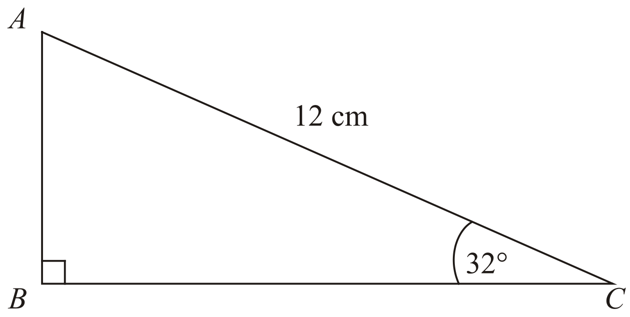


Diagram **NOT** accurately drawn

$AC = 12$ cm.
Angle $ABC = 90°$.
Angle $ACB = 32°$.

Calculate the length of AB.
Give your answer correct to 3 significant figures.

.... cm
(Total 3 marks)

25.

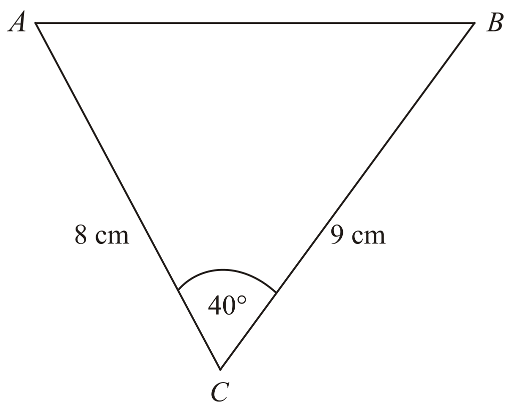


Diagram **NOT** accurately drawn

ABC is a triangle.
AC = 8 cm.
BC = 9 cm.
Angle *ACB* = 40°.

Calculate the length of *AB*.
Give your answer correct to 3 significant figures.

.... cm
(Total 3 marks)

26.

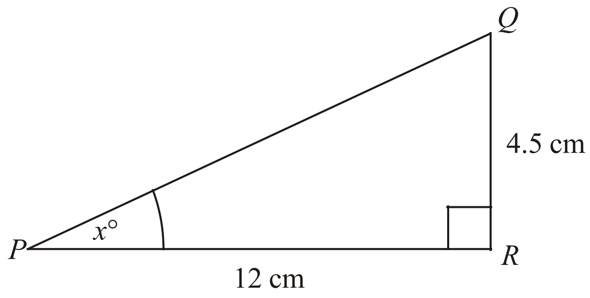


Diagram **NOT** accurately drawn

PQR is a right-angled triangle.
PR = 12 cm.
QR = 4.5 cm.
Angle *PRQ* = 90°.

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

x = ...
(Total 3 marks)

27.

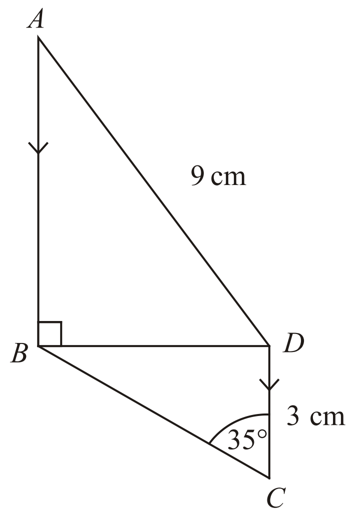


Diagram **NOT** accurately drawn

AB is parallel to *DC*.

AD = 9 cm, *DC* = 3 cm.

Angle *BCD* = 35°.

Angle *ABD* = 90°.

Calculate the size of angle *BAD*.
Give your answer correct to one decimal place.

....

(Total 4 marks)

28. The diagram shows an equilateral triangle.

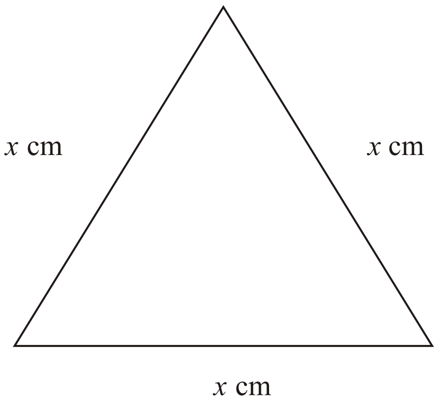


Diagram **NOT** accurately drawn

The area of the equilateral triangle is 36 cm^2.

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

x = ...

(Total 3 marks)

29.

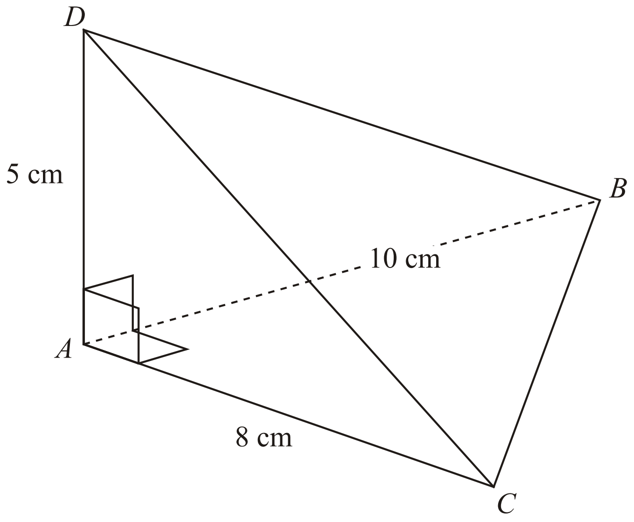


Diagram **NOT** accurately drawn

The diagram shows a tetrahedron.
AD is perpendicular to both *AB* and *AC*.
AB = 10 cm.
AC = 8 cm.
AD = 5 cm.
Angle *BAC* = 90°.

Calculate the size of angle *BDC*.
Give your answer correct to 1 decimal place.

....

(Total 6 marks)

30.

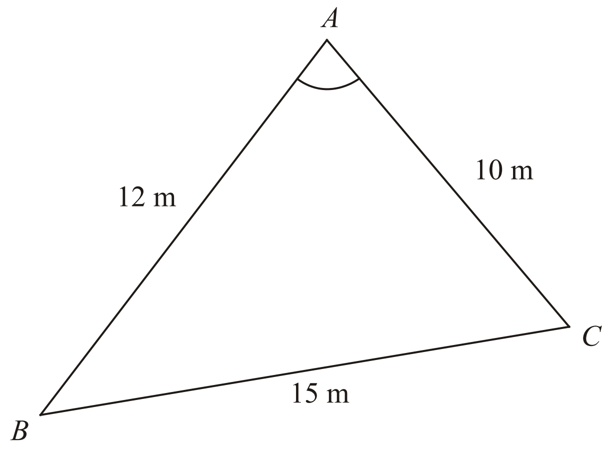


Diagram **NOT** accurately drawn

ABC is a triangle.
AB = 12 m.
AC = 10 m.
BC = 15 m.

Calculate the size of angle *BAC*.
Give your answer correct to one decimal place.

..............................°

(Total 3 marks)

31.

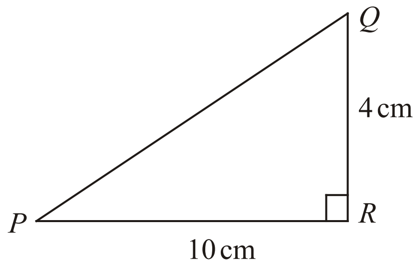


Diagram **NOT** accurately drawn

PQR is a right-angled triangle.

QR = 4 cm
PR = 10 cm

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

......................................°
(Total 3 marks)

32. Here is a right-angled triangle.

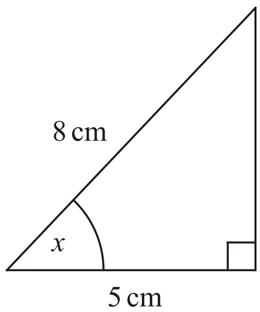


Diagram **NOT** accurately drawn

(a) Calculate the size of the angle marked x.
Give your answer correct to 1 decimal place.

x = ...°
(3)

Here is another right-angled triangle.

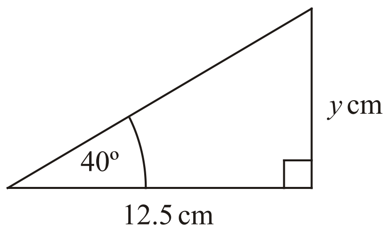


Diagram **NOT** accurately drawn

(b) Calculate the value of y.
Give your answer correct to 1 decimal place.

y = ...
(3)
(Total 6 marks)

33.

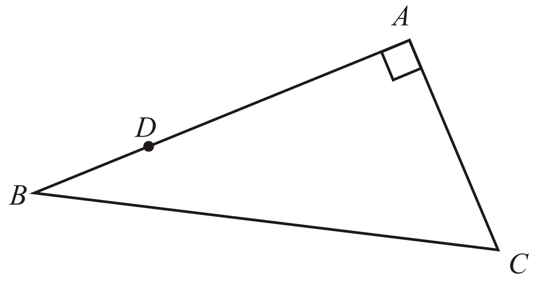


Diagram **NOT** accurately drawn

ABC is a right angled triangle.
D is the point on AB such that $AD = 3DB$.
$AC = 2DB$ and angle $A = 90°$.

Show that $\sin C = \dfrac{k}{\sqrt{20}}$, where k is an integer.

Write down the value of k.

k = ...

(Total 4 marks)

34.

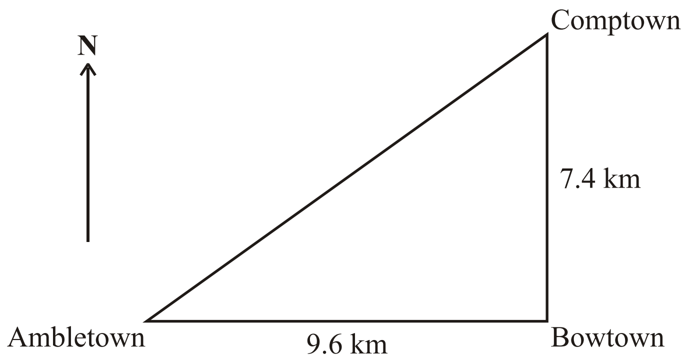


Diagram **NOT** accurately drawn

Ambletown, Bowtown and Comptown are three towns.

Ambletown is 9.6 km due west of Bowtown.
Bowtown is 7.4 km due south of Comptown.

Calculate the bearing of Ambletown from Comptown.
Give your answer correct to one decimal place.

……………………………°
(Total 4 marks)

35.

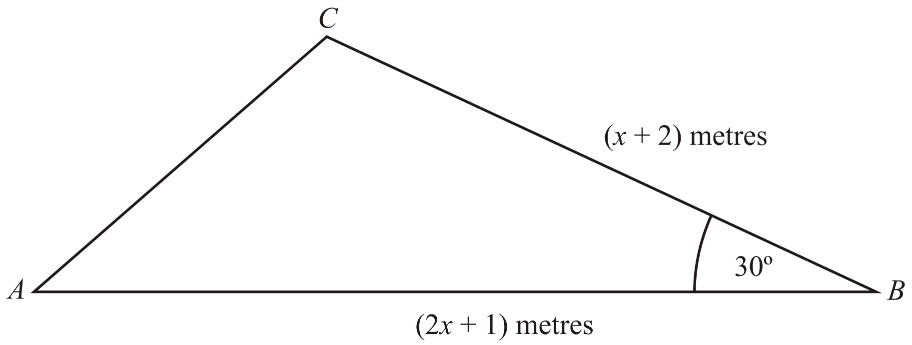


Diagram **NOT** accurately drawn

$AB = (2x + 1)$ metres.
$BC = (x + 2)$ metres.
Angle $ABC = 30°$.

The area of the triangle ABC is 3 m^2.
Calculate the value of x.

Give your answer correct to 3 significant figures.

……………………………
(Total 5 marks)

36.

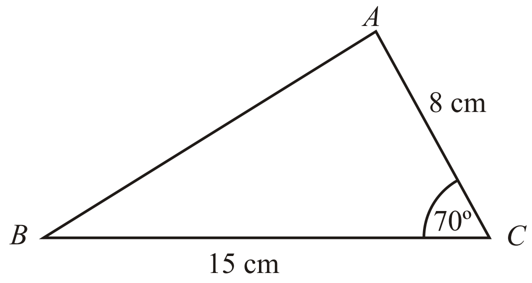


Diagram **NOT** accurately drawn

In triangle *ABC*,
AC = 8 cm,
BC =15 cm,
Angle *ACB* = 70°.

(a) Calculate the length of *AB*.
Give your answer correct to 3 significant figures.

.... cm
(3)

(b) Calculate the size of angle *BAC*.
Give your answer correct to 1 decimal place.

..................................°
(2)
(Total 5 marks)

37.

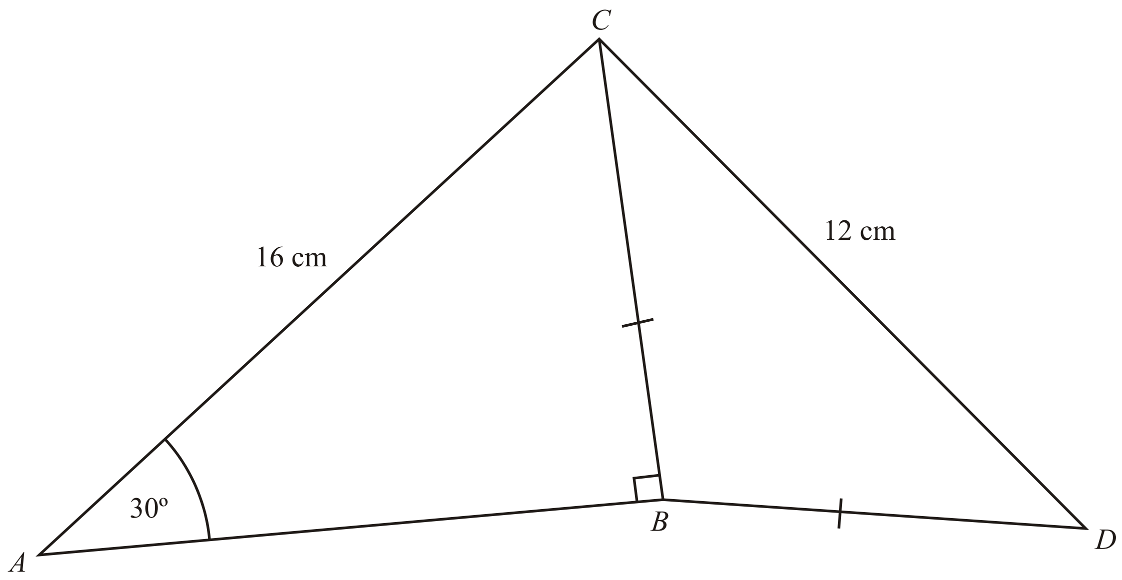


Diagram **NOT** accurately drawn

AC = 16 cm
Angle ABC = 90°
Angle CAB = 30°

BC = BD
CD = 12 cm

Calculate the area of triangle BCD.
Give your answer correct to 3 significant figures.

……………. cm^2
(Total 6 marks)

38.

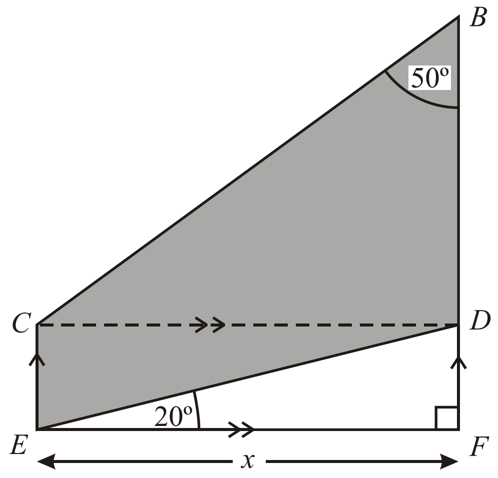


Diagram **NOT** accurately drawn

BCEF is a trapezium.
EC is parallel to *FDB*.
CD is parallel to *EF*.
Angle *CBD* = 50°.   Angle *DEF* = 20°.   Angle *EFD* = 90°.

EF = *x*.

(a) Express, in terms of *x*,

(i) the length of *DF*,

…………….

(ii) the area of triangle *DEF*.

…………….

(3)

(b) Work out the percentage of the trapezium *BCEF* that is **not** shaded.

……………. %

(4)

(Total 7 marks)

39.

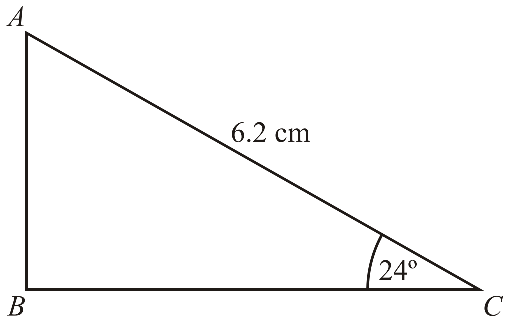


Diagram **NOT** accurately drawn

Angle $ABC = 90°$.
Angle $ACB = 24°$.
$AC = 6.2$ cm.

Calculate the length of BC.
Give your answer correct to 3 significant figures.

…………………………. cm
(Total 3 marks)

40.

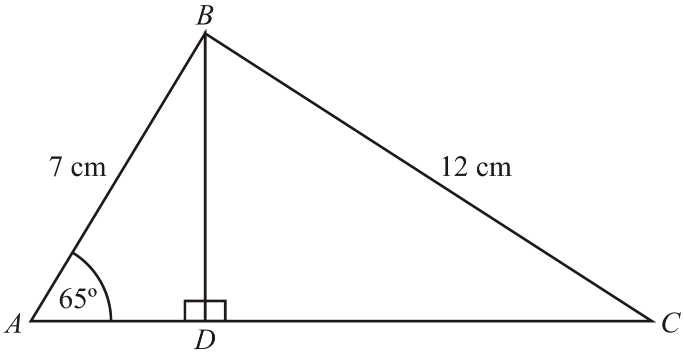


Diagram **NOT** accurately drawn

ABC is a triangle.
ADC is a straight line with *BD* perpendicular to *AC*.
AB = 7 cm.
BC = 12 cm.
Angle *BAD* = 65°.

Calculate the length of *AC*.
Give your answer correct to 3 significant figures.

.... cm
(Total 6 marks)

41. Use your calculator to work out the value of

$$\frac{126}{92 \times \sin 47°}$$

Give your answer correct to 3 significant figures.

....

(Total 2 marks)

42.

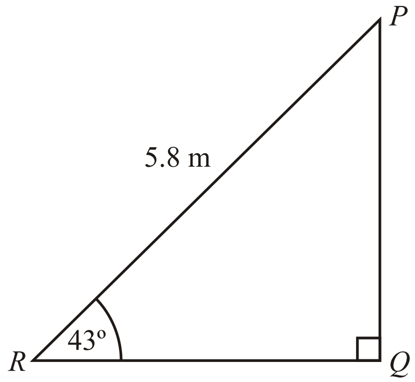


Diagram **NOT** accurately drawn

PQR is a triangle.
Angle $Q = 90°$.
Angle $R = 43°$.
$PR = 5.8$ m.

Calculate the length of *QR*.
Give your answer correct to 3 significant figures.

.... m
(Total 3 marks)

43.

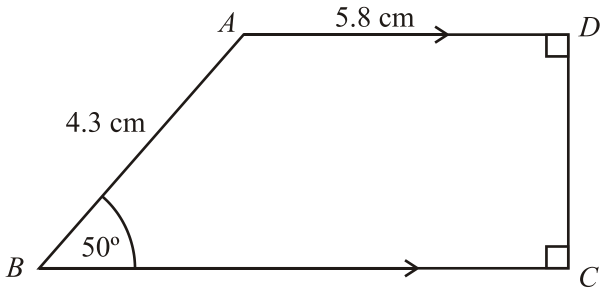


Diagram **NOT** accurately drawn

ABCD is a trapezium.
AD is parallel to *BC*.
Angle C = angle D = 90°.
Angle B = 50°.
AD = 5.8 cm.
AB = 4.3 cm.

Calculate the length of *BC*.
Give your answer, in centimetres, correct to one decimal place.

.... cm
(Total 4 marks)

44. A lighthouse, *L,* is 3.2 km due West of a port, *P*.
A ship, *S,* is 1.9 km due North of the lighthouse, *L*.

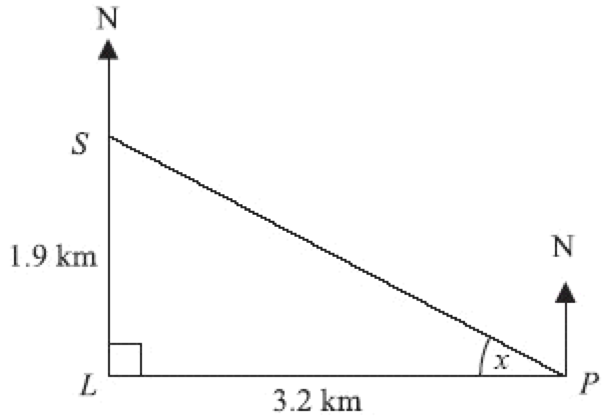


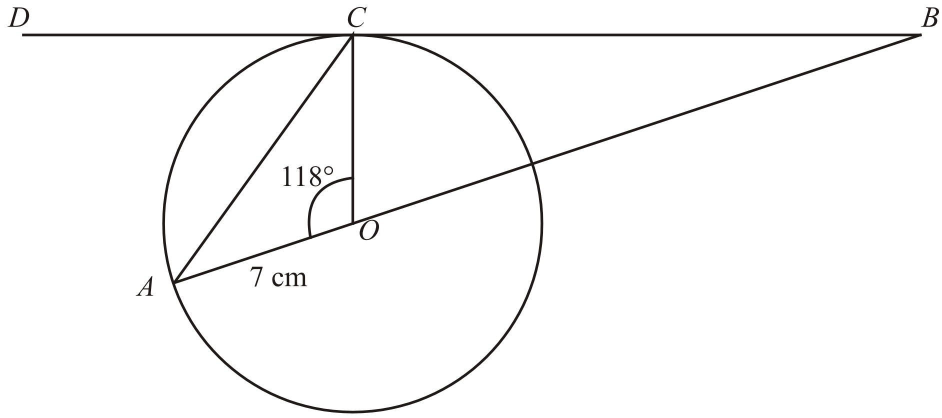
Diagram **NOT** accurately drawn

Calculate the size of the angle marked *x*.
Give your answer correct to 3 significant figures.

x = ………………..°
(Total 3 marks)

45.

Diagram **NOT** accurately drawn



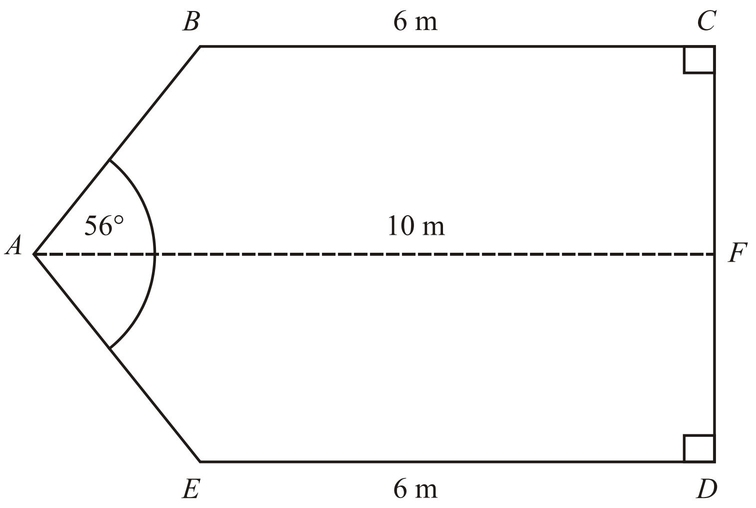
A and *C* are points on a circle, centre *O*.
DCB is the tangent to the circle at *C*.
AOB is a straight line.
OA = 7 cm.
Angle *AOC* = 118°.

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

OB = ... cm
(Total 4 marks)

46.

Diagram **NOT** accurately drawn



ABCDE is a pentagon.
BC = *ED* = 6 m.
Angle *BCD* = angle *CDE* = 90°.
Angle *BAE* = 56°.

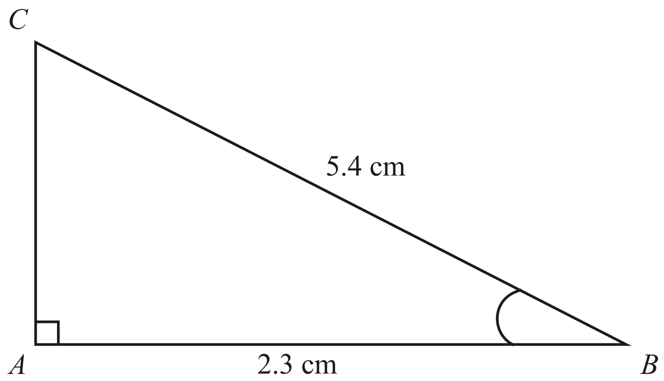
The point *F* lies on *CD* so that *AF* is the line of symmetry of the pentagon and *AF* = 10 m.

Calculate the perimeter of the pentagon.
Give your answer correct to 3 significant figures.

.... m
(Total 6 marks)

47.

Diagram **NOT** accurately drawn



ABC is a right-angled triangle.
Angle $A = 90°$.
$AB = 2.3$ cm.
$BC = 5.4$ cm.

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

.....................................°
(Total 3 marks)

48. Work out $\dfrac{\sqrt{2.56 + \sin 57^\circ}}{8.765 - 6.78}$

(a) Write down all the figures on your calculator display.

…………………….
(2)

(b) Give your answer to part (a) to an appropriate degree of accuracy.

…………………….
(1)
(Total 3 marks)

49. Calculate the length of the side marked x in this right-angled triangle.
Give your answer correct to 3 significant figures.

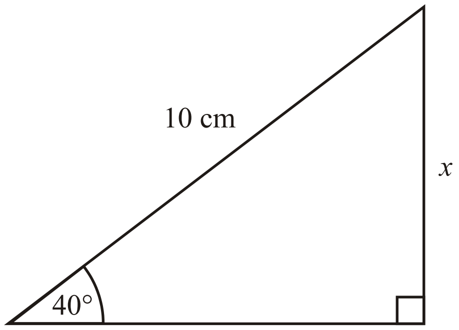


Diagram **NOT** accurately drawn

……………………cm
(Total 3 marks)

50.

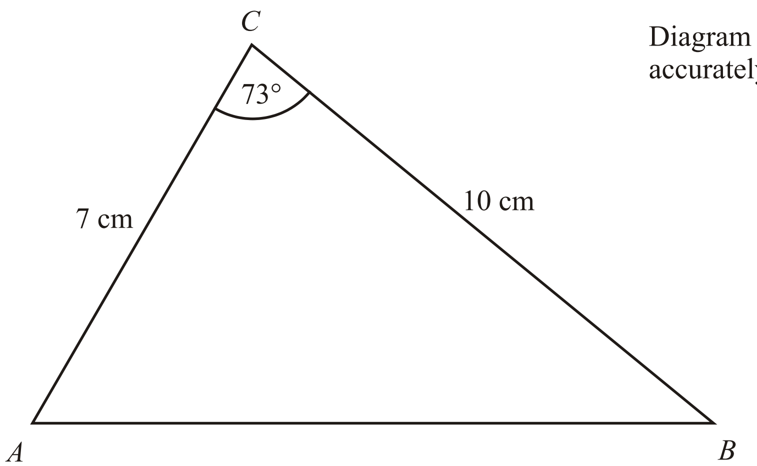


Diagram **NOT** accurately drawn

In triangle ABC,
$AC = 7$ cm,
$BC = 10$ cm,
angle $ACB = 73°$.

Calculate the length of AB.
Give your answer correct to 3 significant figures.

…………………….. cm
(Total 3 marks)

51. Here is a right-angled triangle.

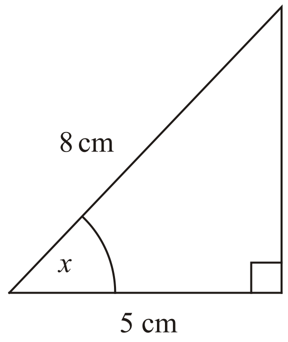


Diagram **NOT** accurately drawn

Calculate the size of the angle marked x.
Give your answer correct to 1 decimal place.

x = ...°

(Total 3 marks)

1. (a) 8 2

$\text{SF} = \frac{10}{6}$

$\frac{10}{6} \times 4.8 = 8$

M1 for sight of $\frac{10}{6}$ *or* $\frac{10}{6}$ *or 1.67 or better or* $\frac{CD}{10} = \frac{4.8}{6}$

A1 cao

(b) 19.8 2

$\frac{10}{6} \times 4.5 - 4.5 = 3$

M1 for use of SF from (a) to find AC or BC or
$\frac{BC}{4.5} = \frac{4}{6}$ *and adding 4 sides*
A1 cao

[4]

2. 6.64 3

$8.5 \times \tan 38 = 8.5 \times 0.7813$

$\frac{8.5}{\sin(90-38)} = \frac{AB}{\sin 38}$

$AB = \frac{8.5 \times \sin 38}{\sin(90-38)}$

$= \frac{5.2331}{0.788} = 6.64$

M1 for correct use of trig, eg $\tan 38 = \frac{opp}{8.5}$
M1 for $8.5 \times \tan 38$
A1 6.64 – 6.641
OR
M1 for correct substitution into the sine rule
M1 (dep) for correct rearrangement for AB =
A1 6.64 – 6.641

[3]

3. (a) 56.4 2

$0.5 \times 8 \times 15 \times \sin 70^{\circ}$

M1 for correct sub into area formula
A1 56.38 – 56.4

(b) 7.84 4

$AB^2 = 8^2 + 15^2 - 2 \times 8 \times 15 \times \cos 70° = 206.9$

EITHER
$0.5 \times AB \times CX =$ '56.38'

OR
$\frac{\sin B}{8} = \frac{\sin 70}{\sqrt{'206.9'}}$
$B = 31.5$
15 sin '31.5'

M1 for correct sub into cos rule
A1 for 206.9 – 207 or 14.38 – 14.4
EITHER
M1 for use of area rule to find CX
A1 7.83 − 7.84
OR
M1 for correct use of sine rule to find sin B or sin A
and then sight of 15 sin B or 8 sin A
A1 7.83 − 7.84

[6]

4. (a) 62.0° 3

$\tan ACB = \frac{12.8}{6.8}$
$x = \tan^{-1}(1.88)$

M1 for $\tan C = \frac{12.8}{6.8}$
M1 (dep) for $x = \tan^{-1}$ *("1.88")*
A1 for 62° to 62.021°
For methods using the sine rule, a fully correct Pythagoras followed by the sine rule to get $\sin C = \frac{12.8}{14.49}$ *is needed for M1*

(b) 19.1m 3

$BD = \frac{12.8}{\sin 42}$

M1 for correct use of sin, $\sin 42° = \frac{12.8}{BD}$
M1 for $\frac{12.8}{\sin 42°}$
A1 for 19.1 to 19.13

[6]

5. (a) 152 — 2

½ × 11.7 × 28.3 × sin 67

M1 for ½ × 11.7 × 28.3 × sin 67
A1 152 to 152.4

(b) 26.1 — 3

$AC^2 = 11.7^2 + 28.3^2 - 2 \times 11.7 \times 28.3 \times \cos 67$
$AC^2 = 937.8 - 258.7 = 679.(03)$

M1 for correct substitution into cosine rule
M1 (dep) for correct order of evaluation
A1 26.05 – 26.1

[5]

6. $A = \pm 2$
$k = 6$ — 4

$3.5 = 5.5 + A \sin 30(3 - k)$
$3.5 = 5.5 \pm A$

M1 for 3.5 = 5.5 + Asin 30(3 – k)
B1 for one of max/min value of sin = +1/–1
A1 for A = 2 or –2
A1 for k = any multiple of 6 consistent with A
A = 2, k = 6 etc
A = 2, k = 6(2n +1)
A = – 2, k = 12n

7. (a) (i) $y = 1 + \sin x$ — 2

B1 for y = 1 + sin x

(ii) $y = 2\sin x$

B1 for y = 2sin x
SC both (i) f(x) + 1, (ii) 2f(x) B1

(b) Stretch parallel to y-axis scale factor 3 — 3

Stretch parallel to x-axis scale factor $\frac{1}{2}$

M1 for 'stretch'
A1 for Stretch parallel to y-axis scale factor 3 oe
A1 for Stretch parallel to x-axis scale factor $\frac{1}{2}$ *oe*

SC if M0 award B1 for "sf 3 vertically" ***and*** *"sf* $\frac{1}{2}$ *horizon."*

[5]

8. (a) 11.7 — 3

$10^2 + 6^2$ or 136
$\sqrt{(100 + 36)}$ or $\sqrt{136} = 11.66\ldots$

M1 for $10^2 + 6^2$ or 136 seen
M1 (dep) $\sqrt{100+36}$ or $\sqrt{136}$
A1 11.66 – 11.7

(b) 36.9 — 3

Cos x = 8/10 or 0.8
$x = \cos^{-1} 0.8 = 36.869°$

M1 for $\cos = \frac{8}{10}$, $\cos = 0.8$(oe)
M1 (dep) for $\cos^{-1}$ (oe)
A1 for 36.86 – 36.9
M1 Use of sine rule and x found
M1 for $x = 90 - \sin^{-1}$("0.8")
A1 for 36.86 – 36.9

[6]

9. 18.3 6

$0.5 \times 3.2 \times 8.4 \times \text{Sin } B = 10$
$\sin B = 0.74404\ldots$
48.077
$AC^2 = 3.2^2 + 8.4^2 - 2 \times 3.2 \times 8.4 \times \cos B$
$AC^2 = 44.8815\ldots..$
$AC = 6.69\ (936\ldots)$
Perimeter = 18.3

Use the altitude *AD*, $\dfrac{h \times 8.4}{2} = 10 \Rightarrow h = (2.381)$

$BD = \sqrt{3.2^2 - h^2} = 2.139$
$DC = 6.261$

$AC = \sqrt{2.38^2 + '6.261'^2} = 6.69(936)$

Perimeter = 18.3

M1 for 0.5 × 3.2 × 8.4 × sin B (= 10)
A1 for sin B = 0.74(404...) or B = 47.7 – 48.1
M1 for $3.2^2 + 8.4^2 - 2 \times 3.2 \times 8.4 \times \cos$ *"48.077"*
M1(dep) for AC^2 *= "44.8(815)"..... with correct order of evaluation*
A1 AC = 6.69 – 6.7
A1 18.29 – 18.3
M1 for $\dfrac{h\ \times 8.4}{2} = 10$ □ $h = (2.381)$
M1 for $BD^2 = 3.2^2 - "2.381"^2$
A1 BD = 2.1 – 2.2
M1 (dep) $AC^2 = "2.381"^2 + "6.261"^2$
A1 AC = 6.69 – 6.7
A1 18.29 – 18.3

10. 22.2º 4

$EB = 60 \times \tan 30^{\circ}$
$BD = \sqrt{(60^2 + 60^2)}$
$\tan BDE = 34.64 \div 84.85$
OR
$EB = 60 \times \tan 30^{\circ}$ (= 34.64)

$$ED^2 = 60^2 + (\frac{60}{\cos 30})^2$$

$$ED = \sqrt{8400} = (91.65)$$

$$\text{Angle} = \sin^{-1}\left(\frac{EB}{\sqrt{8400}}\right) = 22.2$$

M1 for EB = 60 × tan30
M1 for BD = $\sqrt{(60^2 + 60^2)}$
M1 for tan BDE = "34.64" ÷ "84.85"
A1 22.17 – 22.21
M1 for EB = 60 ×tan 30º oe
M1 for fully correct method for ED
M1 for sin BDE = $\left(\frac{'34.84'}{'\sqrt{8400}'}\right)$ (oe)
A1 22.17 – 22.21

[4]

11. 1.79 3

$$\sqrt{\frac{8.8 + 7.2\sin 40}{8.8 - 7.2\sin 40}}$$

$$= \sqrt{\frac{13.428}{4.172}} = \sqrt{3.218}$$

M1 for correct substitution of all values into numerator or denominator (separately) condoning sin x 40,
or for $\frac{40.72}{10.28}$ (= 3.96) or for $\frac{48.8}{8.8}$ (= 5.54)
A1 for 13.4(28) or 4.1(72) or 3.2(18)
A1 1.79 - 1.8

[3]

12. 21.8 3

tan P = 5 – 12.5

M1 for correct use of tan P = 5 – 12.5 (accept tan 5 – 12.5)

M1 for $\tan^{-1}\left(\frac{5}{12.5}\right)$ *oe, condone* $\tan^{-1}$ *5 – 12.5*

A1 21.8 – 21.81

NB 6.29 – 6.3 gets M2 A0 by implication

[3]

13. (a) 9.11 2

$3^2 + 5^2 + 7^2 = 83$

M1 for correct use of 3D Pythagoras formula or 2 correct applications of the 2D formula

A1 for 9.11 to 9.12

(b) 19.2 2

Tan GAC = 3 – $\sqrt{(5^2 + 7^2)}$

M1 correct trig expression for angle GAC

A1 for 19.2 to 19.3

[4]

14. (a) 42.4 2

0.5 × 12 × 10 × sin 45

M1 for 0.5 × 12 × 10 × sin 45

A1 for 42.4 – 42.45

(b) AG 2

Area ABC = 0.5 × BC × h

Area CDB = 0.5 × CD × h

Let angle $YXW = t$

B1 for either 0.5 × BC × h,

Or 0.5 × CD × h seen

B1 for forming the correct fraction and answer

(c) AG 3

Area $YXZ = 0.5 \times XY \times XW \times \sin t$
Area $WXZ = = 0.5 \times XZ \times XW \times \sin$ t
Divide to get the given answer by referring to part (b)

B1 for either $0.5 \times XY \times XW \times \sin t$,
Or $0.5 \times XZ \times XW \times \sin t$
B1 for the other one and divide.
B1 for a referral to part (b)

[7]

15. $32x$ 3

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

$x^2 h = 4 \times 8x^3$

M1 for substitution in correct formulae
M1 (dep.) for correct unsimplified expression eg

$h = \dfrac{\frac{4}{3}\pi(2x)^3}{\frac{1}{3}\pi x^2}$ *oe or $h = 8x$ oe*

1 for 32x cao

[3]

16. (a) 30.7 3

$\tan x = \frac{1.9}{3.2}$

$x = \tan^{-1}\left(\frac{1.9}{3.2}\right) = 30.7$

M1 for $\tan x = \frac{1.9}{3.2}$ or $\tan \frac{1.9}{3.2}$
M1 for $\tan^{-1}\left(\frac{1.9}{3.2}\right)$
A1 for 30.6 – 30.7

(b) 121 1

90 + “30.7”

B1 (indep) ft for 90 + “30.7” rounded to 3 or 4 s.f

[4]

17. 53.8 3

Area $\Delta ABC = ½ \times 14 \times 8 \times \sin 106$ (= 53.8)

M1 for ½ × 14 × 8 × sin106
M1 (dep) for 56 × 0.961(26..) or 107.6…
A1 53.8 – 53.9
SC 107.6 is B2

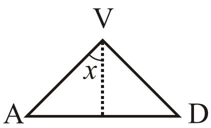
[3]

18. (a) 5.66 2

$6^2 - 2^2 = 32$

M1 for $6^2 - 2^2$ (= 32)
A1 5.65 – 5.66

(b) 38.9 3



$DVA = 2 \times \sin^{-1}(\frac{2}{6})$

OR

$\cos DVA = \frac{6^2 + 6^2 - 16}{2 \times 6 \times 6}$

$= \frac{56}{72}$

$DVA = \cos^{-1}\left(\frac{56}{72}\right) = 38.94$

M1 $\sin x = \frac{2}{6}$ oe

M1 for $DVA = 2 \times \sin^{-1}\left(\frac{2}{6}\right)$

A1 38.9 – 38.95
OR

M1 for ($\cos DVA =$) $\frac{6^2 + 6^2 - 4^2}{2 \times 6 \times 6}$

M1 for $DVA = \cos^{-1}\left(\frac{56}{72}\right)$

A1 38.9 – 38.95

(c) 33.6 — 4

$AC^2 = 2^2 + 2^2 - 2 \times 2 \times 2 \times \cos 120°$

$AC = \sqrt{12}$

OR

$AN = 2 \times \sin 60 = \sqrt{3}$

OR

$\text{VN} = \sqrt{\text{"32"}+1} = \sqrt{33}$

$\cos AVC = \dfrac{6^2 + 6^2 - 12}{2 \times 6 \times 6}$

$\cos AVC = \dfrac{60}{72}$

OR

$AVC = 2 \times \sin^{-1} \dfrac{\sqrt{33}}{6}$, using AN

OR

$\text{AVC} = 2 \times \cos^{-1} \dfrac{\sqrt{33}}{6}$, using VN

M1 for any valid method for AC or AN or VN where N is the midpoint of AC

A1 for $AC^2 = 12$ or $AC = \sqrt{12}$ (= 3.46…) or $AN = \sqrt{3}$ (=1.73…)or $VN = \sqrt{33}$ (=5.74…)

M1 (indep) for correct method to find angle AVC

A1 33.55 – 33.6

[9]

19. (a) $\dfrac{29}{\sin 45^\circ} = \dfrac{18.4}{\sin \angle PEA}$

$\sin \angle PEA = \dfrac{18.4 \times \sin 45^\circ}{29} (= 0.4486...)$

$\angle PEA = 26.6569...$

26.7 — 3

M1 for correct substitution in sine rule

M1 (dep) for rearrangement to get $\dfrac{18.4 \times \sin 45^\circ}{29}$ oe

(award if 0.448(6...) or 0.538(8...) or 0.412(0...) seen)

A1 cao for answers rounding to 26.7

(b) $\angle EPF = 2 \times [45 + \text{‘}26.7\text{’}]$ (= 143.4)

arc $EF = \frac{143.4}{360} \times \pi \times 58$

72.6 4

M1 for valid method to find $\angle EPF$ (award if 143(.4)° seen)

M2 (dep) for $\frac{'143.4'}{360} \times \pi \times 58$

(M1 for either $\frac{'143.4'}{360} \times k_1$ or for $k_2 \times 58\pi$, where $k_2 < 1$)

A1 for 72.5 to 72.6 inclusive

***SC** award B2 for 61.1*

[7]

20. (a) $\tan a = \frac{5}{6}$ 3

Angle a = 39.8°

39.8

M1 for tan(a =) $\frac{5}{6}$

M1 for a = $\tan^{-1}(\frac{5}{6})$ or $\tan^{-1}$ (0.83) to $\tan^{-1}$ (0.834)

(Allow $\tan^{-1} 5 \div 6$)

A1 for 39.8 – 39.81

SC 0.692 – 0.695 or 44.2 – 44.24 seen gets M1M1 A0

(b) $\sin 40° = \frac{x}{10}$ 3

$x = 10 \times \sin 40°$

6.43

M1 for sin 40 $= \frac{x}{10}$

M1 for 10 × sin 40

A1 for 6.427 – 6.43

(SC 7.45... or 5.87... seen gets M1M1 A0)

[6]

21. $\dfrac{\sin ADB}{25} = \dfrac{\sin 28}{DB}$

$DB = \dfrac{25 \times \sin 28}{\sin 26}$

$DB = 26.77$

$DC = 26.77 \times \sin 54$

21.7 5

M1 for $\dfrac{sin"26"}{25} = \dfrac{sin28}{DB}$

M1 for $DB = \dfrac{25 \times sin28}{sin"26"}$

A1 for 26.7– 26.8

M1 for DC = "26.7" × sin54

A1 for 21.65 – 21.7

Or

M1 for $\dfrac{sin"26"}{25} = \dfrac{sin"126^\circ"}{AD}$ *oe*

M1 for $AD = \dfrac{25 \times sin"126^\circ"}{sin26^\circ}$

A1 for 46.1 – 46.2

M1 for "46.1" × sin 28°

A1 for 21.65 – 21.7

[5]

22. $\cos x = \dfrac{3.9}{4.7} = 0.8297...$ 3

33.9

M1 for cos = $\dfrac{3.9}{4.7}$ *(–0.8297...)*

M1 (dep) for cos^{-1}

A1 for 33.9 – 33.93

SC B2 for 0.592(069...) or 37.6(923...) or 37.7

[3]

23. (a) eg $\frac{4.2^2 + 5.3^2 - 7.6^2}{2 \times 4.2 \times 5.3}$ 3

$\frac{-12.03}{44.52}$ or –0.2702...

105.7

M1 for correct substitution into cosine rule to find any angle

M1(dep) for correct order of evaluation of their cosine rule to p get to cosX = $\frac{p}{q}$ *where p and q are numbers*

A1 105.67 – 105.7

(b) eg $\frac{1}{2}$ × 4.2 × 5.3 × sin“105.67°” 3

10.7

M2 for substitution of lengths of 2 sides and their included angle into $\frac{1}{2}ab \sin C$

(M1 if it is their angle but not the included one)

A1 for 10.7 – 10.72

[6]

24. $\sin 32 = \dfrac{AB}{12}$

$AB = 12 \times \sin 32$

$AB = 6.35903\ldots$

6.36 — 3

M1 sin 32 = $\dfrac{AB}{12}$ *(accept Sin* $\dfrac{AB}{12}$*)*

M1 12 × sin 32 or 12 × 0.5299..

A1 accept 6.359 – 6.360

SC Gradians 5.78(1...)

Radians 6.62

Get M1M1A0 or

Use of Sine Rule

$\dfrac{\sin 32}{AB} = \dfrac{\sin 90}{12}$ *or* $\dfrac{AB}{\sin 32} = \dfrac{12}{\sin 90}$ *M1*

$AB = \dfrac{12 \times \sin 32}{\sin 90}$ *M1*

AB = 6.359 – 6.36 A1

SC Gradians 5.85(...)

Radians 7. 40(...)

M1M1A0

[3]

25. $AB^2 = 8^2 + 9^2 - 2 \times 8 \times 9 \times \cos 40$

$AB^2 = 64 + 81 - 144 \times \cos 40$

$AB^2 = 145 - 144 \times 0.766$

$AB^2 = 145 - 110.31\ldots = 34.6896$

$AB = \sqrt{34.6796} = 5.8897877$

5.89 — 3

M1 Subs in Cos Rule: $8^2 + 9^2 - 2 \times 8 \times 9 \times \cos 40$

M1 correct order of evaluation of $8^2 + 9^2 - 2 \times 8 \times 9 \times \cos 40$

A1 cao 5.88 – 5.89

SC: Award B2 for one of

$AB^2 = 241.03\ldots$ *or* $AB = 15.525\ldots$ *(radians)*

$AB^2 = 28.50\ldots$ *or* $AB = 5.33\ldots$ *(gradians)*

[3]

26. $\tan x = \dfrac{4.5}{12} = 0.375$

$x = \tan^{-1} 0.375$

$= 20.6$ 3

M1 $tan\ \dfrac{4.5}{12}$

M1 $tan^{-1}\left(\dfrac{4.5}{12}\right)$

A1 20.55 – 20.6

RAD: 0.3587 GRAD: 22.84 for M2

[3]

27. $BD = 3 \times \tan 35 = 2.101$

$\dfrac{'2.101'}{9} = \sin BAD$

$= 13.5$ 4

M1 $BD = 3 \times tan35$

A1 2.10(06..)

M1 $\dfrac{'2.101'}{9} = sin\ BAD$

A1 13.49 – 13.5

[4]

28. $\frac{1}{2} \times x^2 \times \sin 60 = 36$

$x^2 = \frac{72}{\sin 60} = 83.13..$

$= 9.12$ 3

M1 $\frac{1}{2} \times x^2 \times \sin 60 (= 36)$ *or* $\frac{1}{2} \times ab \times \sin 60 (= 36)$

or $\frac{1}{2} \times x \times \sqrt{x^2 - \left(\frac{x}{2}\right)^2} (= 36)$

M1 $x^2 = \frac{72}{\sin 60}$ *or* $ab = \frac{72}{\sin 60}$ *or* $x^2 = \frac{36 \times 2}{\sqrt{0.75}}$

A1 9.11 – 9.12

[3]

29. $DC^2 = 5^2 + 8^2$; $DC = \sqrt{89}$

$DB^2 = 5^2 + 10^2$; $DB = \sqrt{125}$

$BC^2 = 8^2 + 10^2$; $BC = \sqrt{164}$

$\cos CDB = \frac{89 + 125 - 164}{2 \times \sqrt{89} \times \sqrt{125}} = 0.23702$

$= 76.3$ 6

M1 $(DC^2 =)\ 5^2 + 8^2$ *or* $DC = \sqrt{89} = 9.4(3)$

M1 $(DB^2 =)\ 5^2 + 10^2$ *or* $DB = \sqrt{125} = 11.1(8)$

M1 $(\mathrm{BC}^2) = 8^2 + 10^2$ *or* $\mathrm{BC} = \sqrt{164} = 12.8(1)$

M2 $\cos CDB = \frac{'89' + '125' - '164'}{2 \times '\sqrt{89}' \times '\sqrt{125}'}$

A1 76.2 × 76.3

or

M1 correct sub into cosine rule on formula sheet

$\sqrt{'164'}^2 = \sqrt{'89'}^2 + \sqrt{'125'}^2 - 2 \times \sqrt{'89'} \times \sqrt{'125'} \times \cos x$

M1 correct rearrangement to cos CDB $= \frac{'89' + '125' - '164'}{2 \times '\sqrt{89}' \times '\sqrt{125}'}$

A1 76.2 – 76.3

[6]

30. $\cos x = \dfrac{12^2 + 10^2 - 15^2}{2 \times 12 \times 10} = \dfrac{19}{240}$

$x = \cos^{-1} 0.079 = 85.459\ldots$

OR

$15^2 = 12^2 + 10^2 - 2 \times 12 \times 10 \times \cos x$

$\cos x = \dfrac{15^2 - 12^2 - 10^2}{-2 \times 12 \times 10} = \dfrac{12^2 + 10^2 - 15^2}{2 \times 12 \times 10} = \dfrac{19}{240}$

$x = \cos^{-1} 0.079 = 85.459\ldots$

85.5 3

M2 cosA $= \dfrac{12^2 + 10^2 - 15^2}{2 \times 12 \times 10}$

A1 85.4 -85.5

OR

M1 correct substitution into $a^2 = b^2 + c^2 - 2bc \cos A$

M1 correct rearrangement of $a^2 = b^2 + c^2 - 2bc \cos A$ *algebraically to*

(cos A) = $\dfrac{b^2 + c^2 - a^2}{2 \times b \times c}$ *oe*

or to

(cos A =) $\dfrac{12^2 + 10^2 - 15^2}{2 \times 12 \times 10}$ *oe*

These can be earned in either order

A1 85.4-85.5

SC B2 Radians 1.49 seen

B2 Gradians 94.89-95 seen

[3]

31. $\tan QPR = \dfrac{4}{10}$

$QPR = \tan^{-1}\left(\dfrac{4}{10}\right) = 21.8°$

or

$= \sqrt{4^2 + 10^2}$

$\sin QPR = \dfrac{4}{\sqrt{4^2 + 10^2}}$

$QPR = \sin^{-1}\left(\dfrac{4}{\sqrt{4^2 + 10^2}}\right)$

21.8 3

M1 $\tan QPR = \dfrac{4}{10}$

M1 $\tan^{-1} \dfrac{4}{10}$ ***or*** $\tan^{-1} 0.4$

A1 21.8° – 21.81° inclusive

OR

[$\sqrt{4^2 + 10^2}$ $(= 10.77...)$]

M1 $\sin(QPR =) \dfrac{4}{\sqrt{4^2 + 10^2}}$ ***or*** $\cos(QPR =) \dfrac{10}{\sqrt{4^2 + 10^2}}$

M1 $\sin^{-1} \dfrac{4}{\sqrt{4^2 + 10^2}}$ ***or*** $\cos^{-1} \dfrac{10}{\sqrt{4^2 + 10^2}}$

A1 21.8° – 21.81° inclusive

SC: B2 for 24.2(237.....) or 0.380(5....)

[3]

32. (a) $\cos x = \frac{5}{8}$

51.3 – 51.35 3

M1 for $\cos(x =) \frac{5}{8}$

M1 for $\cos^{-1} \frac{5}{8}$ *or* $\cos^{-1} 0.625$, *or* $\cos^{-1}(5 \div 8)$

A1 for 51.3 – 51.35

(SC B2 for 0.89 – 0.9 or 57 – 57.1 seen)

Alternative Scheme

$h^2 = 8^2 - 5^2$ $(=39)$

M1 for $\sin(x =) \frac{\sqrt{"39"}}{8}$ *or* $\tan(x =) \frac{\sqrt{"39"}}{5}$ *or*

$\frac{\sin x}{\sqrt{"39"}} = \frac{\sin 90}{8}$ *oe or*

$(\sqrt{"39"})^2 = 8^2 + 5^2 - 2 \times 8 \times 5 \times \cos x$

M1 for $\sin^{-1}(\frac{\sqrt{"39"}}{8})$ *or* $\sin^{-1}(\frac{\sqrt{"39"} \times \sin 90}{8})$ *or*

$\tan^{-1}(\frac{\sqrt{"39"}}{5})$ *or* $\cos^{-1}(\frac{8^2 + 5^2 - (\sqrt{"39"})^2}{2 \times 8 \times 5})$

A1 for 51.3 – 51.35

(b) $\tan 40 = \frac{y}{12.5}$

$y = 12.5 \times \tan 40$

10.4 – 10.5 3

M1 for $\tan 40 = \frac{y}{12.5}$

M1 for 12.5 × tan 40

A1 for 10.4 – 10.5

SC: B2 for ±(13.9 – 14.0) or 9 – 9.1 seen

Alternative scheme

M1 for $\frac{y}{\sin 40} = \frac{12.5}{\sin 50}$ *oe*

M1 for $y = \frac{12.5}{\sin 50} \times \sin 40$

A1 for 10.4 – 10.5

SC: B2 for ±(35.4 – 35.5) or 10.39 – 10.396 seen

[6]

33. Let DB = x, then AD = $3x$
And AC = $2x$
BC = $\sqrt{((4x)^2 + (2x)^2)} = \sqrt{20}x$
Sin $C = 4x / \sqrt{20}x$
Sin $C = 4/\sqrt{20}$ 4

M1 for correct ratio of AC and AB [4x and 2x]
M1 for correct use of pythagoras
A1 for BC = $\sqrt{20}\,x$
A1 for completion of proof
SC: B1 for k = 4

[4]

34. 232.4° 4

tan C = $\frac{9.6}{7.4}$

C = $\tan^{-1} \frac{9.6}{7.4}$

C = 52.4
Bearing = 180 + "52.4"

M1 for tan C = $\frac{9.6}{7.4}$

M1 for C = $\tan^{-1} \frac{9.6}{7.4}$

A1 for 52.4 or better
B1 (indep) for 180 + "52.4.."

[4]

35. $x = 1.31\text{m}$ 5

$0.5 \times (2x + 1) \times (x + 2) \times \sin 30 = 3$
$0.25 \times (2x^2 + 4x + x + 2) = 3$
$2x^2 + 5x + 2 = 12$
$2x^2 + 5x - 10 = 0$

$$x = \frac{-5 \pm \sqrt{(5^2 - 4 \times 2 \times -10)}}{2 \times 2}$$

$= 1.311737...$

M1 for $0.5 \times (2x + 1) \times (x + 2) \times \sin 30$ or used
M1 (dep) ... = 3 and an attempt to expand algebraic brackets
A1 oe in form $ax^2 + bx + c = d$
M1 ft (dep on 1st 2 M1s) for correct process to solve quadratic equation
A1 for 1.31 or better

[5]

36. (a) 14.4 cm 3

$(15^2 + 8 - 2.15.8.\cos70)$

M1 for correct subs in cos formula
M1 (dep) for correct order of evaluation
A1 for 14.4 or better

(b) 78.5° 2

$$\text{Sin A} = \frac{15 \sin 70}{\text{"14.4"}}$$

$$\text{Cos A} = \frac{\text{"14.4"}^2 + 8^2 - 15^2}{2 \times 8 \times \text{"14.4"}}$$

M1 for $\dfrac{15\sin70}{\text{"14.4"}}$ *or* $\dfrac{\text{"14.4"}^2 + 8^2 - 15^2}{2 \times 8 \times \text{"14.4"}}$
A1 for $78 < \text{ans} \le 78.6$

[5]

37. 31.7.... 6

16 sin 30 = 8

$\sqrt{64-36}$

= 5.29....

½ × 12 × 5.29

M1 for $\sin 30 = \frac{x}{16}$ *oe*

A1 for 8

M1 ft for $l^2 + 6^2 = \text{“}8\text{”}^2$

A1 ft for $l = \sqrt{\text{"}64\text{"}-36}$ *evaluated as a single term* $(=\sqrt{28})$

M1 (dep on 2nd *M1) for* $\frac{1}{2} \times 12 \times \text{“}\sqrt{28}\text{”}$

A1 $31.7 \le ans < 31.8$

<u>Alternative Method:</u>

M1 for $\sin 30 = \frac{x}{16}$ *oe*

A1 for 8

M1 ft. for correct sub. into cosine rule

A1 ft. for angle

M1 (dep on 2nd *M1) for sub. into ½ ab sin C*

A1 $31.7 \le ans < 31.8$

[6]

38. (a) x tan20

$\frac{1}{2}x^2$ tan20 3

Area = $\frac{1}{2} \times x \times$"$x$ tan20"

M1 for tan 20 = $\frac{DF}{x}$ *or tan70 =* $\frac{x}{DF}$

A1 for x tan20 or $\frac{x}{tan70}$

B1 ft $\frac{1}{2} \times x \times$*"x tan20"or* $\frac{1}{2} \times x \times$" $\frac{x}{\tan 70}$ "*oe*

(b) 23.2% 4

Area BCEF = $\frac{1}{2}(x \tan 20 + x \tan 20 + x \tan 40)\ x$

Proportion = $\frac{\tan 20}{2\tan 20 + \tan 40} \times 100$

B1 for BD = x tan40 or $\frac{x}{tan50}$ oe

M1 (dep on B1) for correct expression for area of trapezium (ft from a(ii))

M1 (dep on 1st M1) ft for fraction $\frac{\text{area of DEF}}{\text{area of trap}}$

A1 for 23≤ ans < 23.3

[7]

39. 5.66… 3

6.2 × cos 24°
= 6.2 × 0.91…

M1 for cos 24° = $\frac{BC}{6.2}$

M1 for 6.2 × cos 24°

A1 for 5.66 or better

[3]

40. 13.1 cm — 6

$\sin 65 = BD/7$
$BD = 7 \times \sin 65$ (= 6.344..)
$DC^2 + \text{“}6.344\text{”}^2 = 12^2$
$DC = \sqrt{(12^2 - \text{“}6.344\text{”}^2)}$ (= 10.185..)
$AD = 7 \times \cos 65$ (= 2.958)
AC = “2.958” + “10.185”

M1 for $\sin 65 = \frac{BD}{7}$ *or* $\cos 65\ \frac{AD}{7}$
M1 for fully correct method to find AD
(eg. 7 × cos 65(= 2.9583…))
M1 for fully correct method to find BD
(eg. 7 × sin 65(= 6.344…))
M1 for $DC^2 + \text{“}6.344\text{”}^2 = 12^2$
M1 for $DC = \sqrt{12^2 - \text{"}6.344\text{"}^2}$
A1 for $13.1 \le ans \le 13.2$

[6]

41. 1.87 or better — 2

126/67.28……..

M1 for correct order of operation
A1 for 1.87 or better
(sc B1 for 67.3 or better seen)

[2]

42. 4.24… — 3

$\text{Cos } 43° = \frac{QR}{5.8}$
QR = 5.8 cos 43°

M1 for correct use of cos
M1 for 5.8 cos 43°
A1 for 4.24(185…) $4.23 \le ans \le 4.242$

[3]

43. 8.6 cm 4

cos 50 = *BN* / 4.3
BN = 4.3 × cos50 (= 2.7639…)
"2.763…" + 5.8

M1 for cos 50 = BN / 4.3
Accept $\cos = \dfrac{BN}{4.3}$
M1 for BN = 4.3 × cos50
A1 for 2.8 or better
B1 ft for "8.6" or better, dep on at least M1 awarded

[4]

44. 30.7 3

$\tan x = \dfrac{1.9}{3.2}$

$x = \tan^{-1}\left(\dfrac{1.9}{3.2}\right) = 30.7$

M1 for $\tan x = \dfrac{1.9}{3.2}$ *or* $\tan \dfrac{1.9}{3.2}$
M1 for $\tan^{-1}\left(\dfrac{1.9}{3.2}\right)$
A1 for 30.6 – 30.7

[3}

45. BOC is a right angle triangle
Angle BOC = 62°

$\text{Cos } 62 = \dfrac{7}{OB}$

$\text{OB} = \dfrac{7}{\cos 62}$

14.91... 4

B1 for <OCB = 90° and one other correct angle in triangle OBC
M1 for $\cos 62\ \dfrac{7}{OB}$ *or* $\sin 28 = \dfrac{7}{OB}$
M1 for $OB\ \dfrac{7}{\cos 62}$ *or* $OB = \dfrac{7}{\sin 28}$
A1 for 14.89 – 14.93

[4]

46. $CF = 4 \tan 28°$ (=2.1268…)
$AB = 4 \div \cos 28°$ (= 4.53028)
6+6+2 × "4.53…" + 2 × "2.126…"
25.3 — 6

M1 for right angled triangle with 4cm in correct position ***or*** *1 correct angle (28° or 62°)*
M1 for correct trig or Pythagoras statement involving
(eg. $\tan "28" = \frac{CF}{"4"}$ *)*
M1 for making CF the subject (eg(CF=) "4" tan "28")
CF (=2.1268...)
M1 for correct trig or Pythagoras statement involving
(eg. $\cos "28" = \frac{"4"}{AB}$
or $\sin "28" = \frac{"CF"}{AB}$
or $"4"^2 + "CF"^2 = AB^2$*)*
M1 for making AB the subject
(eg. (AB =) $\frac{"4"}{\cos "28"}$
or $AB = \frac{"CF"}{\sin "28"}$
or $AB = \sqrt{"4"^2 + "CF"^2}$ *)*
AB (= 4.5302...)
A1 for $25.3 \le ans < 25.32$
SC: If 56° used for angle BAF or 34° for angle $A\hat{B}E$
then award a maximum of M5A0 ($38.16 \le ans \le 38.2$)

[6]

47. Cos B = 2.3/5.4
B = $\cos^{-1}$ (2.3/5.4)
64.8° — 3

M1 for cos B = 2.3/5.4
M1 for B = $\cos^{-1}$ *(2.3/5.4)*
A1 for an answer in the range 64.5 to 65.2

[3]

48. (a) $\frac{\sqrt{3.39...}}{1.985} = \frac{1.84...}{1.985}$
0.9287… — 2

B2 for 0.9287(397....)
(B1 for sight of 3.39(....) ***or*** *1.84(....)* ***or*** *1.985)*

(b) 0.93 1

B1ft (indep) for writing "0.9287..." correct to 2, 3 or 4 sig figs

[3]

49. $\sin 40° = \dfrac{x}{10}$

$x = 10 \times \sin 40$

6.43

M1 for $\sin 40 = \dfrac{x}{10}$

M1 for 10 × sin 40

A1 for 6.427 – 6.43

[SC: 7.45.....or 5.87... seen gets M1M1A0]

[3]

50. $AB^2 = 7^2 + 10^2 - 2(7)(10)\cos 73°$

$= 149 - 140(0.29237...)$

$= 108.0679...$

10.4 3

M1 for correct substitution

M1 for correct order of operations (=108)

[SC :15.87...or9.55 ...seen gets M1M1AO]

A1 for 10.39 – 10.41

[3]

51. $\cos x = \frac{5}{8}$

51.3 – 51.35 3

M1 for $\cos(x =)\frac{5}{8}$

M1 for $\cos^{-1}\frac{5}{8}$ *or* $\cos^{-1} 0.625$, *or* $\cos^{-1}(5 \div 8)$

A1 for 51.3 – 51.35

(SC B2 for 0.89 – 0.9 or 57 – 57.1 seen)

Alternative Scheme

$h^2 = 8^2 - 5^2$ $(=39)$

M1 for $\sin(x =)\frac{\sqrt{"39"}}{8}$ *or* $\tan(x =)\frac{\sqrt{"39"}}{5}$ *or*

$\frac{\sin x}{\sqrt{"39"}} = \frac{\sin 90}{8}$ *oe or*

$(\sqrt{"39"})^2 = 8^2 + 5^2 - 2 \times 8 \times 5 \times \cos x$

M1 for $\sin^{-1}(\frac{\sqrt{"39"}}{8})$ *or* $\sin^{-1}(\frac{\sqrt{"39"} \times \sin 90}{8})$ *or*

$\tan^{-1}(\frac{\sqrt{"39"}}{5})$ *or* $\cos^{-1}(\frac{8^2 + 5^2 - (\sqrt{"39"})^2}{2 \times 8 \times 5})$

A1 for 51.3 – 51.35

[3]

1. Paper 4

This was a very poorly attempted question. Those candidates who recognised similar triangles were usually unable to identify the correct scale factor, with $\frac{6}{4}$ often being used. Some candidates gained one mark in part (b) for correctly calculating the length of *BC* but many assumed the trapezium to be isosceles with *BC* = *ED*.

Paper 6

Candidates who realised that this was the standard question on similar triangles, or enlargement had little trouble with the question. However, there was a great deal of confusion over which sides to use in order to find the scale factor. Few candidates opted to use the expedient of drawing the two triangles separately and specifically identifying the corresponding sides.
Part (b) was a more unusual question. Many candidates tried to find the perimeter of the triangle.
There was a great deal of confusion what to use as scale factors.

2. Paper 4

Many candidates realised that this question involved trigonometry and it was answered well by the more able candidates. Many were able to identify the need to use tangent but some were unable to write down "$\tan 35° = \frac{AB}{8.5}$" and others who did, could not rearrange this correctly to find *AB*. A significant minority used cosine rather than tangent. There was evidence that some candidates had their calculator set in the wrong mode for this question.

Paper 6

A standard trigonometry question. Good candidates had little difficulty with it. However, a sizeable number took advantage of the formula sheet and used the sign rule. Often this led to finding the length of the hypotenuse. (Methods such as this gain no marks unless it is a complete method leading to, in this case, the finding of the opposite side.)

3. Part (a) was generally well done, as candidates had simply to substitute into the formula. Some candidates thought that if they used the cosine rule to find *AB* then they were answering the question.
Part (b) proved to be something of a challenge for many students. Essentially the question involves 2 stages. The first entails finding the length of *AB* using the cosine rule. The most direct way to proceed then is to use the half base times height formula for the area with *AB* as the base and *CX* as the height. Many good students found one of the angles instead and then trigonometry in the right-angled triangle.

4. Paper 3

Correct notation in using trigonometry was frequently absent in this question. Calculator notation or other abbreviations inhibited many candidates from correctly quoting the full trigonometrically formula. This sometimes led to confused or unclear working, which lost candidates marks. Premature approximation frequently spoilt interim working or the final answer. In part (a), a significant number of candidates were able to calculate the angle correctly. In part (b), candidates frequently associated the angle and side with Sine, but were unable to undertake the manipulation to arrive at the required calculation.

Paper 6

This was a harder trigonometric question as it involved two triangles However, no value had to be transferred from one triangle to the next, so providing candidates recognised this, there should have been no major problems.
Part (a) assessed the use of tan in triangle *ABC*. Candidates were able to spot this and then use the inverse to find the angle. Generally the correct trigonometric ratio was selected in part (b) and it was pleasing to see the many correct manipulations to find the length of the side *BD*. Some candidates took advantage of the formula sheet available on this tier and used the sine rule, sometimes in the biggest triangle. Generally they lost a mark because of premature rounding.

5. Candidates who had learned the basic trigonometric rules in a general triangle found this question straightforward. Most candidates applied the $\frac{1}{2}ab \sin C$ rule correctly and found the correct answer.

Furthermore, most candidates could use the cosine rule to find the length of AC. The main source of errors came from those who evaluated $a^2 + b^2 - 2bc \cos A$ as $(a^2 + b^2 - 2bc) \cos A$.

6. This question proved to be too difficult for the candidature. Most earned 1 mark for substitution into the equation. However, most could not make much progress beyond this as they failed to understand the meaning of sin $30(3 - k)$, often giving the answer $0.5(3 - k)$.
One or two candidates realised the significance of the maximum and minimum value of sine to gain a second mark.

7. **Mathematics A Paper 5**

It is a pleasure to report that a majority of candidates graded above C gained at least some credit for correct answer(s) in parts (a) of this final question. As expected part (b) was a challenge to all but the top grade candidates. The examiners required the correct terminology for the transformations to be used (stretch) and also clear indications of the directions and scale factors.

Mathematics B Paper 18

Correct answers to part (a) were seen from approximately half of candidates although $y = \sin 2x$ was a common incorrect answer for the second graph. Few candidates were able to describe the transformations in (b) with the majority of the candidates describing the shape of the graph.

8. Paper 4

Candidates had a clear opportunity to demonstrate their understanding of Pythagoras' and Trigonometry in this question, and the majority did so, even the weaker candidates gaining some credit when method was shown. In part (a) most gained the full marks, though there were some who attempted $10^2 – 6^2$, or stopped at 136 (did they have a calculator without a square root key?). It was encouraging to find that most candidates realised that Cosine was needed in part (b), with greater success than in recent years. Many gained full marks, but a significant number could get no further than Cos $x = 0.8$. Some candidates gave a final answer which was very near to the correct answer, but no marks could be awarded when no working was seen in support of their answer; this could happen whenever a candidates performs the operation solely on a calculator, but incorrectly rounds their answer when writing it on the answer line.

Paper 6

Part (a) was a standard Pythagoras. Candidates did not appear to be put off by the juxtaposition of the two triangles and most obtained the correct answer.
Part (b) was not quite as well done, but competent candidates used (inverse) cosine to find the angle. A few candidates used the formula sheet and gave the sine rule to find angle *E.* They did not receive any credit until they had gone on to find the angle marked *x.*

9. Mathematics A Paper 6

This proved to be a somewhat challenging question, but it is pleasing to see how many candidates made inroads into this multistep problem. Successful candidates fell into two groups. The first used area = $\frac{1}{2}ab\sin C$ to find the angle at *B* and then use the cosine rule to find the length of the opposite side *AC.* The second used the rule area = $\frac{1}{2}bh$ to find the length of the altitude *AD.* Two uses of Pythagoras in triangle *ABD* and *ACB* resulted in *AC* being found.
The two approaches seemed to be equally common. However, those who chose the trigonometrical approach often fell into one of two errors. The first one was to think that they had found the angle *C,* instead of angle *B;* the second was to evaluate the cosine rule incorrectly.

Mathematics B Paper 19

A variety of different methods were seen. The most common approach was to use the sine rule to evaluate angle *B* then the cosine rule to evaluate *AC*. In this approach, the most common error came when evaluating *AC* by carrying out the arithmetic operations in the wrong order. The other method commonly seen was to work out *BC* (or *AB*) from using area of triangle = $\frac{1}{2}$ × base × height, then using Pythagoras's Theorem twice to obtain *AC* (or a combination of trigonometry and Pythagoras's theorem). A very common error was for candidates to assume that triangle *ABC* was right-angled and attempt to use Pythagoras's theorem.

10. Mathematics A Paper 6

3D trigonometry questions have been rare on paper 6, so it was a pleasure to see good attempts. Candidates first had to use tangent in triangle *EBA* to find *EB.* Once they had located angle *EDB,* the approach was to find either *BD,* by using Pythagoras in triangle *ABD,* or to use a combination of cosine (to find *EA*) and Pythagoras in triangle *AED* to find *ED.*
A very common error was to think that the required angle was *EDA.*

Mathematics B Paper 19

This question was poorly done. Many candidates failed to make their method of solution clear. A number of candidates thought that they had to find angle *EDA* rather than angle *EDB*.

11. This is probably the question in which candidates lost most marks through not showing intermediate steps of working out. It is perhaps all too easy simply to attempt to plug the figures into a calculator, yet more than half the candidates gave just an incorrect answer on the answer line and lost all 3 marks. Clear evidence of correct substation would have earned the first mark. Nearly all errors could be linked to incorrect processing of operations on the calculator.

12. Paper 6

A standard trigonometric question. At this tier most candidates were able to find a method to find the angle. Most used tan but a minority had one eye on the formula sheet, found the hypotenuse and then went on to use the sine rule, sometimes successfully.

Paper 4

The proportion of candidates answering this question correctly was far lower than in recent papers. There was some confusion as to whether this was a Pythagoras question. Otherwise few realised that trigonometry was involved, and those who did get no further than some recognition that Tan was involved.

13. Part (a) required candidates to find the length of the space diagonal of a cuboid.. Most successful candidates found the length of the face diagonal of the base first, followed by a second application of Pythagoras to triangle *GAC* Very few examples of $\sqrt{a^2 + b^2 + c^2}$ were seen. Some candidates lost an accuracy mark through premature approximation of the length of the base diagonal.
It was pleasing to see so many successful attempts at part (b) of the question. The best solutions used either sin or tan in the right angled triangle. A minority of candidates seized on the formula page and used the sine rule. These candidates were generally less successful. A few candidates calculated the angle *AGC*.

14. Part (a) was a routine application of the area = $\frac{1}{2}ab \sin C$. Most candidates were able to do this.

Part (b) asked candidates to show that the ratio of areas of triangles with the same height is equal to the ratio of the bases. There was a clue in the question as the height was clearly indicated by h. The idea was to form the expression $\frac{1}{2}b_1h \div (\frac{1}{2}b_2h)$ and cancel the halves and the hs. Many candidates did this but a sizable minority could not get started. A few candidates tried to use $\frac{1}{2}AC \times BC \times \sin C$ in the two triangles and then cancelled the AC and then the C failing to spot that the second expression for the area should have been $\frac{1}{2}AC \times BC \times \sin (180 - C)$. Of course the method will work because $\sin C$ and $\sin (180 - C)$ have the same value. Unless candidates clearly stated this fact they did not get full marks.
A surprising number of candidates wrote that the triangles were similar.

On part (c), candidates had to write down two expressions for areas of triangles using $\frac{1}{2}ab \sin C$ where C is the value of the bisected angle and then use part (b)to get the required result. Few candidates were able to give the full logic required, but many were able to gain at least one mark. Many candidates did not help themselves by using poor notation especially when naming the two halves of the bisected angle.

15. **Specification A**

Although there were few completely correct answers to this question, many candidates scored at least one mark for correctly using the equations for the cone and sphere.
A typical candidate substituted x into the equation for the cone, $2x$ into the equation for the sphere, forgot to cube the 2 and, after rearrangement, arrived at an answer $8x$.

There were a surprising number of candidates who, having started correctly with $\frac{1}{3}\pi x^2h = \frac{4}{3}\pi(2x)^3$, than incorrectly subtract the fractions to get $\pi x^2h = 1\pi(2x)^3$.

Specification B

Approximately two thirds of candidates were able to substitute the given radii into the correct formulae. The formula for the surface area of a sphere was sometimes used instead of the formula for the volume. The most common error on substituting the radii was to give $\frac{4}{3}p2x^3$ instead of the correct $\frac{4}{3}p(2x)^3$. Candidate who made this error lost one mark out of the available three provided they managed to make h the subject of their formula using correct algebraic processes. The level of algebra was generally very poor with very few candidates being able to carry out what should have been a straightforward division. The most common error here was to subtract $\frac{1}{3}$ from either side of the equation rather than multiply by 3.

16. Higher Tier

Weaker candidates always find trigonometry challenging. The first task was to use tan and identify the sides correctly. The next step was to calculate 1.9 ÷ 3.2 and then find the inverse tangent. Here many candidates came to grief because they wrote $\tan^{-1}\frac{1.9}{3.2}$ and found $(\tan^{-1}1.9) \div 3.2$.
Other candidates made use of the formulae at the front of the examination paper. They worked out the length of *SP* using Pythagoras, followed generally by the sine rule, almost invariably with sin*x* in the denominator. Some were able to complete the calculation and get full marks. Part (b) was poorly done as many candidates did not realise that a bearing was an angle measured clockwise from North.

Intermediate Tier

The majority of candidates made an attempt at answering this question despite it being near the end of the paper, but many did not recognise that they needed to use trigonometry. It was encouraging that most of those that did were able to identify the tangent of the angle as 1.9/3.2. Some were unable to proceed any further and others made errors when finding $\tan^{-1}$ (1.9/3.2). It was not uncommon, for example, for $\tan^{-1}1.9 \div 3.2$ to be evaluated. Very few used their answer from part (a) when attempting to find the bearing in part (b). Those that did often subtracted the angle from 360 or added it to 180, instead of adding it to 90. Many candidates chose to measure the bearing on the diagram, despite the “Diagram NOT accurately drawn” warning.

17. Most candidates went straight to $\frac{1}{2}ab\sin C$ and scored full marks. A few candidates took the formula literally and tried to work out angle C or assumed the triangle was isosceles.

18. Specification A

This was a multi-step 3d trigonometry/Pythagoras question. Candidates needed to be able to identify the correct triangles to work in. For part (a) most chose triangle *AOV* and found $6^2 - 2^2$. Some misunderstood the notion of height and found the altitude of triangle *VBC* from $6^2 - 1^2$. For part (b) The preferred triangles were either *VAD* with the use of the cosine formula or triangle *AOV* with the use of sin. Many candidates who adopted the first approach were unable to rearrange correctly the given formula into the form cos V = Common misconception were to assume that angle *AVD* was double angle *BVC*, or that it was three times angle *BVC*.
For part (c), the preferred triangle was *AVC.* Initially candidates had to use the cosine rule in triangle *ABC*, or equivalent, to find the length of *AC.* Then a second use of the cosine rule in the alternative form yields the angle *AVC.* One common misconception in this part was to assume that *AC* could be found by using Pythagoras. Another was to assume that angle *AVC* was double angle *BVC.*

Specification B

Very few fully correct solutions were seen to this question. Candidates should be encouraged to include labelled sketches of the triangles used in questions of this nature. Pythagoras's theorem was frequently incorrectly used in part (a) with many candidates obtaining a value for the height that was longer than the length of the hypotenuse in their right angled triangle. In parts (b) and (c) the most successful candidates were those who sketched the relevant triangle and worked from that. There were two main approaches to part (b) either the cosine rule was used to find the required angle directly or trigonometry was used to find half the required angle. Candidates who used the cosine rule often had trouble rearranging it appropriately so that the angle could be found. Only a very small minority of candidates were able to identify a triangle that contained the required angle in part (c).

19. In part (a), about half the candidates recognised the need to use the sine formula, but a small minority attempted erroneously to use the tangent ratio. Only the best candidates were able to gain much credit in part (b). A significant number thought that the arc *EF* had centre *A,* and consequently used the cosine rule to find *AE.* Candidates should be encouraged to use all stated information and not make assumptions about diagrams. Some candidates attempted to calculate the *length EF.*

20. Intermediate Tier

Only the better candidates gave completely correct solutions to both parts of this question. Many did not recognise that they needed to use trigonometry and some did not attempt the question at all. In part (a) the majority of those using trigonometry identified the tangent of the angle as 5/6. Some were unable to proceed any further. Others rounded the value of 5/6 to 0.8 or 0.83 and lost the required accuracy in the final answer. In part (b) a common error was to use cosine. When sine was used candidates tended to be more successful than in part (a) although some truncated the answer to 6.42 and lost the final mark.

Higher Tier

In part (a), candidates generally used tan correctly to find the angle a. Some candidates lost marks through premature approximation of the decimal equivalent of $\frac{5}{6}$. A few candidates tried to depend on the formula sheet and to calculate the hypotenuse followed by the cosine rule. A few also tried to use either sine or cosine in the triangle. In part (b), candidates were generally successful in using sine to find the length of the side.

21. Specification A

Many candidates recognised that they had to use the sine rule in triangle *ABD* to find the length of either *AD* or *BD.* The better candidates went on to use sine in either triangle *ADC* or triangle *BDC* as appropriate. Other candidates managed to gain nearly full marks by starting in the same way but then finding *BC* followed by Pythagoras or by using tan. Some candidates produced equations by using tan in triangle *DBC* and in triangle *DAC* to get *DC* =*x* 54° tan and *DC* =(*x* + 28° tan)25 followed by equating the two expressions for *DC.* Many weaker candidates assumed that right angled triangle trigonometry could be used in any of the triangles.

Specification B

A great variety of methods were seen in attempts to answer this question, many of them incorrect in various ways. The most efficient method of solution was to apply the sine rule once and then use a trigonometric ratio. A fully correct solution was seen from approximately 25% of candidates. Of the candidates that gained full marks some used the most efficient method of solution while more used the sine rule twice, then a trigonometric ratio or the sine rule followed by the cosine rule then a trigonometric ratio. The majority of candidates were able to gain the final method mark for a correct use of a trigonometric ratio in triangle *BDC*.

22. Paper 5524

Not all candidates attempted this question. Many realised that trigonometry was required, but of those a significant number failed to remember the relationship, or chose the wrong trigonometrical ratio to use.

Paper 5526

Most competent candidates, by definition, used cosine to evaluate the angle. This was well done. A few candidates decided to use right angled trigonometry employing a combination of Pythagoras and either sine or tangent. This usually did not work and the best effort seen still only yielded 2 of the 3 marks because of the premature approximation errors building up under this method. Others took advantage of the formula page and went for a combination of Pythagoras and the sine rule. These candidates were not usually successful either.

23. This proved to be a challenge for all but the better students. Firstly, the task required the use of the cosine rule in the form which is not on the formula page. Secondly, candidates had to realise that the biggest angle was opposite the longest side, or otherwise were in for a lot of additional work. Some who did it this way started with the cosine rule and found correctly one of the other angles. They went on to use the Sine Rule to find the other angle and most inevitably gave the (incorrect) acute angle answer of 74.3. Many candidates were not up to the manipulation of the cosine formula either algebraically or by transforming the substituted expression. The usual error of $b^2 + c^2 - 2bc$) cos A between misinterpreted as $(b^2 + c^2 - 2bc)\cos A$ was frequently seen. Part (b) was more successfully answered, with most candidates realising that $\frac{1}{2}ab\sin C$ had to be used. In addition, there were several candidates who used Hero's formula correctly to find the area.

24. The direct method is to use $\sin x = \frac{\text{opp}}{\text{hyp}}$ and many candidates used this to get full marks. A minority of candidates fell to temptation from the formula sheet and used the sine rule in the triangle. They were generally less successful, but those that did get the correct answer got full marks.

25. This was a standard cosine rule question. Reponses tended to fall into 3 categories: firstly those who used the cosine rule correctly, secondly, those that used the cosine rule incorrectly and thirdly those that did not use the cosine rule at all. The main misuse of the cosine rule occurred at the stage $145 - 144\cos 40° \Rightarrow \cos 40°$ with an answer which is a decimal. This is another BIDMAS error of a similar type to that which occurred in Question 17e. The third category tended to assume that either the triangle was isosceles or that right angled trigonometry could be used.

26. **Higher Tier**

Most candidates recognised the need for tan and then followed through correctly to get an angle of 20.6. A few knew it was tan but were inaccurate using the inverse function and effectively evaluated $\tan^{-1}(4.5) \div 12$. Weaker candidates took advantage of the formula page and went for Pythagoras followed by the sine rule. Often this was not successful and even if the method was carried out correctly, their answer was usually inaccurate due to the rounding carried out through the solution.

Intermediate Tier

Many failed to recognise this needed trigonometry and used Pythagoras. Those that chose Tan often did not write 4.5/12 and others wrote 12/4.5 It is disappointing to see premature still happening in these types of question.

27. This was a 2 – step trigonometrical problem which required the calculation of the length of *BD* using tan for example followed by the use of this value of *BD* in the triangle *BAD* to find 13.5° by using sin.

Many candidates were baffled by the apparent complexity of the diagram and used combinations of the sine rule and Pythagoras. Some candidates calculated the wrong angle in the triangle. A significant number did not use the given lengths at all, assuming that AD and BC were parallel and that angles CBD and ADB were alternate.

28. Good candidates wrote down $\frac{1}{2}ab$ sin 60 as their first step and then applied this idea to get an equation in x. Good candidates went on to write equations like $x^2 = \frac{72}{\sin 60^\circ}$ and then find 9.12 for the value of x. A few candidates lost their marks by writing $2x$ for x^2 or by dividing 36 by 2 instead of multiplying by 2. Candidates who tried to use base × height ÷2 were generally unsuccessful as they could not get the correct algebraic expression for the height, generally writing $\sqrt{x^2 - \frac{1}{2}x^2}$.

29. Although as a whole this was a challenging question to finish off the paper, many candidates recognised that they had to find the 3 sides of the triangle. This many of them succeeded in doing by employing Pythagoras 3 times. (Unfortunately, many found BC to be 6 cm). The next stage was much more difficult. Many assumed that the median of triangle CDB was also perpendicular to the base and thus lost all the remaining marks. Others tried to use the cosine rule from the formula page but were unable to perform the correct algebraic manipulations to isolate the cosine. Candidates who had taken the trouble to learn the cosine rule in this form who generally more successful.

30. Candidates who had put in some preparation were rewarded on this question by a task which involved a straight substitution and it was very telling that this approach yielded much more success than that of using the given formula at the front of the paper and then manipulating to isolate cos$A$. Of the candidates who did adopt this latter approach, many forgot about operator precedence and ended up with 225 = 4 cos$A$ from which they concluded that A was 56.25 degrees.

31. Nearly 65% of candidates were unable to gain any marks. Some candidates found hypotenuse but got no further. Those who realised they should use TAN often could not use inv tan correctly and tan 0.4 was seen. There were a few cases of radians or grads being used. Just under 30% of candidates scored full marks.

32. In part (a) many candidates struggled with this question or adopted a long-winded approach involving Pythagoras and the sine rule.

Common errors included failing to identify cos as the appropriate ratio or using an incorrect order of operations when finding invcos. The sine rule candidates often failed to rearrange correctly, some of them failed to put sine at all and others calculated the third side using Pythagoras incorrectly.

In part (b) most candidates recognised the need to use the tan ratio but faltered when it became necessary to manipulate the formula to make y the subject. A common error was to write tan40 = y/12.5 and then rearrange incorrectly confusing the angle and side length given to calculate 40 × tan12.5. Others attempted tan40 ÷ 12.5 or 12.5 ÷ tan 40. Some candidates identified the third angle as 50 and then successfully used the sine rule.

33. Very few correct answers were seen. A minority of candidates gained marks for the correct ratio of sides AB and AC. The idea of a proof seemed beyond the vast majority of candidates. Those who did attempt the question generally tried to find the size of angle C.

34. This was without doubt the question that caused the greatest difficulty on this paper. Many candidates read the request for the bearing of Ambletown from Comptown as a request for the distance between the two towns and 'happily' applied Pythagoras (often correctly). Attempts were made to calculate an angle using trigonometry, often without specifying the angle (eg tan $= \frac{7.4}{9.6}$) and often without any real purpose. Those candidates who calculated an angle correctly nearly always went no further; the level of understanding of bearings is a cause for concern.

35. There were a few candidates who obtained full marks for the question using a complete algebraic process. Many candidates recognised that they had to use the formula $\frac{1}{2}ab\sin C$ with the appropriate algebraic expressions substituted in. Those candidates who set this equal to 3 and expanded the brackets frequently then failed to get the correct quadratic equation. Of those candidates who did get a quadratic equation (correct or not) it was disappointing to see so few make use of the given quadratic equation formula. A significant number of candidates attempted trial and improvement from a very early stage. Few such candidates reached the correct answer in this approach. A number of candidates tried to use the sine or cosine rule; this led nowhere.

36. Candidates frequently treated the given triangle as a right angled and then incorrectly used trigonometry and/or Pythagoras's Theorem throughout. Of those candidates who recognised that the question was most efficiently solved in (a) by using the cosine rule a disappointingly large number then carried out the calculation in the wrong order frequently writing 289 – 240cos70 as 49cos70. In part (b) candidates frequently had problems in rearranging the sine rule correctly so that sin*BAC* was the subject.

37. The majority of candidates were able to make a start to this question by correctly calculating the length of *BC*. After this initial success many candidates then tried to use Pythagoras's theorem or trigonometry in triangle *BCD* rather than first constructing the perpendicular from *b* to *CD* and then using Pythagoras's theorem or trigonometry to calculate the height. It was pleasing to see a number of fully correct solutions to this question.

38. The combination of algebra and mensuration proved to be too daunting for nearly all students. In part (a), many candidates recognised the need to use tan, followed by the area formula. Very few could even get started on part (b). A minority of candidates were able to find an expression for *BD.* However, hardly any went further successfully.

39. Only a minority (20%) correctly used the cosine of the angle in attempting to solve this problem. Of these the majority (16%) went on to accurately calculate the required length. The others who recognised the need to use trigonometry usually used tan 24°; however the greater number showed little idea at all, often guessing or drawing scale diagrams.

40. A number of candidates made the incorrect assumption that angle *ABC* was 90°. Of those candidates who appreciated the need to start off by using trigonometry in triangle *ABD* generally scored at least one mark. Candidates should be advised to label sides on triangles when using trigonometry and/or Pythagoras's theorem to make it clear which length they are attempting to find. There was clear evidence that some candidates had their calculator set in the wrong angles mode.

41. The inclusion of a trigonometric expression in the calculator question did not put off very many candidates; the order of operation remains the major reason why candidates lose marks in this type of question. An answer of 1.00 or 1.006 was often seen as a result of calculating 126 ÷ 92 × sin 47°. Answers of 0.0534 (92 × sin47° ÷ 126) and 64.4 (126 × 47 ÷ 92) also appeared regularly. A few candidates had their calculators set in the wrong mode but still received some credit if this was their only error.

42. Just under half of all candidates were able to gain full marks for their answer to this question. Of those candidates who used a correct method the vast majority went onto score full marks. Candidates who failed to score any marks generally used the wrong trigonometric ratio. 5.8 sin43 was a very commonly seen incorrect answer. There was clear evidence that a minority of candidates had their calculator set in a mode other than degrees. Some candidates used a combination of Pythagoras's theorem and trigonometry whilst this was a correct method, the final accuracy mark was often lost due to premature rounding.

43. Very few candidates were able to gain access to this question, many believing that merely 'playing' with the numbers given would lead to the correct answer. Many candidates attempted to find the length of *BC* by scale drawings. This gained no marks whether correct or not. Some gave 11.6 (5.8 × 2) as their answer. 10.1 (4.3 + 5.8) and 24.95 (5.8 × 4.3) were also common answers while 7.2 was often seen by those candidates choosing to use Pythagoras. Those candidates who realised that the use of trigonometry was required often went on to gain three or four marks.

44. Again the understanding of, and the ability to use trigonometry, was not good. Pythagoras was tried by some and scale diagrams by others. When trigonometric methods were attempted the setting out of the solutions left much to be desired with poor notation; $\tan(\frac{1.9}{3.2})$, $(\frac{1.9}{3.2})\tan$, $\tan 1.9 \div 3.2$ were common statements made, and only subsequent working convinced the reader of the understanding of the candidate.

$\tan^{-1}\frac{1.9}{3.2}$ was often interpreted as $(\tan^{-1} 1.9) \div 3.2$ resulting in error.

45. Over half of all candidates gained a mark by identifying the right angle and working out one other angle in triangle *OBC*. After this, success was varied. Those candidates who recognised that *OC* was a radius of the circle and therefore of length 7cm were generally able to go and find a correct solution. A disappointingly large number of candidates failed to recognise that *OC* was of length 7cm and tried to incorrectly use trigonometry in triangle *OAC* to evaluate the length of *OC*. Fully correct solutions to this question were given by approximately 12% of candidates.

46. The majority of candidates were able to realise that a right angled triangle needed to be formed in order to calculate the missing lengths needed to calculate the perimeter. A fully correct method was seen from approximately one quarter of candidates. Some candidates used 56° for angle *BAF* instead of the correct 28°A common error of candidates was to write $\cos 28° = \frac{4}{hyp}$ and then follow up with hyp = 4 × cos28°. Some of these candidates then went on to use Pythagoras with the hypotenuse shorter than the adjacent side.

47. use of trigonometry was poor; very few even attempted trigonometric methods, preferring instead Pythagoras to calculate the length of the third side. Of those who did use trigonometry few went beyond cos? = $\frac{2.3}{5.4}$.

48. In part (a) the correct answer was seen from only approximately 60% of candidates. Of those who failed to gain the correct answer some, but not all candidates, were able to gain a method mark for demonstrating that at least part of the calculation had been carried out with due regard for the correct order of operations. A number of candidates showed no interim working so, when their final answer was wrong, were unable to pick up the available method mark. A common incorrect answer was 1.2285… which occurs when the square root of just 2.56 and not the complete numerator is taken. The majority of candidates were able to round their answer to part (a) correctly to gain a mark in part (b).

49. Many fully correct solutions were seen. In some cases candidates did not round their final answer correctly and did not show their uncorrected answer. In such circumstances, the final accuracy mark was lost. The majority of candidates use the trigonometric ratio for sine, a number of candidates successfully used the sine rule. The common incorrect method was to use cosine.

50. The relevant values were frequently substituted correctly into the cosine rule. This was then frequently simplified incorrectly to 9cos 73^o rather than left as 149 – 140cos73^o. A few candidates forgot to take the square root and so lost the final accuracy mark. The most common error was to use Pythagoras's theorem even though the triangle was clearly not right angled.

51. This was a standard right-a angled trigonometry question involving cos. Not all candidates could access the question with a lot of confusion over rules and misuse of the correct function - for example, cos5 ÷ 8, which would have given an error on the calculator, or cos 0.625, which gives a plausible answer albeit close to 90°.