19 The diagram shows a triangular prism.

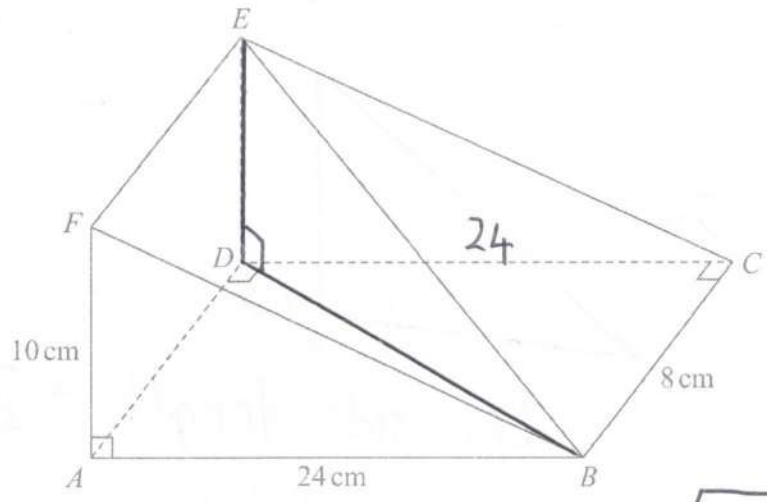


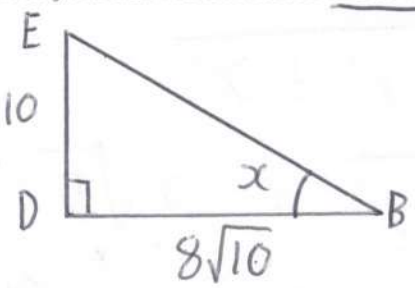
Diagram **NOT** accurately drawn

$AF = 10$ cm, $AB = 24$ cm and $BC = 8$ cm.
Angle FAB = angle ADC = angle $BCD = 90°$

Work out the size of the angle between the line BE and the plane $ABCD$.
Give your answer correct to 1 decimal place.

$BD = \sqrt{24^2 + 8^2}$

$= 8\sqrt{10}$



(T)°A $\quad x = \tan^{-1}\left(\frac{10}{8\sqrt{10}}\right)$

$= 21.56...$

21.6

(Total for Question 19 is 3 marks)

20 Here is a cube *ABCDEFGH*.

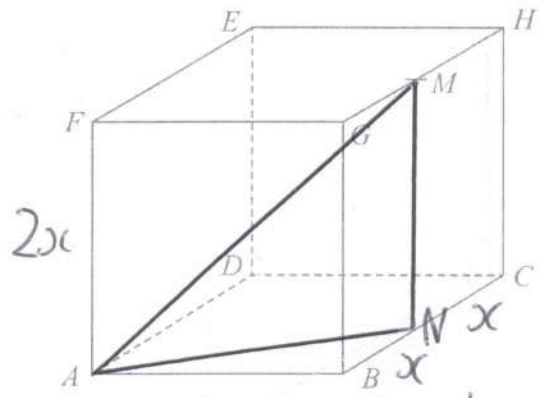
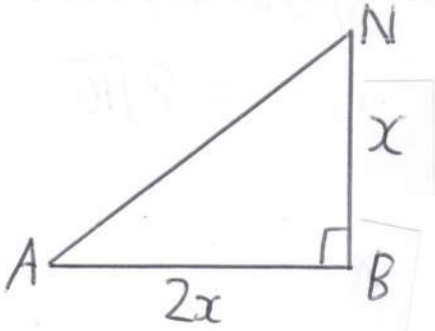


Diagram **NOT** accurately drawn

M is the midpoint of the edge *GH*.

Let side length = 2x

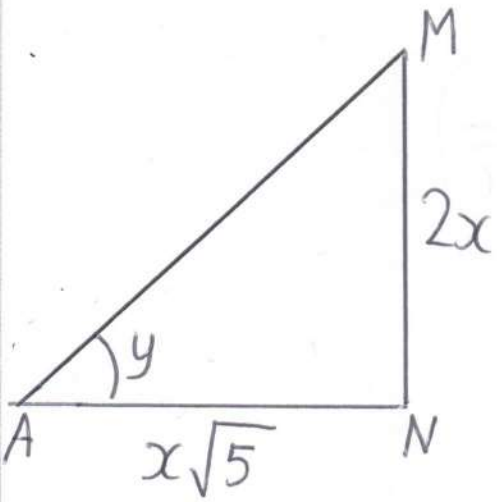
Find the size of the angle between the line *MA* and the plane *ABCD*.
Give your answer correct to 1 decimal place.



$AN = \sqrt{(2x)^2 + (x)^2}$

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

$= \sqrt{5x^2} = x\sqrt{5}$



(T) ^{O}A

$y = \tan^{-1}\left(\frac{2x}{x\sqrt{5}}\right)$

$y = \tan^{-1}\left(\frac{2}{\sqrt{5}}\right)$

$= 41.810\ldots = 41.8$

(Total for Question 20 is 4 marks)

21 The diagram shows cuboid *ABCDEFGH*.

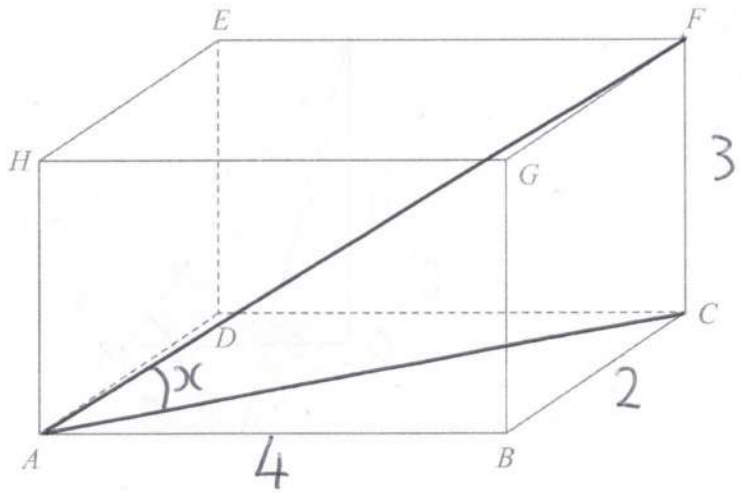
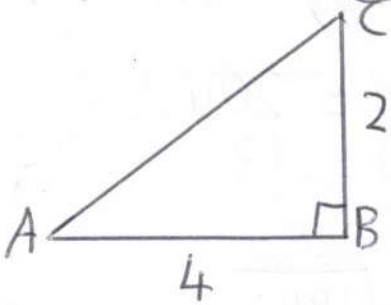


Diagram **NOT** accurately drawn

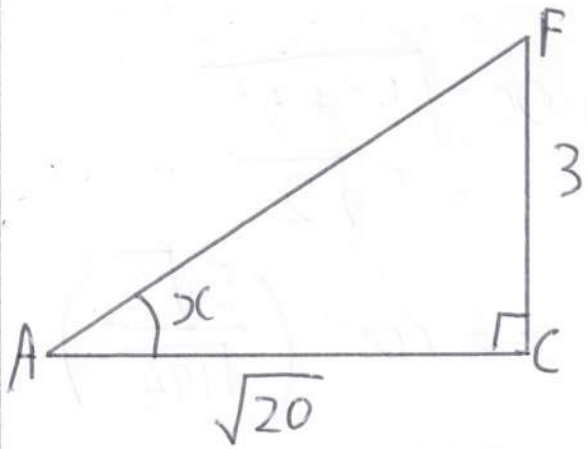
For this cuboid

the length of *AB* : the length of *BC* : the length of *CF* = 4 : 2 : 3

Calculate the size of the angle between *AF* and the plane *ABCD*.
Give your answer correct to one decimal place.



$AC = \sqrt{4^2 + 2^2} = \sqrt{20}$ or $2\sqrt{5}$



(T) ^{O}A

$x = \tan^{-1}\left(\frac{3}{2\sqrt{5}}\right)$

$= 33.85...$

$= 33.9$

(Total for Question 21 is 3 marks)

23 The diagram shows a solid pyramid $ABCDE$ with a horizontal base.

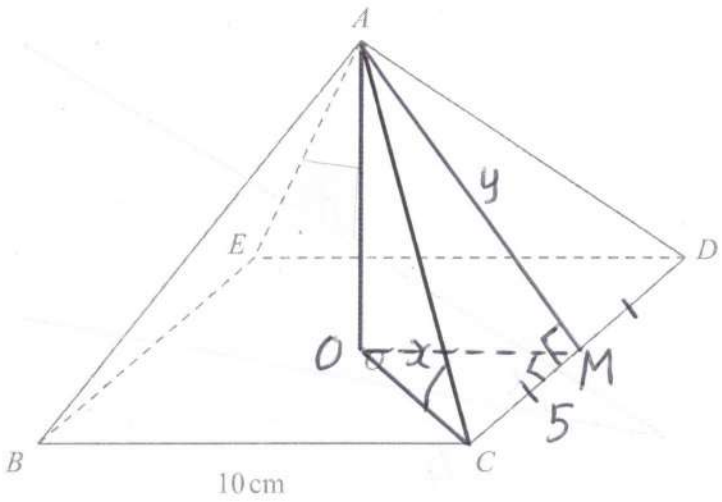


Diagram **NOT** accurately drawn

The base, $BCDE$, of the pyramid is a square of side 10 cm.

The vertex A of the pyramid is vertically above the centre O of the base so that $AB = AC = AD = AE$

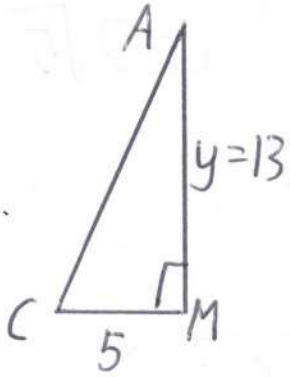
The **total** surface area of the pyramid is 360 cm^2

$= 4\left(\frac{1}{2} \times 10 \times y\right) + (10 \times 10)$

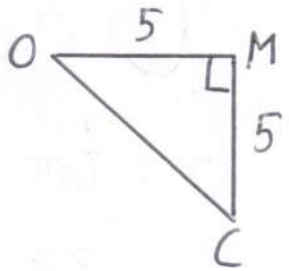
Work out the size of the angle between AC and the base $BCDE$.
Give your answer correct to 3 significant figures.

$260 = 20y$

$y = 13$

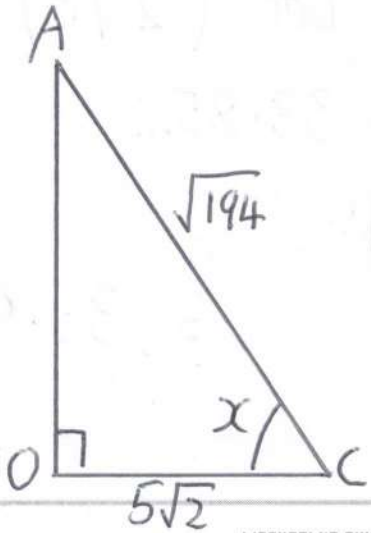


$AC = \sqrt{13^2 + 5^2} = \sqrt{194}$



$OC = \sqrt{5^2 + 5^2}$

$= 5\sqrt{2}$



$x = \cos^{-1}\left(\frac{5\sqrt{2}}{\sqrt{194}}\right)$

$= 59.49$

$= \underline{59.5°}$

(6 marks)

19 The diagram shows a cuboid *ABCDEFGH*.

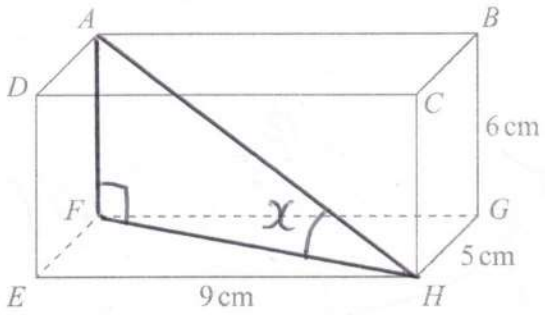
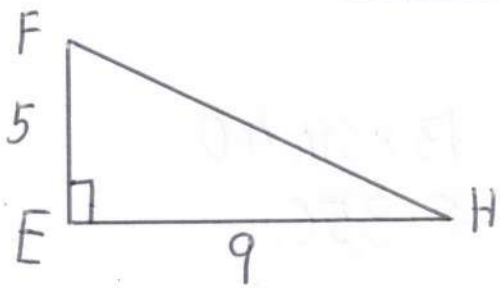


Diagram **NOT** accurately drawn

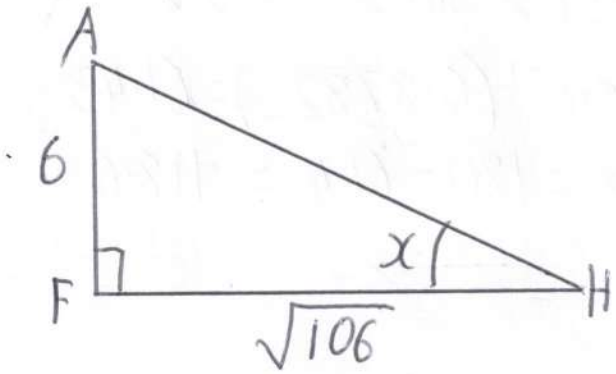
EH = 9 cm, *HG* = 5 cm and *GB* = 6 cm.

Work out the size of the angle between *AH* and the plane *EFGH*.
Give your answer correct to 3 significant figures.



$FH = \sqrt{9^2 + 5^2}$

$= \sqrt{106}$



O
T A

$x = \tan^{-1}\left(\frac{6}{\sqrt{106}}\right)$

$= 30.23...$

30.2

(Total for Question 19 is 4 marks)

21 The diagram shows the prism $ABCDEF$ with cross section triangle ABC.

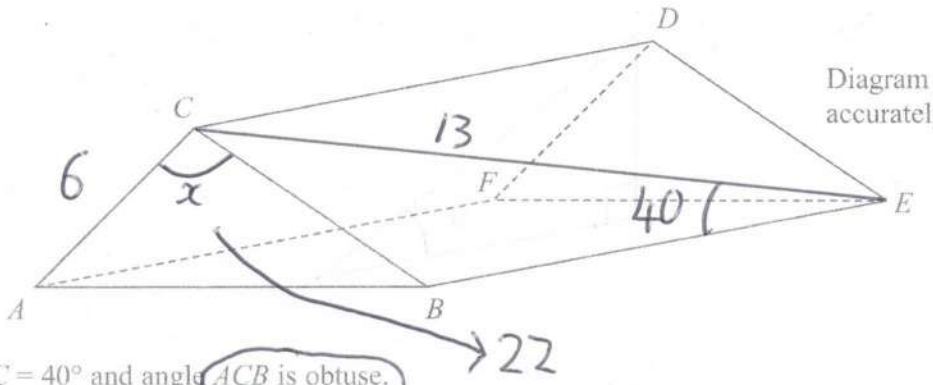
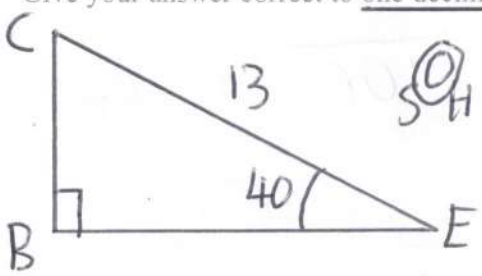


Diagram **NOT** accurately drawn

Angle $BEC = 40°$ and angle ACB is obtuse.
$AC = 6$ cm and $CE = 13$ cm

The area of triangle ABC is 22 cm^2

Calculate the length of AB.
Give your answer correct to one decimal place.

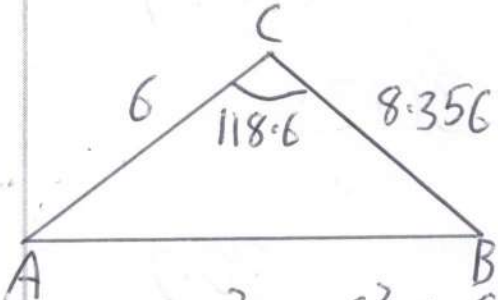


$BC = 13 \times \sin 40$
$= 8.356...$

Area $ABC = \frac{1}{2} \times 6 \times 8.356 \times \sin x = 22$

'x' $= \sin^{-1}(0.8782...) = 61.43$

$=$ acute so $x = 180 - 61.4 = 118.6$



$AB^2 = 6^2 + 8.356^2 - (2 \times 6 \times 8.356 \cos 118.6)$

$AB = \sqrt{153.82} = 12.40... = 12.4$

cm

(Total for Question 21 is 6 marks)

17 The diagram shows a prism *ABCDEFGH* with a horizontal base.

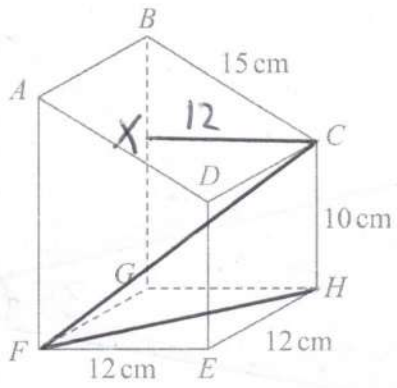


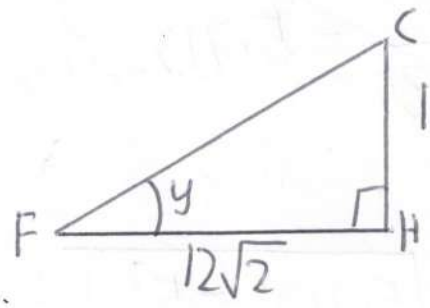
Diagram **NOT** accurately drawn

The base of the prism, *EFGH*, is a square of side 12 cm.
Trapezium *ADEF* is a cross section of the prism where *AF* and *DE* are vertical edges.

$DE = CH = 10$ cm
$AD = BC = 15$ cm

$FH = \sqrt{12^2 + 12^2} = 12\sqrt{2}$

(a) Work out the size of the angle between *CF* and the base *EFGH*.
Give your answer correct to one decimal place.



T O A

$y = \tan^{-1}\left(\frac{10}{12\sqrt{2}}\right) = 30.508...$

30.5 °

(3)

(b) Work out the length of *BE*.
Give your answer correct to one decimal place.

$BX = \sqrt{15^2 - 12^2}$
$= 9$

so $BG = 19$

$BE = \sqrt{12^2 + 12^2 + 19^2}$
$= 25.47...$

25.5 cm

(3)

(Total for Question 17 is 6 marks)

18 The diagram shows cuboid *ABCDEFGH*.

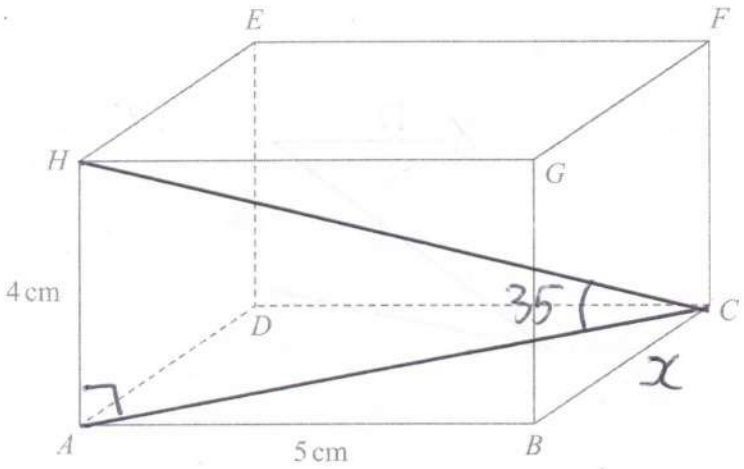
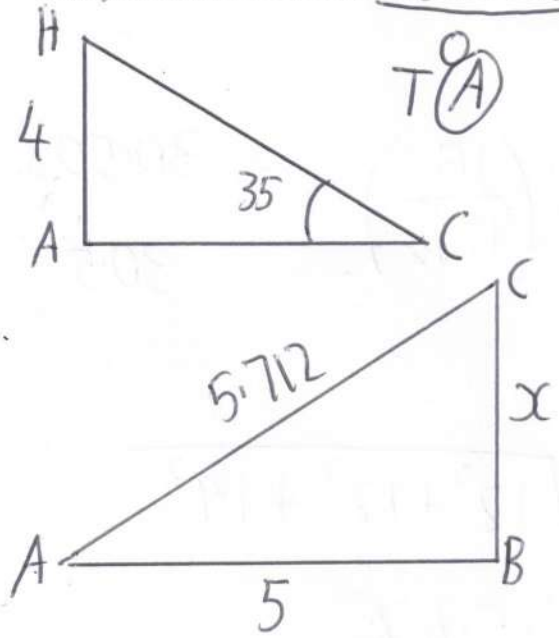


Diagram **NOT** accurately drawn

AB = 5 cm
AH = 4 cm
The size of the angle between *CH* and the plane *ABCD* is 35°

Calculate the volume of the cuboid. → need x
Give your answer correct to 3 significant figures.



TOA

$$AC = \frac{4}{\tan 35} = 5.712...$$

$$CB = \sqrt{5.712^2 - 5^2}$$
$$= 2.7629...$$

$$\text{Vol} = 4 \times 5 \times 2.7629 = 55.25...$$
$$= 55.3$$

..... cm^3

(Total for Question 18 is 5 marks)

17 The diagram shows a solid prism *ABCDEFGH*.

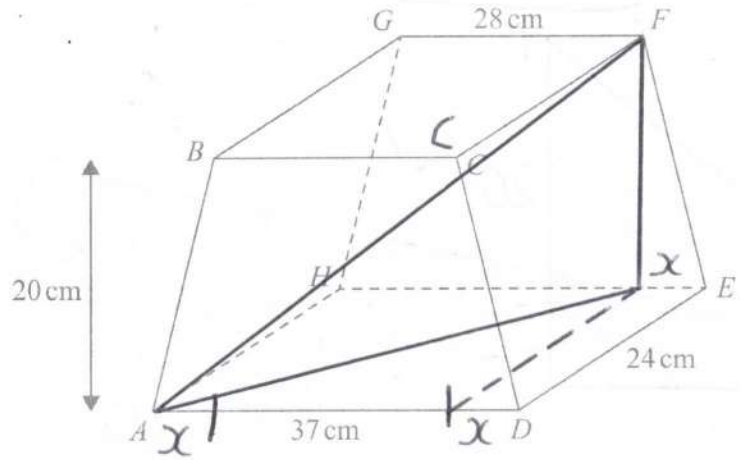


Diagram **NOT** accurately drawn

The trapezium *ABCD*, in which *AD* is parallel to *BC*, is a cross section of the prism.
The base *ADEH* of the prism is a horizontal plane.
ADEH and *BCFG* are rectangles.
The midpoint of *BC* is vertically above the midpoint of *AD* so that *BA* = *CD*.

AD = 37 cm *GF* = 28 cm *DE* = 24 cm

The perpendicular distance between edges *AD* and *BC* is 20 cm.

(a) Work out the total surface area of the prism.

$x = \frac{37-28}{2} = 4.5$

$CD = \sqrt{20^2 + 4.5^2}$

$= 20.5$

Base Front + Back

$SA = (37 \times 24) + \left(2 \times \left(\frac{37+28}{2}\right) 20\right)$

$+ 2(20.5 \times 24) + (28 \times 24)$

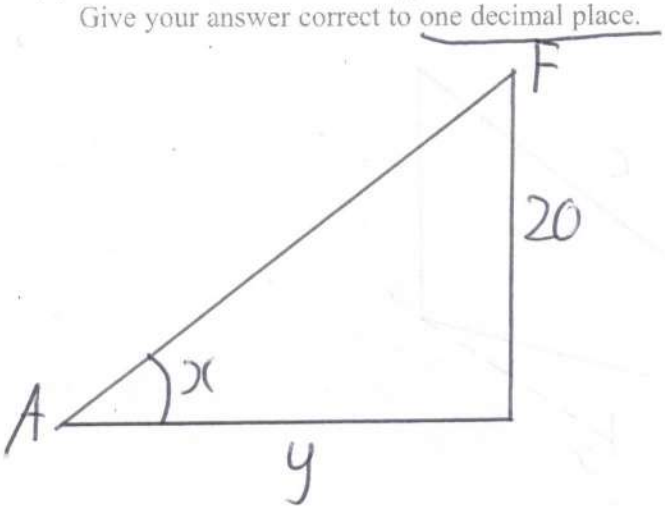
Sides Top

3844

..... cm²

(4)

(b) Calculate the size of the angle between AF and the plane $ADEH$.
Give your answer correct to one decimal place.



$$y = \sqrt{24^2 + (37 - 4.5)^2}$$

$$= 40.401...$$

T O A

$$x = \tan^{-1}\left(\frac{20}{40.401}\right)$$

$$= 26.337...$$

26.3°

(3)

(Total for Question 17 is 7 marks)

22 *ABC* is an isosceles triangle in a horizontal plane.
The point *T* is vertically above *B*.

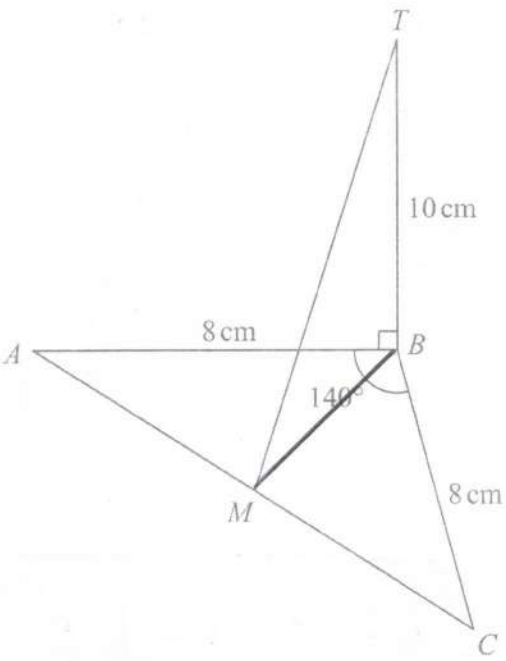
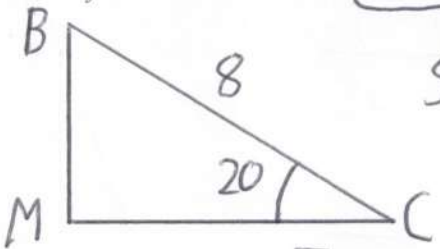


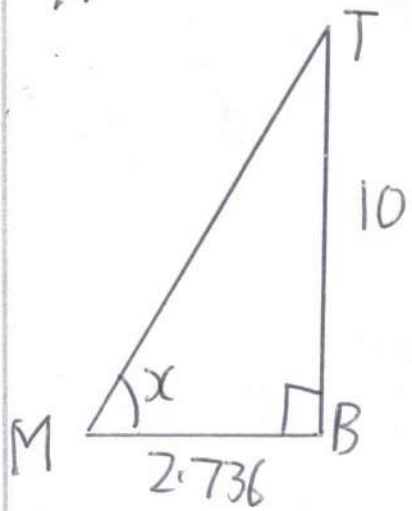
Diagram **NOT** accurately drawn

Angle $ABC = 140°$
$AB = BC = 8$ cm
$TB = 10$ cm
M is the midpoint of *AC*.

Calculate the size of the angle between *MT* and the horizontal plane *ABC*.
Give your answer correct to one decimal place.



SOH $BM = 8\sin 20$
$= 2.736...$



TOA $x = \tan^{-1}\left(\frac{10}{2.7}\right)$

$= 74.69...$ $= 74.7°$

4marks