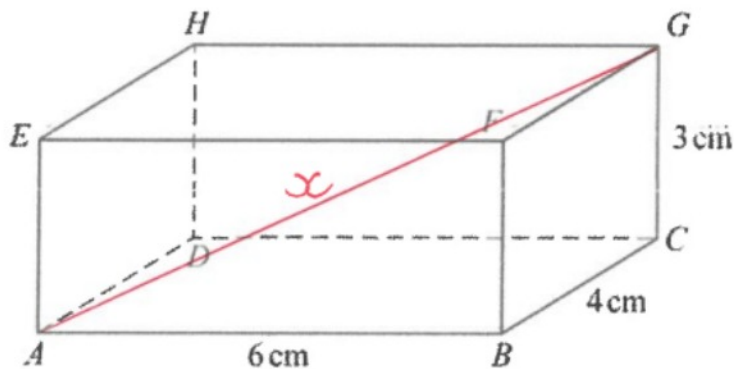


11



NOT TO
SCALE

$ABCDEFGH$ is a cuboid.

Find the length of AG .

Give your answer in surd form.

$$x^2 = 6^2 + 4^2 + 3^2$$

$$x = \sqrt{6^2 + 4^2 + 3^2}$$

$$= \sqrt{36 + 16 + 9}$$

$$= \sqrt{61}$$

$$\sqrt{61} \text{ cm [3]}$$

24 A cuboid measures 24 cm by 12 cm by 8 cm.

Calculate the length of a diagonal of the cuboid.

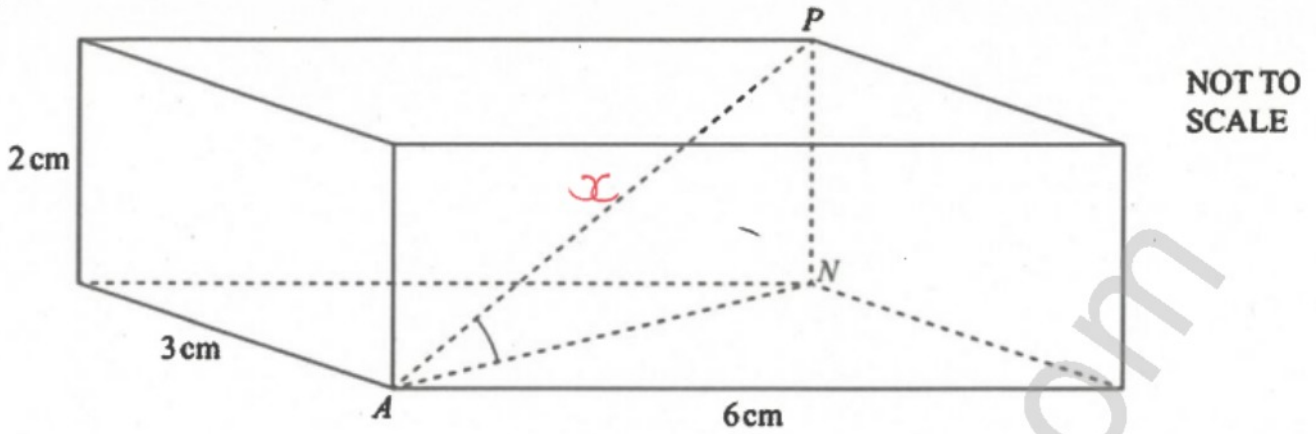
$$x^2 = 24^2 + 12^2 + 8^2$$

$$x = \sqrt{24^2 + 12^2 + 8^2}$$

$$= \sqrt{784}$$

$$= 28$$

$$28 \text{ cm [3]}$$



The diagram shows a cuboid measuring 6 cm by 3 cm by 2 cm.

Find the sine of the angle PAN , the angle between the diagonal PA and the base of the cuboid.

Use 3D Pythag to find side AP :

$$x^2 = 6^2 + 3^2 + 2^2$$

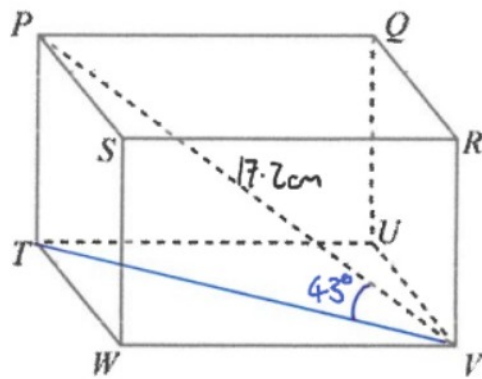
$$x^2 = 49$$

$$x = 7 \text{ cm}$$



$$\sin y = \frac{2}{7}$$

Sine of angle PAN = $\frac{2}{7}$ [4]



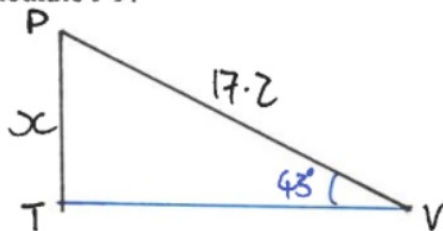
NOT TO
SCALE

The diagram shows a cuboid $PQRSTUW$.

$PV = 17.2$ cm

The angle between the line PV and the base $TUVW$ of the cuboid is 43° .

Calculate PT .

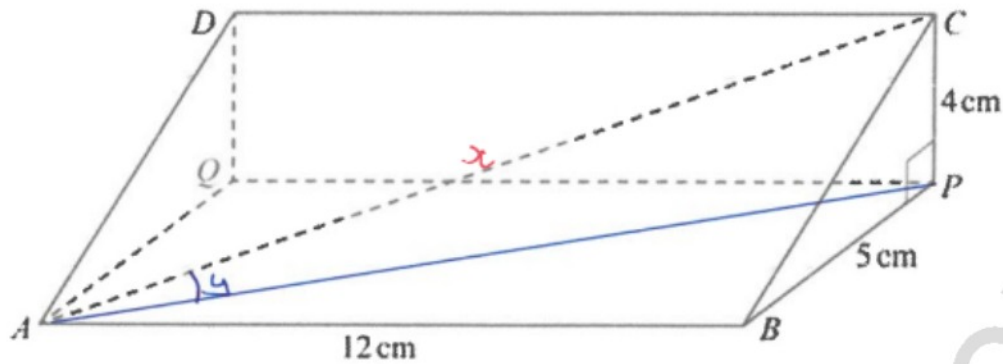


$$\sin 43 = \frac{x}{17.2}$$

$$17.2 \sin 43 = x$$

$$11.7 = x$$

$$PT = 11.7 \text{ cm [3]}$$



NOT TO SCALE

The diagram shows a triangular prism.
Angle $BPC = 90^\circ$.

(a) Calculate AC .

$$x^2 = 12^2 + 5^2 + 4^2$$

$$x^2 = 144 + 25 + 16$$

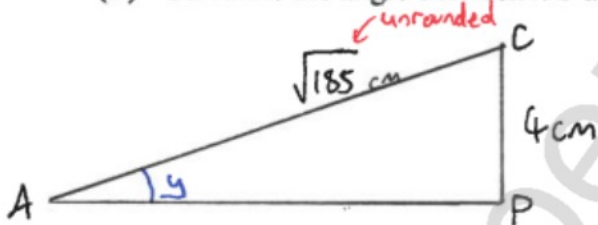
$$x = \sqrt{185}$$

or:

$$13.6 \text{ cm}$$

$$AC = 13.6 \text{ cm [3]}$$

(b) Calculate the angle between AC and the base $ABPQ$.

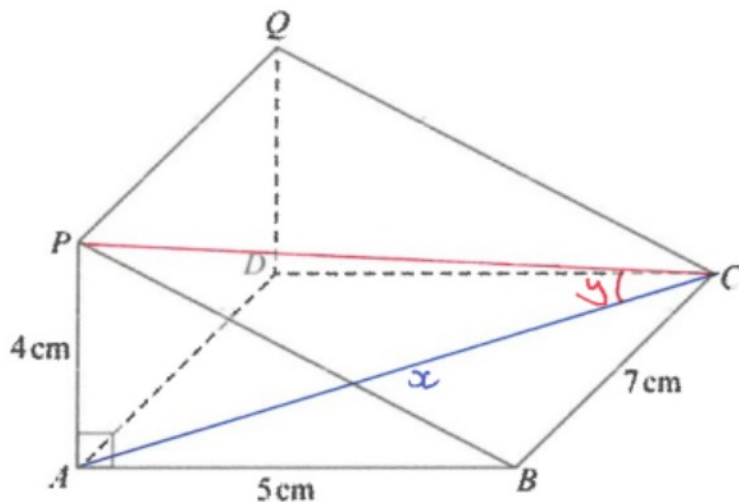


$$\sin y = \frac{4}{\sqrt{185}}$$

$$y = \sin^{-1}\left(\frac{4}{\sqrt{185}}\right)$$

$$= 17.1^\circ$$

$$17.1^\circ \text{ [3]}$$

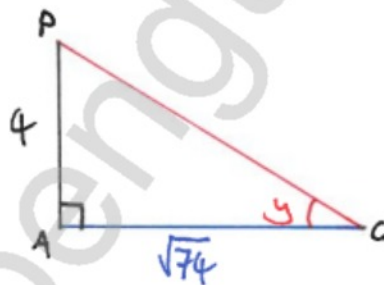
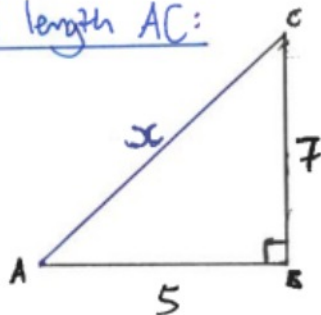


NOT TO
SCALE

The diagram shows a triangular prism $ABCDQP$ of length 7 cm.
The cross-section is triangle PAB with $PA = 4$ cm, $AB = 5$ cm and angle $PAB = 90^\circ$.

Calculate the angle between the line PC and the base $ABCD$.

Find length AC :



$$\tan y = \frac{4}{\sqrt{74}}$$

$$y = \tan^{-1} \left(\frac{4}{\sqrt{74}} \right)$$

$$= 24.9^\circ$$

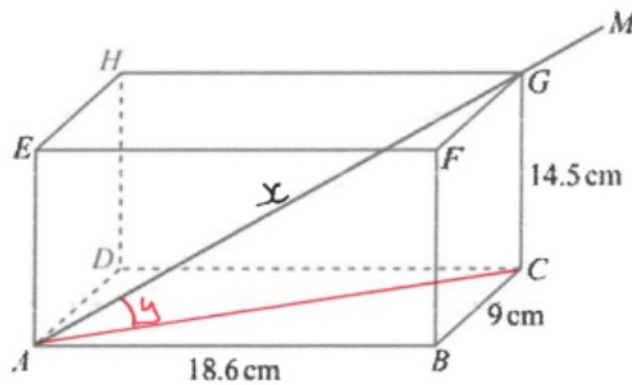
$$x^2 = 5^2 + 7^2$$

$$x^2 = 74$$

$$x = \sqrt{74}$$

$$24.9^\circ$$

[4]



NOT TO SCALE

The diagram shows an open rectangular box $ABCDEFGH$.

$AB = 18.6$ cm, $BC = 9$ cm and $CG = 14.5$ cm.

A straight stick AGM rests against A and G and extends outside the box to M .

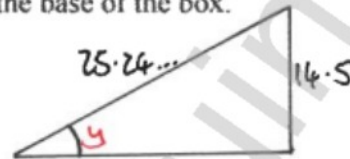
(a) Calculate the angle between the stick and the base of the box.

Find length AG:

$$x^2 = 18.6^2 + 9^2 + 14.5^2$$

$$x = \sqrt{18.6^2 + 9^2 + 14.5^2}$$

$$x = \underline{25.24...} \text{ STO}$$



$$\sin y = \frac{14.5}{25.24...}$$

$$y = \sin^{-1}\left(\frac{14.5}{25.24...}\right)$$

$$= \underline{35.1^\circ}$$

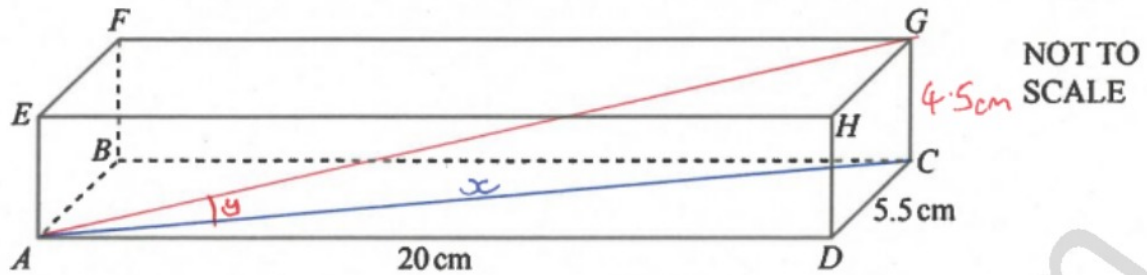
$$\underline{\underline{35.1^\circ}} \quad [4]$$

(b) $AM = 30$ cm.

Show that $GM = 4.8$ cm, correct to 1 decimal place.

$$\begin{aligned} GM &= AM - AG \\ &= 30 - 25.2430... \\ &= 4.7569 \\ &= \underline{4.8 \text{ to 1dp}} \end{aligned}$$

[3]



The diagram shows cuboid $ABCDEFGH$ of length 20 cm and width 5.5 cm. The volume of the cuboid is 495 cm^3 .

Find the angle between the line AG and the base of the cuboid $ABCD$.

Find height:

$$20 \times 5.5 \times h = 495$$

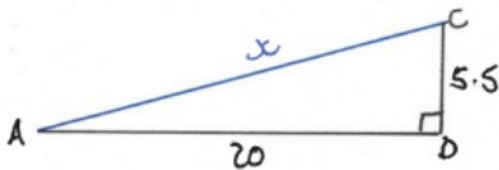
$$110 \times h = 495$$

$\div 110$

$\div 110$

$$h = 4.5 \text{ cm}$$

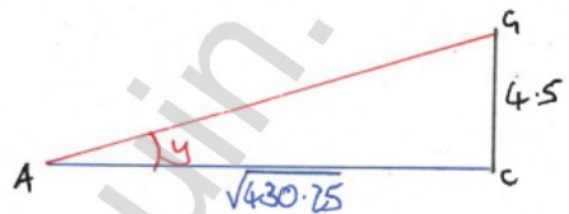
Find AC:



$$x^2 = 20^2 + 5.5^2$$

$$x^2 = 430.25$$

$$x = \sqrt{430.25}$$

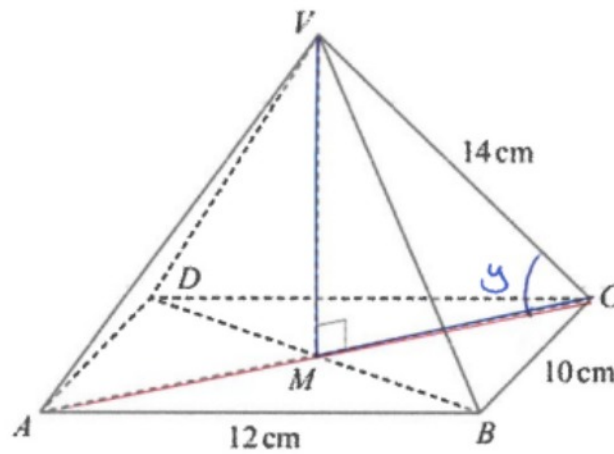


$$\tan y = \frac{4.5}{\sqrt{430.25}}$$

$$y = \tan^{-1}\left(\frac{4.5}{\sqrt{430.25}}\right)$$

$$= 12.2^\circ$$

$$\dots\dots\dots 12.2^\circ \dots\dots\dots [5]$$

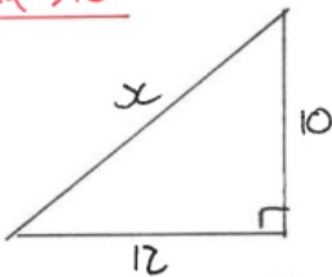


NOT TO
SCALE

The diagram shows a pyramid $VABCD$ with a rectangular base. V is vertically above M , the intersection of the diagonals AC and BD . $AB = 12$ cm, $BC = 10$ cm and $VC = 14$ cm.

Calculate the angle that VC makes with the base $ABCD$.

Find AC:



$$x^2 = 10^2 + 12^2$$

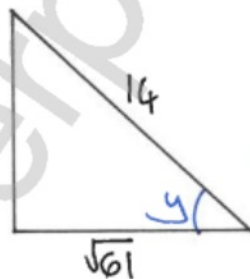
$$x = \sqrt{244}$$

$$= \underline{2\sqrt{61}}$$

$$MC = \frac{1}{2} AC$$

$$= \frac{1}{2} \times 2\sqrt{61}$$

$$= \underline{\sqrt{61}}$$



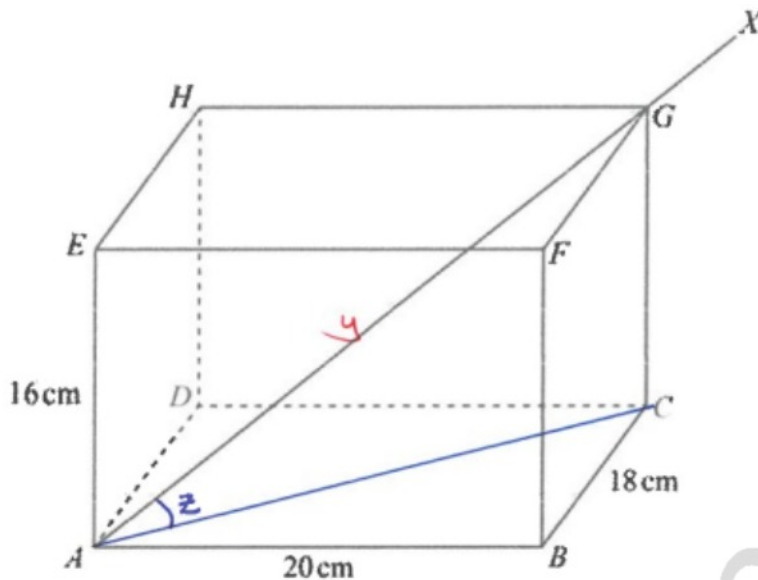
$$\cos y = \frac{\sqrt{61}}{14}$$

$$y = \cos^{-1}\left(\frac{\sqrt{61}}{14}\right)$$

$$= \underline{56.1^\circ}$$

..... 56.1° [4]

(b)



The diagram shows an open box $ABCDEFGH$ in the shape of a cuboid.
 $AB = 20$ cm, $BC = 18$ cm and $AE = 16$ cm.
A thin rod AGX rests partly in the box as shown.
The rod is 40 cm long.

(i) Calculate GX , the length of the rod which is outside the box.

Find length AG:

$$y^2 = 20^2 + 18^2 + 16^2$$

$$y = \sqrt{20^2 + 18^2 + 16^2}$$

$$= 14\sqrt{5}$$

$$GX = AX - AG$$

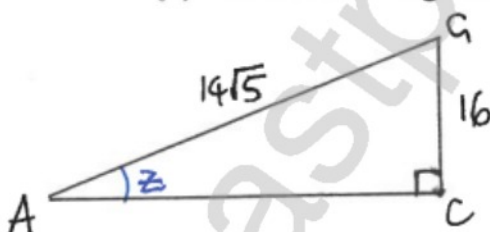
$$= 40 - 14\sqrt{5}$$

$$= 8.695\dots$$

$$= 8.70 \text{ (3sf)}$$

$$GX = 8.70 \text{ cm [4]}$$

(ii) Calculate the angle the rod makes with the base of the box.

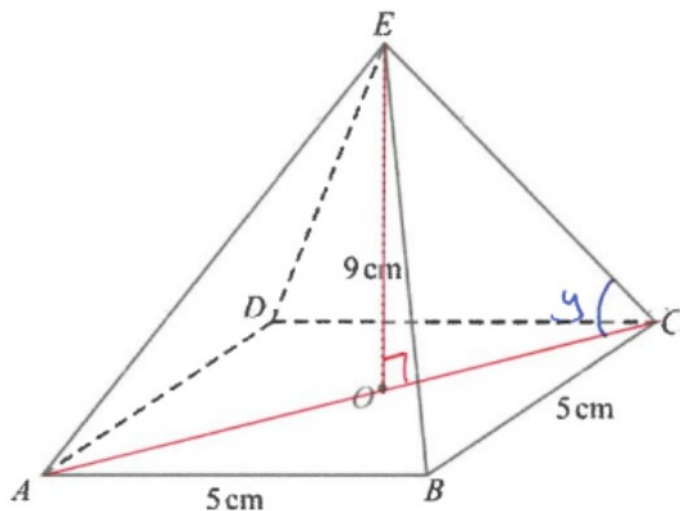


$$\sin z = \frac{16}{14\sqrt{5}}$$

$$z = \sin^{-1}\left(\frac{16}{14\sqrt{5}}\right)$$

$$= 30.7^\circ$$

$$30.7^\circ \text{ [3]}$$

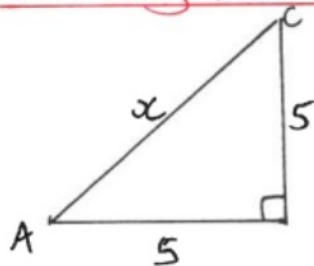


NOT TO
SCALE

The diagram shows a pyramid $ABCDE$.
The pyramid has a square horizontal base $ABCD$ with side 5 cm.
The vertex E is vertically above the centre O of the base.
The height OE of the pyramid is 9 cm.

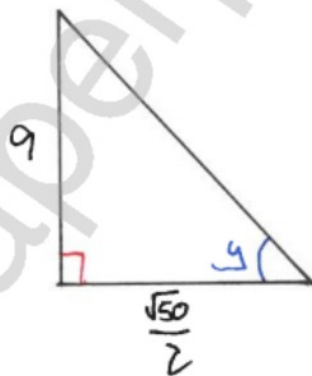
Calculate the angle that EC makes with the base $ABCD$.

Find length AC :



$$\begin{aligned} x^2 &= 5^2 + 5^2 \\ x &= \sqrt{25 + 25} \\ &= \sqrt{50} \end{aligned}$$

$$\begin{aligned} OC &= \frac{1}{2} AC \\ &= \frac{\sqrt{50}}{2} \end{aligned}$$

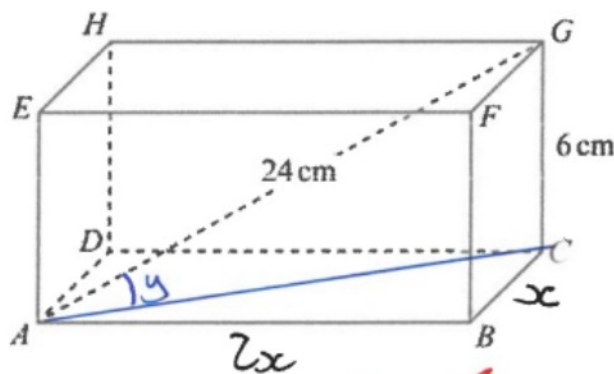


$$\tan y = \frac{9}{\frac{\sqrt{50}}{2}}$$

$$\begin{aligned} y &= \tan^{-1} \left(\frac{9}{\frac{\sqrt{50}}{2}} \right) \\ &= \underline{68.6^\circ} \end{aligned}$$

68.6°

[4]



NOT TO
SCALE

The diagram shows a cuboid $ABCDEFGH$.
 $CG = 6$ cm, $AG = 24$ cm and $AB = 2BC$.

(a) Calculate AB .

3D Pythagoras:

$$x^2 + (2x)^2 + 6^2 = 24^2$$

$$x^2 + 4x^2 + 36 = 576$$

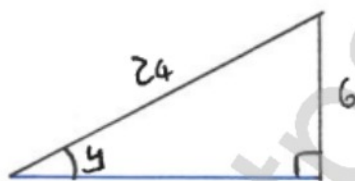
$$5x^2 = 540$$

$$x^2 = 108$$

$$x = \sqrt{108}$$

$$= 6\sqrt{3} \text{ or } 10.4 \text{ (3sf)} \quad AB = \dots\dots\dots 10.4 \dots\dots\dots \text{ cm [4]}$$

(b) Calculate the angle between AG and the base $ABCD$.



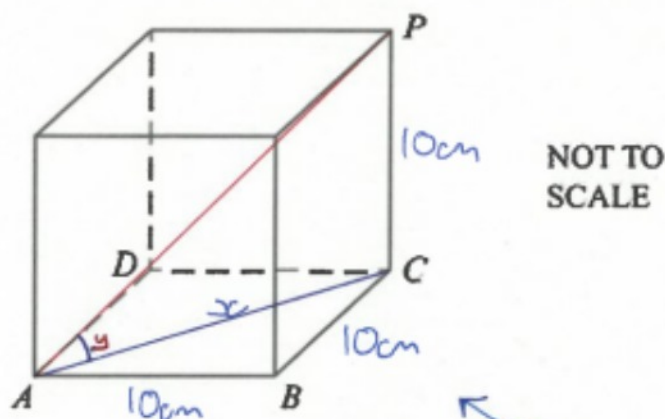
$$\sin y = \frac{6}{24}$$

$$y = \sin^{-1}\left(\frac{6}{24}\right)$$

$$= 14.5^\circ$$

$$14.5^\circ$$

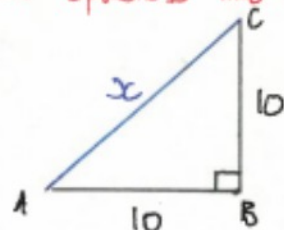
[3]



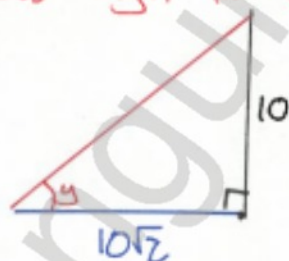
The diagram shows a cube.

Calculate the angle between the diagonal AP and the base $ABCD$.

In questions like this, you can use any side length for the cube, e.g. 10:



$$\begin{aligned}x^2 &= 10^2 + 10^2 \\x^2 &= 200 \\x &= 10\sqrt{2}\end{aligned}$$



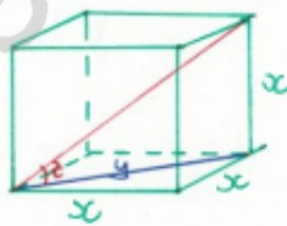
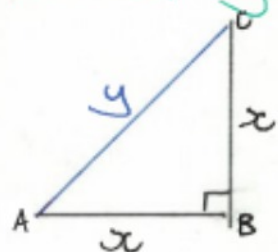
$$\tan y = \frac{10}{10\sqrt{2}}$$

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

$$= 35.3^\circ$$

$$35.3^\circ \quad [4]$$

Alternative, algebraic method:



$$y^2 = x^2 + x^2$$

$$y^2 = 2x^2$$

$$\begin{aligned}y &= \sqrt{2x^2} \\&= x\sqrt{2}\end{aligned}$$



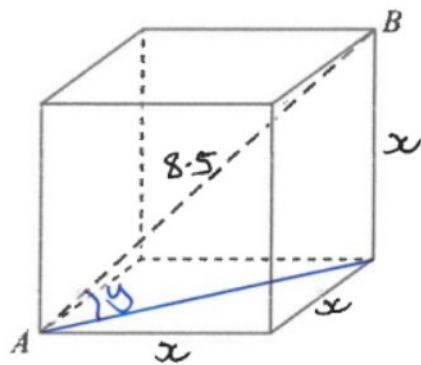
$$\tan z = \frac{x}{x\sqrt{2}}$$

$$\tan z = \frac{1}{\sqrt{2}}$$

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

$$= 35.3^\circ$$

(b)



NOT TO
SCALE

The diagram shows a cube.
The length of the diagonal AB is 8.5 cm.

(i) Calculate the length of an edge of the cube.

3D Pythagoras:

$$x^2 + x^2 + x^2 = 8.5^2$$

$$3x^2 = 72.25$$

$$\div 3 \quad \div 3$$

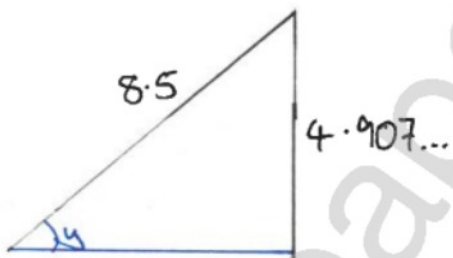
$$x^2 = \frac{72.25}{3}$$

$$x = 4.91 \text{ cm (3sf)}$$

Store unrounded answer

$$4.91 \text{ cm [3]}$$

(ii) Calculate the angle between AB and the base of the cube.



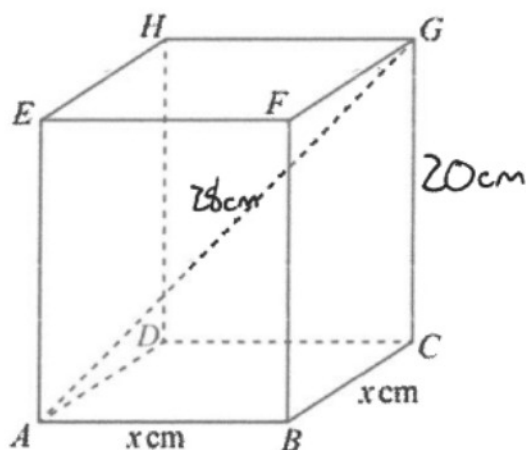
$$\sin y = \frac{4.907...}{8.5}$$

$$y = \sin^{-1} \left(\frac{4.907...}{8.5} \right)$$

$$= 35.3^\circ$$

$$35.3^\circ \text{ [3]}$$

10 (a)



NOT TO
SCALE

$ABCDEFGH$ is a cuboid with a square base of side x cm.
 $CG = 20$ cm and $AG = 28$ cm.

Calculate the value of x .

3D Pythagoras:

$$x^2 + x^2 + 20^2 = 28^2$$

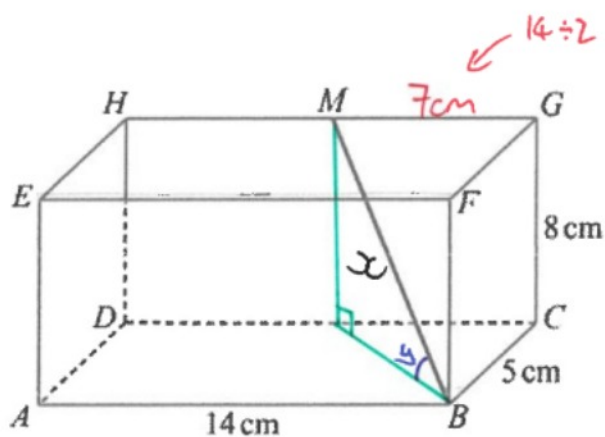
$$2x^2 + 400 = 784$$

$$2x^2 = 384$$

$$x^2 = 192$$

$$x = \sqrt{192} \text{ or } 13.9 \text{ cm}$$

$$x = \underline{\quad 13.9 \text{ cm} \quad} [4]$$

NOT TO
SCALE

The diagram shows a cuboid $ABCDEFGH$.
 $AB = 14$ cm, $BC = 5$ cm and $CG = 8$ cm.
 M is the midpoint of HG .

(a) Calculate BM .

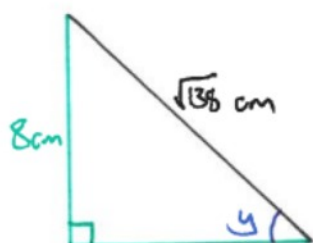
$$x^2 = 5^2 + 8^2 + 7^2$$

$$x^2 = 138$$

$$x = \sqrt{138} \text{ or } 11.7 \text{ cm}$$

..... 11.7 cm [3]

(b) Calculate the angle that BM makes with the base $ABCD$.



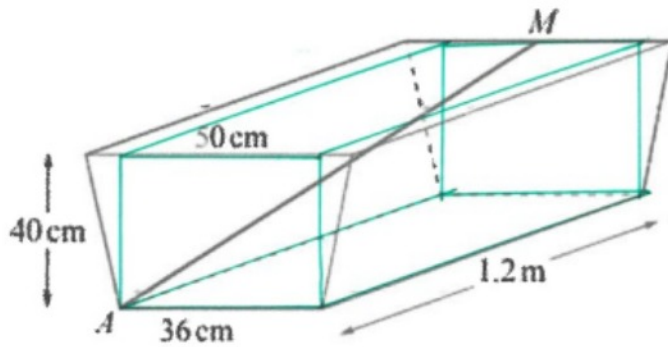
$$\sin y = \frac{8}{\sqrt{138}}$$

$$y = \sin^{-1}\left(\frac{8}{\sqrt{138}}\right)$$

$$= 42.9^\circ$$

..... 42.9° [3]

(d)

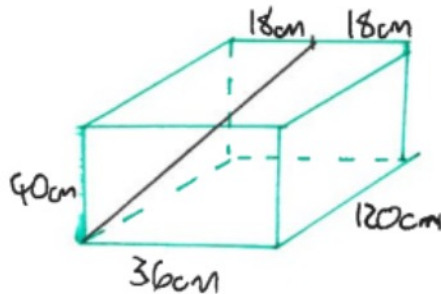


NOT TO
SCALE

A steel rod AM is placed inside the empty water trough as shown in the diagram.
 A is a vertex at the base of the isosceles trapezium and M is the midpoint of the top edge on the opposite face.

Calculate the length of the steel rod, AM .

Imagine chopping off the "extra" bits from the trapezium to leave a cuboid:

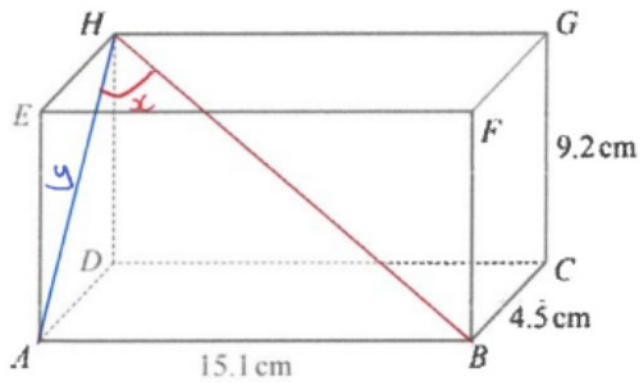


$$3D \text{ Pythag: } x^2 = 18^2 + 40^2 + 120^2$$

$$x = \sqrt{18^2 + 40^2 + 120^2}$$

$$= \underline{128 \text{ cm}} \quad (3 \text{ sf})$$

$$AM = \underline{128} \text{ cm [4]}$$

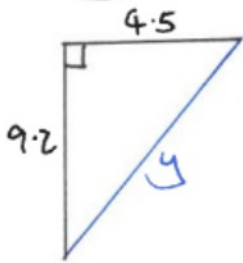


NOT TO
SCALE

The diagram shows a cuboid $ABCDEFGH$.
 $AB = 15.1$ cm, $BC = 4.5$ cm and $CG = 9.2$ cm.

Calculate the angle that the diagonal BH makes with the face $ADHE$. ← angle x on diagram.

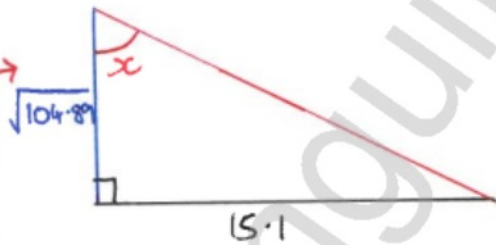
Find length AH :



$$y^2 = 4.5^2 + 9.2^2$$

$$y^2 = 104.89$$

$$y = \sqrt{104.89}$$



$$\tan x = \frac{15.1}{\sqrt{104.89}}$$

$$x = \tan^{-1}\left(\frac{15.1}{\sqrt{104.89}}\right)$$

$$= \underline{\underline{55.9^\circ}} \quad [4]$$