Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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3-D Pythagoras and trigonometry

Time allowed: 1 hour 5 minutes

Subject code **0580**

Mathematics

Questions from Paper 2 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
You may use a calculator.

Total marks

/ 51

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 51 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

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

Calculate the length of a diagonal of the cuboid.

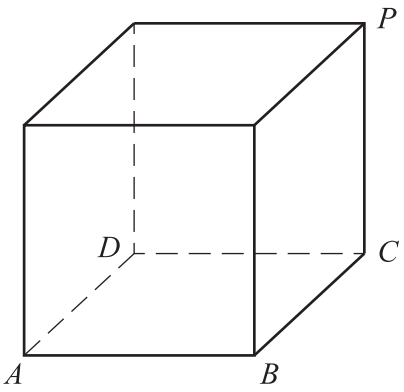
..... cm [3]

3D Pythagoras and trigonometry Click for more variations

1	28	**3**	**M2** for $24^2 + 12^2 + 8^2$ or **M1** for $24^2 + 12^2$ or $24^2 + 8^2$ or $12^2 + 8^2$

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2



NOT TO SCALE

The diagram shows a cube.

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

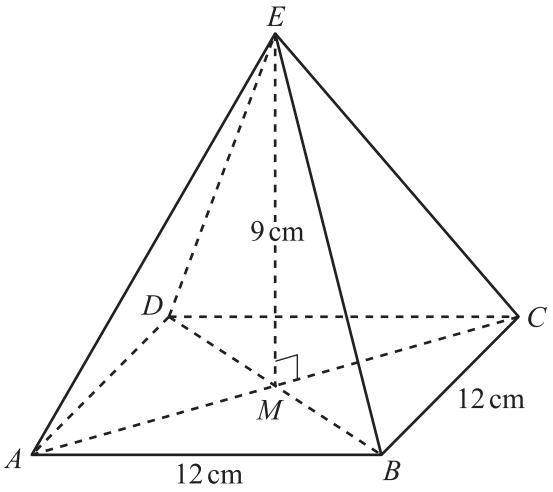
..... [4]

3D Pythagoras and trigonometry Click for more variations

2	35.3 or 35.26…	**4**	**M3** for correct numerical trig statement for angle PAC e.g. $\tan = \frac{l}{\sqrt{l^2+l^2}}$ or $\frac{1}{\sqrt{2}}$ oe or $\sin = \frac{l}{\sqrt{l^2+l^2+l^2}}$ or $\frac{1}{\sqrt{3}}$ oe or $\cos = \frac{\sqrt{l^2+l^2}}{\sqrt{l^2+l^2+l^2}}$ or $\frac{\sqrt{2}}{\sqrt{3}}$ oe where l is a value or **M2** for a correct Pythagoras statement soi or correct trig statement for diagonal of a face with angle 45 used soi e.g. For side length k, AC shown as $k\sqrt{2}$ or **M1** for recognition of angle PAC

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3



NOT TO SCALE

The diagram shows a square-based pyramid $ABCDE$.
The diagonals of the square meet at M.
E is vertically above M.
$AB = BC = 12$ cm and $EM = 9$ cm.

Calculate the angle between the edge EC and the base, $ABCD$, of the pyramid.

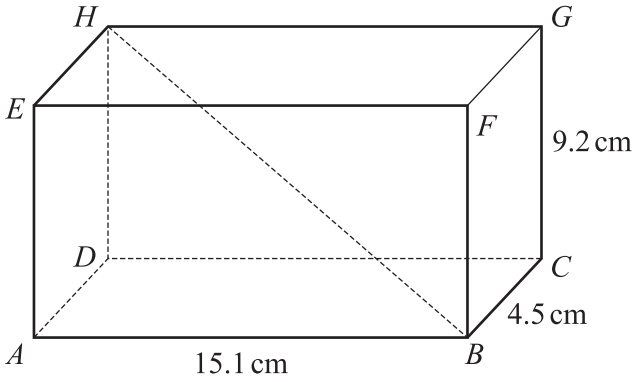
..... [4]

3D Pythagoras and trigonometry Click for more variations

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3	46.7 or 46.68 to 46.69	**4**	**M3** for tan […=] $\frac{9}{\frac{1}{2}\sqrt{12^2+12^2}}$ oe or **M1** for $\left[\frac{1}{2}\times\right]\sqrt{12^2+12^2}$ oe e.g. $\sqrt{\frac{12^2}{2}}$ and **M1** for identifying angle *MCE*

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 $ADHE$.

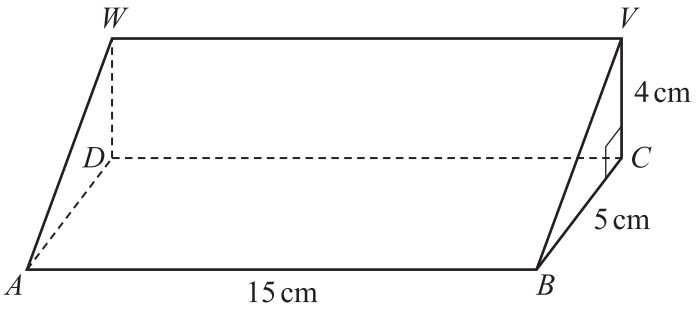
..... [4]

3D Pythagoras and trigonometry Click for more variations

4	55.9 or 55.85…	**4**	**M3** for $\tan[\ldots] = \dfrac{15.1}{\sqrt{4.5^2 + 9.2^2}}$ oe or **M2** for $[AH^2 =] 4.5^2 + 9.2^2$ or $[BH^2 =] 4.5^2 + 9.2^2 + 15.1^2$ or **M1** for recognising angle BHA if 0 scored **SC1** for [angle BHD =] 59.7[1…] or 59.72

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5



NOT TO SCALE

The diagram shows a triangular prism with cross-section triangle BCV.
Angle $BCV = 90°$, $BC = 5\,\text{cm}$, $CV = 4\,\text{cm}$ and $AB = 15\,\text{cm}$.

Calculate the angle between AV and the base $ABCD$.

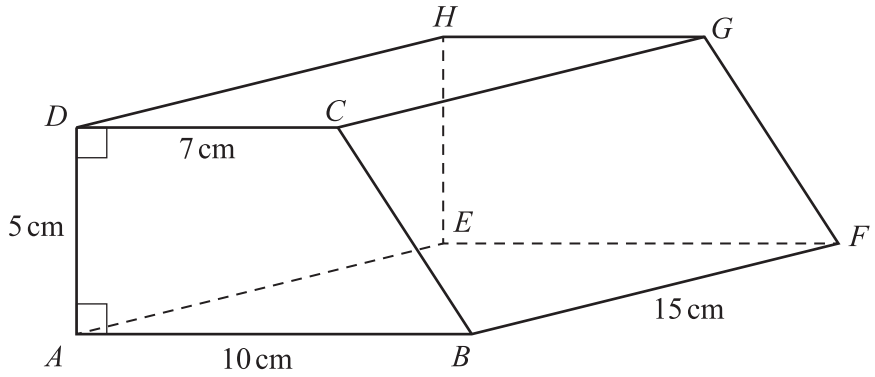
..... [4]

3D Pythagoras and trigonometry Click for more variations

5	14.2 or 14.19 to 14.20	**4**	**M3** for $\tan = \frac{4}{\sqrt{15^2 + 5^2}}$ oe or **M2** for $15^2 + 5^2$ or $15^2 + 5^2 + 4^2$ or **M1** for recognition of angle VAC

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6



NOT TO SCALE

The diagram shows a prism of length 15 cm.
The cross-section of the prism is a trapezium.

Angle $DAB = 90°$ and angle $ADC = 90°$.
$AB = 10$ cm, $AD = 5$ cm and $DC = 7$ cm.

Calculate the angle the diagonal AG makes with the base $ABFE$.

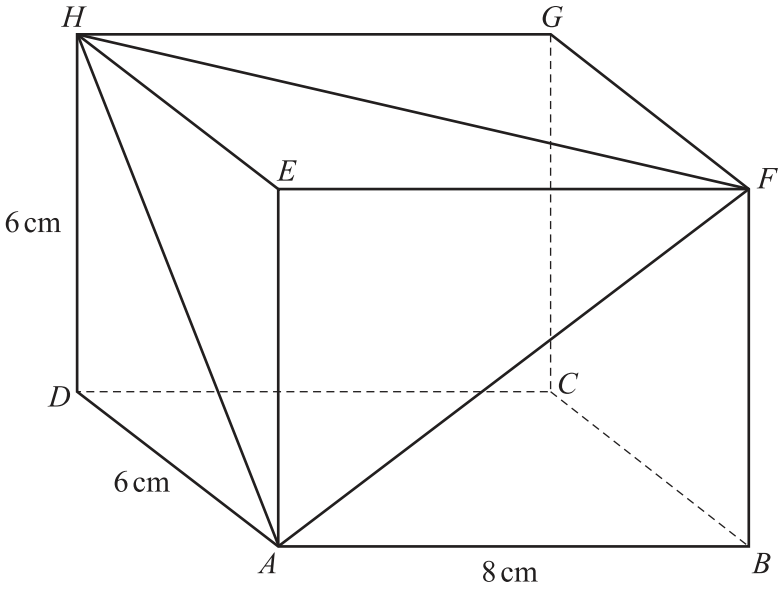
..... [4]

3D Pythagoras and trigonometry Click for more variations

6	16.8 or 16.80 to 16.81	**4**	**M3** for $\tan = \frac{5}{\sqrt{15^2 + 7^2}}$ oe or $\sin = \frac{5}{\sqrt{15^2 + 7^2 + 5^2}}$ oe or $\cos = \frac{\sqrt{15^2 + 7^2}}{\sqrt{15^2 + 7^2 + 5^2}}$ oe or **M2** for $15^2 + 7^2$ or $15^2 + 7^2 + 5^2$ or **M1** for indication of correct angle

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7



NOT TO SCALE

The diagram shows a cuboid.
$AB = 8\,\text{cm}$, $AD = 6\,\text{cm}$ and $DH = 6\,\text{cm}$.

Calculate angle HAF.

Angle HAF = ... [6]

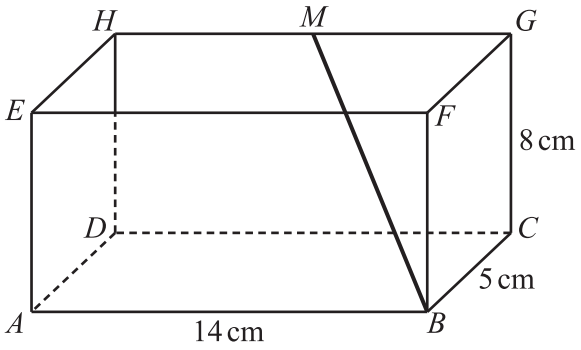
3D Pythagoras and trigonometry Click for more variations

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7	64.9 or 64.89 to 64.90	**6**	**B5** for [cos =] $\frac{100+72-100}{2\times10\times\sqrt{72}}$ OR **M1** for $8^2 + 6^2$ **M1** for $6^2 + 6^2$ **M2** for $\frac{(theirAF)^2+(theirAH)^2-(theirHF)^2}{2\times(theirAF)\times(theirAH)}$ or **M1** for $(theirHF)^2 = (theirAF)^2 + (their\ AH)^2 - 2\times(theirAF)\times(their\ AH)\cos(HAF)$ *AF*, *AH* etc from correct method

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8



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.

..... cm [3]

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

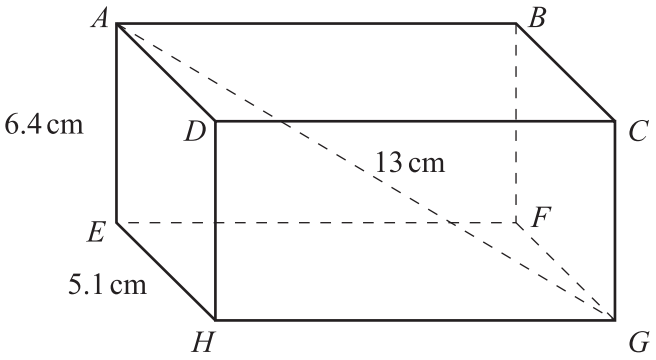
..... [3]

(a) 3D Pythagoras and trigonometry (b) 3D Pythagoras and trigonometry Click for more variations

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8(a)	11.7 or 11.74 to 11.75	**3**	**M2** for $\left(\frac{14}{2}\right)^2 + 5^2 + 8^2$ oe or **M1** for $\left(\frac{14}{2}\right)^2 + 5^2$, $5^2 + 8^2$ or $\left(\frac{14}{2}\right)^2 + 8^2$
8(b)	42.9 to 43.14	**3**	**M2** for $\sin[\ldots] = \frac{8}{\textit{their}\ \textbf{(a)}}$ oe or **M1** for recognising angle MBX where X is the midpoint of DC

9



NOT TO SCALE

The diagram shows a cuboid $ABCDEFGH$.
$AE = 6.4$ cm, $EH = 5.1$ cm and $AG = 13$ cm.

(a) Calculate EF.

$EF =$ ..... cm [3]

(b) Calculate the angle between the line AG and the base $EFGH$ of the cuboid.

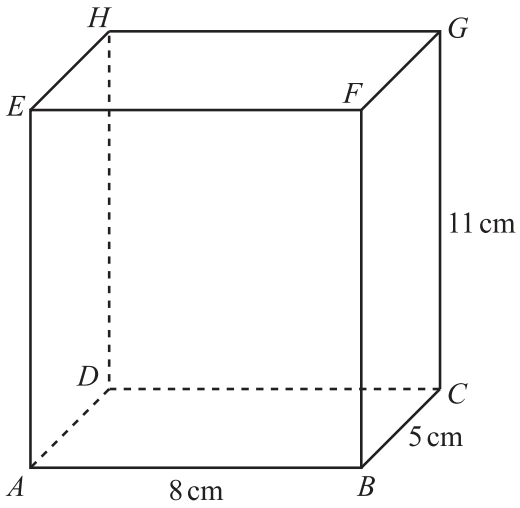
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..... [3]

(a) 3D Pythagoras and trigonometry (b) 3D Pythagoras and trigonometry Click for more variations

9(a)	10.1 or 10.10…	**3**	**M2** for $EF^2 + 6.4^2 + 5.1^2 = 13^2$ or better or **M1** for $6.4^2 + 5.1^2$ or $13^2 - 6.4^2$ or $13^2 - 5.1^2$
9(b)	29.5 or 29.49… to 29.54…	**3**	**M2** for $\sin[\ldots =] \frac{6.4}{13}$ oe or **M1** for identifying angle AGE

10



NOT TO SCALE

$ABCDEFGH$ is a cuboid.
$AB = 8$ cm, $BC = 5$ cm and $CG = 11$ cm.

(a) Work out the volume of the cuboid.

..... cm^3 [2]

(b) Ivana has a pencil of length 13 cm.

Does this pencil fit completely inside the cuboid?
Show how you decide.

[4]

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(c) **(i)** Calculate angle CAB.

Angle CAB = ... [2]

(ii) Calculate angle GAC.

Angle GAC = ... [2]

(a) Volume of cuboids (b) 3D Pythagoras and trigonometry (c)(i) SOHCAHTOA (c)(ii) 3D Pythagoras and trigonometry Click for more variations

10(a)	440	**2**	**M1** for $8 \times 5 \times 11$
10(b)	$\sqrt{8^2 + 5^2 + 11^2}$ oe or $8^2 + 5^2 + 11^2$ and 13^2 ALTERNATIVE $\sqrt{8^2 + 11^2}$ or $8^2 + 11^2$ and 13^2	**M3**	**M2** for $8^2 + 5^2 + 11^2$ or $8^2 + 11^2$ oe or **M1** for $8^2 + 5^2$ or $5^2 + 11^2$ oe
	Yes and 14.5 or 14.4 or 14.49… or Yes and 13.6[0…]	**A1**	Accept equivalent conclusion
10(c)(i)	32.0[…]	**2**	**M1** for tan[..] = $\frac{5}{8}$ oe
10(c)(ii)	49.4 or 49.38 to 49.39	**2**	**M1** for sin[..] = $\frac{11}{\textit{their } AG}$ oe

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