Section B | Contexts and Applications | 150 marks

Answer **all three** questions from this section.
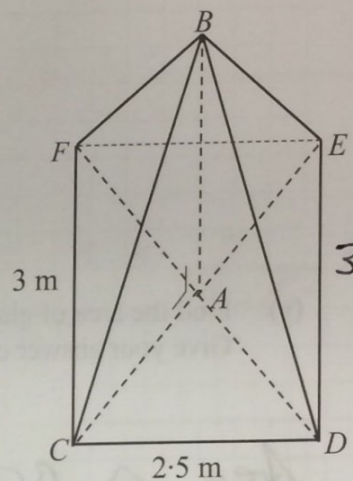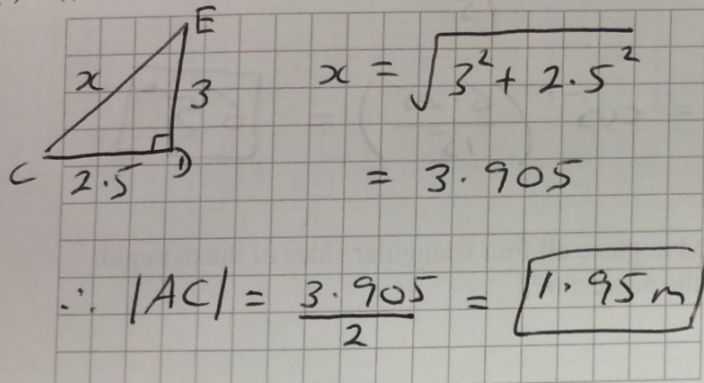
Question 1   Oct 16   **(55 marks)**
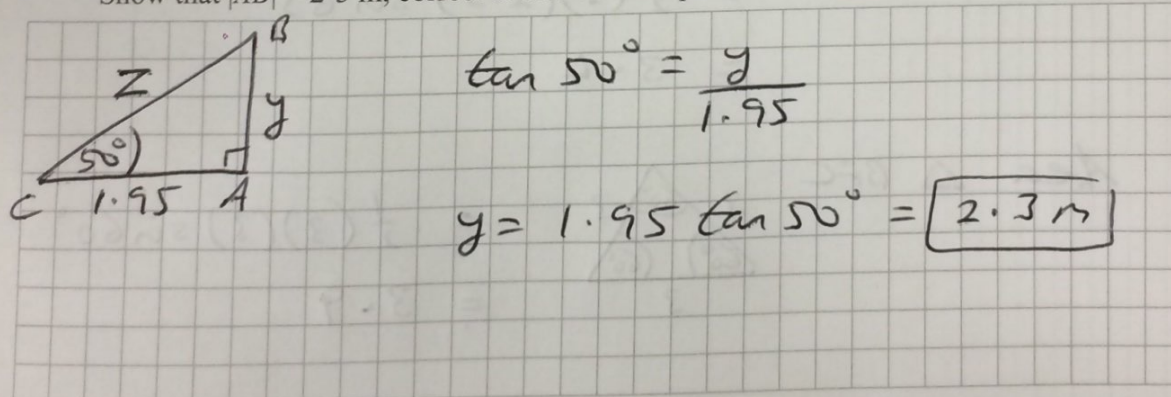
A glass Roof Lantern in the shape of a pyramid has a rectangular base *CDEF* and its apex is at *B* as shown. The vertical height of the pyramid is $|AB|$, where *A* is the point of intersection of the diagonals of the base as shown in the diagram.
Also $|CD| = 2 \cdot 5$ m and $|CF| = 3$ m.

(a) **(i)**   Show that $|AC| = 1 \cdot 95$ m, correct to two decimal places.

$$x = \sqrt{3^2 + 2 \cdot 5^2}$$
$$= 3 \cdot 905$$

$$\therefore |AC| = \frac{3 \cdot 905}{2} = \boxed{1 \cdot 95 \, m}$$

(diagram: right triangle with E top, C and D base, labels x, 3, 2·5)

(diagram: pyramid with apex B, base C D E F, A centre, 3 m, 2·5 m)

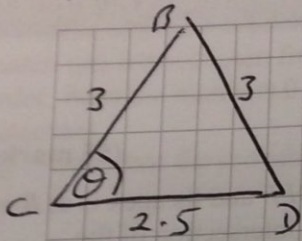**(ii)**   The angle of elevation of *B* from *C* is 50° (i.e. $|\angle BCA| = 50°$).
Show that $|AB| = 2 \cdot 3$ m, correct to one decimal place.

(diagram: right triangle C, A, B with z, y, 1·95, 50°)

$$\tan 50° = \frac{y}{1 \cdot 95}$$

$$y = 1 \cdot 95 \tan 50° = \boxed{2 \cdot 3 \, m}$$

(iii)   Find $|BC|$, correct to the nearest metre.

$$z = \sqrt{2 \cdot 3^2 + 1 \cdot 95^2} = \boxed{3 \, m}$$

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(iv) Find $|\angle BCD|$, correct to the nearest degree.

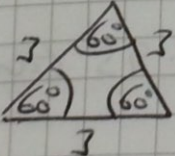$$3^2 = 3^2 + 2 \cdot 5^2 - 2(3)(2 \cdot 5)\cos\theta$$

$$\therefore 9 = 9 + 6 \cdot 25 - 15\cos\theta$$

$$\therefore 15\cos\theta = 6 \cdot 25$$

$$\therefore \cos\theta = \frac{6 \cdot 25}{15}$$

$$\theta = \cos^{-1}\left(\frac{6 \cdot 25}{15}\right) = \boxed{65^\circ}$$

(v) Find the area of glass required to glaze all four triangular sides of the pyramid. Give your answer correct to the nearest m².

$$\text{Area } \triangle BCD = \tfrac{1}{2}ab\sin C$$

$$= \tfrac{1}{2}(3)(2 \cdot 5)\sin 65^\circ$$

$$= 3 \cdot 4$$

Area $\triangle BFC$

$$= \tfrac{1}{2}(3)(3)\sin 60^\circ$$

$$= 3 \cdot 9$$

$$\therefore \text{Total area glass}$$

$$= 2(3 \cdot 4) + 2(3 \cdot 9)$$

$$= 14 \cdot 6$$

$$\approx \boxed{15 \text{ m}^2}$$
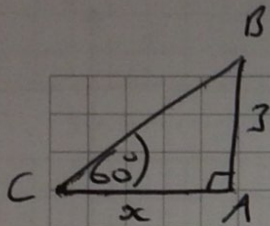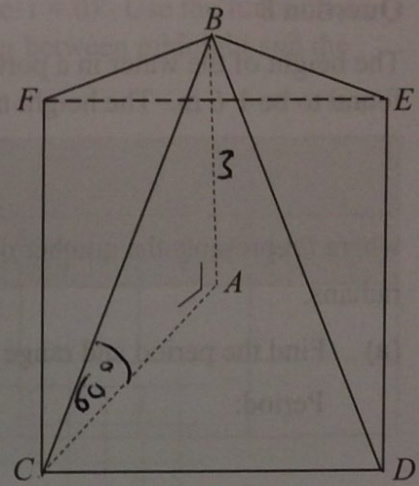
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(b) Another Roof Lantern, in the shape of a pyramid, has a square base *CDEF*. The vertical height $|AB| = 3$ m, where *A* is the point of intersection of the diagonals of the base as shown.
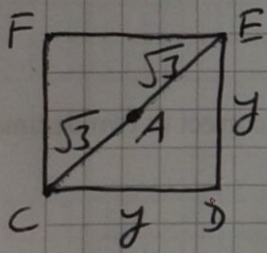
The angle of elevation of *B* from *C* is 60°
(i.e. $|\angle BCA| = 60°$).

Find the length of the side of the square base of the lantern.
Give your answer in the form $\sqrt{a}$ m, where $a \in \mathbb{N}$.

$$\tan 60° = \frac{3}{x} \qquad \therefore x = \frac{3}{\tan 60°} = \sqrt{3}$$

$$y^2 + y^2 = (2\sqrt{3})^2$$

$$2y^2 = 12$$

$$y^2 = 6$$

$$y = \boxed{\sqrt{6} \text{ m}}$$

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