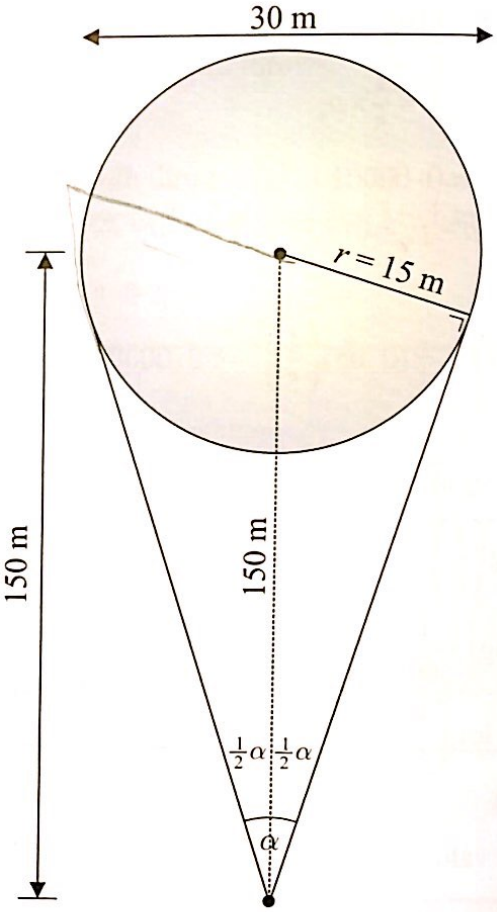
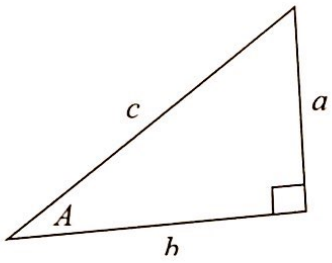
Question 9 (45 marks)

Question 9 (a)



Formulae and Tables Book
Trigonometry: Right-angled triangle [page 16]



$$\sin A = \frac{a}{c},\ \cos A = \frac{b}{c},\ \tan A = \frac{a}{b}$$

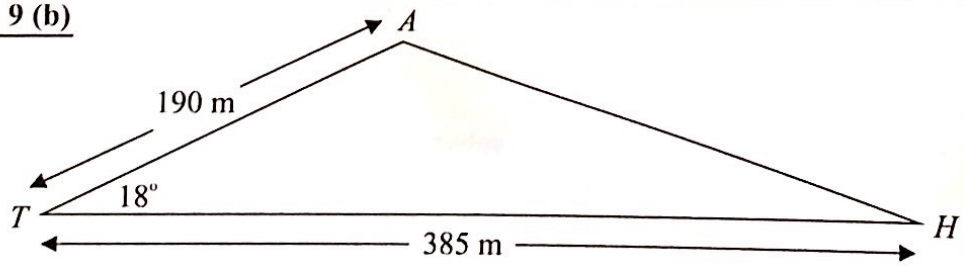
$$\sin\left(\frac{\alpha}{2}\right) = \frac{\text{Opposite}}{\text{Hypotenuse}} = \frac{15}{150}$$

$$\left(\frac{\alpha}{2}\right) = \sin^{-1}\left(\frac{1}{10}\right) = 5\cdot 74^\circ$$

$$\therefore \alpha = 2\times 5\cdot 74^\circ = 11\cdot 5^\circ$$

Marking Scheme Notes
Question 9 (a) [Scale 10C (0, 4, 8, 10)]
4: • Effort at expressing sine function in terms of 15 and 150
• Finds third side of triangle and makes effort to find an angle
8: • Half angle found

Question 9 (b)



$$|AH|^2 = 190^2 + 385^2 - 2(190)(385)\cos 18^\circ$$

$$\therefore |AH| = \sqrt{190^2 + 385^2 - 2(190)(385)\cos 18^\circ} \approx 213 \text{ m}$$

Formulae and Tables Book
Trigonometry of the triangle: Cosine rule [page 16]

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Marking Scheme Notes
Question 9 (b) [Scale 10C (0, 4, 8, 10)]
4: • Cosine Rule with some correct substitution
• Effort at calculating $|AX|$ or $|TX|$
8: • Cosine Rule substituted correctly
• Finds $|AX|$ and formulates for $|TX|$ (or vice versa)

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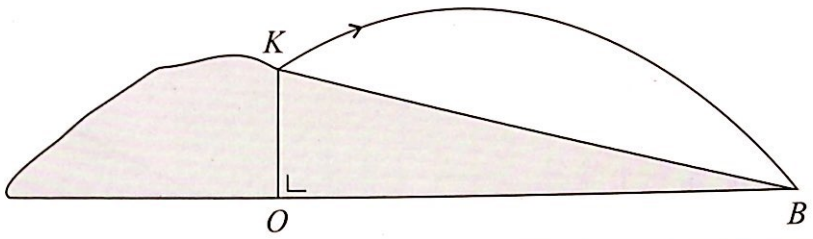
Question 9 (c) (i)

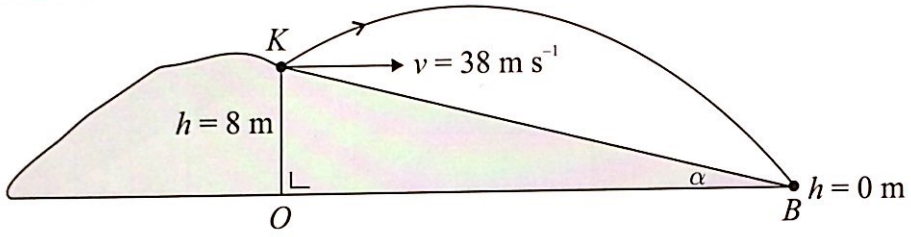
$h = -6t^2 + 22t + 8$

$t = 0 : h = 8$ m



Marking Scheme Notes
Question 9 (c) (i) [Scale 5B (0, 2, 5)]
2: • $t = 0$ indicated
Note: Accept $h = 8$ m without work

Question 9 (c) (ii)



Find the time for the ball to land by putting $h = 0$ m:

$h = 0 : h = -6t^2 + 22t + 8$

$\therefore -6t^2 + 22t + 8 = 0$

$3t^2 - 11t - 4 = 0$

$(3t + 1)(t - 4) = 0$

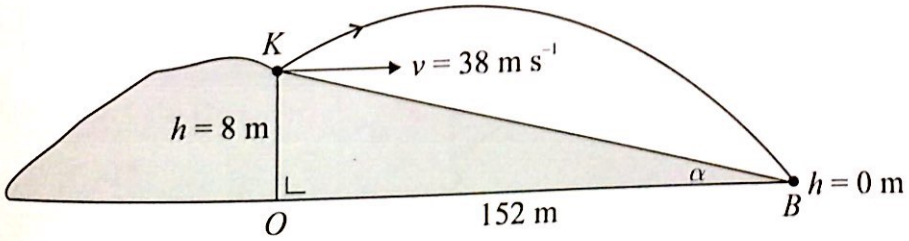
$\therefore t = 4$ s

Formulae and Tables Book
Speed:

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

$$v = \frac{s}{t}$$

Horizontal distance $|OB| = v \times t = 38 \times 4 = 152$ m



$$\tan\alpha = \frac{8}{152} \Rightarrow \alpha = \tan^{-1}\left(\frac{8}{152}\right) \approx 3^\circ$$

Marking Scheme Notes
Question 9 (c) (ii) [Scale 10C (0, 4, 8, 10)]
4: • $h = 0$ indicated
8: • $|OB|$ found for positive value for t

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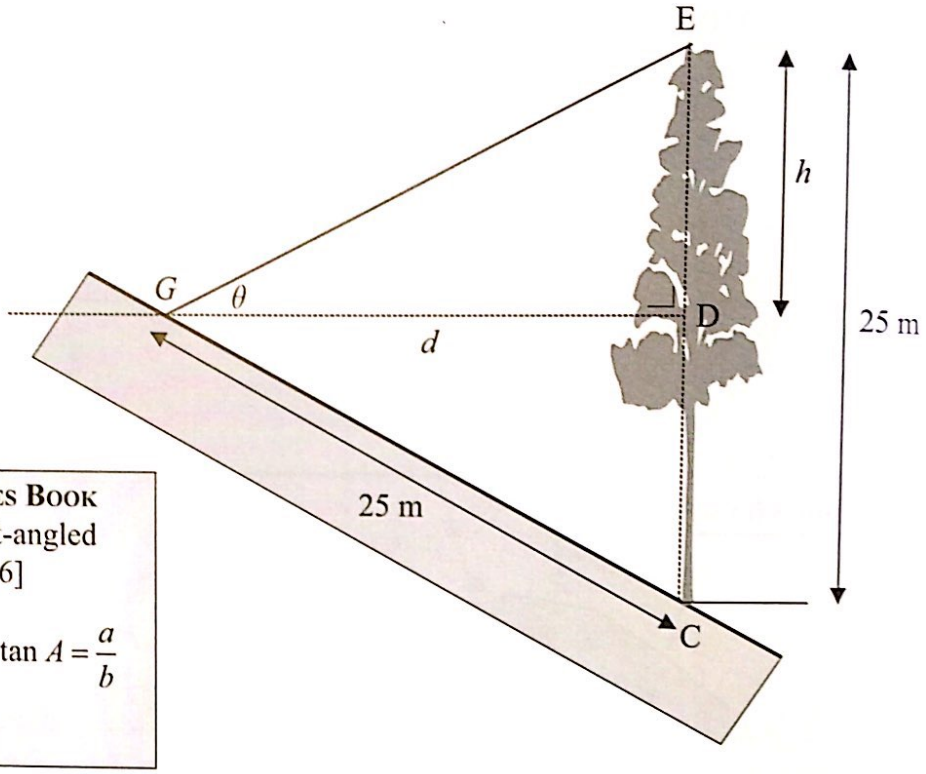
Question 9 (d) (i)

$$\tan\theta = \frac{1}{2} = \frac{h}{d} \Rightarrow d = 2h$$

$$|CD| = 25 - h$$



Formulae and Tables Book
Trigonometry: Right-angled triangle [page 16]

$$\sin A = \frac{a}{c},\ \cos A = \frac{b}{c},\ \tan A = \frac{a}{b}$$

$$c^2 = a^2 + b^2$$

Marking Scheme Notes
Question 9 (d) (i) [Scale 5B (0, 2, 5)]

2: • $\frac{h}{d} = \frac{1}{2}$

• $|CD| = 25 - h$

Question 9 (d) (ii)

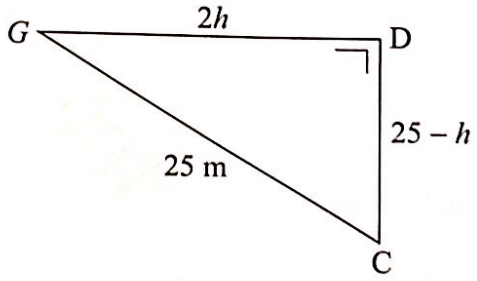
$$25^2 = (2h)^2 + (25-h)^2$$

$$625 = 4h^2 + 625 - 50h + h^2$$

$$5h^2 + 50h = 0$$

$$5h(h-10) = 0$$

$$\therefore h = 10 \text{ m}$$



Marking Scheme Notes
Question 9 (d) (ii) [Scale 5D (0, 2, 3, 4, 5)]

2: • Pythagoras with some correct substitution

3: • Pythagoras correctly substituted

4: • Quadratic equation expanded correctly

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