IB Questionbank Mathematical Studies 3rd edition

Pythag and trig ans studies

0 min 0 marks

1.	Unit penalty applies in parts (a) and (b)				
	(a)	$AC^2 = 7.2^2 + 9.6^2$	(M1)		
		<i>Note:</i> Award (M1) for correct substitution in Pythagoras Theorem.			
UP		AC = 12 m	(A1)	(C2)	
	(b)	$AG^2 = 12^2 + 3.5^2$	(M1)		
		<i>Note:</i> Award (M1) for correct substitution in Pythagoras Theorem.			
UP		AG = 12.5m	A1)(ft)	(C2)	
		<i>Note:</i> Follow through from their answer to part (a).			
	(c)	$\tan \theta = \frac{3.5}{12}$ or $\sin \theta = \frac{3.5}{12.5}$ or $\cos \theta = \frac{12}{12.5}$	(M1)		
		Note: Award (M1) for correct substitutions in trig ratio.			
		$\theta = 16.3^{\circ} \tag{4}$	A1)(ft)	(C2)	
		Notes: Follow through from parts (a) and/or part (b) whe appropriate. Award $(M1)(A0)$ for use of radians (0.284).	re		

2. Unit penalty applies in parts (a) and (b)

(a) $AG = \sqrt{0.8^2 + 0.5^2}$ (M1)

[6]

UP
$$AG = 0.943 \text{ m}$$
 (A1) (C2)

(b)
$$AF = \sqrt{AG^2 + 1.80^2}$$
 (M1)

$$= 2.03 \text{ m}$$
 (A1)(ft) (C2)

Note: Follow through from their answer to part (a).

(c)
$$\cos G\hat{A}F = \frac{0.943(39...)}{2.03(22...)}$$
 (M1)

$$GAF = 62.3^{\circ}$$
 (A1)(ft) (C2)

Notes: Award (M1) for substitution into correct trig ratio. Accept alternative ratios that give 62.4° or 62.5° . Follow through from their answers to parts (a) and (b).

[6]

3. Note: Unit penalty (UP) applies in part (a)

UP

(a)
$$PB = \frac{1}{2}\sqrt{40^2 + 40^2} = \sqrt{800} = 28.28 (28.3)$$
 (M1)(A1)

Note: Award (M1) for correct substitutions, (A1) for correct answer.

UP OB =
$$\sqrt{40^2 + 28.28^2}$$
 = 49.0 cm ($\sqrt{2400}$ cm) (M1)(A1)(ft) (C4)

Note: Award (M1) for correct substitution, can (ft) from any answer to PB.

(b)
$$\sin^{-1}\left(\frac{40}{49}\right)$$

OR
 $\cos^{-1}\left(\frac{28.28}{49}\right)$
OR
 $\tan^{-1}\left(\frac{40}{28.28}\right)$ (M1)
= 54.7 (54.8) (A1)(ft) (C2)
Note: Award (M1) for any correct trig. ratio.
In radians = 0.616, award (M1)(A0).
Note: Common error: (a) $OB = \sqrt{40^2 + 20^2} = 44.7$ cm.
Award (M0)(A0)(M1) (A1)(ft), and (b) angle
 $OBP = 63.4^{\circ} (63.5^{\circ})(M1)(A1)(ft).$

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- 4. Unit penalty (UP) is applicable where indicated.
 - (a) (i)



			For A, B, C, 7.3, 60°, 90°, shown in correct places	(A1)	
			Note: The 90° should look like 90° (allow \pm 10°)		
		(ii)	Using tan 60 or tan 30	(M1)	
UP			4.21 cm	(A1)(ft)	
			(ft) on their diagram		
		Or			
			Using sine rule with their correct values	(M1)	
UP			4.21 cm	(A1)(ft)	
		Or			
			Using special triangle $\frac{7.3}{\sqrt{3}}$	(M1)	
UP			4.21 cm	(A1)(ft)	
		Or			
			Any other valid solution		
			<i>Note:</i> If A and B are swapped then $BC = 8.43$ cm		(C3)
	(b)	(i)	For ACD in a straight line and all joined up to B, for 20° show in correct place and D labelled. D must be on AC extended.	⁷ n (A1)	
		(ii)	$\hat{BCD} = 120^{\circ}$	(A1)	
		()		()	
			$CBD = 40^{\circ}$	(A1)	(C3)

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5. Unit penalty (UP) applies in parts (a) and (b) in this question.

6.

(a)
$$VM^2 = 13^2 - 5^2$$
 (M1)
UP = 12 cm (A1) (C2)

(b)
$$h^2 = 12^2 - 5^2$$
 (or equivalent) (M1)
UP = 10.9 cm (A1)(ft) (C2)

(c)
$$\cos \theta = \frac{5}{12}$$
 (or equivalent) (M1)

$$\theta = 65.4^{\circ}$$
 (A1)(ft) (C2)

Note: Accept
$$\theta = 65.3^{\circ}$$
 (use of 10.9 with sine ratio).

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(a)	For using tan	(M1)
	$h = 12.3 \times \tan 63$ For using tan something	(A1)
	h = 24.1	(A1) (G3)

(b)	$24.1 = 4.9t^2$ For substituting for h in the formula and attempting to					
	solve	(M1)				
	For taking a square root (can be implied)	(M1)				
	2.22 sec	(A1)	(C3)			
				[6]		

7.
$$\frac{\text{height}}{5.7} = \tan 42^{\circ}$$
, (M1)
therefore height =5.7 tan 42° (= 5.1323...cm) (A1)

Volume of prism =
$$\frac{5.7 \tan (42^\circ) \times 5.7 \times 8}{2}$$
 (M1)

$$= 117 \text{ cm}^3 (3 \text{ s.f.})$$
 (A1)
or (G2)

Note: The only departures from the substituted volume formula allowed are those where the 5.7 tan (42) is replaced with a value that the candidate seems to believe is the height. eg 5.7 repeated is a possibility. In such cases, award (M1)(A0).

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B. (a)
$$XM = 2$$
 (A1) (C1)

(b)
$$DM = \sqrt{(9+4)} = \sqrt{13} (= 3.61)$$
 (M1)(A2) (C3)

(c)
$$\tan D\hat{M}X = \frac{3}{2}$$
 (M1)(A1)

Note: Award (M1) for the correct angle, (A1) for the correct ratio.

angle
$$D\hat{M}X = 56.3^{\circ}$$
 (A2) (C4) **OR**

$$\sin \hat{DMX} = \frac{3}{3.61}$$
 (M1)(A1)

angle
$$D\hat{M}X = 56.2^{\circ}$$
 (A2)
OR
 $\cos D\hat{M}X = \frac{2}{3.61}$ (M1)(A1)

angle
$$D\hat{M}X = 56.4^{\circ}$$
 (A2)

Note: Accept correct answer given in radians, or degrees, minutes and seconds.

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[8]

9. (a)
$$\sqrt{5^2 + 1^2} = \sqrt{26}$$
 (or 5.10 (3 s.f.)) (M2)(A2) (C4)
(b) $\sqrt{4^2 + \sqrt{26}^2}$ (M2)
 $= \sqrt{42} = 6.48$ (3 s.f.) (A2) (C4)

8.

10.

(b)
$$x = \frac{26.5}{\tan 28^{\circ}}$$
 (or equivalent, allow follow-through from part (a)) (M1)
= 49.83925... (A1)
= 50 m (correct to nearest metre) (A1)

11. (a)

450 m

$$x$$
 (M1) (C1)
Note: All three (23° x 450 m) must be labelled and in correct

Note: All three $(23^\circ, x, 450 \text{ m})$ must be labelled and in correct position for (M1)

(b)
$$\tan 23^\circ = \frac{450}{x}$$
 (M1)

Note: Follow through from candidate's diagram

$$x = \frac{450}{\tan 23^{\circ}}$$
(M1)
 $x = 1060.13...$
 $x = 1060 (3 \text{ s.f.})$
(A1) (C3)

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[4]