



# **Cambridge Technicals**

## **Engineering**

Unit 1: Mathematics for Engineering

Level 3 Cambridge Technical Certificate/Diploma in Engineering

**05822 - 05825**

## **Mark Scheme for January 2017**

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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Question			Answer	Marks	Guidance
1	(a)		$2x+3=7 \Rightarrow 2x=4$ $\Rightarrow x=2$	<b>M1</b> <b>A1</b>	Soi subtraction of 3 or division by 2
				[2]	
	(b)	(i)	$x^2 - 3x + 2x - 6$ $= x^2 - x - 6$	<b>M1</b> <b>A1</b>	4 terms SOI ( $x^2 \pm px \pm qx \pm r$ )
				[2]	
	(b)	(ii)	$(x+5)(x-3)$ or $(x+5)$ and $(x-3)$	<b>M1</b> <b>A1</b>	$(x \pm 5)(x \pm 3)$ or $(x \pm 5)$ and $(x \pm 3)$
				[2]	
	(c)	(i)	$f(1) = 1$	<b>B1</b>	
				[1]	
	(c)	(ii)	No. For $x = 1$ to be a root, $f(1) = 0$ , but it isn't.  Accept "it is not = 0"	<b>B1</b> <b>B1</b>	Do not award without an explanation. Or $f(1) = 1$ means that division by $(x - 1)$ gives a remainder. Full marks can be earned even if $f(1) \neq 1$ Give B2 for Yes if their $f(1) = 0$
				[2]	

Question			Answer	Marks	Guidance
2	(a)	(i)	Whole graph shifted up (or down) Up by 2 and labelled correctly	M1 A1	Ignore (incorrect) labels
				[2]	
	(a)	(ii)	Whole graph shifted left (or right) Left by 2 and labelled correctly.	M1 A1	Ignore (incorrect) labels
				[2]	
	(b)		Whole graph stretched, through same points on $x$ - axis Above graph when $x$ positive and below graph when $x$ is negative.	M1 A1	Must have correct orientation
				[2]	
	(c)	(i)	Straight line through origin with positive gradient Correct line	B1 B1	
				[2]	
	(c)	(ii)	(3, 6)	B1	ft their intersection Allow even if line in (c)(i) is wrong.
				[1]	

Question			Answer	Marks	Guidance
3	(a)	(i)	$6x + 8y = 10$ $9x + 6y = 10.2$	<b>B1</b> <b>B1</b>	oe oe
				[2]	
	(a)	(ii)	For e.g. mult 1st eqn by 1.5 $\Rightarrow 9x + 12y = 15$ Subtract $\Rightarrow 6y = 4.8 \Rightarrow y = 0.8$ Substitute $\Rightarrow x = 0.6$ Spanner costs 60p and screwdriver 80p	<b>M1</b> <b>A1</b> <b>M1</b> <b>A1</b> <b>A1</b>	Method to eliminate or substitute Correct equation(s) Substitute to find other value x and y Answer stated
				[5]	
	(b)		Substitute given values correctly into $v^2 = u^2 + 2as$ $\Rightarrow v^2 = 0 + 2 \times 2 \times 100 = 400$ $\Rightarrow v = 20$ (Speed of car is $20 \text{ ms}^{-1}$ )	<b>M1</b> <b>A1</b> <b>A1</b>	
				[3]	

Question		Answer	Marks	Guidance
4	(i)	Values in table: 14 40 70 88	<b>B2</b>	B1 one error (but ft remaining entries)
			[2]	
	(ii)	Smooth curve through <i>their</i> points	<b>B2</b>	B1 one error
			[2]	
	(iii) (A)	Attempt to find 50th percentile Answer: $148 \pm 3$	<b>M1</b> <b>A1</b>	Horizontal line drawn across at 50 on the y-axis soi Ft an incorrect graph
			[2]	
	(iii) (B)	Attempt to find 25th, 75th percentiles Answer: $162 - 128 = 34 \pm 4$	<b>M1</b> <b>A1</b>	Ft an incorrect graph
			[2]	
	(iii) (C)	Attempt to find number at 175 Answer: $84 \pm 2$	<b>M1</b> <b>A1</b>	Ft an incorrect graph Sc "16% last longer" 2 marks
			[2]	

N.B. Care in (iii) (A), (B) and (C) that lines drawn to find values are “across and down” rather than “up and back”.

N.B. In 4(ii) do **not** accept a series of straight lines through the points. It must be a smooth curve.

In 4(iii) accept calculations based on ratios. B2 in each case, providing the answers are within the ranges given above.

Question		Answer	Marks	Guidance
5	(a)	Anything involving $\sin 3x$ $\frac{1}{3} \sin 3x + c$	M1 A1	Condone lack of $c$
			[2]	
	(b) (i)	$\left(v = \frac{dh}{dt}\right) = 20 - 10t$	M1 A1	Evidence of differentiation eg $a + bt$ If $t^0$ seen then only give M mark if $t^0 = 1$ also seen
			[2]	
	(b) (ii)	$v = 0 \Rightarrow 20 - 10t = 0$ $\Rightarrow t = 2$	M1 A1	Their function set = 0 Cao
			[2]	
	(b) (iii)	$t = 2 \Rightarrow h = 20 \times 2 - 5 \times 2^2$ $= 20$	M1 A1	Substitute their value for $t$ Cao
			[2]	
	(c)	$RC = 2000 \times 0.001 = 2$ $10 = 12 \left(1 - e^{-t/2}\right)$ $\Rightarrow e^{-t/2} = \frac{1}{6}$ $\Rightarrow \frac{t}{2} = \ln 6 = 1.79$ oe $\Rightarrow t = 3.58$	B1 M1  M1  A1	Attempt to solve equation  Take logs  Ft from incorrect $RC$ . Accept $t = 3.6$
			[4]	

Question		Answer	Marks	Guidance
6	(a)	$\frac{10}{AB} = \cos 60 \quad (= \sin 30)$ $\Rightarrow AB = \frac{10}{\cos 60}$ $= 20 \text{ cm}$	<b>M1</b> <b>A1</b> <b>A1</b>	Accept $\frac{AB}{\sin 90} = \frac{10}{\sin 30}$ oe
			[3]	
	(b)	$\cos \theta = \frac{8^2 + 9^2 - 11^2}{2 \times 8 \times 9}$ $= 0.1666$ $\Rightarrow \theta = 80.4$ Accept $80^0$ or $81^0$ if all working correct.	<b>M1</b> <b>M1</b> <b>A1</b> <b>A1</b>	Any correct application of cosine rule. Correct angle. (Or 0.6969... or 0.5909...) (Or 45.8 or 53.8) i.e. a correct "wrong angle" gets 3. SC. Finding all 3 angles correctly B4
			[4]	
	(c)	Use of $s = 2\pi r \frac{\theta}{360} \Rightarrow 5 = 20\pi \frac{\theta}{360} = \frac{\theta\pi}{18}$ $\Rightarrow \theta = \frac{90}{\pi} = 28.6\dots$ Alternatively: Use of $s = \theta r \Rightarrow 5 = 10\theta \Rightarrow \theta = \frac{1}{2}$ radians $\Rightarrow \theta = \frac{1}{2} \times \frac{180}{\pi} = 28.6\dots$	<b>M1</b>  <b>M1</b> <b>A1</b>	Correct formula in degrees or radians with correct substitutions  Evidence of making $\theta$ the subject
			[3]	

**OCR (Oxford Cambridge and RSA Examinations)**  
1 Hills Road  
Cambridge  
CB1 2EU

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

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**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

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