

## **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.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Question			Answer	Marks	Guidance
1	(a)		$2x+3=7 \Rightarrow 2x=4$ $\Rightarrow x=2$	M1 A1	Soi subtraction of 3 or division by 2
				[2]	
	(b)	(i)	$x^2 - 3x + 2x - 6$ $= x^2 - x - 6$	M1 A1	4 terms SOI ( $x^2 \pm px \pm qx \pm r$ )
				[2]	
	(b)	(ii)	$(x+5)(x-3)$ or $(x+5)$ and $(x-3)$	M1 A1	$(x \pm 5)(x \pm 3)$ or $(x \pm 5)$ and $(x \pm 3)$
				[2]	
	(c)	(i)	$f(1) = 1$	B1	
				[1]	
	(c)	(ii)	No. For $x = 1$ to be a root, $f(1) = 0$ , but it isn't.  Accept "it is not = 0"	B1 B1	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]	



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