OCR
Oxford Cambridge and RSA

Cambridge Technicals

Engineering

Unit **1:** Mathematics for Engineering

Level 3 Cambridge Technical Certificate/Diploma in Engineering
05822 - 05825

Mark Scheme for January 2017

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 $\left(x^2 \pm px \pm qx \pm r \right)$
				[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)**	$6x + 8y = 10$ $9x + 6y = 10.2$	**B1** **B1**	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	**M1** **A1** **M1** **A1** **A1**	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 ms^{-1})	**M1** **A1** **A1**	
				[3]	

Question			Answer	Marks	Guidance
4	**(i)**		Values in table: 14 40 70 88	**B2**	B1 one error (but ft remaining entries)
				[2]	
	(ii)		Smooth curve through *their* points	**B2**	B1 one error
				[2]	
	(iii)	**(A)**	Attempt to find 50th percentile Answer: 148 ± 3	**M1** **A1**	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: $162 - 128 = 34 \pm 4$	**M1** **A1**	Ft an incorrect graph
				[2]	
	(iii)	**(C)**	Attempt to find number at 175 Answer: 84 ± 2	**M1** **A1**	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 sin3x $\frac{1}{3}\sin 3x + c$	**M1** **A1**	Condone lack of *c*
				[2]	
	(b)	**(i)**	$\left(v = \dfrac{\mathrm{d}h}{\mathrm{d}t}\right) = 20 - 10t$	**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)**	$t = 2 \Rightarrow h = 20 \times 2 - 5 \times 2^2$ $\quad\quad = 20$	**M1** **A1**	Substitute their value for *t* Cao
				[2]	
	(c)		$RC = 2000 \times 0.001 = 2$ $10 = 12\left(1 - e^{-t/2}\right)$ $\Rightarrow e^{-t/2} = \dfrac{1}{6}$ $\Rightarrow \dfrac{t}{2} = \ln 6 = 1.79 \quad$ **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)**		$\dfrac{10}{AB} = \cos 60 \quad (= \sin 30)$ $\Rightarrow AB = \dfrac{10}{\cos 60}$ $= 20$ cm	**M1** **A1** **A1**	Accept $\dfrac{AB}{\sin 90} = \dfrac{10}{\sin 30}$ **oe**
				[3]	
	(b)		$\cos \theta = \dfrac{8^2 + 9^2 - 11^2}{2 \times 8 \times 9}$ $= 0.1666$ $\Rightarrow \theta = 80.4$ Accept 80^0 or 81^0 if all working correct.	**M1** **M1** **A1** **A1**	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 $s = 2\pi r \dfrac{\theta}{360} \Rightarrow 5 = 20\pi \dfrac{\theta}{360} = \dfrac{\theta \pi}{18}$ $\Rightarrow \theta = \dfrac{90}{\pi} = 28.6......$ Alternatively: Use of $s = \theta r \Rightarrow 5 = 10\theta \Rightarrow \theta = \dfrac{1}{2}$ radians $\Rightarrow \theta = \dfrac{1}{2} \times \dfrac{180}{\pi} = 28.6....$	**M1** **M1** **A1**	Correct formula in degrees or radians with correct substitutions Evidence of making θ the subject
				[3]	

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