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Mark Scheme (Results)
Summer 2010

Principal Learning

Engineering
EG308 Mathematical Techniques and Applications for Engineering

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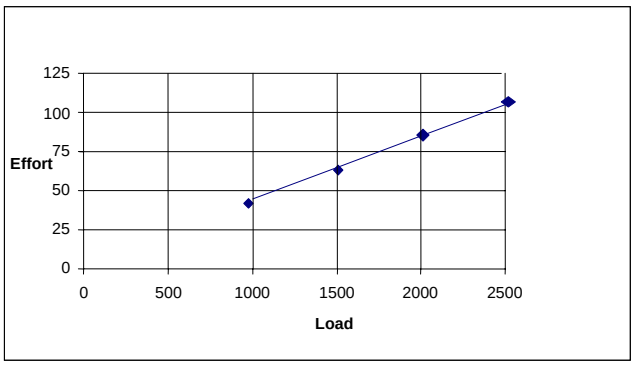
General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Mark	Coverage
1 (a)	$V = \frac{4}{3}\pi r^3$ $\frac{3V}{4\pi} = r^3$ $r = \sqrt[3]{\frac{3V}{4\pi}}$ $r = \sqrt[3]{\frac{3\times 2000}{4\pi}} = 7.82$	**(4)**	**M1** **M1** **B1** **A1**

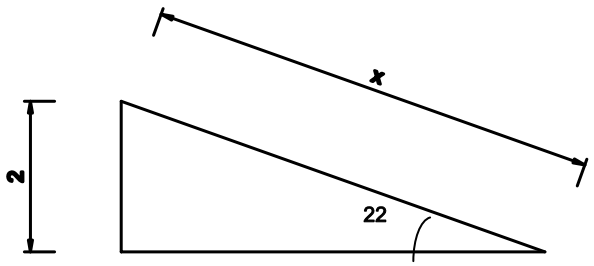
Question Number	Answer	Mark	Coverage
1 (b)	$\log\left(\frac{24}{6}\right) + \log 8 = 5\log x$ $\log 4 + \log 8 = \log x^5$ $\log 32 = \log x^5$ $x^5 = 32$ $x = 2$ If solved using logs give 1 mark	**(3)**	**B1** **B1** **A1**

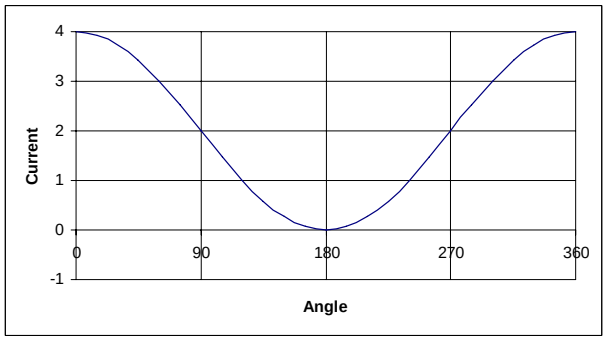
Question Number	Answer	Mark	Coverage
1 (c)	$G = 10\log_{10}\left(\frac{P_{out}}{P_{in}}\right)$ $\frac{G}{10} = \log_{10}\left(\frac{P_{out}}{P_{in}}\right)$ $10^{\frac{G}{10}} = \frac{P_{out}}{P_{in}}$ $P_{in}\times 10^{\frac{20}{10}} = P_{out}$ $0.25\times 10^2 = P_{out}$ $P_{out} = 25\,\text{W}$ accept 25000mW	**(3)**	**M1** **M1** **A1**

Question Number	Answer	Mark	Coverage
2 (a)	 Points correctly plotted		
2 (a)(i)	Line drawn through points (ft from their points) Equation of line $E = 0.04W + 6$		**B1**
2 (a)(ii)	At $W = 0,\ E = 6$		**B1**
2 (a) (iii)	At $W = 4000, E = 166$		**B1**
	ft from incorrect equation full marks Accurate estimates without equation allowable (such as extension of line to extend axis, extension of table to calculate value at 4000)	**(4)**	**B1**

Question Number	Answer	Mark	Coverage
2 (b)	$\frac{\pi d^2}{4} + d^2$ = $d\left(\frac{\pi d}{4} + d\right)$ (1 mark if left at this stage) $= d^2\left(\frac{\pi}{4} + 1\right)$	**(2)**	**B2**

Question Number	Answer	Mark	Coverage
2 (c)	Area $= x(x+7) = 30$ $x^2 + 7x - 30 = 0$		**M1**
	$(x+10)(x-3) = 0$		**M1**
	$x - 3 = 0$ gives $x = 3$		**B1**
	correct answer without working give 1 mark with proof ***x(x+7)=30*** give additional 1 mark	**(4)**	**A1**

Question Number	Answer	Mark	Coverage
3 (a)	 $\sin 22 = \frac{2}{x}$ $x = \frac{2}{\sin 22} = 5.34$ m (other techniques accepted)	**(3)**	**M1** **M1A1**

Question Number	Answer	Mark	Coverage
3 (b)	 Graph correctly sketched, 1 mark for amplitude, 1 mark for offset 0	**(3)**	**B2** **A1**

Question Number	Answer	Mark	Coverage
3 (c)	$c^2 = a^2 + b^2 - 2ab\cos C$ $c^2 = 60^2 + 65^2 - 2 \times 60 \times 65 \times \cos 115^0$ $c^2 = 3600 + 4225 - (-3296.422) = 11121.422$ $c = 105\,\text{N}$	**(4)**	**M1** **M1** **B1** **A1**

Question Number	Answer	Mark	Coverage
4 (a)	Volume $= \frac{1}{3}\pi r^2 h$ $= \frac{1}{3}\pi \times 30^2 \times 40 = 37\,699\,\text{mm}^3$ (NB 1 mark allowed for use of $r = 60$ and no other errors) Surface area $= \pi r \times$ slant height Slant height $= \sqrt{30^2 + 40^2} = 50$ Surface area $= \pi \times 30 \times 50 = 4\,712\,\text{mm}^2$ (NB allow follow through of $r = 60$) If h is used instead of slant 's' , giving 3769.9 as answer, accept and award 2 marks as total	**(5)**	**M1A1** **M1** **M1A1**

Question Number	Answer	Mark	Coverage
4 (b)	1.2 radians $= 1.2 \times \frac{180}{\pi} = 69^0$	**(2)**	**M1A1**

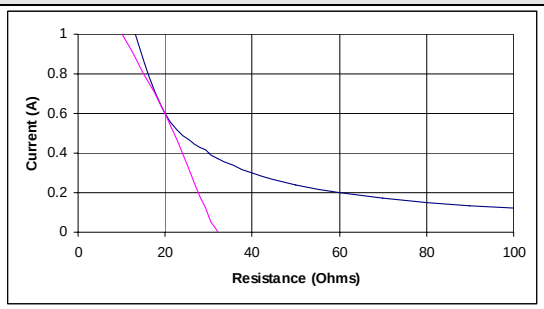
Question Number	Answer	Mark	Coverage
4 (c)	1 rpm = $\frac{1}{60}$ revolutions per second 750 rpm $= \frac{750}{60} = 12.5$ revolutions per second 12.5 revolutions per second $12.5 \times 2\pi = 78.5$ rads^{-1}	**(3)**	**M1** **B1** **A1**

Question Number	Answer	Mark	Coverage
5 (a)	8	**(1)**	**A1**

Question Number	Answer	Mark	Coverage
5 (b)	Values 5,7,6,5,8,7,8,9,8 In order 5,5,6,7,7,8,8,8,9 Median = 7	**(2)**	**M1** **A1**

Question Number	Answer	Mark	Coverage
5 (c)	Mean = (5+5+6+7+7+8+8+8+9)/9 = 63/9 = 7	**(3)**	**M1** **M1** **A1**

Question Number	Answer	Mark	Coverage
5 (d)	MTTF increasing Production improving/becoming more reliable Other suggestions acceptable but only give 1 mark if mean, mode, median values are simply stated	**(2)**	 **A1** **M1**

Question Number	Answer	Mark	Coverage
6 (a)	 Tangent drawn at $R = 20$ Change in resistance identified as $30 - 10 = 20$ Change in current identified as $0 - 1 = -1$ Change calculated as $\frac{-1}{20} = -0.05$ [accept -0.03 to -0.07 if tangent and working OK]	 **(4)**	 **M1** **B1** **B1** **A1**

Question Number	Answer	Mark	Coverage
6 (b)	$v = 12t - 3t^2$ $a = \frac{dv}{dt}$ $\frac{dv}{dt} = 12 - 6t$ At $t = 3$, $a = -6$ ms^{-1} -ve sign means decelerating If incorrect solution, but –ve is shown, allow 1 mark if deceleration is stated	 **(4)**	 **M1** **M1** **A1** **M1**

Question Number	Answer	Mark	Coverage
6 (c)	$s = \int_0^3 (12t - 3t^2)dt$		**M1**
	$s = \left[6t^2 - t^3 + c\right]_0^3$		**M1**
	[constant of integration (+c) option] $s = (6 \times 3^2) - 3^3 = 27$ m		**A2**
	no penalty for not showing the constant '+c'	**(4)**	

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