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Mark Scheme (Results)

January 2013

Principal Learning

Engineering
EG308 Paper 01

Mathematical Techniques and Applications for Engineers

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General Marking Guidance

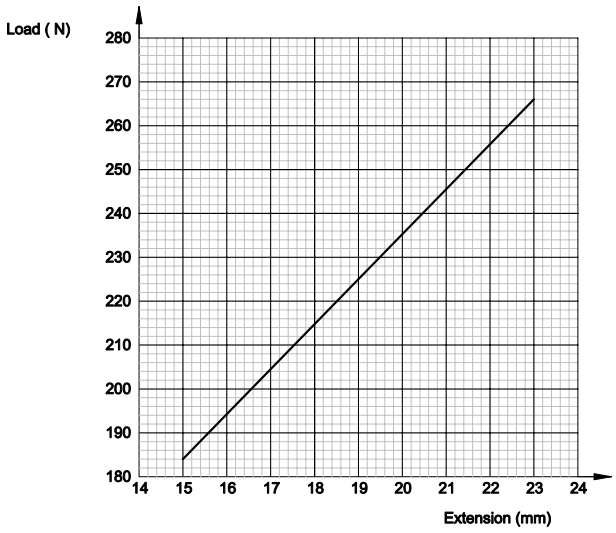
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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	
1 (a)	$b^{(7-3)}$ $= b^4$	 **(2)**	**1** **1**

Question Number	Answer	Mark	
1(b)	$\alpha = \frac{x}{1\Delta t}$ $\alpha = \frac{0.08}{(200 \times 25)}$ $\alpha = \frac{0.08}{5000}$ $\alpha = 0.000016$ or 1.6×10^{-5} Other index forms such as 16×10^{-6} may be accepted	 **(3)**	**1** **1** **1**

Question Number	Answer	Mark	
1(c)	$\log 36 - \log 4 = \log x$ $\log \frac{36}{4} = \log x$ $x = 9$ S.C. If calculated using logs 1 mark only eg $0.954 = \log x$	 **(3)**	**1** **1** **1**

Question Number	Answer	Mark	
1(d)	$T_1 = 24e^{1.39\mu}$ $34 = 24e^{1.39\mu}$ $\frac{34}{24} = e^{1.39\mu}$ $\ln 1.42 = 1.39\mu$ *(note 1.416 rounded to 1.42)* $\frac{0.35}{1.39} = \mu$ $\mu = 0.25$	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
2(a)(i)	 Line or points plotted accurately	**(1)**	**1**

Question Number	Answer	Mark	
2(a)(ii)	Slope = $\frac{254-194}{22-16}=10$ (varies to approx. 10.25) intercept $234=(10\times 20)+c$ $c=34$ law $L=10E+34$	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
2(a)(iii)	$L=(10\times 4.75)+34$ $=81.5$ Allow follow through of up to 1 mark for method used for the values from 2(a)(ii)	**(2)**	**1** **1**

Question Number	Answer	Mark	
2(b)	$\frac{\pi}{4}h(D^2-d^2)$ $\frac{\pi}{4}h(D+d)(D-d)$ Any correct partial factorisation such as $\frac{\pi}{4}(D^2h-d^2h)$ can be awarded 1 mark	**(2)**	**1** **1**

Question Number	Answer	Mark	
2(c)	$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $t = \dfrac{--25 \pm \sqrt{-25^2 - 4 \times 2.5 \times -60}}{2 \times 2.5}$ $t = \dfrac{25 \pm \sqrt{625 + 600}}{5}$ $t = \dfrac{25 \pm 35}{5}$ $t = 12,\ t = -2$ so $t = 12$	**(3)**	**1** **1** **1**

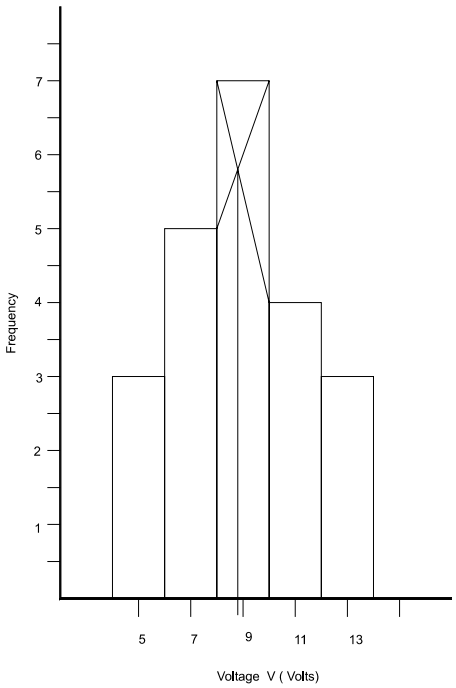
Question Number	Answer	Mark	
3(a)	• 45° • 225°	**(2)**	**1** **1**

Question Number	Answer	Mark	
3(b)	$\tan 32° = \dfrac{\text{opp}}{\text{adj}}$ So $h = \tan 32 \times 16$ $h = 10$ m rounded from 9.99 (sine rule may also be evident)	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
3(c)	Angle 140° obtained for 1 mark to allow cosine rule to be used Let side $a = R_F$ $a^2 = b^2 + c^2 - 2bc\cos A$ $a^2 = 60^2 + 72.5^2 - (2\times 60\times 72.5\cos 140^o)$ $a^2 = 3600 + 5256.25 - (-6664.59)$ $a^2 = 15520.8$ $a = \sqrt{15520.8}$ $a = 124.58$ (accept rounding)	**(4)**	**1** **1** **1** **1**

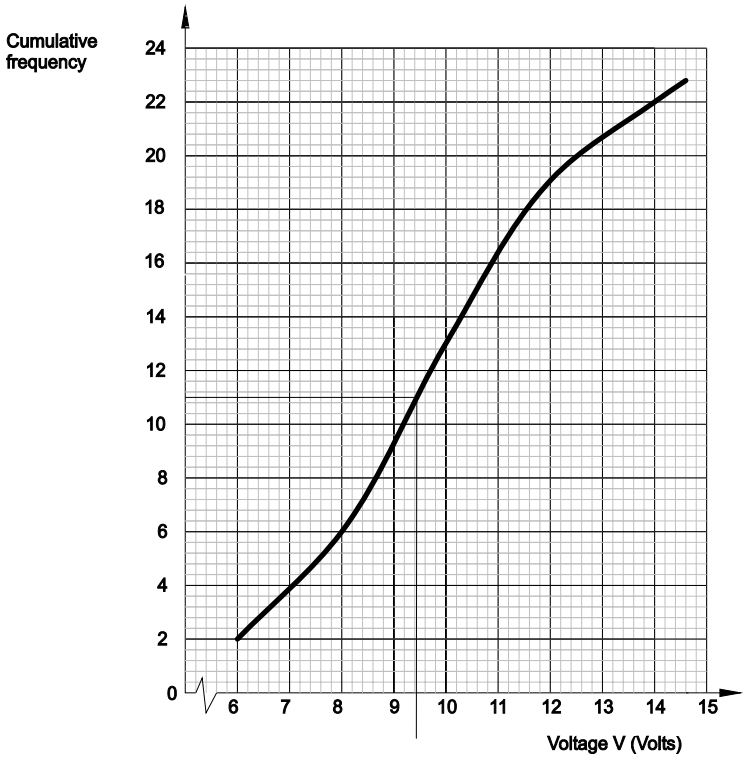
Question Number	Answer	Mark	
4(a)	Area of cam $= \pi 40^2 \times \frac{75}{360} = 1047.2 \text{ mm}^2$ Volume of cam $= 5\times 1047.2 = 5236 \text{ mm}^3$ Volume of rectangle $= 12\times 3\times 5 = 180 \text{ mm}^3$ Volume of cam $= 5236 - 180 = 5056 \text{ mm}^3$ Accept rounding (Area of cam may also be worked out from $A = \frac{1}{2}r^2\theta$) 1 mark for this method also $\theta = 75\times(2\pi/360) = 1.31$ rads $\text{Area} = 0.5\times 40^2\times 1.31 = 1048 \text{ mm}^2$	**(4)**	**1** **1** **1** **1**

Question Number	Answer	Mark	
4(b)	Angle 150^o in radians = 2.618 rad $s = r\theta$ $r = \frac{s}{\theta}$ $r = \frac{523.5}{2.618}$ $r = 199.96$ Diameter = 400mm alternative method length $= \pi D \times 150/360$ $360 \times \text{length}/150\pi = 400$	**(4)**	**1** **1** **1** **1**

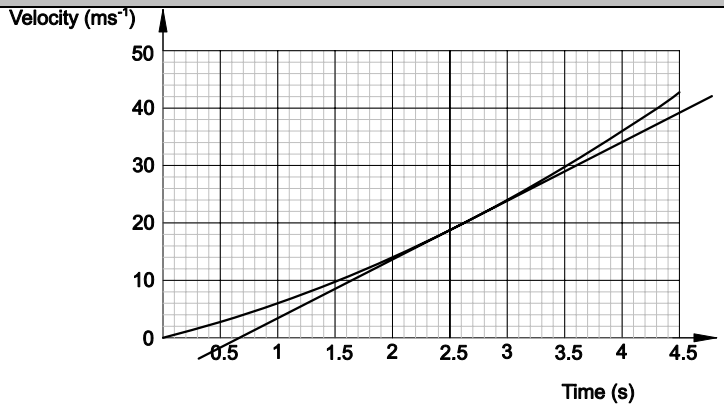
Question Number	Answer	Mark	
5(a)	 Line from intersection to 8.8 V Allow up to 1 mark for values stated between 8 and 10	**(2)**	**1** **1**

Question Number	Answer	Mark	
5(b)	Sum of mid values × frequency $=(5\times3)+(7\times5)+(9\times7)+(11\times4)+(13\times3)=196$ Total number of batteries = 22 Mean = 196/22 = 8.91	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
5(c)	Cumulative frequency totals shown as Cumulative Frequency: 2, 6, 13, 19, 22	**(1)**	**1**

Question Number	Answer	Mark	
5 (d)(i)	 Plotting points Curve drawn Allow follow through for incorrect data entered in 5(c)	**(2)**	**1** **1**

Question Number	Answer	Mark	
5(d) (ii)	Median obtained from graph (shown above) drawn at 11^{th} or the (n+1)/2th value. Median = 9.4 (will vary from graph so allow for this)	**(2)**	**1** **1**

Question Number	Answer	Mark	
6 (a)(i)	 Tangent drawn at t = 2.5	**(1)**	**1**

Question Number	Answer	Mark	
6(a)(ii)	Change in velocity given as 34 – 10 or other correct values Change in time given as 4 – 1.6 or other correct values Rate of change calculated as 10 (ms^{-2})	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
6(b)	$v = 25t + 3t^2$ $\frac{dv}{dt} = 25 + 6t$ $= 25 + (6 \times 8)$ $= 73\ (ms^{-2})$	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
6 (c)	$25t + 3t^2$ $s = \int_0^8 25t + 3t^2 \, dt$ $s = \left[\frac{25t^2}{2} + \frac{3t^3}{3} \right]_0^8$ $s = \left[12.5t^2 + t^3 \right]_0^8$ $s = 12.5 \times 8^2 + 8^3$ $s = 1312$ (m)	**(4)**	**1** **1** **1** **1**

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