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Mark Scheme (Results)

January 2010

Principal Learning

Engineering EG308
Mathematical Techniques and Applications for Engineering

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General Marking Guidance

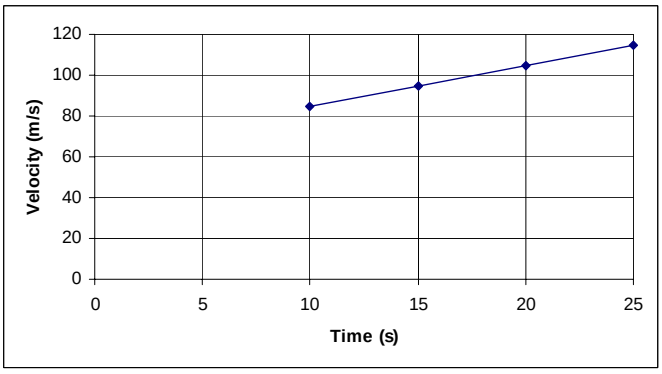
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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.
- There is no credit or penalty for correct or incorrect units in candidate responses.

Question Number	Answer	Mark	Coverage
1 (a)(i)	$A=\frac{1}{2}r^2\theta$ $\frac{2A}{\theta}=r^2$ $r=\sqrt{\frac{2A}{\theta}}$ also accept $r=\sqrt{\frac{A}{\frac{1}{2}\theta}}$	**(3)**	**M1** **M1** **B1**

Question Number	Answer	Mark	Coverage
1 (a)(ii)	$r=\sqrt{\frac{2\times 50}{0.6}}=12.9$ (allow follow through)	**(1)**	**A1**

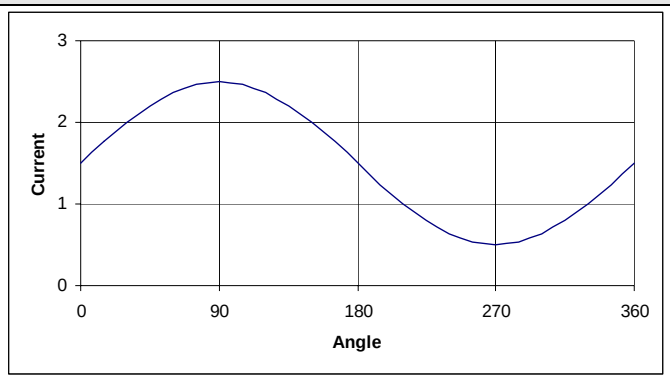
Question Number	Answer	Mark	Coverage
1 (b)	$\log 48-\log x=3\log 2$ $\log 48-\log x=\log 8$ $\log 48-\log 8=\log x$ $\log x=\log\frac{48}{8}$ $\log x=\log 6$ $x=6$ S.C. If <u>calculated</u> using logs =0.778 (1 mark only) Allow follow through	**(3)**	**B1** **B1** **A1**

Question Number	Answer	Mark	Coverage
1 (c)	$v = 20(1 - e^{-\frac{t}{\tau}})$ $e^{-\frac{t}{\tau}} = 1 - \frac{v}{20}$ $-\frac{t}{\tau} = \ln\left(1 - \frac{v}{20}\right)$ $t = -5\ln 0.4$ $= 4.58$ s	**(3)**	**M1** **M1** **A1**

Question Number	Answer	Mark	Coverage
2 (a)	 (i) Points correctly plotted Line drawn through points (ft from their points) (and allow plotted points, no line, if accurate) (ii) Equation of line $v = 2t + 65$ (iii)At $t = 0,\ v = 65$; At , $t = 40,\ v = 145$ Allow follow through from incorrect equation full marks. Accurate estimates without equation allowable	**(4)**	**B1** **B1** **B1B1**

Question Number	Answer	Mark	Coverage
2 (b)	$2\pi r^2 + 2\pi rh$ $2\pi r(r+h)$ 2 π (r^2 + rh) - allow 1 mark only OR 2πr (r+rh) - allow 1 mark only OR (r^2 + rh) - allow 1 mark only	**(2)**	**B2**

Question Number	Answer	Mark	Coverage
2 (c)	(i) $d = 2t^2 + 5t - 12$ $d = (2t \pm \ \ )(t \pm \ \ )$ $d = (2t - 3)(t + 4)$ $t = 1.5 \, and \, d = -4$ S.C Accept formula method (ii) Distance can't be -4m (negative), therefore must be 1.5m SC: -1.5 and 4 = A1	**(4)**	**M1** **B1** **A1** **B1**

Question Number	Answer	Mark	Coverage
3 (a)	 Graph correctly sketched 1 mark for amplitude, 1 mark for offset 0.5	**(3)**	**B2** **A1**

Question Number	Answer	Mark	Coverage
3 (b)	$\tan 29^0 = \frac{h}{50}$ $h = 50 \times 0.554$ $h = 27.72$ m Accept 27m to 28m Allow follow through if alternative method used (eg sine rule)	**(3)**	**M1** **B1** **A1**

Question Number	Answer	Mark	Coverage
3 (c)	$A\hat{B}C = 180 - (120 + 45) = 15^0$ $\frac{10}{\sin 15} = \frac{AB}{\sin 45}$ $AB = \frac{10 \sin 45}{\sin 15}$ $AB = 27.32\,\text{m}$ Allow follow through Accept 27.0 to 27.6	**(4)**	**M1** **M1** **B1** **A1**

Question Number	Answer	Mark	Coverage
4 (a)	Volume = $\frac{4}{3}\pi r^3$ $= \frac{4}{3}\pi \times 15^3 = 14137$ mm^3 Surface area = $4\pi r^2$ $= 4\pi \times 15^2 = 2827$ mm^2	**(4)**	**M1A1** **M1A1**

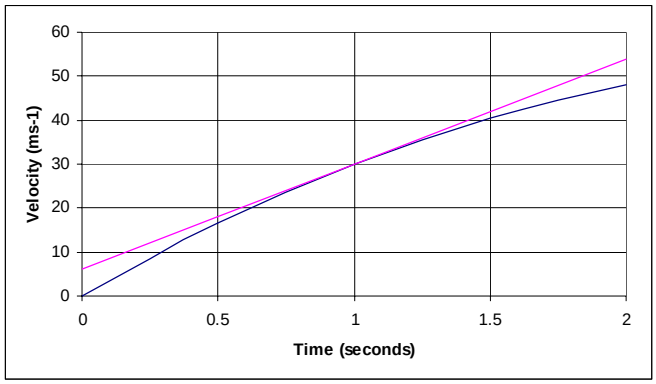
Question Number	Answer	Mark	Coverage
4 (b)	Circumference $= 2\pi r = 2\pi \times 35 = 220\,\text{m}$ Angle $= \frac{150}{220} \times 360 = 245^0$ (Allow answers within the range 245 - 246^0) Can use s=rθ therefore θ = s/r= 150/35 = 4.28rads	**(3)**	**M1** **M1A1**

Question Number	Answer	Mark	Coverage
4 (c)	1 radian per second $= \frac{1}{2\pi}$ revolutions per second		**M1**
	80 radians per second $= \frac{80}{2\pi} = 12.73$ revolutions per second		**B1**
	$= 12.73 \times 60 = 763.8$ rpm		**A1**
	(Allow answers within the range 762 - 764) Accept 2746800 rev per second	**(3)**	

Question Number	Answer	Mark	Coverage
5 (a)	The value which occurs most often 7	 **(2)**	**M1** **A1**

Question Number	Answer	Mark	Coverage
5 (b)	The middle value – 2, 4, 5, 6, **7**, 7, 9, 11, 12 Total 9 values – median is 5th value Median is 7	 **(3)**	**M1** **M1** **A1**

Question Number	Answer	Mark	Coverage
5 (c)	Mean = (2+4+5+6+7+7+9+11+12) / 9 = 63/9 = 7	 **(3)**	**M1** **A1** **A1**

Question Number	Answer	Mark	Coverage
6 (a)	 Change in time identified as $54-6=48$ Change in velocity identified as $2-0=2$ Rate of change of velocity calculated as $\frac{48}{2}=24\,\text{ms}^{-2}$ Any reasonable values used for gradient Accept 20-28	 **(3)**	 **B1** **B1** **A1**

Question Number	Answer	Mark	Coverage
6 (b)(i)	$a = \frac{dv}{dt}$		M1
	$\frac{dv}{dt} = 36 - 12t$		M1
	Max velocity occurs at $\frac{dv}{dt} = 0$		M1
	Time for maximum velocity is $36 - 12t = 0$ which gives $t = 3$ s	(4)	A1

Question Number	Answer	Mark	Coverage
6 (b)(ii)	Maximum velocity is $36(3) - 6(3)^2 = 54$ ms^{-1}	(1)	A1

Question Number	Answer	Mark	Coverage
6 (c)	$s = \int_0^2 (36t - 6t^2)dt$		M1
	$s = \left[18t^2 - 2t^3(+c)\right]_0^2$		M1
	$s = 18(2)^2 - 2(2)^3 = 56$ m		M1A1
	note: (+c) is optional. Allow follow through.	(4)	

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