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Mark Scheme (Results)

Summer 2015

Principal Learning Engineering (EG308/01)

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General Marking Guidance

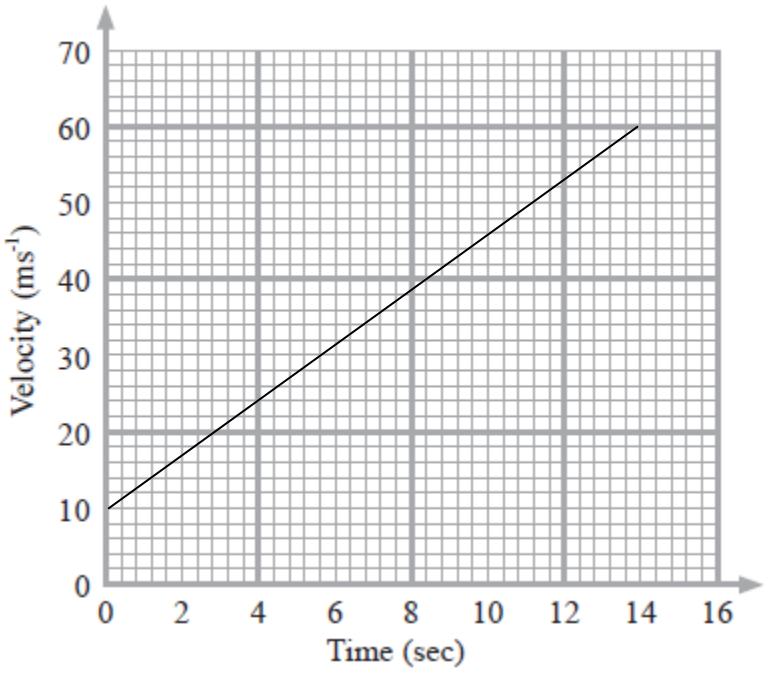
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should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

Question Number	Answer	Mark	
1 (b)	$\frac{a^3}{a^{-2}}$ *becomes* a^5	**(1)**	**1**

Question Number	Answer	Mark	
1(c)	$\log 12 - \log x = \log 3 + \log 2$ $\log 12 - \log x = \log 6$ $\log 12 - \log 6 = \log x$ $\log \frac{12}{6} = \log x$ $\log 2 = \log x$ $x = 2$ **Award of 1 mark if a calculator has been used ($\log^{-1}$ 0.3013 = 2) to obtain the solution.**	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
1 (d)	$20 = 50e^{-\frac{k}{t}}$ $\frac{20}{50} = e^{-\frac{k}{t}}$ $\ln 0.4 \times 45 = -k$ $-0.9163 \times 45 = -k$ $-41.23 = -k$ $k = 41.23$	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
2 (a) (i)	 Plotted data	**(1)**	**1**

Question Number	Answer	Mark	
2(a)(ii)	Values for gradient $\frac{60-10}{14}=3.57$ (accept values in the range 3.5- 3.625) Intercept value from graph = 10 Equation for the line $v=3.57t+10$	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
2(b)	In the production stage for this paper, the '=' sign in the equation had been changed to a '+' sign. This meant that it was no longer an equation, just a general statement. The task to solve it could hence not be performed. It is unfortunate that this has occurred and centres are assured that no candidate has been penalised in not being able to solve it, with the 3 marks for the task subtracted from the paper total. This has also been taken into consideration by the Awarding Committee in agreeing the grade boundaries for this subject.	**(0)**	**0**

Question Number	Answer	Mark	
2(c)	$t=\frac{-10.5\pm\sqrt{10.5^2-4\times6\times-3}}{2\times6}$ $t=\frac{-10.5\pm\sqrt{110.25+72}}{12}$ $t=\frac{-10.5\pm\sqrt{182.25}}{12}$ $t=\frac{-10.5\pm13.5}{12}$ $t=-2$ and $t=0.25$ There is a possibility of solving by factorisation	**(3)**	**1** **1** **1**

	$12t^2 + 21t - 6 = 0$ (1) $(t+2)(12t-3) = 0$ (1) $t = -2$ and $t = 0.25$ (1)		

Question Number	Answer	Mark	
3(a)	$\cos 20° = \frac{2.35}{x}$ $x = \frac{2.35}{\cos 20°}$ $x = \frac{2.35}{09397}$ $x = 2.5$ m The sine rule can also be used; $a = \frac{b \sin A}{\sin B}$ **(1)** *so* $x = \frac{2.35 \sin 90}{\sin 70}$ **(1)** x= 2.5 m **(1)**	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
3(b)	$a^2 = b^2 + c^2 - 2bc\cos A$ $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$ $\cos A = \frac{60^2 + 35^2 - 80^2}{2 \times 60 \times 35}$ $\cos A = \frac{4825 - 6400}{4200}$ $\cos A = -0.375$ $A = \cos^{-1} 0.375 = 112°$	**(4)**	**1** **1** **1** **1**

Question Number	Answer	Mark	
4(a)	Vol of cylinder $= \frac{\pi \times 25^2}{4} \times 70 = 34361.17$ Vol of machined square $10 \times 10 \times 70 = 7000$ Volume of component $= 34361.17 - 7000$ $= 27361.17\,\text{mm}^3$	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
4(b)	$s = r\theta$ $\theta = 240 \times \frac{2 \times \pi}{360} = 4.1887$ rads $s = 120 \times 4.2 = 502.56$ mm s = 120 x 4.1887 = 502.64 If θ is rounded to 4.2 answer varies to 504mm Accept solutions arrived at by ratios π x 240 = 754 **(1)** 754 x (240/360) = 502 **(1)**	**(2)**	**1** **1**

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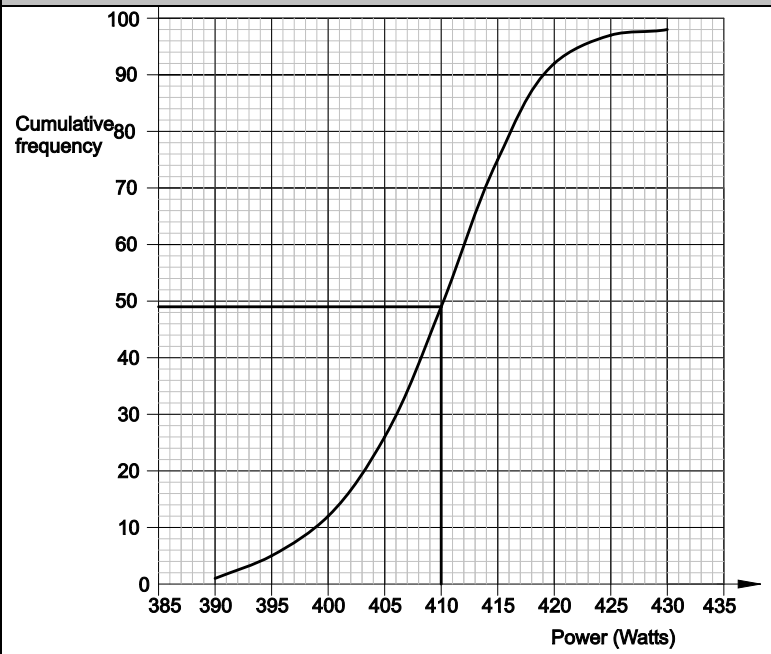
Question Number	Answer	Mark	
4(c)	$25 \times 2\pi = 157.1$ $\frac{157.1}{60} = 2.62$ rad/s Can also be done in one step $\frac{25 \times 2\pi}{60}$	**(2)**	**1** **1**

Question Number	Answer	Mark	
4(d)	$A = \frac{1}{2} r^2 \theta$ $\theta = \frac{75 \times 2 \times \pi}{360} = 1.31$ rads $A = 0.5 \times 50^2 \times 1.31 = 1637.5$ mm^2 Alternate answer with ratio of 75/360 gives 1636.25	**(3)**	**2** **1**

Question Number	Answer	Mark	
5(a)	Table showing CF values as 1,5,12,26,49,75,92,97,98	**(1)**	**1**

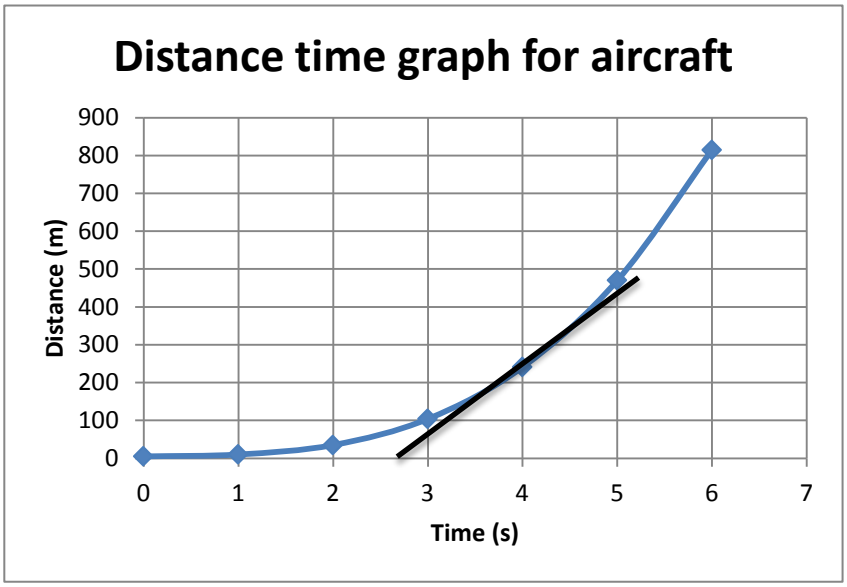
Question Number	Answer	Mark	
5(b)	The most common occurring	**(1)**	**1**

Question Number	Answer	Mark	
5(c)	411- 415 W	**(1)**	**1**

Question Number	Answer	Mark	
5(d)(i)	 1 mark for plotting values from table 1 mark for drawing cumulative frequency curve	**(2)**	**1** **1**

Question Number	Answer	Mark	
5(d)(ii)	Line from 49th cumulative frequency value as shown in 5(d) above Or line drawn from 49.5 cumulative frequency value Reading of 410 W from graph Accept variations of the value power, projected from the line as the quality and accuracy of the graph may affect this.	**(2)**	**1** **1**

Question Number	Answer	Mark	
5(e)	Mid values $\times$ frequency totals to show $(388\times1)+(393\times4)+(398\times7)+(403\times14)+(408\times23)$ $+(413\times26)+(418\times17)+(423\times5)+(428\times1)=40159$ $\frac{40159}{98}$ = 409.79 W Accept rounding if above procedure is evident	**(3)**	**1** **1** **1**

Question Number	Answer	Mark	
6(a)	 Tangent drawn at $T = 4\text{s}$ Gradient values $\frac{420-60}{2}$ $=180\ \text{ms}^{-1}$ Gradient value will depend on the accuracy of the tangent	**(4)**	**1** **2** **1**

Question Number	Answer	Mark	
6(b)	$v = 12t^2 - 4t + 3$ $\frac{\text{dv}}{\text{dt}} = 24t - 4$ $= (24 \times 5) - 4$ $= 120 - 4$ $= 116\ \text{m s}^{-2}$	**(4)**	**2** **1** **1**

Question Number	Answer	Mark	
6(c)	$s = \int_2^5 12t^2 - 4t + 3 \, \mathrm{d}t$		**1**
	$= \frac{12t^3}{3} - \frac{4t^2}{2} + 3t + c$		**1**
	$= \left[4t^3 - 2t^2 + 3t + c \right]_2^5$		**1**
	$= \left[(4 \times 5^3) - (2 \times 5^2) + (3 \times 5) \right] - \left[(4 \times 2^3) - (2 \times 2^2) + (3 \times 2) \right]$		**1**
	$= 465 - 30$		
	$= 435 \text{ m}$	**(5)**	**1**