

Mark Scheme for January 2011

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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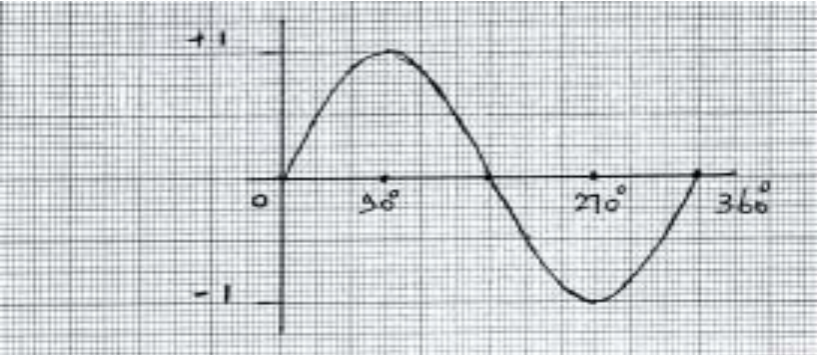
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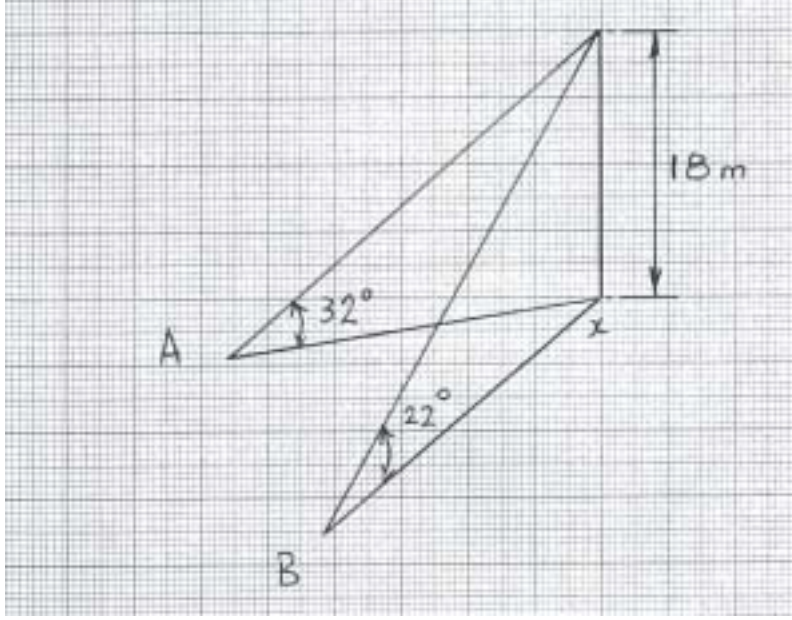
Question	Expected Answer	Mark	Rationale/Additional Guidance
Section A			
1	$10(x - 3) = 10x - 30$ $10x$ $- 30$	[1] [1]	Ignore references to x-3
2	$x^2 - 16 = (x + 4)(x - 4)$ $(x + 4)$ $(x - 4)$	[1] [1]	
3	$(x + 5)/3 - (x + 2)/6 = (2x + 10 - x - 2)/6 = (x + 8)/6$ $(2x + 10 - x - 2)/6$ $(x + 8)/6$	[1] [1]	
4	$4(x - 3) = 5x + 6$ $4x - 12 = 5x + 6$ $4x - 5x = 6 + 12$ $- x = 18$ $x = - 18$	[1] [1]	
5	Length of minor arc (s) = $(\pi r^2 \theta)/180$ $s = (\pi \times 70 \times 60)/180$ $= 73.3 \text{ mm correct to 1dp}$	[1] [1]	
6	$\tan A = 75/250 = 0.3$ Angle A = $\tan^{-1} 0.3$ $= 16.699^\circ$ $= 17^\circ$ correct to the nearest degree	[1] [1]	

Question	Expected Answer	Mark	Rationale/Additional Guidance
Section A			
7	<p>Fig.1 Graph of $y = \sin \theta$</p>  <p>Marks: y axis +1 and -1 points x axis 180° and 360° points</p>	<p>[1] [1]</p>	<p>Accept correct curve without numerical value for full marks.</p>
8	<p>$\sin A = 3/5$ indicating a 3, 4 5 triangle $\cos A = 4/5$</p>	<p>[1] [1]</p>	<p>Accept any correct alternative method</p>
9	<p>$y = 2x^5 + 3x^4$ $dy/dx = 10x^4 + 12x^3$ $10x^4$ $12x^3$</p>	<p>[1] [1]</p>	
10	<p>$y = e^{-2x} + \ln(3x)$ $dy/dx = -2e^{-2x} + 1/x$ $-2e^{-2x}$ $+ 1/x$</p>	<p>[1] [1]</p>	

Question	Expected Answer	Mark	Rationale/Additional Guidance
Section A			
11	$\int (\cos x + \sin x) dx = \sin x - \cos x + C$ $\sin x - \cos x$ $+C$	[1] [1]	
12	$\int \cos 5x. dx = (\sin 5x)/5 + C$ $(\sin 5x)$ $/5$	[1] [1]	Ignore +C
13	(a)	Standardised score = $(86 - 74)/6 = 2$	[1]
	(b)	Standardised score = $(65 - 74)/6 = - 1.5$	[1]
14		Mean = $(7 + 7 + 11 + 9 + 10 + 10 + 10 + 12 + 8 + 8)/10 = 9.2$ Mode = 10 i.e. most frequently occurring value	[1] [1]
15	(a)	probability that a good fuse is chosen is $3/8$	[1]
	(b)	probability that a blown fuse is chosen is $5/8$.	[1]
		Total	[30]

Question	Expected Answer	Mark	Rationale/Additional Guidance
Section B			
1	(a)	Given $V = (4\pi R^3)/3$ When $R = 9$ m Then $V = (4 \times \pi \times 9^3)/3$ $= 3053.6 \text{ m}^3$ correct to 1 dp	[1] [1]
	(b) (i)	Given $V = (4\pi R^3)/3$. Multiply both sides by 3 then $4\pi R^3 = 3V$ Divide both sides by 4π then $R^3 = 3V/4\pi$ Cube root of both sides then $R = \sqrt[3]{(3V/4\pi)}$	[3]
	(ii)	When $V = 1000 \text{ mm}^3$ then $R^3 = (3 \times 1000)/4\pi$ So $R^3 = 238.7324$ So $R = \sqrt[3]{238.7324}$ So $R = 6.2 \text{ mm}$ correct to 1 dp	[2]
	(c)	Given $Z = \sqrt{(R^2 + X^2)}$ Square both sides then $Z^2 = R^2 + X^2$ Subtract X^2 from both sides then $R^2 = Z^2 - X^2$ square root both sides then $R = \sqrt{(Z^2 - X^2)}$	[1] [1] [1]
		Total	[10]

Question	Expected Answer	Mark	Rationale/Additional Guidance
2 (a)	<p>Total surface area of a cylinder = Cross-sectional area of two ends + curved surface area</p> <p>So $4400 = (\pi d^2)/2 + \pi dh$</p> <p>Multiply through by 2 so $8800 = \pi d^2 + 2\pi dh$</p> <p>Divide through by $22/7$ so $2800 = d^2 + 2dh$</p> <p>Now $h = 260$ mm.</p> <p>So $2800 = d^2 + 2d(260)$</p> <p>So $2800 = d^2 + 520d$</p> <p>Therefore So $d^2 + 520d - 2800 = 0$ QED</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p>	
(b)	<p>Given equation $d^2 + 520d - 2800 = 0$</p> <p>Solution of quadratic equation by formulae</p> <p>$d = [-b \pm \sqrt{b^2 - 4ac}]/2a$</p> <p>where $a = 1$, $b = 520$ and $c = -2800$</p> <p>so $d = [-520 \pm \sqrt{520^2 - 4 \times 1 \times -2800}]/(2 \times 1)$</p> <p>$d = [-520 \pm \sqrt{270400 + 11200}]/2$</p> <p>$d = [-520 \pm \sqrt{281600}]/2$</p> <p>$d = [-520 \pm 530.66]/2$</p> <p>Use $d = [-520 + 530.66]/2$</p> <p>$d = 10.66/2$</p> <p>$d = 5.33$ mm. correct to 2 dp.</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p>	
	Total	[10]	

Question	Expected Answer	Mark	Rationale/Additional Guidance
3	<p data-bbox="371 228 450 260">Fig. 2</p>  <p data-bbox="230 930 275 962">(a)</p> <p data-bbox="371 930 790 1058"> $\cot 32^\circ = Ax/18$ So $Ax = 18 \cot 32^\circ$ $= 28.8 \text{ m. correct to 1dp.}$ </p>	<p data-bbox="1272 930 1317 962">[1]</p> <p data-bbox="1272 1026 1317 1058">[1]</p>	
	<p data-bbox="230 1098 275 1129">(b)</p> <p data-bbox="371 1098 790 1225"> $\cot 22^\circ = Bx/18$ So $Bx = 18 \cot 22^\circ$ $= 44.6 \text{ m. correct to 1dp.}$ </p>	<p data-bbox="1272 1098 1317 1129">[1]</p> <p data-bbox="1272 1193 1317 1225">[1]</p>	
	<p data-bbox="230 1265 275 1297">(c)</p> <p data-bbox="371 1265 757 1297">Angle $AxB = 260 - 210 = 50^\circ$</p>	<p data-bbox="1272 1265 1317 1297">[1]</p>	

Question	Expected Answer	Mark	Rationale/Additional Guidance
(d)	$AB^2 = Ax^2 + Bx^2 - 2 \cdot Ax \cdot Bx \cdot \cos AxB$ $= 28.8^2 + 44.6^2 - 2 \times 28.8 \times 44.6 \cos 50^\circ$ $= 1167.3$ <p>Therefore $AB = \sqrt{1167.3} = 34.2$ m. correct to 1dp</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p>	
(e)	$Bx/\sin XAB = AB/\sin 50^\circ$ <p>So $\sin XAB = (44.6 \times \sin 50^\circ)/34.2$</p> $= 0.999 \text{ (approx 1)}$ <p>Angle $XAB = \sin^{-1} 0.999 = 90^\circ$ correct to the nearest degree</p>	<p>[1]</p> <p>[1]</p>	Accept 87° to 90°
	Total	[10]	

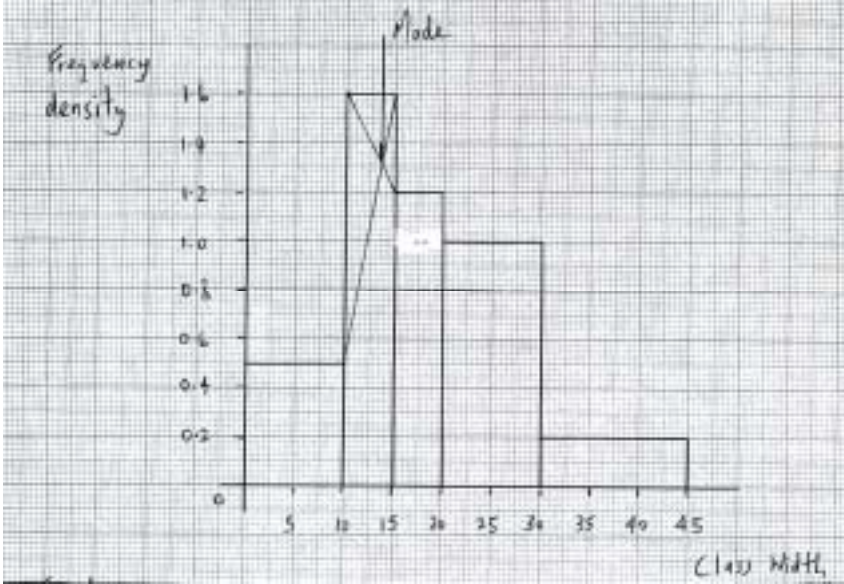
Question	Expected Answer	Mark	Rationale/Additional Guidance
(c) (i)	Given $\sin^2\theta - \cos^2\theta = 0.25$ But $\sin^2\theta + \cos^2\theta = 1$ so $\sin^2\theta = 1 - \cos^2\theta$ Replace $\sin^2\theta$ with $1 - \cos^2\theta$ So $(1 - \cos^2\theta) - \cos^2\theta = 0.25$ $1 - 2\cos^2\theta = 0.25$ Transpose $2\cos^2\theta = 1 - 0.25$ $= 0.75$ So $\cos^2\theta = 0.375$ Then $\cos\theta = \sqrt{0.375}$ $= \pm 0.6124$ So $\theta = \cos^{-1} 0.6124 = 52^\circ$ correct to the nearest degree.	 [1] [1] [1] [1] [1]	 All 3 answers for 1 mark
	Total	[10]	

Question	Expected Answer	Mark	Rationale/Additional Guidance
5 (a)	Given equation $y = x^3 + 3x^2 - 24x$ $dy/dx = 3x^2 + 6x - 24$ $dy/dx = 0$ for zero gradient so $3x^2 + 6x - 24 = 0$ $3(x^2 + 2x - 8) = 0$ $(x + 4)(x - 2) = 0$ So $x = -4$ or $x = +2$	 [1] [1] [1]	
(b)	At the maximum turning point $x = -4$ so substitute this value into the original equation $y = x^3 + 3x^2 - 24x$ $y = (-4)^3 + 3(-4)^2 - 24(-4)$ $y = +80$ At the minimum turning point $x = 2$ $y = x^3 + 3x^2 - 24x$ $y = (2)^3 + 3(2)^2 - 24(2)$ $y = -28$	 [1] [1] [1]	
(c)	Given equation $y = x^3 + 3x^2 - 24x$ $dy/dx = 3x^2 + 6x - 24$ $d^2y/dx^2 = 6x + 6$ When $x = -4$ then $d^2y/dx^2 = (6 \times -4) + 6 = -18$ i.e. Maximum turning point When $x = +2$ then $d^2y/dx^2 = (6 \times 2) + 6 = +18$ i.e. Minimum turning point	 [2] [1] [1]	Award 1 mark for $6x$ and 1 mark for $+6$
	Total	[10]	

Question			Expected Answer	Mark	Rationale/Additional Guidance
6	(a)	(i)	<p>Given distance $s = \int_{t_1}^{t_2} v \, dt.$</p> <p>So $s = \int_0^4 (4 + 6t) \, dt.$</p> <p>$s = [4t + 3t^2]_0^4$</p> <p>$s = (16 + 48) - 0 = 64 \text{ meters}$</p>	<p>[1]</p> <p>[1]</p>	
	(a)	(ii)	<p>So $s = \int_4^5 (4 + 6t) \, dt.$</p> <p>$s = [4t + 3t^2]_4^5$</p> <p>$s = (20 + 75) - (16 + 48) = 31 \text{ meters}$</p>	<p>[1]</p> <p>[1]</p>	

Question	Expected Answer	Mark	Rationale/Additional Guidance
(b)	<p>At the points of intersection the straight line and the curve are equal.</p> <p>Given equations are $y = x^2 + 4$ and $y = 24 - x$</p> <p>So $x^2 + 4 = 24 - x$</p> <p>Which gives $x^2 + 4 - 24 + x = 0$</p> $x^2 + x - 20 = 0$ <p>So $(x - 4)(x + 5) = 0$</p> <p>So $x = +4$ and -5</p> <p>So area $= \int_{-5}^4 (24 - x) dx - \int_{-5}^4 (x^2 + 4) dx.$</p> $= [24x - x^2/2]_{-5}^4 - [x^3/3 + 4x]_{-5}^4$ $= [20x - x^2/2 - x^3/3]_{-5}^4$ <p>$= (96 - 8) - (-120 - 12.5) - ((64/3 + 16) - (-125/3 - 20))$</p> <p>$= 88 + 132.5 - 112/3 - 185/3$</p> <p>$= 121.5$ square units correct to 1 dp</p>	<p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p>	
	Total	[10]	

Question		Expected Answer			Mark	Rationale/Additional Guidance
7	(a)	Time in minutes (t)			[2]	Award 1 mark for correct Class Width column and 1 mark for frequency density column
		Frequency (f)	Class width	Frequency density		
		$0 \geq t < 10$	5	10	0.5	
		$10 \geq t < 15$	8	5	1.6	
		$15 \geq t < 20$	6	5	1.2	
		$20 \geq t < 30$	10	10	1	
		$30 \geq t < 45$	3	15	0.2	

Question	Expected Answer	Mark	Rationale/Additional Guidance
(b)	<p>Fig. 4 Histogram</p> 	[4]	<p>Accept error carried forward from part (a) Award 1 mark for frequency density axis Award 1 mark for class width axis Award 1 mark for position of 10/15/20/30/45 Award 1 mark for position of 0.5/1.6/1.2/1/0.2</p>
(c)	The histogram is positively skewed.	[1]	
(d)	The modal group is 10 – 15 minutes.	[1]	
(e)	Mode = 13.5 minutes	[2]	<p>Accept any value between 12.5 and 14.5 minutes for 2 marks. Award 1 mark for any understanding of mode within question part(e)</p>
	Total	[10]	

Question		Expected Answer	Mark	Rationale/Additional Guidance																																										
8	(a)	<table style="border-collapse: collapse; margin-left: 20px;"> <tr> <td style="padding-right: 10px;">(x)</td> <td style="padding-right: 10px;">(f)</td> <td style="padding-right: 10px;">fx</td> <td style="padding-right: 10px;">$x - \text{mean}$</td> <td style="padding-right: 10px;">$(x - \text{mean})^2$</td> <td style="padding-right: 10px;">$f(x - \text{mean})^2$</td> </tr> <tr> <td>30</td> <td>1</td> <td>30</td> <td>-24</td> <td>576</td> <td>576</td> </tr> <tr> <td>54</td> <td>1</td> <td>54</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>56</td> <td>3</td> <td>168</td> <td>2</td> <td>4</td> <td>12</td> </tr> <tr> <td>57</td> <td>2</td> <td>114</td> <td>3</td> <td>9</td> <td>18</td> </tr> <tr> <td>58</td> <td>3</td> <td>174</td> <td>4</td> <td>16</td> <td>48</td> </tr> <tr> <td colspan="2" style="text-align: center;">$\Sigma 10$</td> <td style="text-align: center;">$\Sigma 540$</td> <td></td> <td></td> <td style="text-align: center;">$\Sigma 654$</td> </tr> </table>	(x)	(f)	fx	$x - \text{mean}$	$(x - \text{mean})^2$	$f(x - \text{mean})^2$	30	1	30	-24	576	576	54	1	54	0	0	0	56	3	168	2	4	12	57	2	114	3	9	18	58	3	174	4	16	48	$\Sigma 10$		$\Sigma 540$			$\Sigma 654$	[5]	Award 1 mark for each column
		(x)	(f)	fx	$x - \text{mean}$	$(x - \text{mean})^2$	$f(x - \text{mean})^2$																																							
30	1	30	-24	576	576																																									
54	1	54	0	0	0																																									
56	3	168	2	4	12																																									
57	2	114	3	9	18																																									
58	3	174	4	16	48																																									
$\Sigma 10$		$\Sigma 540$			$\Sigma 654$																																									
Mean = $540/10 = 54$	[1]	Error carried forward from f and fx column																																												
Variance = $654/10 = 65.4$	[1]	Error carried forward from f and $f(x - \text{mean})^2$ column																																												
Standard deviation = $\sqrt{65.4} = 8.09$ correct to 2dp	[1]	Error carried forward from variance value																																												
	(b)	Mean – the value would increase	[1]																																											
		Standard deviation – the value would reduce	[1]																																											
		Total	[10]																																											

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