

Mark Scheme for January 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.





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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

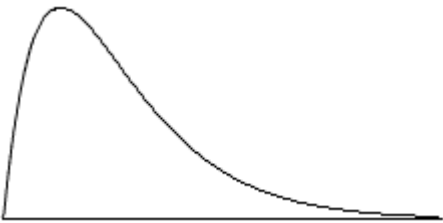
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1. Annotations

Annotation	Meaning
	Correct
	Incorrect
	Error carried forward
	Benefit of doubt

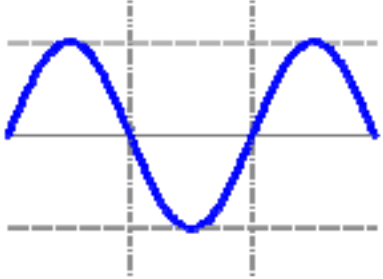
Question	Expected Answer	Mark	Rationale/Additional Guidance
Section A			
1	$-4(-3x - 5) = 12x + 20$ $12x$ 20	[1] [1]	Award two marks for $12x + 20$ seen. Ignore subsequent working
2	$x^2 - 25 = (x + 5)(x - 5)$ $(x + 5)$ $(x - 5)$	[1] [1]	
3	$(x + 6)/4 - (x + 5)/8 = (2x + 12 - x - 5)/8 = (x + 7)/8$ $(2x + 12 - x - 5)/8$ $(x + 7)/8$	[1] [1]	
4	$(2x - 3)/4 = (x - 1)/3$ $6x - 9 = 4x - 4$ $6x - 4x = -4 + 9$ $2x = 5$ $x = 2.5$	[1] [1]	
5	$\text{Area of sector} = (r^2 \alpha)/2$ $= (100^2 \times 1.2)/2$ $= 6000 \text{ m}^2$	[1] [1]	Award one mark for correct numerical value with or without the unit
6	$\sin 30^\circ = BC/1.5$ $BC = 1.5 \sin 30^\circ$ $= 1.5 \times 0.5$ $= 0.75 \text{ m}$	[1] [1]	Award one mark for correct numerical value with or without the unit
7	$v = 50 \sin \theta$ $= 50 \sin 210^\circ$		

Question	Expected Answer	Mark	Rationale/Additional Guidance
Section A			
	$= 50x - 0.5$ $= -25 \text{ V}$	[1] [1]	Award one mark for correct numerical value with or without the unit
8	cross-sectional area = $\frac{1}{2}bh$ $= \frac{1}{2} \times 0.8 \times 0.5$ $= 0.2 \text{ m}^2$	[1] [1]	Award one mark for correct numerical value with or without the unit
9	$y = 5x^4 + \sin x$ $dy/dx = 20x^3 + \cos x$ $20x^3$ $\cos x$	[1] [1]	
10	$y = \cos x + \ln(5x)$ $dy/dx = -\sin x + 1/x$ $-\sin x$ $1/x$	[1] [1]	
11	$\int \cos(4x) dx = \frac{\sin 4x}{4} + C$ $\frac{\sin 4x}{4}$ $+C$	[1] [1]	
12	$\int_4^6 4x^3 dx = \left[\frac{4x^4}{4} \right]_4^6$ $= 6^4 - 4^4 = 1040$	[1] [1]	
13	Mean = $(5 + 9 + 7 + 15 + 8 + 12 + 7)/7$ $= 63/7 = 9$ 5 7 7 <u>8</u> 9 12 15 Median = 8	[1] [1]	

Question	Expected Answer	Mark	Rationale/Additional Guidance	
Section A				
14		[2]	Award one or two marks dependent upon correct shape and positive skew.	
15	(a)	40/55 or 8/11	[1]	Accept decimal equivalent for one mark.
	(b)	15/55 or 3/11	[1]	Accept decimal equivalent for one mark.
Total			[30]	

Question	Expected Answer	Mark	Rationale/Additional Guidance
Section B			
1	(a)	<p>Given $R = R_0(1 + \alpha t)$ When $R_0 = 10$, $\alpha = 0.006$ and $t = 100$. Then $R = 10(1 + 0.006 \times 100)$ $= 10 \times 1.6$ $= 16$</p>	[1] [1]
1	(b) (i)	<p>Given $R = R_0(1 + \alpha t)$ Divide both sides by R_0 then $R/R_0 = (1 + \alpha t)$ Subtract both sides by -1 then $[R/R_0] - 1 = \alpha t$ Divide both sides by α then $t = \{[R/R_0] - 1\}/\alpha$</p>	[1] [1] [1]
	(ii)	<p>$R = 25$, $R_0 = 12.5$ and $\alpha = 0.006$ $t = \{[R/R_0] - 1\}/\alpha$ $t = \{[25/12.5] - 1\}/0.006$ $t = 166.66$</p>	[1] [1] [1] Do not accept error carried forward for formula. Accept answers between 166 and 167.
1	(c)	<p>Given $W = \frac{1}{2}CV^2$ Multiply both sides by 2 then $2W = CV^2$ Divide both sides by C then $2W/C = V^2$ Square root both sides then $V = \sqrt{2W/C}$</p>	[1] [1]
		Total	[10]

Question	Expected Answer	Mark	Rationale/Additional Guidance
2 (a)	Factorisation. Given $3x^2 + 14x + 8 = 0$ By inspection $(3x + 2)(x + 4) = 0$ So $(3x + 2) = 0$ then $3x = -2$ so $x = -\frac{2}{3}$ So $(x + 4) = 0$ then $x = -4$	[1] [1] [1]	
2 (b)	Completing the square. Given $x^2 - 4x = 5$ Divide both sides of the equation by the value of a i.e. 1. So equation becomes $x^2 - 4x = 5$ Add to each side of the equation the square of one-half of the value of b i.e 4 So equation becomes $x^2 - 4x + (4/2)^2 = 5 + (4/2)^2$ Then $x^2 - 4x + 4 = 5 + 4 = 9$ So $(x - 2)^2 = 9$ $x - 2 = \sqrt{9} = \pm 3$ So $x = +3 + 2 = 5$ Or $x = -3 + 2 = -1$	[1] [1] [1]	
2 (c)	Given $x^2 - 4x - 12 = 0$. Solution of quadratic equation by formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ where $a = 1$, $b = -4$ and $c = -12$ so $x = \frac{4 \pm \sqrt{(-4)^2 - 4 \times 1 \times -12}}{2 \times 1}$ $x = \frac{4 \pm \sqrt{16 + 48}}{2}$ $x = \frac{4 \pm \sqrt{64}}{2}$ $x = \frac{4 \pm 8}{2}$ Use $x = \frac{4 + 8}{2}$ $x = 6$ Or $x = \frac{4 - 8}{2}$. $x = -2$	[1] [1] [1] [1]	
	Total	[10]	

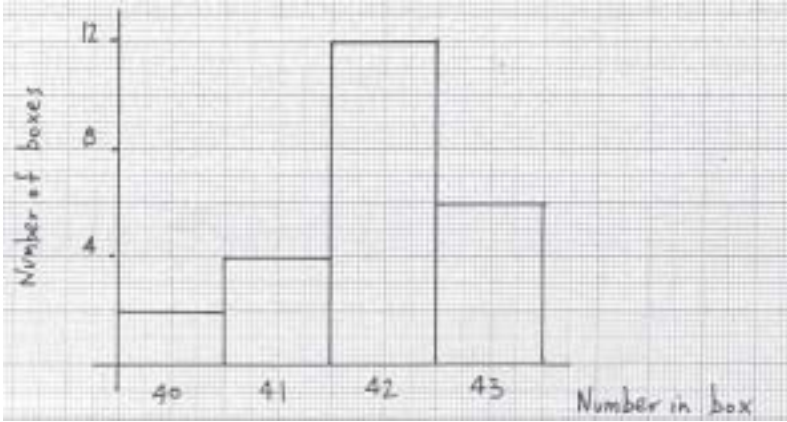
Question	Expected Answer	Mark	Rationale/Additional Guidance
3 (a)	(i) Given $v = 200 \sin 100\pi t$ volts. By observation Peak value = 200 V (ii) By observation $2\pi ft = 100\pi t$ Frequency $f = 100\pi t / 2\pi t = 50$ Hz (iii) Periodic time $T = 1/f = 1/50$ $= 0.02$ s (iv) $v = 200 \sin (100\pi t)$ volts $= 200 \sin (100\pi \times 0.015)$ (Remember radians) $= 200 \times -1 = -200$ V	[1] [1] [1] [1] [1] [1] [3]	Award one mark for correct numerical value with or without the unit Award one mark for correct numerical value with or without the unit
3 (b)	 <p>0 0.02 s</p> [10]	Award one mark for correct numerical value with or without the unit Award one mark for correct numerical value with or without the unit
TOTAL			Award one mark for the peak value at 200 V Award one mark for periodic time 0 to 360° along the x axis ie $T = 0.02$ s Award one mark for the shape of the sine wave

Question		Expected Answer	Mark	Rationale/Additional Guidance
4	(a)	$\sin 32^\circ = 200/AB$ So $AB = 200/\sin 32^\circ$ $= 377.42 \text{ m}$	[1] [1] [1]	Accept answers between 377 and 378 m. Award one mark for correct numerical value with or without the unit
4	(b)	$\tan 32^\circ = 200/BD$ So $BD = 200/\tan 32^\circ$ $= 320.07 \text{ m}$ $\tan 45^\circ = 200/DC$ So $DC = 200/\tan 45^\circ$ $= 200 \text{ m.}$ Then length $BC = 320.07 + 200 = 520.07\text{m}$	[1] [1] [1] [1]	Accept answers between 320 and 321 m. Award one mark for correct numerical value with or without the unit Award one mark for correct numerical value with or without the unit Award one mark for correct numerical value with or without the unit Accept answers between 520 and 520.5 m
4	(c)	$32^\circ + 45^\circ + \text{Angle BAC} = 180^\circ$ So $\text{Angle BAC} = 180^\circ - 32^\circ - 45^\circ$ $\text{Angle BAC} = 103^\circ$	[1] [1] [1]	Award one mark for correct numerical value with or without the unit
Total			[10]	

Question	Expected Answer	Mark	Rationale/Additional Guidance
5 (a)	Given $V = \frac{1}{3} \pi r^2 h$. Substitute $h = 6 - r$ into the formula. Then $V = \frac{1}{3} \pi r^2(6 - r)$	[1]	
5 (b)	$V = \frac{1}{3} \pi r^2(6 - r)$ $= 2 \pi r^2 - \frac{1}{3} \pi r^3$ So $dV/dr = 4 \pi r - \pi r^2$	[1] [1]	
5 (c)	$dV/dr = 0$ at a turning point	[1]	
5 (d)	$dV/dr = 4 \pi r - \pi r^2$ So $0 = 4 \pi r - \pi r^2$ then $0 = r(4 \pi - \pi r)$ So $r = 0$ and $(4 \pi - \pi r) = 0$ From $4 \pi - \pi r = 0$ $4 \pi = \pi r$ So $r = 4$ The values for r at the turning points are 0 and 4.	[1] [1]	
5 (e)	Check that $r = 4$ is at a maximum volume. $dV/dr = 4 \pi r - \pi r^2$ $d^2V/dr^2 = 4 \pi - 2 \pi r$ When $r = 4$ $d^2V/dr^2 = 4 \pi - 8 \pi = -4 \pi$ The negative value confirms that $r = 4$ is at a maximum volume.	[1] [1] [1] [1]	
	Total	[10]	

Question	Expected Answer	Mark	Rationale/Additional Guidance
6 (a)	Given equation $v = 3\sin 3t + 4t^3$ $\text{distance } s = \int_{t_1}^{t_2} v \, dt.$ $\text{distance } s = \int_0^2 (3\sin 3t + 4t^3) \, dt.$ $\text{distance } s = [-\cos 3t + t^4]_0^2$ $s = (-\cos 6 + 16) - (-\cos 0 + 0)$ $s = -0.96 + 16 + 1$ $s = 16.04$	[1] [1] [1] [1] [1]	Accept any answer between 16 and 16.5
6 (b)	$\text{Area} = \int_1^5 y \, dx.$ $\text{Area} = \int_1^5 (x^3 + 4) \, dx.$ $\text{Area} = [x^4/4 + 4x]_1^5$ $\text{Area} = (625/4 + 20) - (1/4 + 1)$ $\text{Area} = 175$	[1] [1] [1] [1] [1]	
7 (a)	<p style="text-align: right;">Total</p> <p>The addition law of probability is recognised by the word "OR" joining the probabilities. Let P_x be the probability of event x happening and let P_y be the probability of event y happening. IF events x and y are mutually exclusive then $P(x \text{ OR } y) = P(x) + P(y).$</p>	[10] [1] [1]	

Question		Expected Answer	Mark	Rationale/Additional Guidance																																
		IF events are not mutually exclusive then $P(x \text{ OR } y) = P(x) + P(y) - P(x \text{ AND } y)$.																																		
7	(b)	The multiplication law of probability is recognised by the word "AND" joining the probabilities. Let P_x be the probability of event x happening and let P_y be the probability of event y happening. IF events x and y are independent then $P(x \text{ AND } y) = P(x).P(y)$ IF events x and y are NOT independent then $P(x \text{ AND } y) = P(x).P(y/x)$ (ie conditional probability)	[1] [1]																																	
7	(c)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">1st draw</td> <td style="text-align: center;">2nd draw</td> <td style="text-align: center;">3rd draw</td> <td></td> </tr> <tr> <td>SSW 36/200</td> <td>35/199</td> <td>74/198</td> <td>= 0.01183</td> </tr> <tr> <td>SSN 36/200</td> <td>35/199</td> <td>90/198</td> <td>= 0.01439</td> </tr> <tr> <td>WSS 74/200</td> <td>36/199</td> <td>35/198</td> <td>= 0.01183</td> </tr> <tr> <td>NSS 90/200</td> <td>36/199</td> <td>35/198</td> <td>= 0.01439</td> </tr> <tr> <td>SWS 36/200</td> <td>74/199</td> <td>35/198</td> <td>= 0.01183</td> </tr> <tr> <td>SNS 36/200</td> <td>90/199</td> <td>35/198</td> <td>= 0.01439</td> </tr> <tr> <td style="text-align: center;">[1]</td> <td style="text-align: center;">[1]</td> <td style="text-align: center;">[1]</td> <td style="text-align: center;">[1]</td> </tr> </table> Probability = $(3 \times 0.01439) + (3 \times 0.01183)$ = $0.04317 + 0.03549$ = 0.079	1 st draw	2 nd draw	3 rd draw		SSW 36/200	35/199	74/198	= 0.01183	SSN 36/200	35/199	90/198	= 0.01439	WSS 74/200	36/199	35/198	= 0.01183	NSS 90/200	36/199	35/198	= 0.01439	SWS 36/200	74/199	35/198	= 0.01183	SNS 36/200	90/199	35/198	= 0.01439	[1]	[1]	[1]	[1]	[4] [1] [1]	Award one mark for each correct numerical column up to a maximum of four
1 st draw	2 nd draw	3 rd draw																																		
SSW 36/200	35/199	74/198	= 0.01183																																	
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[1]	[1]	[1]	[1]																																	
Total			10																																	

Question	Expected Answer	Mark	Rationale/Additional Guidance
8 (a)	Data Handling: Collection of data Analysis of data	[1] [1]	Accept other reasonable relevant phrases such as: interrogation, charting, statistical calculations, recording etc.
(b)		[2]	Award one mark for correct vertical and horizontal axes. Award one mark for correct size and position of quantities. Accept a correct bar chart with thin unconnected bars rather than joined up ones
(c)	$\Sigma x = 20 + 30 + 40 + 50 + 60 = 200$ $\text{Mean} = 200/5 = 40$ $\Sigma x^2 = 20^2 + 30^2 + 40^2 + 50^2 + 60^2 = 9000$ $\text{Standard deviation} = \sqrt{(\Sigma x^2/n) - (\Sigma x/n)^2}$ $= \sqrt{(9000/5) - (200/5)^2}$ $= \sqrt{(1800 - 1600)}$ $= \sqrt{200}$ $= 14.14$	[1] [1] [1] [1] [1] [1]	Accept any answer between 14 and 14.5
Total		[10]	

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