FSMQ

Additional Mathematics

ADVANCED FSMQ **6993**

Mark Scheme for the Unit

June 2008

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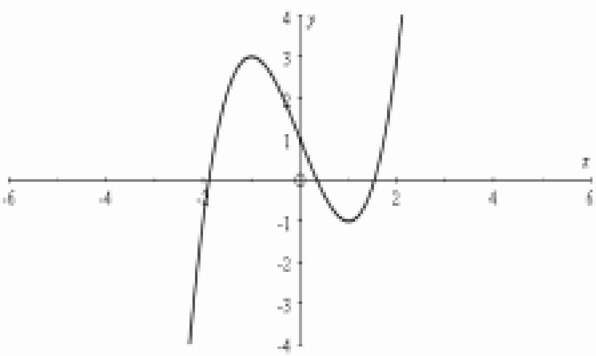
Additional Mathematics FSMQ (6993)

MARK SCHEME FOR THE UNIT

6993 Additional Mathematics

Section A

Q.		**Answer**	**Marks**	**Notes**
1	**(i)**	$v = u + at$ with $v = 0, u = 30, t = 10$ $\Rightarrow 10a = -30$ $\Rightarrow a = -3$ Deceleration is 3 ms^{-2}	M1 A1 **2**	Must be used a = 3 or decel = −3 are wrong
	(ii)	E.g. $v^2 = u^2 + 2as$ with $v = 0, u = 30, a = -3$ $\Rightarrow 6s = 900$ $\Rightarrow s = 150$ Distance is 150 m Alternatives: $s = \left(\frac{u+v}{2}\right)t$ with $v = 0, u = 30, t = 10$ $\Rightarrow s = 15 \times 10 = 150$ Or: $s = ut + \frac{1}{2}at^2$ with $u = 30, t = 10, a = -3$ $\Rightarrow s = 300 - 150 = 150$ Or: $s = vt - \frac{1}{2}at^2$ with $v = 0, t = 10, a = -3$ $\Rightarrow s = 0 - (-150) = 150$	M1 A1 **2**	 Allow alternatives
2	**(i)**	$\frac{x}{6} + \frac{y}{8} = 1$ $\Rightarrow 4x + 3y = 24$ Any correct equation will do. Usual answer $y = -\frac{4}{3}x + 8$ **SC.** Omission of $y =$: give M1 A0	B1 soi M1 A1 isw **3**	Gradient Any valid method In form $ax + by = c$ N.B. Drawing of graph is 0.
	(ii)	Midpoint is (3, 4) Gradient is $\frac{3}{4}$ $\Rightarrow$ equation is $y - 4 = \frac{3}{4}(x - 3)$ $\Rightarrow 4y = 3x + 7$ **SC.** Omission of $y =$: give M1 A0	B1 soi E1 M1 A1 **4**	 -ve reciprocal of their gradient Use *their* gradient plus *their* midpoint In form $ax + by = c$ N.B. Drawing of graph is 0.

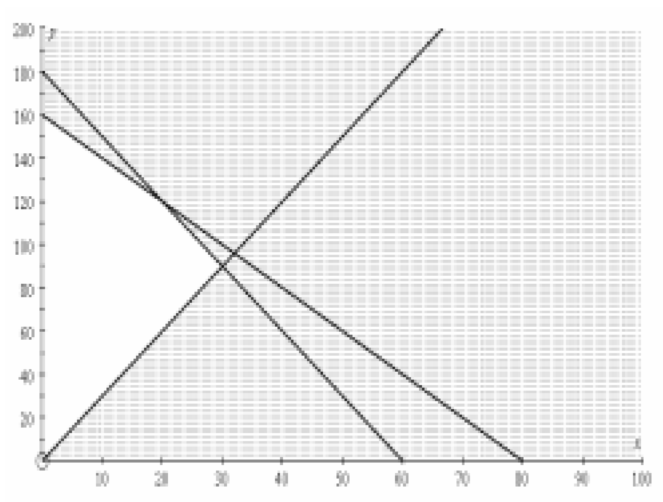
Q.		Answer	Marks	Notes
3		$x^2+(5x+13)^2=13$ $\Rightarrow x^2+25x^2+130x+169-13=0$ $\Rightarrow 26x^2+130x+156=0$ $\Rightarrow x^2+5x+6=0$ $\Rightarrow (x+2)(x+3)=0 \Rightarrow x=-2,-3$ $\Rightarrow y=3,-2$ $\Rightarrow$ Points of intersection $(-2,3),(-3,-2)$ **SC:** For each pair obtained from accurate graph or table of values, or trial, B1	M1 A1 soi M1 A1 A1 **5**	Attempt at substitution. Expansion of $(5x+13)^2$ Solve 3 term quadratic Either both x or one pair Either both y or other pair
4	**(i)**	$\left(\frac{7}{10}\right)^5 \approx 0.168$	B1 soi B1 **2**	p **and** power Ans
	(ii)	$\binom{5}{3}\left(\frac{7}{10}\right)^3\left(\frac{3}{10}\right)^2 \approx 0.3087$ 0 if more than one term *Allow 3, 4 or 5 sig figs in both parts* *Apply tmsf or tfsf otherwise.*	B1 soi B1 B1 **3**	coeff powers mult (p correct) ans
5	**(i)**	$y=x^3-3x+1 \Rightarrow \frac{dy}{dx}=3x^2-3$ $\frac{dy}{dx}=0$ when $x=\pm1$, giving $(1,-1)$ and $(-1,3)$ $\frac{d^2y}{dx^2}=6x$; when $x=1, \frac{d^2y}{dx^2}>0$ giving minimum at $x=1$ when $x=-1, \frac{d^2y}{dx^2}<0$ giving maximum at $x=-1$ Any alternative method OK.	B1 M1 A1 A1 M1 A1 **6**	Correct derivative Setting their derivative $=0$ Both x or one pair Both y or other pair (*y values could be seen in (ii)*) Identify one turning point Both correct
	(ii)	 Curve to be consistent in (i)	E1 **1**	General shape including axes and turning points At *their* x values. (but don't worry about intercepts on the axes.) This *does* require a scale on the x axis.

Q.		Answer	Marks	Notes
6	(i)	$a = \dfrac{dv}{dt} = 0.72t - 0.072t^2$	M1 A1 A1 **3**	Diffn Each term
	(ii)	$s = \int_0^{10} \left(0.36t^2 - 0.024t^3\right) dt = \left[0.12t^3 - 0.006t^4\right]_0^{10}$ $= 120 - 60 = 60\,\text{m}$ N.B. Watch $s = \left(\dfrac{0+12}{2}\right)10 = 60$	M1 A1 M1 A1 **4**	Int the given fn Both terms Deal with def.int
7	(i)	$\dfrac{AC}{VC} = \tan 40 \Rightarrow AC = 10\tan 40 = 8.39$ m **Alt forms for AC acceptable.** i.e. $AC = \dfrac{10\sin 40}{\sin 50} = \dfrac{10}{\tan 50}$	B1 B1 **2**	Tan function Correct
	(ii)	Angle C = $180 - 50 - 60 = 70$ $\Rightarrow \dfrac{AB}{\sin C} = \dfrac{AC}{\sin B}$ $\Rightarrow AB = 8.39 \times \dfrac{\sin 70}{\sin 60} = 9.10$ m	B1 M1 F1 A1 **4**	 To find AB Must be 3 s.f.
8	(i)	$2(1-\sin^2 x) = 5\sin x - 1$ $\Rightarrow 2\sin^2 x + 5\sin x - 3 = 0$	M1 A1 **2**	Use of pythag.to change $\cos^2$ **All working - answer given**
	(ii)	$(2\sin x - 1)(\sin x + 3) = 0$ $\Rightarrow \sin x = \dfrac{1}{2}$ $\Rightarrow x = 30^0, 150^0$ **SC.** $\sin x = -\dfrac{1}{2} \Rightarrow x = 210, 330$ M1 A0 A0 F1	M1 A1 A1 F1 **4**	Solve quad in sin x or s etc ½ seen 30 seen 180 – ans (only one extra angle)
9		3 roots are 1, 2, 13 – allow ±1, ±2, ±13 Equation is $(x-1)(x-2)(x-13) = 0$ Giving $x^3 - 16x^2 + 41x - 26 = 0$ i.e. $a = -16$, $b = 41$ (Can be seen in cubic. **Alternative method.** $f(1) = 0 \Rightarrow a + b = 25$ B1 $f(2) = 0 \Rightarrow 4a + 2b = 18$ B1 Solve to give a and b M1 A1, A1	B1 soi B1 M1 A1 A1 isw **5**	 Factor form. Condone no = 0 Expand to give cubic

Section B

Q.		**Answer**	**Marks**	**Notes**
10	**(i)**	$\frac{140}{v}$, $\frac{140}{v+5}$	B1 B1 **2**	
	(ii)	Gavin's time minus Simon's time is 15 mins = $\frac{1}{4}$hr $\Rightarrow \frac{140}{v} - \frac{140}{v+5} = \frac{1}{4}$ $\Rightarrow 4\left(140(v+5) - 140v\right) = v(v+5)$ $\Rightarrow 2800 = v(v+5) \Rightarrow v^2 + 5v - 2800 = 0$	B1 B1 M1 A1 soi A1 **5**	¼ hr Subtract Clear fractions 700
	(iii)	$v = \frac{-5 \pm \sqrt{25 + 4 \times 2800}}{2} \approx 50.47$ or 50.5 $\Rightarrow$ Gavin: 2.77 hrs, Simon 2.52 hrs $\Rightarrow$ Gavin takes 2 hrs 46 mins (166 mins) Simon takes 2 hrs 31 mins (151 mins) **SC** For v = 50 $\Rightarrow$ 168, 153 give full marks but -1 tfsf	M1 A1 M1 A1 F1 **5**	Solve in decimals (ignore anything else) Convert (only one needs to be seen) Or give B1 for both in decimals This is for one 15 less than the other

Q.		**Answer**	**Marks**	**Notes**
11	**(i)**	$2 = 16\lambda \Rightarrow \lambda = \frac{1}{8}$	B1 **1**	
	(ii)	$\frac{dy}{dx} = \frac{1}{8}.2x = \frac{x}{4}$ When $x = 4, \frac{dy}{dx} = 1$ $\Rightarrow$ Tangent at T is $y - 2 = 1(x - 4)$ $\Rightarrow y = x - 2$ When $y = 0, x = 2$ So B is (2, 0)	E1 M1 A1 DM1 A1 A1 **6**	Correct derivative from their λ or leaving it in Sub $x = 4$ (numeric gradient to give tangent)
	(iii)	Area under curve = $\int_0^4 \frac{x^2}{8} dx = \left[\frac{x^3}{24}\right]_0^4$ Area of triangle = 2 Shaded area = $\left[\frac{x^3}{24}\right]_0^4 - 2 = 2\frac{2}{3} - 2 = \frac{2}{3}$ **N.B.** Area under (curve − line) from 0 to 4 M1 A1 only	M1 A1 B1 M1 A1 **5**	Int. Function Sub limits for int and subtract triangle

Q.		Answer	Marks	Notes
12	**(i)**	Worker hours for tables = $12x$ Worker hours for chairs = $6y$ $\Rightarrow 12x + 6y \le 24 \times 40 = 960 \Rightarrow 2x + y \le 160$	M1 A1 **2**	Must see $12x$ and $6y$
	(ii)	$30x + 10y \le 1800$ $(\Rightarrow 3x + y \le 180)$ $y \ge 3x$	M1 A1 B1 **3**	 Does not have to be simplified
	(iii)	 N.B. Intercepts on axis must be seen N.B. Ignore < instead of ≤	B1 B1 E1 E1 **4**	Each line For $y \ge 3x$ Must be a region including the y axis as boundary
	(iv)	We wish to maximise the profit. Profit per table = 20, profit per chair = 5 i.e. $P = 20x + 5y$	B1 **1**	Something that connects 20 with x
	(v)	Greatest profit will occur where the lines $y = 3x$ and $3x + y = 180$ intersect. This is at (30, 90). Allow even if shading for $y \ge 3x$ is wrong. **SC:** Trying all corners without the corect answers B1 **SC:** Drawing an O.F. line without the right answer B1	 B1 B1 **2**	 30 ± 2 90 ± 2 But answers must be integers.

13	**(i)**	Angles on straight line means $\alpha = 180 - \beta$ And $\cos(180 - \beta) = -\cos\beta$	B1 B1 **2**	Must make reference to the figure of the question
	(ii)	$\cos\alpha = \dfrac{x^2 + \left(\frac{a}{2}\right)^2 - c^2}{2.\left(\frac{a}{2}\right)x}$ $= \dfrac{x^2 + \frac{1}{4}a^2 - c^2}{ax} = \dfrac{4x^2 + a^2 - 4c^2}{4ax}$	M1 A1 **2**	Correct cosine formula. Condone missing brackets.
	(iii)	$\cos\beta = \dfrac{4x^2 + a^2 - 4b^2}{4ax}$ N.B. also $-\dfrac{4x^2 + a^2 - 4c^2}{4ax}$	B1 **1**	
	(iv)	$\dfrac{4x^2 + a^2 - 4b^2}{4ax} = -\dfrac{4x^2 + a^2 - 4c^2}{4ax}$ $\Rightarrow 4x^2 + a^2 - 4b^2 = -\left(4x^2 + a^2 - 4c^2\right)$ $\Rightarrow 4x^2 + a^2 - 4b^2 = -4x^2 - a^2 + 4c^2$ $\Rightarrow 8x^2 + 2a^2 = 4\left(b^2 + c^2\right)$ $\Rightarrow 4x^2 + a^2 = 2\left(b^2 + c^2\right)$	M1 M1 A1 M1 A1 **5**	Use of (i), (ii) and (iii) Clear fractions Simplify
	(v)	$a = 46,\ b = 29,\ c = 27$ gives $4x^2 + 46^2 = 2(29^2 + 27^2)$ gives $x^2 = 256$ i.e. $x = 16$ **S.C.** Use of cosine formula in large triangle to get an angle (C = 36.2, B = 33.4) Then use of cosine formula in small triangle to get $x = 16$ M1, A1 only if the answer is 16. **SC:** Scale drawing gets 0.	M1 A1 **2**	Can be substituted in any order

Grade Thresholds

FSMQ Advanced Mathematics 6993

June 2008 Assessment Series

Unit Threshold Marks

Unit	Maximum Mark	A	B	C	D	E	U
6993	100	68	58	48	38	29	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
6993	26.4	36.7	46.5	56.0	64.7	100	7261

Statistics are correct at the time of publication

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