



**Grade thresholds** taken for Syllabus 0606 (Additional Mathematics) in the June 2004 examination.

	maximum mark available	minimum mark required for grade:		
		A	C	E
Component 1	80	53	27	18
Component 2	80	57	31	21

Grade A\* does not exist at the level of an individual component.

## Mark Scheme Notes

- Marks are of the following three types:
  - M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
  - A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).
  - B Mark for a correct result or statement independent of method marks.
- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep\*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- The symbol  $\surd$  implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.
- Note: B2 or A2 means that the candidate can earn 2 or 0.  
B2, 1, 0 means that the candidate can earn anything from 0 to 2.
- The following abbreviations may be used in a mark scheme or used on the scripts:
  - AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
  - BOD Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)
  - CAO Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
  - ISW Ignore Subsequent Working
  - MR Misread
  - PA Premature Approximation (resulting in basically correct work that is insufficiently accurate)
  - SOS See Other Solution (the candidate makes a better attempt at the same question)

## Penalties

- MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through  $\checkmark$ " marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy.
- OW –1, 2 This is deducted from A or B marks when essential working is omitted.
- PA –1 This is deducted from A or B marks in the case of premature approximation.
- S –1 Occasionally used for persistent slackness.
- EX –1 Applied to A or B marks when extra solutions are offered to a particular equation.

**JUNE 2004**

**INTERNATIONAL GCSE**

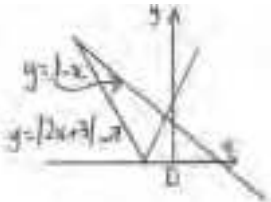
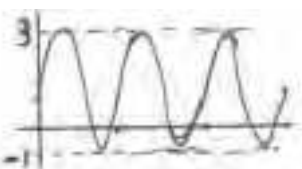
**MARK SCHEME**

**MAXIMUM MARK: 80**

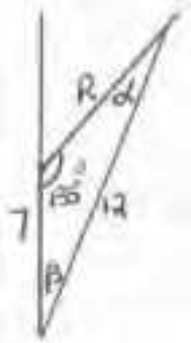
**SYLLABUS/COMPONENT: 0606/01**

**ADDITIONAL MATHEMATICS  
Paper 1**

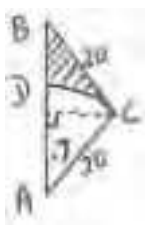
Page 1	Mark Scheme	Syllabus	Paper
	ADDITIONAL MATHEMATICS– JUNE 2004	0606	1

<p>1. (i) <math>y = (3x-2) \div (x^2+5)</math>  <math>dy/dx = \frac{(x^2+5)3 - (3x-2)2x}{(x^2+5)^2}</math></p> <p>(ii) Num = <math>15 + 4x - 3x^2 = 0</math> when  <math>\rightarrow x = -5/3</math> or <math>x = 3</math></p>	<p>M1 A1</p> <p>M1 A1</p> <p>[4]</p>	<p>Formula must be correct - allow unsimplified.</p> <p>Setting to 0 + attempt to solve. Both correct.</p>
<p>2. <math>x^3 = 5x-2</math>  <math>x^3 - 5x + 2 = 0</math> Tries to find a value  <math>x = 2</math> fits  <math>\div (x-2) \rightarrow x^2 + 2x - 1 = 0</math>  Solution  <math>\rightarrow x = -1 \pm \sqrt{2}</math></p>	<p>M1 A1</p> <p>M1 DM1 A1</p> <p>[5]</p>	<p>Equating + attempt at a value by TI Co - allow for (x-2) or for f(2)  Must be <math>\div</math> by (x-his value)  As by quadratic scheme  Co</p>
<p>3. (i)</p>  <p><math>y =  2x+3 </math>  -ve then +ve slope  Vertex at <math>(-h,0)</math>  <math>y = 1 - x</math>  Line, -ve m, <math>(k,0)</math></p> <p>(ii) <math>x + 2x + 3 = 1 \rightarrow x = -2/3</math>  <math>(-0.65 \text{ to } -0.70)</math>  <math>x - (2x+3) = 1 \rightarrow x = -4</math>  <math>(-3.9 \text{ to } -4.1)</math></p>	<p>B1</p> <p>DB1</p> <p>B1</p> <p>[3]</p> <p>B1</p> <p>M1 A1</p> <p>[3]</p>	<p>Must be 2 parts – ignore -2 to -1</p> <p>V shape-Vertex on -ve x-axis + lines</p> <p>-ve slope, crosses axes at x,y +ve – allow if only in 1<sup>st</sup> or 2<sup>nd</sup> quadrants</p> <p>From graph, or calculation or guess</p> <p>B2 if correct. M mark for any method. Squares both sides M1 quadratic A1  Answers A1</p>
<p>4. <math>x = a \sin(bx) + c</math></p> <p>(i) <math>a = 2</math> and <math>b = 3</math></p> <p>(ii) <math>c = 1</math></p> <p>(iii)</p>  <p>3 cycles (0 to 360)  -1 to 3</p> <p>Period <math>120^\circ</math> + all correct.</p>	<p>B1 B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>DB1</p> <p>[6]</p>	<p>Wrong way round - no marks. No labels - allow B1 if both correct. Co</p> <p>Even if starting incorrectly. Needs to be marked - allow for any trig graph.  Everything in relatively correct position - needs both B's</p>

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<p>5. <math>xy + 24 = 0</math> and <math>5y + 2x = 1</math>          Makes x or y the subject and subs  <math>\rightarrow 5y^2 = y + 48</math> or <math>2x^2 - x = 120</math>          Solution of quadratic = 0  <math>\rightarrow (8, -3)</math> and <math>(-7.5, 3.2)</math></p> <p><math>d = \sqrt{(15.5^2 + 6.2^2)} = 16.7</math></p>	<p>M1          A1          DM1          A1</p> <p>M1 A1 <math>\checkmark</math>          [6]</p>	<p>x or y removed completely – condone poor algebra. A1 co.          By scheme for quadratic = 0          Co</p> <p>M mark ind of anything before. A1 <math>\checkmark</math> on his 2 points.</p>
<p>6.</p> $(300 \quad 240) \begin{pmatrix} .6 & .3 & .1 \\ .5 & .4 & .1 \end{pmatrix} \begin{pmatrix} 4 \\ 6 \\ 8 \end{pmatrix}$ $\left[ \text{or } (4 \quad 6 \quad 8) \begin{pmatrix} .6 & .5 \\ .3 & .4 \\ .1 & .1 \end{pmatrix} \begin{pmatrix} 300 \\ 240 \end{pmatrix} \right]$ $(300 \quad 186 \quad 54) \begin{pmatrix} 4 \\ 6 \\ 8 \end{pmatrix} \text{ or } (300 \quad 240) \begin{pmatrix} 5 \\ 5.2 \end{pmatrix}$ <p>Final answer <math>\rightarrow</math> \$2748</p>	<p>B2, 1.0</p> <p>M1 A1</p> <p>M1 B1          [6]</p>	<p>For 3 correct matrices – independent of whether they are conformable – allow with or without the factor of 100.</p> <p>1<sup>st</sup> product. Co. Matrices must be written in correct order – for M mark, the 2x3 or 3x2 must be used.</p> <p>2nd product. By any method, inc numerical. Omission of 100 loses last B1 only.</p>
<p>7.</p>  <p><math>\frac{\sin \alpha}{7} = \frac{\sin 135}{12}</math></p> <p><math>\rightarrow \alpha = 24.4^\circ</math></p> <p>= 20.6°.      Bearing is 020.6°</p>	<p>B1</p> <p>M2</p> <p>A1</p> <p>A1          [5]</p>	<p>Correct triangle of velocities - must be 7, 12 and 135° opposite 12.          Sine rule used in his triangle.          If 45° or 135° between 7 and 12, allow M1 for cos rule, M1 for sine rule          Co.</p> <p>Co. Allow 21°.</p>

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<p>8. <math>y = (ax+3)\ln x</math>  On x-axis, <math>y = 0</math>  <math>ax + 3 = 0 \rightarrow x</math> is -ve <math>\rightarrow</math> no soln  But <math>\ln x = 0 \rightarrow x = 1</math></p> <p><math>dy/dx = a\ln x + (ax+3).(1/x)</math></p> <p>Use of <math>m_1 m_2 = -1</math>  Gradient of tangent = <math>-1 \div (-1/5)</math></p> <p><math>\rightarrow a = 2</math></p>	<p>M1  A1  M1  B1  M1  A1  A1</p> <p>[7]</p>	<p>Needs an attempt at solution.  Ignore other solutions at this stage.  Correct use of "uv" formula.  For <math>d/dx(\ln x)</math>, even if M0 given above.  Could equate m with <math>-1 \div (dy/dx)</math>  Co.  Co.</p>
<p>9. (a) <math>\left(x - \frac{1}{2x^5}\right)^{18}</math>  <math>{}^{18}C_{15} (x)^{15} (1/2x^5)^3</math>  <math>\rightarrow 18.17.16(-1/8) \div 6</math>  <math>\rightarrow -102</math></p> <p>(b) <math>(1 + kx)^n</math>  Coeff of <math>x^2 = {}_n C_2 k^2</math>  Coeff of <math>x^3 = {}_n C_3 k^3</math></p> <p>Equating and changing to factorials  <math>\rightarrow k = 3/(n-2)</math>  or equivalent without factorials</p>	<p>B1  B1  B1  B1  M1  A1</p> <p>[3]  [4]</p>	<p>For <math>{}^{18}C_3</math> or <math>{}^{18}C_{15}</math>  For <math>(\pm 1/2)^3</math> – even if in <math>(1/2x)^3</math>  Co  Co.  Co.  Needs attempt at nCr  Co</p>
<p>10. (i) Area = <math>\Delta</math> – sector  BCA = <math>\pi - 1.4</math> or height = <math>20\sin 0.7</math>  <math>\Delta = \frac{1}{2} \cdot 20^2 \sin(\pi - 1.4)</math>  or <math>\frac{1}{2}bh = 197.1</math></p>  <p>Sector = <math>\frac{1}{2} \cdot 20^2 \cdot 0.7 = 140</math>  <math>\rightarrow</math> Area = 57.1</p> <p>(ii) DC = <math>20 \times 0.7 (=14)</math>  AB = <math>2 \times 20\cos 0.7</math> or cos rule  BD = AB – 20 = 10.6  <math>\rightarrow</math> Perimeter = 44.6</p> <p>Could be [5] + [3] if AB used in part (i)</p>	<p>M1  M1  M1  A1  M1  M1  M1  A1</p> <p>[4]  [4]</p>	<p>Award for either of these.  Correct method for area of <math>\Delta</math>  Use of <math>\frac{1}{2}r^2\theta</math>  Co  Use of <math>s = r\theta</math>  Correct trig – could gain this in (i)  Co</p>



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<p>11. (i) <math>m = -a/x^3 \rightarrow y = \frac{1}{2}ax^{-2} (+c)</math>  Puts in (2, 3.5) <math>\rightarrow 28 = a + 8c</math>  Puts in (5, 1.4) <math>\rightarrow 70 = a + 50c</math>  Solution <math>\rightarrow a = 20, c = -1</math></p> <p>(ii) <math>\int (10x^{-2} + 1)dx = -10x^{-1} + x</math>  <math>A = [ ]^p - [ ]^2 = -10/p + p + 3</math>  <math>B = [ ]^5 - [ ]^p = 10/p - p + 3</math></p> <p><math>P = \sqrt{10}</math> or 3.16</p>	<p>M1 A1 DM1</p> <p>M1 A1 [5]</p> <p>M1 A1√ M1 M1</p> <p>A1 [5]</p>	<p>Any attempt to integrate. Co. Substitutes one of his points – even if +c missing</p> <p>Correct method of soln. Both co. (beware fortuitous ans. a = 20 given) N.B: assumes a = 20 without checking that both points work (M1A0DM1M0A1)</p> <p>Integrates his "curve" Use of limits correctly in either A or B or in A+B (2 to 5). Award M1 for each. (Can get these if only one integration) co</p>
<p>12 EITHER</p> <p>12 questions – 3 trig, 4 alg, 5 calc Answer 8 from 12.</p> <p>(a) (i) <math>{}_{12}C_8 = 495</math>  (ii) T and A <math>\rightarrow 0</math>  T and C <math>\rightarrow 1</math>  A and C <math>\rightarrow 9</math>                      Total = 10</p> <p>8 dresses, A <math>\rightarrow</math> H</p> <p>(b) (i) <math>{}_8P_5 = 6720</math>  (ii) <math>\frac{1}{8}</math> of (i) = 840 or <math>{}_7P_4</math>  (iii) <math>\frac{5}{8}</math> of (i) = 4200  or 5 x (ii) or <math>{}_8P_5 - {}_7P_5</math></p>	<p>M1 A1</p> <p>M1 A1 [4]</p> <p>M1 A1 M1 A1√ M1 A1√ [6]</p>	<p><math>{}_{12}C_8</math> gets M1. Answer only gets both marks.</p> <p>Needs to have considered 2 of the possibilities.</p> <p>Must be <math>{}_8P_5</math> for M1 – co for A1. Any method ok. <math>\sqrt{\quad}</math> on (i) if appropriate Any method ok. <math>\sqrt{\quad}</math> on (i) or (ii)</p>

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12 OR							
x	2	4	6	8	10		
y	9.8	19.4	37.4	74.0	144.4		
lgy	0.99	1.29	1.57	1.87	2.16		
(i) Finds values of lgy						M1	Knows what to do.
Draws graph accurately.						A1	Don't penalise incorrect scale. Points correct to ½ small square.
(ii) $lgy = lga + xlg b$						[2]	Anywhere – even if no graph
$m = lgb \rightarrow b = 1.4 (\pm 0.05)$						B1	Gradient measured + equated to lgb.
$c = lga \rightarrow A = 5.0 (\pm 0.2)$						M1 A1	Intercept measured + equated to lga.
(iii) $lgy = xlg 2$						[5]	Even if no line – give if line correct.
i.e Straight line $Y = 0.301x$						B1	Must be a line.
$x = 4.5 (\pm 0.2)$						M1	To this accuracy.
Use of simultaneous eqns in part (ii) gets B1 only, unless both points used are on his line, in which case allow marks if to correct accuracy.						A1	
DM 1 for quadratic equation. Equation must be set to 0 if using formula or factors.							
<u>Formula</u>							<u>Factors</u>
Must be correct							Must attempt to put quadratic into 2 factors.
– ignore arithmetic and algebraic slips.							Each factor then equated to 0.

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MARK SCHEME

MAXIMUM MARK: 80

**SYLLABUS/COMPONENT: 0606/02**

**ADDITIONAL MATHEMATICS  
Paper 2**



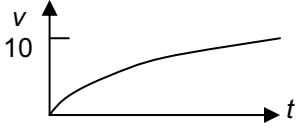
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1 [4]	$(i - 7j) + \lambda(0.6i + 0.8j) = 4i + kj$ $1 + 0.6\lambda = 4 \quad \Rightarrow \quad \lambda = 5$ $-7 + 0.8\lambda \quad \Rightarrow \quad -7 + 0.8 \times 5 = -3 = k$	M1 A1  M1 A1
2 [4]	Attempt at $\cos^{-1} 0.3 \Rightarrow [72.5^\circ \text{ A0}] = 1.266 [5.017, 7.549]$ accept 1.3 $x + 1 = 2.532, 10\,034, 15.098 \Rightarrow x = 14.1$ or better	M1 A1  M1 A1
3 [4]	(i) Some vegetarians in the college are over 180 cm tall [or equivalent] (ii) No cyclists in the college are over 180 cm tall [or equivalent] (iii) $B \cap C \subset A'$ [or equivalent]	B1 B1 B1 B1
4 [4]	$\left(1 + \frac{1}{\cos \theta}\right) \left(\frac{1}{\sin \theta} - \frac{\cos \theta}{\sin \theta}\right) \Rightarrow \frac{1 - \cos^2 \theta}{\cos \theta \sin \theta}$ $1 - \cos^2 \theta \equiv \sin^2 \theta$ Must be useful use of Pythagoras $\frac{\sin^2 \theta}{\cos \theta \sin \theta} \rightarrow \tan \theta$	M1 M1  B1 A1
5 [5]	$x = \frac{\sqrt{20} \pm \sqrt{20 - (4 \times 2)}}{2} = \sqrt{5} \pm \sqrt{3}$ or $\frac{\sqrt{20} \pm \sqrt{12}}{2}$ $\frac{1}{\sqrt{5} + \sqrt{3}} + \frac{1}{\sqrt{5} - \sqrt{3}}$ [or $\frac{2}{\sqrt{20} + \sqrt{12}} + \frac{2}{\sqrt{20} - \sqrt{12}}$ ] rationalising each fraction or bringing to common denominator Denominator = 2 [or 8] $\Rightarrow \frac{1}{c} + \frac{1}{d} = \sqrt{5}$	M1 A1 M1  A1 A1
6 [6]	(a) $2x^2 - 3x - 14 = 0 \Rightarrow (2x - 7)(x + 2) = 0 \Rightarrow x = -2, 3.5$ $\{x : x < -2\} \cup \{x : x > 3.5\}$ (b) Eliminate $y \Rightarrow x^2 + 4(8 - kx) = 20$ [or $x \Rightarrow \left(\frac{8 - y}{k}\right)^2 + 4y = 20$ ] $x^2 - 4kx + 12 = 0$ [or $y^2 + (4k^2 - 16)y + (64 - 20k^2) = 0$ ] Apply "b <sup>2</sup> = 4ac" $16k^2 = 48$ [or $16k^4 = 48k^2$ ] $\Rightarrow k = \pm\sqrt{3}$	M1 A1 A1 M1  M1 A1

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7 [6]	<p>(i) <math>e^{2x-3} (= 7) \Rightarrow x = \frac{1}{2}(3 + \ln 7) \approx 2.47 \sim 2.48</math> (not 2.5)</p> <p>(ii) <math>h = 2e^x - 3</math> (x, y or) <math>h &gt; -3</math> accept <math>\geq</math></p> <p>(iii) <math>h^{-1}</math> (or y) = <math>\ln\{\frac{1}{2}(x+3)\}</math> or <math>\ln(x+3) - \ln 2</math> or <math>\lg\{\frac{1}{2}(x+3)\}/\lg e</math> but <math>\ln\{\frac{1}{2}(y+3)\}</math> M1 A0 <math>\lg</math> (or <math>\log</math>) <math>\{\frac{1}{2}(x+3)\}</math> M1 A0</p>	<p>M1 A1</p> <p>B1 B1</p> <p>M1 A1 (M1 for logs taken in valid way)</p>
8 [8]	<p>(i) <math>\log_3(2x+1) - \log_3(3x-11) = \log_3 \frac{2x+1}{3x-11}</math> [Or, later, give M1 for <math>\log + \log = \log(\text{product})</math>] <math>\log_3(\quad) = 2 \Rightarrow (\quad) = 3^2</math> <math>2x+1 = 9(3x-11) \Rightarrow x = 4</math></p> <p>(ii) <math>\log_4 y = \frac{\log_2 y}{\log_2 4} = \frac{1}{2} \log_2 y</math> [or <math>\log_2 y = \frac{\log_4 y}{\log_4 2} = 2 \log_4 y</math>] <math>\frac{1}{2} \log_2 y + \log_2 y = 9</math> [or <math>\log_4 y + 2 \log_4 y = 9</math>] <math>\Rightarrow y = 2^6</math> or <math>4^3 = 64</math></p>	<p>M1</p> <p>B1</p> <p>DM1 A1</p> <p>M1 A1</p> <p>DM1 A1</p>
9 [8]	<p><math>6 + 4x - x^2 \equiv 10 - (x-2)^2</math></p> <p>(i) <math>x = 2</math> <math>y = 10</math> Maximum</p> <p>(ii) <math>f(0) = 6, f(2) = 10, f(5) = 1 \Rightarrow 1 \leq f \leq 10</math> [alternatively <math>1 \leq B1, \leq 10 B1</math>]</p> <p>(iii) f has no inverse; it is not 1:1</p>	<p>M1 A1</p> <p>B1√B1√B1</p> <p>M1 A1</p> <p>B1</p>
10 [10]	<p>(i) <math>m_{BC} = 3/5</math> Equation of AD is <math>y - 4 = 3/5(x + 2)</math> <math>m_{AC} = -1/4</math> Equation of CD is <math>y - 2 = 4(x - 6)</math></p> <p>(ii) Solve <math>x = 8, y = 10</math></p> <p>(iii) Length of AC = Length of CD = <math>\sqrt{68}</math></p>	<p>B1 M1 A1</p> <p>B1 M1 A1</p> <p>M1 A1</p> <p>M1 A1</p>
11 [10]	<p>(i) <math>d/dx (2x-3)^{3/2} = (2x-3)^{1/2} \times 3/2 \times 2</math> <math>dy/dx = 1 \times (2x-3)^{3/2} + (x+1) \times \{\text{candidate's } d/dx (2x-3)^{3/2}\}</math> <math>= \sqrt{2x-3} \{(2x-3) + 3(x+1)\} = 5x\sqrt{2x-3} \Rightarrow k = 5</math></p> <p>(ii) <math>\delta y \approx dy/dx \times \delta x = (dy/dx)_{x=6} \times p = 90p</math> <math>(y)_{x=6+p} = (y)_{x=6} + \delta y = 189 + 90p</math></p> <p>(iii) <math>\int x\sqrt{2x-3} dx = 1/5 (x+1)(2x-3)^{3/2}</math> <math>[ ]_2^6 = 1/5 (189 - 3) = 37.2</math></p>	<p>M1 A1</p> <p>M1</p> <p>A1</p> <p>M1 A1</p> <p>A1√</p> <p>M1</p> <p>DM1 A1</p>

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<p><b>12 [11]</b> <b>EITHER</b></p>	<p>(i) <math>a = dv/dt = 5e^{-1/2t}</math>  <math>v = 8 = 10(1 - e^{-1/2t}) \Rightarrow e^{-1/2t} = 0.2 \Rightarrow a = 1</math></p> <p>(ii) <math>s = \int v dt = \int (10 - 10e^{-t/2}) dt = 10t + 20e^{-t/2}</math>  <math>\left[ \right]_0^6 = (60 + 20e^{-3}) - (20) \approx 41</math></p> <p>(iii) 10</p> <p>(iv) </p>	<p>M1 A1 M1 A1 M1 A1 DM1 A1 B1 B2,1,0</p>
<p><b>12 [11]</b> <b>OR</b></p>	<p>(i) <math>d/d\theta \{(\cos\theta)^{-1}\} = -(\cos\theta)^{-2}(-\sin\theta) = \sin\theta/\cos^2\theta</math></p> <p>(ii) <math>AX = 2\sec\theta \quad PX = 2\tan\theta</math>  <math>T = \frac{2\sec\theta}{3} + \frac{10 - 2\tan\theta}{5}</math></p> <p>(iii) <math>\frac{dT}{d\theta} = \frac{2}{3} \frac{\sin\theta}{\cos^2\theta} - \frac{2}{5} \sec^2\theta</math>  <math>= 0</math> when <math>5\sin\theta = 3 \Rightarrow \sin\theta = 3/5</math>  <math>PX = 2\tan\theta = 2 \times \frac{3}{4} = 1.5</math></p>	<p>M1 A1 B1 B1 M1 A1 B1 B1√ M1 A1 A1</p>