

**November 2003**

**INTERNATIONAL GCSE**

**MARK SCHEME**

**MAXIMUM MARK: 80**

**SYLLABUS/COMPONENT: 0606/02**

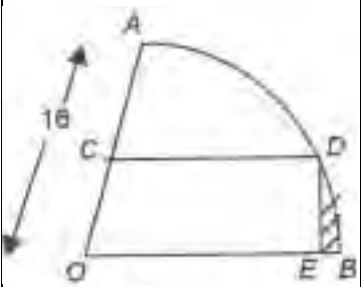
**ADDITIONAL MATHEMATICS  
Paper 2**



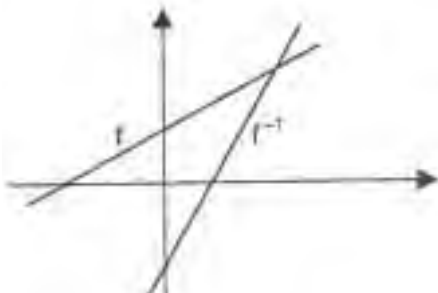
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|       |                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                            |                                         |
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| 1 [4] |                                                                                                                                                                                       | <p>Eliminate x or y</p> $\Rightarrow y^2 - 8y + 15 = 0 \quad x^2 - 10x + 9 = 0$ <p>Factorise or formula <math>\Rightarrow</math> (1, 3) and (9, 5)</p> <p>Midpoint is (5, 4)</p>                                                                                                                                                                                           | <p>M1</p> <p>DM1 A1</p> <p>B1 ✓</p>     |
| 2 [4] |                                                                                                                                                                                       | $\cos \theta \left( \frac{1 + \sin \theta - (1 - \sin \theta)}{1 - \sin^2 \theta} \right) = \cos \theta \left( \frac{2 \sin \theta}{1 - \sin^2 \theta} \right) = \frac{2 \sin \theta \cos \theta}{1 - \sin^2 \theta}$ <p>Use of Pythagoras <math>\Rightarrow \frac{2 \sin \theta \cos \theta}{\cos^2 \theta} = 2 \tan \theta \Rightarrow k = 2</math></p>                  | <p>M1 A1</p> <p>B1 A1</p>               |
| 3 [4] |                                                                                                                                                                                       | <p><math>\log_2 x = 2 \log_4 x</math> or <math>\log_4 (x - 4) = \frac{1}{2} \log_2 (x - 4)</math></p> <p><math>2 \log_4 x - \log_4 (x - 4) = 2</math> or <math>\log_2 x - \frac{1}{2} \log_2 (x - 4) = 2</math></p> <p>Eliminate logs <math>\frac{x^2}{x - 4} = 16</math> or <math>\frac{x}{\sqrt{x - 4}} = 4</math></p> <p>Solve for x <math>\Rightarrow x = 8</math></p> | <p>B1</p> <p>M1 A1</p> <p>A1</p>        |
| 4 [4] | <p>(i)</p>  <p>(ii) <math>A \cap B' \cap C'</math></p> <p>(iii) <math>B \cup (A \cap C)</math></p> |                                                                                                                                                                                                                                                                                                                                                                            | <p>B2 B1 B1</p>                         |
| 5 [5] | <p>(i)</p> $243x^5 - 405x^4 + 270x^3$ <p>(ii)</p> <p>Coefficient of <math>x^4 = (-405 \times 1) + (270 \times 2) = 135</math></p>                                                     |                                                                                                                                                                                                                                                                                                                                                                            | <p>B1 B1 B1</p> <p>M1 A1</p>            |
| 6 [6] |                                                                                                                                                                                       | <p>At B, <math>v = 40(e^{-t} - 0.1) = 0 \Rightarrow e^{-t} = 0.1 \Rightarrow t = \ln 10 (=2.30)</math></p> $\int 40(e^{-t} - 0.1) dt = 40(-e^{-t} - 0.1t)$ $AB = \int_0^{\log 10} = 40 \left[ \left( -\frac{1}{10} - \frac{\ln 10}{10} \right) - (-1) \right] = 4(9 - \ln 10) \approx 26.8$                                                                                | <p>M1 A1</p> <p>M1 A1</p> <p>DM1 A1</p> |

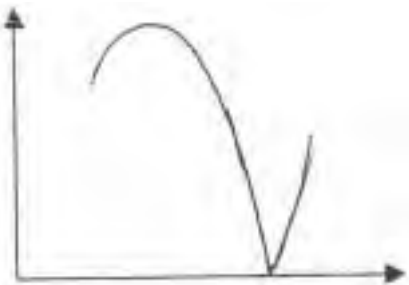
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| 7 [7]   | <p>Dealing with elements <math>\begin{pmatrix} 1 &amp; -2 \\ -3 &amp; 4 \end{pmatrix}</math> and <math>\begin{pmatrix} 3 &amp; -1 \\ 2 &amp; 2 \end{pmatrix}</math></p> <p><math>\mathbf{A}^{-1} = -\frac{1}{2} \begin{pmatrix} 1 &amp; -2 \\ -3 &amp; 4 \end{pmatrix} \quad \mathbf{B}^{-1} = \frac{1}{8} \begin{pmatrix} 3 &amp; -1 \\ 2 &amp; 2 \end{pmatrix}</math></p> <p>(i) <math>\mathbf{C} = \mathbf{B} - 2\mathbf{A}^{-1} = \begin{pmatrix} 2 &amp; 1 \\ -2 &amp; 3 \end{pmatrix} + \begin{pmatrix} 1 &amp; -2 \\ -3 &amp; 4 \end{pmatrix} = \begin{pmatrix} 3 &amp; -1 \\ -5 &amp; 7 \end{pmatrix}</math></p> <p>(ii) <math>\mathbf{D} = \mathbf{B}^{-1}\mathbf{A} = \frac{1}{8} \begin{pmatrix} 3 &amp; -1 \\ 2 &amp; 2 \end{pmatrix} \begin{pmatrix} 4 &amp; 2 \\ 3 &amp; 1 \end{pmatrix} = \frac{1}{8} \begin{pmatrix} 9 &amp; 5 \\ 14 &amp; 6 \end{pmatrix}</math></p> | M1<br><br>A1 A1<br><br>M1 A1<br><br>M1 A1             |
| 8 [7]   | <p>(i) <math>\frac{10!}{6!4!} = \frac{10 \times 9 \times 8 \times 7}{1 \times 2 \times 3 \times 4} = 210</math></p> <p>(ii) No pink selected i.e. any 6 from <math>(5 + 2) = 7</math></p> <p>(iii) All selections contain at least 1 red</p> <p>No yellow selected i.e. any 6 from <math>(3 + 5) = \frac{8!}{6!2!} = 28</math></p> <p>At least 1 of each colour – <math>120 - (7 + 28) = 175</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | M1 A1<br><br>B1<br><br>M1 A1<br><br>M1 A1             |
| 9 [8]   | <p>(i) <math>\frac{d}{dx}(\sqrt{4x-3}) = (4x-3)^{-\frac{1}{2}} \times \frac{1}{2} \times 4</math></p> <p><math>\frac{d}{dx}\{(2x+3)\sqrt{4x-3}\} = (2x+3)\left(\frac{2}{\sqrt{4x-3}}\right) + 2\sqrt{4x-3}</math></p> <p><math>= \frac{12x}{\sqrt{4x-3}} \Rightarrow k = 12</math></p> <p>(ii) <math>\int \frac{x}{\sqrt{4x-3}} dx = (2x+3)\sqrt{4x-3} \times \frac{1}{12}</math></p> <p><math>\int_1^7 = \frac{1}{2}(85-5) = 6\frac{2}{3}</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                 | M1 A1<br><br>M1 A1 ✓<br><br>A1<br><br>M1 A1<br><br>A1 |
| 10 [10] |  <p>(i) <math>\angle AOB = 19.2 + 16 = 1.2</math></p> <p>(ii) <math>DE = 8 \sin 1.2 \approx 7.46</math></p> <p>(iii) <math>\angle DOE = \sin^{-1}(7.46 \div 16) \approx 0.485</math> (AG)</p> <p>(iv) Sector <math>DOB = \frac{1}{2} \times 16^2 \times 0.485 = 62.08</math></p> <p>Length <math>OE = \sqrt{16^2 - 7.46^2} \approx 14.2</math></p> <p><math>\triangle DOE = \frac{1}{2} \times 7.46 \times 14.2 \approx 52.97</math></p> <p>Shaded area <math>\approx 9.1 - 9.3</math> (9.275)</p>                                                                                                                                                                                                                                                                                                 | M1 A1<br>M1 A1<br>M1 A1<br>M1<br>M1<br>M1<br>A1       |

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| 11 [10]              |       | $v$ 5    10    15    20    25    (i) Plotting $\lg R$ against $\lg v$<br>$R$ 32    96    180    290    420    Accuracy of points: Straight line<br>$\lg v$ 0.70    1.00    1.18    1.30    1.40    (ii) $R = kv^\beta \Rightarrow \lg R = \lg k + \beta \lg v$<br>$\lg R$ 1.51    1.98    2.26    2.46    2.61 $\beta = \text{gradient} \approx 1.55 - 1.60$<br>$\lg k = \lg R \text{ intercept} \approx 0.4 \Rightarrow k \approx 2.4 - 2.6$ | M1<br>A2, 1, 0<br>B1<br>M1 A1<br>M1 A1 |
|                      | (iii) | $\lg R = \lg 75 \approx 1.88 \Rightarrow \text{from graph } \lg v \approx 0.92 - 0.96 \Rightarrow v \approx 8.3 - 9.1$<br>[Or by solving e.g., $75 = 2.5v^{1.58}$ or $1.88 = 0.4 + 1.58 \lg v$ ]                                                                                                                                                                                                                                              | M1 A1                                  |
| 12<br>EITHER<br>[11] | (i)   | $gf(x) = \frac{4}{2 - (3x - 2)}$<br><br>Solve $\frac{4}{4 - 3x} = 2$ [or solve $fg(x) = 3 \left( \frac{4}{2 - x} \right) - 2 = 2$ ]<br><br>$\Rightarrow x = 2/3$                                                                                                                                                                                                                                                                              | B1<br><br>M1<br><br>A1                 |
|                      | (ii)  | $f(x) = g(x) \Rightarrow 3x - 2 = \frac{4}{2 - x} \Rightarrow 3x^2 - 8x + 8 = 0$<br><br>Discriminant = $64 - 96 < 0 \Rightarrow$ No real roots                                                                                                                                                                                                                                                                                                | M1 A1                                  |
|                      | (iii) | $f^{-1}: x \mapsto (x + 2) \div 3$<br><br>$y = 4 / (2 - x) \Rightarrow x = 2 - 4/y \Rightarrow g^{-1}: x \mapsto 2 - 4/x$                                                                                                                                                                                                                                                                                                                     | B1<br>M1 A1                            |
|                      | (iv)  |                                                                                                                                                                                                                                                                                                                                                            | B1 B1                                  |
|                      |       | Lines intersect at (1, 1)                                                                                                                                                                                                                                                                                                                                                                                                                     | B1                                     |

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| <b>12 OR<br/>[11]</b> | <b>(i)</b>   | $1 - x^2 + 6x \equiv a - (x + b)^2 = a - x^2 - 2bx - b^2 \Rightarrow a - b^2 = 1 \text{ and } -2b = 6$<br><br>[or $1 - x^2 + 6x \equiv 1 - (x^2 - 6x) \equiv 1 - \{(x-3)^2 - 9\}$ ]<br><br>$\Rightarrow b = -3, a = 10$ | M1        | A1 |
|                       | <b>(ii)</b>  | $1 - x^2 + 6x \equiv 10 - (x - 3)^2 \Rightarrow \text{Maximum at } (3, 10)$<br><br>$\therefore$ Single-valued for $x \geq 3$ and hence for $x \geq 4$                                                                   | M1        | A1 |
|                       | <b>(iii)</b> | $y = 10 - (x - 3)^2 \Rightarrow (x - 3)^2 = 10 - y \Rightarrow x - 3 = \sqrt{10 - y}$<br><br>$\Rightarrow f^{-1} : x \mapsto 3 + \sqrt{10 - x}$                                                                         | M1        | A1 |
|                       | <b>(iv)</b>  | When $x = 2$ , $g(x) = 9$ and when $x = 7$ , $g(x) = -6$<br><br>Range of $g$ is $-6 \leq g \leq 10$                                                                                                                     | B1        | B1 |
|                       | <b>(v)</b>   |                                                                                                                                       | B 2, 1, 0 |    |