

**Mixed Calculus Exam Questions MS (From OCR 4752)**

**Q1, (Jan 2007, Q12)**

|     |   |                          |  |   |
|-----|---|--------------------------|--|---|
| i   | $(2x - 3)(x - 4)$<br>$x = 4$ or $1.5$   | M1<br>A1A1               | or $(11 \pm \sqrt{(121 - 96)})/4$<br>if M0, then B1 for showing $y = 0$<br>when $x = 4$ and B2 for $x = 1.5$ | 3 |
| ii  | $y = 4x - 11$<br>$= 5$ when $x = 4$ c.a.o.<br>grad of normal = $-1/\text{their } y$<br>$y[-0] = \text{their } -0.2(x - 4)$                          | M1<br>A1<br>M1f.t.<br>M1 | or $0 = \text{their } (-0.2)x4 + c$ dep on<br>normal attempt   | 6 |
|     | y-intercept for <u>their</u> normal<br>area = $\frac{1}{2} \times 4 \times 0.8$ c.a.o.  | B1f.t.<br>A1             | s.o.i. normal must be linear or<br>integrating <u>their</u> $f(x)$ from 0 to 4 M1                            |   |
| iii | $\frac{2}{3}x^3 - \frac{11}{2}x^2 + 12x$<br>attempt difference between value<br>at 4 and value at 1.5<br>$[-]5\frac{5}{24}$ o.e. or $[-]5.2(083..)$ | M1<br>M1<br>A1           | condone one error, ignore + c<br>ft their (i), dep on integration attempt.<br>c.a.o.                         | 3 |

**Q2, Jan 2012, Q12)**

|       |   |  |   |
|-------|---|--|---|
| (i)   | $x^2(9 - x^2) = 0$ soi<br>$x = 0$ and $\pm 3$ , [so $a = 3$ or $a = -3$ ]   | B1<br>B1<br><b>[2]</b>                             | $9 \times 0^2 - 0^4 = 0$<br>$9 \times 3^2 - 3^4 = 0$ and $9 \times (-3)^2 - (-3)^4 = 0$   |
| (ii)  | $y' = 18x - 4x^3$<br>$y'' = 18 - 12x^2$ or ft<br>their $y' = 0$ soi<br>$2x(9 - 2x^2) = 0$ so $x = 0$ oe<br>$x = 0, y'' = 18$ cao so minimum<br><br>$x = \pm \sqrt{4.5}$ oe eg $\pm \frac{3\sqrt{2}}{2}$ | B1<br>B1<br>M1<br>A1<br>B1<br><br>A1<br><b>[6]</b> | or $18 \times 0 - 4 \times 0^3 = 0$ oe<br>or evaluation of $y'$ at $\pm h$ oe where<br>$h < \sqrt{4.5}$<br><br>accept 2.12 or better for $\sqrt{4.5}$ |
| (iii) | $\int_0^3 (9x^2 - x^4) dx$ soi or ft<br>$3x^3 - 0.2x^5$<br>F[ their positive $a$ ] [- F[0]]<br><b>or (not and) F[0] - F[their negative <math>a</math>]</b><br><br>32.4 oe cao                           | M1<br><br>A1<br>M1<br><br>A1<br><b>[4]</b>         | condone omission of, or wrong limits<br><br>correct answer implies M1<br>dependent on at least one term correct                                       |

**Q3, (Jan 2011, Q11)**

(i)  $\frac{x^4}{4} - x^3 - \frac{x^2}{2} + 3x$

their integral at 3 – their integral at 1  
[= -2.25 – 1.75]

= -4 isw

represents area between curve and x  
axis between  $x = 1$  and 3

negative since below x-axis

**M2** **M1** if at least two terms correct

**M1** dependent on integration attempted

**A1**

**B1**

**B1**

(ii)  $y' = 3x^2 - 6x - 1$

their  $y' = 0$  so i

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  with  $a = 3$ ,  $b = -6$  and  $c = -1$  isw

$x = \frac{6 \pm \sqrt{48}}{6}$  or better as final answer

$\frac{6 - \sqrt{48}}{6} < x < \frac{6 + \sqrt{48}}{6}$  or ft their

final answer

**M1**

**M1** dependent on differentiation attempted

**M1** or  $3(x - 1)^2 - 4 [= 0]$  or better

**A1**

eg **A1** for  $1 \pm \frac{2}{3}\sqrt{3}$

**B1**

allow  $\leq$  instead of  $<$

**Q4, (Jun 2015, Q10)**

|              |  |   |  |
|--------------|--|---|--|
| <b>(i)</b>   | $\left[\frac{dy}{dx} = \right] 4 \times 2 + 3 \text{ or } 11 \text{ isw}$ <p>9 = their <math>(4 \times 2 + 3) \times 2 + c</math></p> <p><math>y = 11x - 13</math> or <math>y = 11x + c</math> and <math>c = -13</math><br/>stated<br/>isw</p>   | <p><b>M1*</b></p> <p><b>M1dep*</b></p> <p><b>A1</b></p> <p><b>[3]</b></p>   | <p>or <math>y - 9 = \text{their } (4 \times 2 + 3) \times (x - 2)</math></p> <p>or <math>y - 9 = 11(x - 2)</math> isw</p>  |
| <b>(ii)</b>  | $\frac{4x^2}{2} + 3x$ <p><math>[y = ] 2x^2 + 3x + c</math></p> <p><math>9 = 2 \times 2^2 + 3 \times 2 + c</math></p> <p><math>y = 2x^2 + 3x - 5</math> cao</p> <p><math>(1, 0)</math> and <math>(-2.5, 0)</math> oe cao</p> <p><math>x = -\frac{3}{4}</math></p> <p><math>y = -\frac{49}{8}</math></p> | <p><b>M1*</b></p> <p><b>A1</b></p> <p><b>M1dep*</b></p> <p><b>A1</b></p> <p><b>B1</b></p> <p><b>B1</b></p> <p><b>B1</b></p> <p><b>[7]</b></p> | <p>must see “2” and “+ c”; may be earned later eg after attempt to find <math>c</math></p> <p>must include constant, which may be implied by answer</p> <p>allow first 4 marks for <math>y = 2x^2 + 3x + c</math> and <math>c = -5</math> stated</p> <p>or for <math>x = 1, y = 0</math> and <math>x = -2.5, y = 0</math></p> <p><math>-6.125</math> or <math>-6\frac{1}{8}</math></p>   |
| <b>(iii)</b> | <p>substitution to obtain<br/><math>[y = ] f(2x)</math> in polynomial form</p> <p><math>y = (2x - 1)(4x + 5)</math> or <math>y = 8x^2 + 6x - 5</math><br/>or <math>y = 2\left(2x + \frac{3}{4}\right)^2 - \frac{49}{8}</math></p> <p><math>\left(-\frac{3}{8}, -\frac{49}{8}\right)</math> oe</p>      | <p><b>M1</b></p> <p><b>A1FT</b></p> <p><b>B1</b></p> <p><b>[3]</b></p>  | <p><math>f(x)</math> must be the quadratic in <math>x</math> with linear and constant term obtained in part (ii), may be in factorised form</p> <p>must be simplified to one of these forms, <b>FT</b> their quadratic in <math>x</math> with linear and constant term obtained in part (ii)</p> <p>or <b>FT</b> their (both non-zero) co-ordinates for minimum point or their quadratic in <math>x</math> with linear and constant term obtained in part (ii)</p> |

**Q5, (Jan 2013, Q10)**

|             |   |  |  |
|-------------|---|--|--|
| <b>(i)</b>  | <p>at A <math>y = 3</math></p> $\frac{dy}{dx} = 2x - 4$ <p>their <math>\frac{dy}{dx} = 2 \times 4 - 4</math></p> <p>grad of normal = <math>^{-1}/_{\text{their } 4}</math></p> <p><math>y - 3 = (^{-1}/_4) \times (x - 4)</math> oe isw</p> <p>substitution of <math>y = 0</math> and completion to given result with at least 1 correct interim step www</p> | <p>B1</p> <p>B1</p> <p>M1*</p> <p>M1dep*</p> <p>A1</p> <p>A1</p> <p><b>[6]</b></p> | <p>must follow from attempt at differentiation</p> <p>or substitution of <math>x = 16</math> to obtain <math>y = 0</math></p>                    |
| <b>(ii)</b> | <p>at B, <math>x = 3</math></p> $F[x] = \frac{x^3}{3} - \frac{4x^2}{2} + 3x$ <p><math>F[4] - F[\text{their } 3]</math></p> <p>area of triangle = 18 soi</p> <p>area of region = <math>19\frac{1}{3}</math> oe isw</p>   | <p>B1</p> <p>M1*</p> <p>M1*<br/>dep</p> <p>B1</p> <p>A1</p> <p><b>[5]</b></p>      | <p>may be embedded</p> <p>condone one error, must be three terms, ignore + c</p> <p>dependent on integration attempted</p> <p>19.3 or better</p> |

**Q6, (Jan 2009, Q10)**

|            |   |  |  |   |
|------------|---|--|--|---|
| <b>i</b>   | $7 - 2x$<br>$x = 2$ , gradient = 3<br>$x = 2$ , $y = 4$<br>$y - \text{their } 4 = \text{their grad } (x - 2)$<br><br>subst $y = 0$ in their linear eqn<br>completion to $x = \frac{2}{3}$ (ans given) | M1<br>A1<br>B1<br>M1<br><br>M1<br>A1       | differentiation must be used<br><br>or use of $y = \text{their } mx + c$ and subst<br>(2, their 4), dependent on diffn<br>seen | 6 |
| <b>ii</b>  | $f(1) = 0$ or factorising to<br>$(x - 1)(6 - x)$ or $(x - 1)(x - 6)$<br>6 www   | 1<br><br>1                                 | or using quadratic formula<br>correctly to obtain $x = 1$  | 2 |
| <b>iii</b> | $\frac{7}{2}x^2 - \frac{1}{3}x^3 - 6x$<br>value at 2 - value at 1<br>$2\frac{1}{6}$ or 2.16 to 2.17<br><br>$\frac{1}{2} \times \frac{4}{3} \times 4$ - their integral<br>0.5 o.e.                     | M1<br><br>M1<br><br>A1<br><br>M1<br><br>A1 | for two terms correct; ignore $+c$<br><br>ft attempt at integration only   | 5 |