

Activity 4

Use the accompanying mark scheme to mark these questions from January 2019 Paper 1.

1. Find

$$\int \left(\frac{2}{3}x^3 - \frac{1}{2x^3} + 5 \right) dx$$

simplifying your answer.

(4)

Question Number	Scheme	Marks
1.	$\int \frac{2}{3}x^3 - \frac{1}{2x^3} + 5 dx = \frac{2}{3} \times \frac{x^4}{4} - \frac{1}{2} \times \frac{x^{-2}}{-2} + 5x + c$ $= \frac{1}{6}x^4 + \frac{1}{4}x^{-2} + 5x + c$	<p>M1 A1</p> <p>A1 A1</p> <p>(4 marks)</p>
M1	For raising any power by 1 eg. $x^3 \rightarrow x^4$, $x^{-3} \rightarrow x^{-2}$, $5 \rightarrow 5x$ or eg. $x^3 \rightarrow x^{3+1}$	
A1	For two of $\frac{2}{3} \times \frac{x^4}{4}$, $-\frac{1}{2} \times \frac{x^{-2}}{-2}$, $+5x$ correct (un-simplified). Accept $5x^1$ This may be implied by a correct simplified answer	
A1	For two of $\frac{1}{6}x^4$, $+\frac{1}{4}x^{-2}$, $+5x$ correct and in simplest form. Accept forms such as $\frac{x^4}{6}$, $\frac{1}{4x^2}$, CONDONE $+\frac{0.25}{x^2}$ but NOT $\frac{1/4}{x^2}$, $\frac{5x}{1}$, $-\left(-\frac{1}{4}x^{-2}\right)$	
A1	Fully correct and simplified with $+c$ all on one line. Accept simplified equivalents (see above) and ignore any spurious notation. ISW after a correct simplified answer is achieved.	



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A

$$\frac{dy}{dx} = \frac{2}{3}x^3 - \frac{1}{2x^3} + 5$$

$$= \frac{\cancel{2}x^4}{\cancel{3}4} + \frac{\cancel{2}x^4}{\cancel{2}4} + \sqrt{5x^1}$$
~~$$= \frac{2}{3}x^4 - 2x^4 + 5x$$~~

$$= \frac{2}{3}x^3 - 2x^{-3} + 5$$

$$y = \frac{\cancel{2}x^4}{4} - \frac{2x^{-2}}{-2} + \frac{5x^1}{1}$$

$$y = \frac{1}{6}x^4 - 1x^{-2} + 5x$$

B

$$f(x) = \frac{\frac{2}{3}}{4}x^4 - \left(\frac{\frac{1}{2}}{-2}\right)x^{-2} + 5x + C$$

$$= \frac{2}{3}x^4 + x^{-2} + 5x + C$$

C

$$\frac{2}{3}x^3 - \frac{1}{2x^3} + 5$$

$$= \frac{1}{6}x^4 - \frac{1}{8}x^4 + 5x + C$$

$$= \frac{\cancel{7}}{\cancel{24}}x - \frac{1}{24}x^4 + 5x + C$$

4.

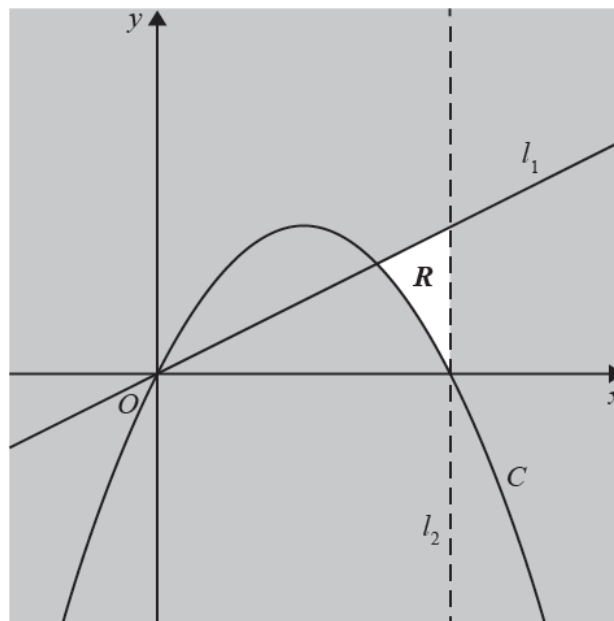


Figure 1

Figure 1 shows a line l_1 with equation $2y = x$ and a curve C with equation $y = 2x - \frac{1}{8}x^2$

The region R , shown unshaded in Figure 1, is bounded by the line l_1 , the curve C and a line l_2

Given that l_2 is parallel to the y -axis and passes through the intercept of C with the positive x -axis, identify the inequalities that define R .

(3)

Question Number	Scheme	Marks
4.	<p>When ---- represents $<$ or $>$ and ——— represents \leq or \geq</p> <p>Either $2y \leq x$ or $y \geq 2x - \frac{1}{8}x^2$</p> <p>$2x - \frac{1}{8}x^2 = 0 \Rightarrow x = 16 \Rightarrow x < \dots$ or $x \leq \dots$</p> <p>$x < 16$, $2y \leq x$ and $y \geq 2x - \frac{1}{8}x^2$</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>(3)</p> <p>(3 marks)</p>
Alt1	<p>When ---- represents \leq or \geq and ——— represents $<$ or $>$</p> <p>Either $2y < x$ or $y > 2x - \frac{1}{8}x^2$</p> <p>$2x - \frac{1}{8}x^2 = 0 \Rightarrow x = 16 \Rightarrow x < \dots$ or $x \leq \dots$</p> <p>$x \leq 16$, $2y < x$ and $y > 2x - \frac{1}{8}x^2$</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>(3)</p>

B1 Sight of $2y \leq x$ or $y \geq 2x - \frac{1}{8}x^2$. Either inequality is sufficient for B1 and they may be written in an equivalent correct form (see NB below)

NB Inequalities cannot be in terms of R

M1 Attempts to find the upper bound for x to define R . Solves to find where the quadratic intersects the x -axis and then uses their value to write $x < \dots$ or $x \leq \dots$. Use general principles for solving a quadratic equation (page 5). They do not need to find or state $x = 0$ and ignore any lower bound eg $0 < x < \dots$

A1 $2y \leq x$, $y \geq 2x - \frac{1}{8}x^2$ and $x < 16$ (Allow $A \leq x < 16$ where $A \leq 12$).

Candidates may write more than one inequality for a particular boundary. In these cases mark the last one. Correct inequalities labelled on the graph are also acceptable, however, an inequality written below takes precedence.

NB You may see $y \leq \frac{x}{2}$ for $2y \leq x$ or even $2x - \frac{1}{8}x^2 \leq y \leq \frac{x}{2}$ oe

Alternatively, some candidates may express their inequalities involving a boundary for a dashed line using \leq or \geq and a boundary for a solid line using $<$ or $>$. It may not always be clear so mark positively. See Alt1



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D

$$\begin{aligned} \text{ans : } R &< \frac{x}{2} \\ R &< x + c \\ R &> 2x - \frac{1}{8}x^2 \end{aligned}$$

E

$$\begin{aligned} \text{12 when } y=0 \quad x &= \\ 2x - \frac{1}{8}x^2 &= 0. \\ x(2 - \frac{1}{8}x) &= 0. \\ x &= \frac{1}{8}x = 2 \\ x &= 16 \\ x &< 16 \end{aligned}$$

$$\begin{aligned} R = 2y &\leq x \\ y &\leq 2x - \frac{1}{8}x^2. \\ x &< 16 \end{aligned}$$

F

$$\begin{aligned} 0 &= 2x - \frac{1}{8}x^2 \\ x(2 - \frac{1}{8}x) &= 0 \\ x &= 0, \quad 2 - \frac{1}{8}x = 0 \\ \frac{1}{8}x &= 2 \quad x = \frac{1}{4} \\ \left(\frac{1}{4}, 0\right) & \\ L_1 = 2y &= \frac{x}{2} \\ y &= \frac{1}{4}x \\ y &\geq \frac{2x - \frac{1}{8}x^2}{8} \\ y &\leq \frac{1}{2}x \\ y &< \frac{1}{4} \end{aligned}$$