A Level Mathematics A

H240/01 Pure Mathematics

Question Set 6

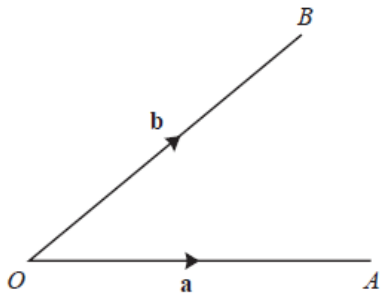
1 Simplify fully.

(a) $\sqrt{12a} \times \sqrt{3a^5}$ **[2]**

(b) $(64b^3)^{\frac{1}{3}} \times (4b^4)^{-\frac{1}{2}}$ **[2]**

(c) $7 \times 9^{3c} - 4 \times 27^{2c}$ **[4]**

2



The diagram shows points A and B, which have position vectors **a** and **b** with respect to an origin O. P is the point on OB such that $OP : PB = 3:1$ and Q is the midpoint of AB.

(a) Find $\overrightarrow{PQ}$ in terms of **a** and **b**. **[2]**

The line OA is extended to a point R, so that PQR is a straight line.

(b) Explain why $\overrightarrow{PR} = k(2\mathbf{a} - \mathbf{b})$, where k is a constant. **[2]**

(c) Hence determine the ratio $OA : AR$. **[4]**

3 A mobile phone company records their annual sales on 31st December every year.

Paul thinks that the annual sales, S million, can be modelled by the equation $S = ab^t$, where a and b are both positive constants and t is the number of years since 31st December 2015.

Paul tests his theory by using the annual sales figures from 31st December 2015 to 31st December 2019. He plots these results on a graph, with t on the horizontal axis and $\log_{10} S$ on the vertical axis.

(a) Explain why, if Paul's model is correct, the results should lie on a straight line of best fit on his graph. **[3]**

The results lie on a straight line of best fit which has a gradient of 0.146 and an intercept on the vertical axis of 0.583.

(b) Use these values to obtain estimates for a and b, correct to 2 significant figures. **[2]**

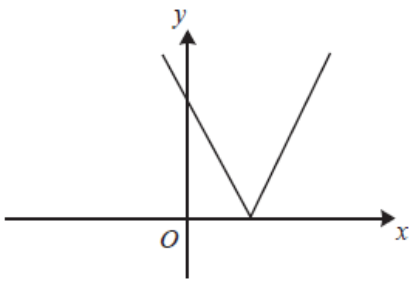
(c) Use this model to predict the year in which, on the 31st December, the annual sales would first be recorded as greater than 200 million. **[3]**

(d) Give a reason why this prediction may not be reliable. **[1]**

4 **(a)** Differentiate $(2+3x^2)e^{2x}$ with respect to x. **[3]**

(b) Hence show that $(2+3x^2)e^{2x}$ is increasing for all values of x. **[4]**

5



The diagram shows the graph of $y = |2x-3|$.

(a) State the coordinates of the points of intersection with the axes. **[2]**

(b) Given that the graphs of $y = |2x-3|$ and $y = ax+2$ have two distinct points of intersection, determine

(i) the set of possible values of a, **[4]**

(ii) the x-coordinates of the points of intersection of these graphs, giving your answers in terms of a. **[3]**

6 Find the general solution of the differential equation

$$(2x^3-3x^2-11x+6)\frac{dy}{dx} = y(20x-35).$$

Give your answer in the form $y = f(x)$. **[9]**

Total Marks for Question Set 6: 50 Marks

OCR
Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge