

	Give 1 mark for each •	Illustration(s) for awarding each mark
1.	<p>(a) ans: $k = 2$ 4 marks</p> <ul style="list-style-type: none"> •1 gradient of AB •2 gradient of AP •3 equating gradients •4 finding k <p>(b) ans: $y = 2x$ 2 marks</p> <ul style="list-style-type: none"> •1 gradient of PQ •2 equation <p>(c) ans: R(2,4) 5 marks</p> <ul style="list-style-type: none"> •1 coordinates of M •2 equation of median •3 setting up a system •4 finding first coordinate •5 finding 2nd coordinate 	<p>(a)</p> <ul style="list-style-type: none"> •1 $m_{AB} = \frac{-3-5}{11+5} = -\frac{1}{2}$ •2 $m_{AP} = \frac{k-5}{6}$ or $m_{BP} = \frac{k+3}{-10}$ •3 $\frac{k-5}{6} = -\frac{1}{2}$ or $-\frac{k+3}{10} = -\frac{1}{2}$ •4 $k = 2$ <p>(b)</p> <ul style="list-style-type: none"> •1 $m_{PQ} = \frac{8-2}{4-1} = 2$ •2 $y - 2 = 2(x - 1)$ <p>(c)</p> <ul style="list-style-type: none"> •1 M(9,3) <i>no mark given for gradient of AM ... $m_{AM} = -\frac{1}{7}$</i> •2 $y - 3 = -\frac{1}{7}(x - 9)$ •3 $7y = -x + 30$ $y = 2x$ •4 $x = 2$ •5 $y = 4$
2.	<p>(a) ans: 1011.33 bats (ignore rounding) 3 marks</p> <ul style="list-style-type: none"> •1 first two lines of calculation •2 lines 3 and 4 of calculations •3 answer <p>(b) ans: Colony is in danger. 600 prior to breeding week is less than 700 bats 4 marks</p> <ul style="list-style-type: none"> •1 knows to calculate limit + knows formula •2 calculates limit correctly •3 knows to subtract 200 •4 explanation 	<p>(a)</p> <ul style="list-style-type: none"> •1 Low High $U_1 = 0.75(2100) = 1575 + 200 = 1775$ $U_2 = 0.75(1775) = 1331.25 + 200 = 1531.25$ •2 $U_3 = 0.75(1531.25) = 1148.44 + 200 = 1348.44$ $U_4 = 0.75(1348.44) = 1011.33$ •3 1011.33 <p>(b)</p> <ul style="list-style-type: none"> •1 $L = \frac{b}{1-a}$ •2 $L = \frac{200}{1-0.75} = 800$ •3 low population $800 - 200 = 600$ •4 600 prior to breeding week is less than 700 bats so colony in danger

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3.	<p>(a) ans: proof 4 marks</p> <ul style="list-style-type: none"> •1 area of rectangle •2 area of triangle •3 subtracting areas •4 tidy up and common factor <p>(b) ans: $p = -\frac{1}{4}$ 6 marks</p> <ul style="list-style-type: none"> •1 equating to zero •2 discriminant statement •3 establish co-efficients a, b and c •4 substitution into discriminant •5 re-arrange to quadratic form •6 answer (with invalid value discarded) <p>(c) ans: $x = 1$ 2 marks</p> <ul style="list-style-type: none"> •1 substitution •2 solving to answer 	<p>(a)</p> <ul style="list-style-type: none"> •1 $A_{rec} = (2x+2)(x-4p)$ $= 2x^2 + 2x - 8px - 8p$ •2 $A_{tri} = \frac{1}{2}(x+6) \times 2x = x^2 + 6x$ •3 $A_1 - A_2 =$ $= 2x^2 + 2x - 8px - 8p - (x^2 + 6x)$ •4 $A_1 - A_2 = x^2 - (8p+4)x - 8p$ <p>(b)</p> <ul style="list-style-type: none"> •1 $x^2 - (8p+4)x - 8p - 1 = 0$ •2 $b^2 - 4ac = 0$ for equal roots •3 $a = 1, b = -(8p+4), c = -8p-1$ •4 $(8p+4)^2 - 4(-8p-1) = 0$ •5 $64p^2 + 96p + 20 = 0$ •6 $4(4p+5)(4p+1) = 0$ $p = \frac{5}{4}$ or $p = -\frac{1}{4}$ <p>(c)</p> <ul style="list-style-type: none"> •1 $x^2 - (8(-\frac{1}{4})+4)x - 8(-\frac{1}{4}) - 1 = 0$ •2 $(x-1)(x-1) = 0, x = 1$
4.	<p>(a) ans: A(2,6) 5 marks</p> <ul style="list-style-type: none"> •1 preparing to differentiate •2 differentiating •3 solving to zero •4 finds x coordinate •5 finds y coordinate <p>(b) ans: B(4,10) 6 marks</p> <ul style="list-style-type: none"> •1 know to form a system •2 combining equations •3 manipulation to polynomial form •4 sets up synthetic division •5 finds x coordinate •6 finds y coordinate 	<p>(a)</p> <ul style="list-style-type: none"> •1 $y = \frac{1}{2}x^2 + 8x^{-1}$ •2 $\frac{dy}{dx} = x - 8x^{-2} = x - \frac{8}{x^2}$ •3 $x - \frac{8}{x^2} = 0$ •4 $x^3 - 8 = 0 \therefore x = 2$ •5 $y = 6$ <p>(b)</p> <ul style="list-style-type: none"> •1 $y = \frac{x^2}{2} + \frac{8}{x}$ $2y = 7x - 8$ •2 $7x - 8 = x^2 + \frac{16}{x}$ •3 $x^3 - 7x^2 + 8x + 16 = 0$ •4 $\begin{array}{r rrrr} 1 & -7 & 8 & 16 \\ & & & & 0 \end{array}$ •5 $4 \begin{array}{r rrrr} 1 & -7 & 8 & 16 \\ & 4 & -12 & -16 \\ \hline 1 & -3 & -4 & 0 \end{array} \quad x = 4$ •6 $2y = 7(4) - 8 \therefore y = 10$

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5.	<p>ans: $V = \frac{1}{9} p^{\frac{1}{2}}$ 5 marks</p> <ul style="list-style-type: none"> •1 for knowing original form $V = kp^n$ •2 calculating gradient •3 for gradient is power •4 for finding k •5 for final equation 	<ul style="list-style-type: none"> •1 original data in form $V = kp^n$ (stated <u>or</u> implied) •2 $m = \frac{2}{4} = \frac{1}{2}$ •3 power = gradient $\therefore n = \frac{1}{2}$ •4 y-intercept, $\log_3 k = -2$, $3^{-2} = k = \frac{1}{9}$ •5 $V = \frac{1}{9} p^{\frac{1}{2}}$ (or equivalent)
6.	<p>(a) ans: proof 2 marks</p> <ul style="list-style-type: none"> •1 for solving to 4 •2 for answer <p>(b) ans: $7\frac{1}{3} \text{ cm}^2$ 6 marks</p> <ul style="list-style-type: none"> •1 setting up integral •2 integrating •3 substituting limits •4 area under curve •5 area of rectangle •6 subtraction to answer 	<p>(a)</p> <ul style="list-style-type: none"> •1 $x^2 - 6x + 12 = 4$ •2 $(x-4)(x-2) = 0 \therefore x = 2 \text{ or } 4$ <p>(b)</p> <ul style="list-style-type: none"> •1 $A = \int_2^4 x^2 - 6x + 12 \, dx$ •2 $= \left[\frac{x^3}{3} - 3x^2 + 12x \right]_2^4$ •3 $= \left(\frac{64}{3} - 3(16) + 12(4) \right) - \left(\frac{8}{3} - 12 + 24 \right)$ •4 $= 6\frac{2}{3} \text{ cm}^2$ •5 $A_{rec} = 2 \times 7 = 14$ •6 $A = 14 - 6\frac{2}{3} = 7\frac{1}{3} \text{ cm}^2$

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7.	<p>(a) ans: proof 4 marks</p> <ul style="list-style-type: none"> •1 length of MR •2 length of PR •3 value of $\sin x$ •4 required form <p>(b) ans: proof 4 marks</p> <ul style="list-style-type: none"> •1 knowing angle is equivalent to $\sin 2x$ •2 use replacement for $\sin 2x$ •3 for value of $\cos x$ and substitution •4 required answer 	<p>(a)</p> <ul style="list-style-type: none"> •1 $MR = \sqrt{2}$ •2 $PR^2 = 2^2 + \sqrt{2}^2 = 6 \therefore PR = \sqrt{6}$ •3 $\sin x = \frac{\sqrt{2}}{\sqrt{6}}$ •4 $\sin x = \frac{\sqrt{2}}{\sqrt{6}} = \frac{\sqrt{2}}{\sqrt{6}} = \frac{\sqrt{1}}{\sqrt{3}} = \frac{\sqrt{1}}{\sqrt{3}} = \frac{1}{\sqrt{3}}$ <p>(b)</p> <ul style="list-style-type: none"> •1 $\sin RPQ = \sin 2x$ •2 $= 2 \sin x \cos x$ •3 $= 2 \times \frac{1}{\sqrt{3}} \times \frac{2}{\sqrt{6}}$ •4 $\frac{4\sqrt{3}}{\sqrt{18}} = \frac{4}{3\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{2}}{3}$ 									
8.	<p>(a) ans: $r^2 = 144 - h^2$ 1 mark</p> <ul style="list-style-type: none"> •1 answer <p>(b) ans: proof 2 marks</p> <ul style="list-style-type: none"> •1 substituting for r^2 •2 required form <p>(c) ans: $h = \sqrt{48} = 4\sqrt{3}$ ft 5 marks</p> <ul style="list-style-type: none"> •1 know to differentiate •2 solve derivative to zero •3 differentiate •4 solve for h •5 justification 	<p>(a) •1 $r^2 = 144 - h^2$</p> <p>(b)</p> <ul style="list-style-type: none"> •1 $V = \frac{1}{3}\pi(144 - h^2)h$ •2 $V(h) = 48\pi h - \frac{1}{3}\pi h^3$ <p>(c)</p> <ul style="list-style-type: none"> •1 strategy to diff. (stated or implied) •2 solve $V'(h) = 0$ (stated or implied) •3 $V'(h) = 48\pi - \pi h^2$ •4 $48\pi - \pi h^2 = 0$ $h^2 = 48$ $h = \sqrt{48} = 4\sqrt{3}$ •5 <div style="text-align: center;"> <table style="border-collapse: collapse; margin: auto;"> <tr> <td style="border-right: 1px solid black; padding: 0 5px;">→</td> <td style="border-right: 1px solid black; padding: 0 5px;">$4\sqrt{3}$</td> <td style="padding: 0 5px;">→</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 0 5px;">+</td> <td style="border-right: 1px solid black; padding: 0 5px;">0</td> <td style="padding: 0 5px;">-</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 0 5px;">/</td> <td style="border-right: 1px solid black; padding: 0 5px;">max</td> <td style="padding: 0 5px;">\</td> </tr> </table> </div>	→	$4\sqrt{3}$	→	+	0	-	/	max	\
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		<div style="border: 1px solid black; padding: 10px; display: inline-block;"> <p>Total 70 marks</p> </div>									