A-LEVEL MATHS (EDEXCEL 9MA0) · PURE YEAR 1 · CHAPTER 5: STRAIGHT LINE GRAPHS · A* EXAM PRACTICE

Hints online, answers free with an account:
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Straight line graphs: A* questions

81 marks

Date

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X A* exam questions

A to A*

Extended Edexcel-style questions. Show every step. The hints are at the end of the sheet. Use one at a time.

X1 The triangle ABC has vertices $A(-4, -2)$, $B(6, 3)$ and $C(2, 7)$. An altitude of a triangle is the line through a vertex that is perpendicular to the opposite side. Prove that the three altitudes of triangle ABC meet at a single point, and find the coordinates of that point. [9 marks]

Answer They meet at $(\ldots, \ldots)$

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X2 For each real number k, the line l_k has equation $(k+2)x + (k-1)y = 5k+1$.

(a) Show that every line l_k passes through the same point P, and find the coordinates of P. [3 marks]

(b) Find the value of k for which l_k is perpendicular to the line $x - 2y = 4$. Give the equation of this l_k in the form $y = mx + c$. [3 marks]

Answer $k = \ldots$, $y = \ldots$

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(c) Find the set of values of k for which l_k meets the line $y = x$ at a point in the first quadrant, where $x > 0$ and $y > 0$. [4 marks]

Answer $k < \ldots$ or $k > \ldots$

(d) Show that every straight line through P is one of the lines l_k except one line, and find the equation of that line. [4 marks]

Answer The line is $\ldots$

Total for X2: 14 marks

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X3 The points P and Q lie on the curve $y = 2x^2$. The tangents to the curve at P and at Q are perpendicular. Prove that these two tangents always meet on a fixed straight line, and find the equation of that line. [9 marks]

Answer The line is $y = \ldots$

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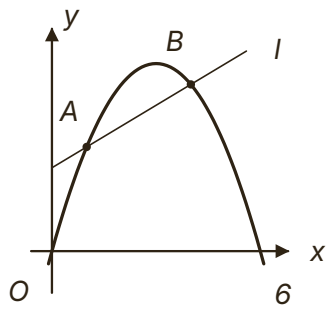
X4 The curve C has equation $y = 6x - x^2$. The point $A(1, 5)$ lies on C. The line l passes through A and has gradient m, where $m < 4$. The line l meets C again at B. The figure is not to scale.

(a) Show that the x-coordinate of B is $5 - m$. [3 marks]



(b) Show that the area of the region between l and C is $\frac{(4-m)^3}{6}$. [5 marks]

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(c) The area of the region between l and C is 36. Find the equation of l. [3 marks]

Answer $y = \ldots$

(d) Show that, for every value of m with $m < 4$, the tangent to C that is parallel to l touches C at the point whose x-coordinate is halfway between the x-coordinates of A and B. [3 marks]

Total for X4: 14 marks

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X5 $PQRS$ is any quadrilateral. K, L, M and N are the midpoints of PQ, QR, RS and SP.

(a) By taking the vertices to be $P(2a, 2b)$, $Q(2c, 2d)$, $R(2e, 2f)$ and $S(2g, 2h)$, prove that $KLMN$ is a parallelogram. [5 marks]

(b) The quadrilateral $PQRS$ has vertices $P(0, 1)$, $Q(5, -1)$, $R(8, 5)$ and $S(1, 7)$. Show that $KLMN$ is a square and find its area. [4 marks]

Answer Area $= \ldots$

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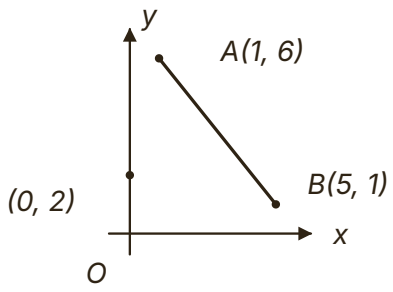
(c) Show that the area of $PQRS$ is twice the area of $KLMN$. [3 marks]

Total for X5: 12 marks

X6 The points $A(1, 6)$ and $B(5, 1)$ are joined by a straight line segment. The line l has equation $y = mx + 2$.

(a) Find an equation of the line through A and B, and show that l meets it at the point with x-coordinate $\dfrac{21}{5 + 4m}$. [4 marks]



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(b) Find the set of values of m for which l meets the segment AB. [4 marks]

Answer $\cdots \leq m \leq \ldots$

(c) The line l meets AB at the point P with $AP : PB = 1 : 3$. Find the value of m. [3 marks]

Answer $m = \ldots$

Total for X6: 11 marks

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X7 A spring hangs from a hook. When a load of w newtons hangs from the spring, its length is L cm. For spring A the model is $L = 18 + 0.6w$. For spring B these readings were taken.

Load w (N)	10	30
Length L (cm)	26	30

(a) Find a linear model $L = a + bw$ for spring B. [2 marks]

Answer $L = \ldots$

(b) Interpret, in context, the values of a and b in your model. [2 marks]

(c) Find the load for which the two springs have the same length, and that length. [3 marks]

Answer $w = \ldots$ N, $L = \ldots$ cm

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(d) With a load of 60 N, spring B is measured to be 41 cm long. Comment on the model for spring B. [2 marks]

(e) For loads from 30 N to 60 N, a new linear model for spring B is made using the readings $(30, 30)$ and $(60, 41)$. Use it to find the load for which spring B is 35 cm long. [3 marks]

Answer $w =$ ... N

Total for X7: 12 marks

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F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can prove a geometric result using coordinates and gradients.	○	○	○
I can work with a line whose equation has a parameter in it.	○	○	○
I can find the values of a constant for which a line meets a segment or a region.	○	○	○
I can make a linear model, use it and say when it stops working.	○	○	○

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Hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

X1

Hint 1 The altitude from C is perpendicular to AB, so its gradient is the negative reciprocal of the gradient of AB.

Hint 2 Find two altitudes and the point where they meet.

Hint 3 To prove all three meet, find the third altitude and show the point lies on it. Finding where two meet proves nothing about the third.

X2

Hint 1 Write the equation as $k(\dots) + (\dots) = 0$. Both brackets are zero at the fixed point.

Hint 2 For (c), solve with $y = x$ and ask when a fraction is positive: its top and bottom have the same sign.

Hint 3 For (d), take a line through P with gradient m and try to solve for k. Which value of m gives no k? Do not forget the vertical line.

X3

Hint 1 Call the points $(p, 2p^2)$ and $(q, 2q^2)$ and find the tangent at each.

Hint 2 Perpendicular tangents: the product of the gradients is -1. This gives pq.

Hint 3 Solve the two tangent equations together. The y-coordinate of the meeting point uses only pq.

X4

Hint 1 The equation for the x-coordinates of the meeting points has $x = 1$ as one root, because A is on both.

Hint 2 Write the curve minus the line as $-(x-1)(x-n)$ with $n = 5 - m$, then integrate from 1 to n.

Hint 3 The tangent parallel to l has gradient m. Set $\dfrac{dy}{dx} = m$.

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X5

Hint 1 The midpoint of $(2a, 2b)$ and $(2c, 2d)$ is $(a + c, b + d)$. That is why the factor 2 is there.

Hint 2 Opposite sides of a parallelogram are parallel and equal: compare the change in x and the change in y along KL and along NM.

Hint 3 For the area of $PQRS$, draw the rectangle around it and take away the four right-angled triangles at its corners.

X6

Hint 1 Find the equation of AB first, then solve with $y = mx + 2$.

Hint 2 The meeting point is on the segment only when its x-coordinate is between 1 and 5. Check the sign of $5 + 4m$ before you multiply by it. Lines through $(0, 2)$ and A or B give the end values.

Hint 3 $AP : PB = 1 : 3$ means P is $\frac{1}{4}$ of the way along from A to B.

X7

Hint 1 The gradient of a linear model is the change in L divided by the change in w.

Hint 2 The springs have the same length when the two models give the same L.

Hint 3 Compare the model's prediction at 60 N with the measurement. The new model starts at $(30, 30)$.

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