GCSE MATHS (EDEXCEL 1MA1) · HIGHER · GRADE 8/9 MIXED REVISION · SHEET 9 OF 15

Hints online, answers free with an account:
mathswariz.uk/worksheets/gcse-grade-8-9-mixed-revision-9/

Grade 8/9 mixed revision 9

52 marks

Date

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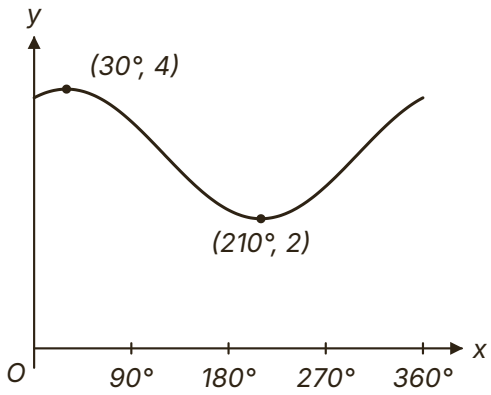
X Exam questions

Edexcel GCSE Higher style. Show all your working. The hints are at the end of the sheet. Use one at a time.

X1 The diagram shows the graph of $y = \sin(x + b) + a$ for $0° \leqslant x \leqslant 360°$, where a and b are constants and $0 < b < 180$. [3 marks]

The graph has a maximum point at $(30°, 4)$ and a minimum point at $(210°, 2)$.

Find the value of a and the value of b.



Answer $a = \ldots$, $b = \ldots$

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X2 Solve $3x - 7 = x\sqrt{5} + 1$. [3 marks]

Give your answer in the form $a + b\sqrt{5}$, where a and b are integers.

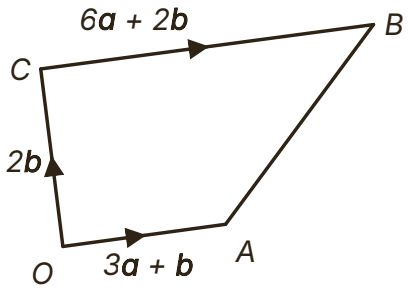
You must show all your working.

Answer $x = \ldots$

X3 $OABC$ is a quadrilateral. [3 marks]

$\overrightarrow{OA} = 3\mathbf{a} + \mathbf{b}$, $\overrightarrow{OC} = 2\mathbf{b}$ and $\overrightarrow{CB} = 6\mathbf{a} + 2\mathbf{b}$.

Prove that $OABC$ is a trapezium.



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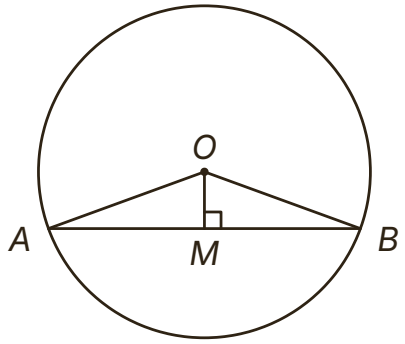
X4 A and B are points on a circle, centre O. [3 marks]

M is the point on the chord AB such that OM is perpendicular to AB.

Prove that M is the midpoint of AB.

Diagram NOT accurately drawn



X5 Simplify fully $\dfrac{x^2 - 9y^2}{x^2 + xy - 6y^2}$ [3 marks]

Answer .....

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X6 The equation $x^3 - 6x + 2 = 0$ has a solution between $x = 2$ and $x = 3$.
Two iteration formulae are formed from the equation:

$$\text{A: } x_{n+1} = \sqrt[3]{6x_n - 2} \qquad \text{B: } x_{n+1} = \frac{x_n^3 + 2}{6}$$

(a) Using $x_0 = 2.2$, find x_1, x_2 and x_3 for each formula. [3 marks]
Give your answers correct to 4 decimal places.

Answer A: ... B: ...

(b) Which formula should be used to find the solution between 2 and 3? Give a reason for your answer. [1 mark]

Total for X6: 4 marks

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X7 Solve the simultaneous equations [4 marks]

$$y^2 = 2x + 7$$

$$x - y = 4$$

You must show all your working.

Answer $x = \ldots, y = \ldots$ or $x = \ldots, y = \ldots$

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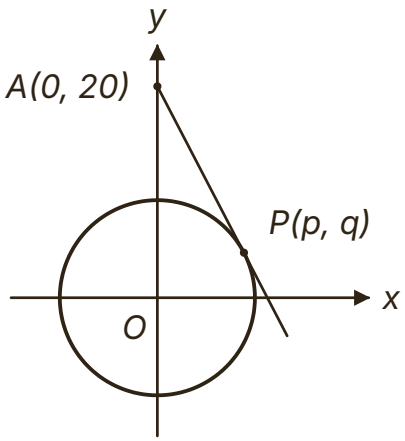
X8 The point $P(p, q)$ lies on the circle with equation $x^2 + y^2 = 40$, where $p > 0$. [5 marks]

The tangent to the circle at P passes through the point $A(0, 20)$.

Find the coordinates of P.

You must show all your working.

Diagram NOT accurately drawn



Answer $(\ldots, \ldots)$

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X9 a and b are integers.

(a) Prove that the product of any two odd numbers is odd. [2 marks]

(b) Prove that the sum of the squares of any two odd numbers is even, but is never a multiple of 4. [4 marks]

Total for X9: 6 marks

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X10 The equation $x^2 + kx + 2k + 5 = 0$, where k is a constant, has no real roots.

(a) By completing the square, show that [2 marks]

$$x^2 + kx + 2k + 5 = \left(x + \frac{k}{2}\right)^2 - \frac{k^2 - 8k - 20}{4}$$

(b) Find the range of possible values of k. [3 marks]

Answer .....

(c) Write down the largest integer value of k for which the equation has no real roots. [1 mark]

Answer $k = \ldots$

Total for X10: 6 marks

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X11 The function f is defined by $f(x) = ax + b$, where a and b are constants.
$f(3) = 19$ and $f^{-1}(4) = -2$

(a) Find the value of a and the value of b. [4 marks]

Answer $a = \ldots$ $b = \ldots$

(b) Solve $f(x) = f^{-1}(x)$. [2 marks]

Answer $x = \ldots$

Total for X11: 6 marks

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X12 The time, T seconds, for one swing of a pendulum of length L metres is given by [6 marks]

$$T = 2\pi\sqrt{\frac{L}{g}}$$

$L = 0.84$ correct to 2 decimal places.
$g = 9.81$ correct to 3 significant figures.
By considering bounds, work out the value of T to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

Answer $T =$ ... seconds

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F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can prove results with vectors, algebra and circle theorems, giving a reason for each step.	○	○	○
I can find tangents to circles and solve non-linear simultaneous equations and quadratic inequalities.	○	○	○
I can work with composite and inverse functions, algebraic fractions, surds and transformations of graphs.	○	○	○
I can use bounds with division and subtraction, and find roots by iteration.	○	○	○

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Hints

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

X1

Hint 1 $y = \sin x$ has a maximum value of 1 and a minimum value of -1. Compare with 4 and 2.

Hint 2 The middle of 4 and 2 tells you how far the graph has moved up. $y = \sin x$ has its maximum at $x = 90°$.

Hint 3 Here the maximum is at $x = 30°$, so $x + b = 90$ when $x = 30$. Solve for b.

X2

Hint 1 Collect the terms in x on one side and the numbers on the other.

Hint 2 Factorise: $x(3 - \sqrt{5}) = 8$, then divide by $3 - \sqrt{5}$.

Hint 3 Rationalise $\dfrac{8}{3 - \sqrt{5}}$ by multiplying the top and the bottom by $3 + \sqrt{5}$. The denominator is 4.

X3

Hint 1 A trapezium has one pair of parallel sides. Look for a side that is a multiple of another.

Hint 2 Compare $\overrightarrow{CB}$ with $\overrightarrow{OA}$. Then find the fourth side $\overrightarrow{AB}$ by going $A \to O \to C \to B$.

Hint 3 $\overrightarrow{CB} = 2\,\overrightarrow{OA}$. Show that $\overrightarrow{AB}$ is not a multiple of $\overrightarrow{OC} = 2\mathbf{b}$, so the other pair of sides is not parallel.

X4

Hint 1 Look at the two triangles OAM and OBM.

Hint 2 Which sides are equal, and why? Both triangles have a right angle at M.

Hint 3 $OA = OB$ (radii), OM is common and the angles at M are $90°$. State which condition for congruence this is, then say what it tells you about AM and BM.

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X5

Hint 1 The numerator is a difference of two squares: $x^2 - (3y)^2$.

Hint 2 Factorise the denominator as $(x + \ldots y)(x + \ldots y)$, with two numbers that multiply to -6 and add to 1.

Hint 3 $x^2 + xy - 6y^2 = (x + 3y)(x - 2y)$. Cancel the common bracket.

X6

Hint 1 Work through each formula separately, starting each one with $x_0 = 2.2$.

Hint 2 A: $x_1 = \sqrt[3]{6 \times 2.2 - 2} = \sqrt[3]{11.2}$. B: $x_1 = \dfrac{2.2^3 + 2}{6}$.

Hint 3 Look at what happens to each list of values: one list is settling between 2 and 3, the other is falling away from it.

X7

Hint 1 Rearrange the linear equation. Here $x = y + 4$ is quicker than making y the subject.

Hint 2 Substitute $x = y + 4$ into $y^2 = 2x + 7$ and rearrange to a quadratic in y.

Hint 3 $y^2 - 2y - 15 = 0$ factorises. For each value of y, find x from $x = y + 4$.

X8

Hint 1 The radius OP is perpendicular to the tangent AP. So triangle OPA has a right angle at P.

Hint 2 Use Pythagoras: $OA^2 = OP^2 + AP^2$, with $OP^2 = p^2 + q^2 = 40$ and $AP^2 = p^2 + (q - 20)^2$.

Hint 3 Expand and replace $p^2 + q^2$ by 40. You get a linear equation in q. Then use $p^2 + q^2 = 40$ with $p > 0$.

X9

Hint 1 Use a different letter for each odd number, $2a + 1$ and $2b + 1$, because the two numbers can be any odd numbers.

Hint 2 Expand. To show a number is odd, write it as $2(\ldots) + 1$.

Hint 3 For part (b), the expansion is $4a^2 + 4a + 4b^2 + 4b + 2$. Take out 2 for even, and write it as $4(\ldots) + 2$ for the second statement.

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X10

Hint 1 Halve the coefficient of x: $x^2 + kx = \left(x + \frac{k}{2}\right)^2 - \frac{k^2}{4}$.

Hint 2 A square is never negative, so the equation has no real roots when the number left over after the square is more than 0. That gives $k^2 - 8k - 20 < 0$.

Hint 3 $(k - 10)(k + 2) < 0$ holds between the critical values. The inequality is strict, so $k = 10$ is not allowed.

X11

Hint 1 $f^{-1}(4) = -2$ means that $f(-2) = 4$.

Hint 2 This gives two equations: $3a + b = 19$ and $-2a + b = 4$.

Hint 3 Subtract one equation from the other to find a, then b. For (b), find $f^{-1}(x)$ and solve $3x + 10 = \dfrac{x - 10}{3}$.

X12

Hint 1 Write down the bounds for L and for g.

Hint 2 L is on the top of the fraction and g is on the bottom. The largest T uses the largest L and the smallest g.

Hint 3 Work out both bounds of T, then round them both to 3 s.f., then to 2 s.f. Use the most accurate value they agree on.

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