Hints online, answers free with an account:
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Grade 8/9 mixed revision 13

51 marks

Date

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 n is an integer. [3 marks]

Find the smallest value of n for which $n^2 + 3n < 200$

You must show all your working.

Answer $n = \ldots$

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X2 The graph of $y = f(x)$ is drawn on a coordinate grid.

(a) The point $(5, 7)$ lies on the graph of $y = f(-x) + 2$. [1 mark]
Write down the coordinates of a point that must lie on the graph of $y = f(x)$.

Answer $(\ldots, \ldots)$

(b) The point $(2, -1)$ lies on the graph of $y = -f(x - 3)$. [2 marks]
Find the coordinates of a point that must lie on the graph of $y = f(x)$.

Answer $(\ldots, \ldots)$

Total for X2: 3 marks

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X3 Write $\dfrac{3\sqrt{5}+\sqrt{3}}{\sqrt{5}-\sqrt{3}}$ in the form $a+b\sqrt{15}$, where a and b are integers. [3 marks]

You must show all your working.

Answer ...

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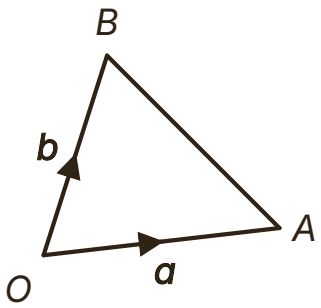
X4 $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$. [3 marks]

P, Q and R are points such that

$$\overrightarrow{OP} = \mathbf{a} + 2\mathbf{b}, \quad \overrightarrow{OQ} = 3\mathbf{a} + \mathbf{b}, \quad \overrightarrow{OR} = 7\mathbf{a} - \mathbf{b}.$$

Show that P, Q and R lie on a straight line, and state which of the three points lies between the other two. Give a reason for your answer.



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X5 The point $P(-6, 9)$ lies on the circle with equation $x^2 + y^2 = 117$.
Sam tries to find the equation of the tangent to the circle at P. Here is his working.

$$\text{gradient of } OP = \frac{9}{6} = \frac{3}{2} \qquad \text{gradient of tangent} = -\frac{2}{3}$$

$$y - 9 = -\frac{2}{3}(x + 6) \qquad y = -\frac{2}{3}x + 5$$

(a) Explain the mistake Sam made. [1 mark]

(b) Find the correct equation of the tangent at P. [3 marks]
Give your answer in the form $y = mx + c$.

Answer $y = \ldots$

Total for X5: 4 marks

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X6 n is an integer.

(a) Prove that the sum of the squares of any three consecutive integers is 2 more than a multiple of 3. [3 marks]

(b) Every square number leaves a remainder of 0 or 1 when divided by 3.
Explain why the sum of the squares of three consecutive integers is never a square number. [1 mark]

Total for X6: 4 marks

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X7 Solve $\dfrac{6}{x+1} + \dfrac{1}{x-2} = 2$ [4 marks]

Answer $x = \ldots$

X8 A ramp rises 0.44 m, correct to 2 decimal places, over a horizontal distance of 3.6 m, correct to 1 decimal place. [4 marks]
A rule says that the gradient of the ramp must be no more than 0.125.
Ali says, "$0.44 \div 3.6 = 0.122$, so the ramp definitely meets the rule."
Is Ali correct? You must show all your working.

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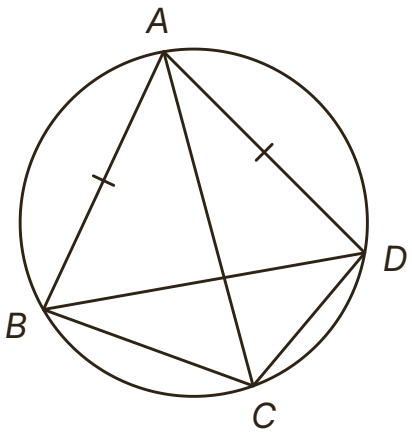
X9 A, B, C and D are points on a circle. [5 marks]

$AB = AD$

Prove that CA bisects angle BCD.

Give a reason for each stage of your working.

Diagram NOT accurately drawn



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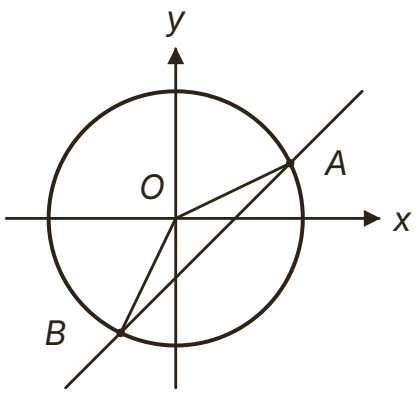
X10 The line with equation $y = x - 7$ meets the circle with equation $x^2 + y^2 = 109$ at the points A and B. [6 marks]

O is the centre of the circle.

Work out the area of triangle OAB.

You must show all your working.

Diagram NOT accurately drawn



Answer ... square units

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X11 The function f has inverse

$$f^{-1}(x) = \frac{x+7}{2x-1} \qquad x \neq \frac{1}{2}$$

(a) Find $f(3)$. [2 marks]

Answer .....

(b) Find $f(x)$. [3 marks]

Answer $f(x) = \ldots$

(c) What does your answer to part (b) show about the graph of $y = f(x)$? [1 mark]

Total for X11: 6 marks

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X12 The equation $x^2 - 5x + 3 = 0$ has two positive solutions.

(a) Show that $x^2 - 5x + 3 = 0$ can be rearranged to give $x = \sqrt{5x - 3}$ [1 mark]

(b) Using $x_{n+1} = \sqrt{5x_n - 3}$ with $x_0 = 1$, find x_1, x_2 and x_3 [3 marks]
Give your answers correct to 4 decimal places.

Answer $x_1 = \ldots$ $x_2 = \ldots$ $x_3 = \ldots$

(c) Riya says, "Starting at $x_0 = 1$, the iteration will find the solution that lies between 0 and 1." [2 marks]
Is Riya correct? You must give a reason for your answer.

Total for X12: 6 marks

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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 Find where $n^2 + 3n = 200$ by solving $n^2 + 3n - 200 = 0$.

Hint 2 The formula gives $n = \dfrac{-3 \pm \sqrt{809}}{2}$. The inequality holds between the two critical values.

Hint 3 The lower critical value is about -15.7. The smallest integer is the first one above it, so check -15 and -16.

X2

Hint 1 Substitute the point into the equation of the transformed graph. For (a), $7 = f(-5) + 2$.

Hint 2 From $7 = f(-5) + 2$ you know the value of $f(-5)$, which gives a point on $y = f(x)$. For (b), $-1 = -f(2 - 3)$.

Hint 3 In (b), $f(2 - 3) = f(-1)$ and the minus sign in front changes -1 into 1. Write the point as $(x, f(x))$.

X3

Hint 1 The denominator has two surds. Multiply the top and the bottom by $\sqrt{5} + \sqrt{3}$.

Hint 2 $(\sqrt{5} - \sqrt{3})(\sqrt{5} + \sqrt{3}) = 5 - 3$. In the numerator, $\sqrt{5} \times \sqrt{3} = \sqrt{15}$.

Hint 3 The numerator is $15 + 3\sqrt{15} + \sqrt{15} + 3$. Collect the terms and divide each by 2.

X4

Hint 1 Find $\overrightarrow{PQ}$ and $\overrightarrow{QR}$ by subtracting position vectors.

Hint 2 Look for one of them being a number times the other. If they also share a point, the three points are on one line.

Hint 3 $\overrightarrow{QR} = 2\,\overrightarrow{PQ}$. The multiple is positive, so you keep going the same way from P to Q to R. Decide which point is in the middle.

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X5

Hint 1 Check Sam's first line. Work out the gradient of OP yourself from $O(0, 0)$ to $P(-6, 9)$.

Hint 2 Change in y is 9 and change in x is -6. Compare this with what Sam wrote.

Hint 3 The gradient of OP is $-\frac{3}{2}$, so the tangent has gradient $\frac{2}{3}$. Use it with $P(-6, 9)$.

X6

Hint 1 Use $n - 1$, n and $n + 1$ for the three integers. This makes the algebra shorter.

Hint 2 Expand $(n - 1)^2$ and $(n + 1)^2$. The $2n$ terms cancel.

Hint 3 You should get $3n^2 + 2$. For part (b), what remainder does $3n^2 + 2$ leave when divided by 3? Compare with square numbers.

X7

Hint 1 Multiply every term, including the 2, by $(x + 1)(x - 2)$.

Hint 2 $6(x - 2) + (x + 1) = 2(x + 1)(x - 2)$. Expand and collect everything on one side.

Hint 3 You should get $2x^2 - 9x + 7 = 0$. Find two numbers that multiply to 14 and add to -9.

X8

Hint 1 Write down the bounds of the rise and of the horizontal distance.

Hint 2 The gradient is rise divided by horizontal distance. Find the largest value it could be.

Hint 3 Work out $0.445 \div 3.55$ and compare it with 0.125.

X9

Hint 1 $AB = AD$, so look at triangle ABD first.

Hint 2 Angle ACD and angle ABD stand on the same chord AD. Angle ACB and angle ADB stand on the same chord AB.

Hint 3 Angle $ABD =$ angle ADB, so the two angles at C are each equal to one of these. Write the chain of equal angles with a reason for each link.

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X10

Hint 1 Find the coordinates of A and B by substituting $y = x - 7$ into the circle's equation.

Hint 2 Solve $x^2 - 7x - 30 = 0$, then use the line to find each y-coordinate.

Hint 3 The line crosses the y-axis at $(0, -7)$. Split triangle OAB along the y-axis into two triangles with base 7; their heights are the distances of A and B from the y-axis.

X11

Hint 1 $f(3) = y$ means that $f^{-1}(y) = 3$.

Hint 2 Solve $\dfrac{y + 7}{2y - 1} = 3$ for y.

Hint 3 For (b), f is the inverse of f^{-1}: write $y = \dfrac{x + 7}{2x - 1}$, multiply by $2x - 1$ and make x the subject.

X12

Hint 1 For part (a), move $-5x + 3$ to the other side, then take the square root.

Hint 2 For part (b), $x_1 = \sqrt{5 \times 1 - 3} = \sqrt{2}$. For part (c), solve the quadratic with the formula to find both solutions.

Hint 3 The solutions are about 0.70 and 4.30. Compare: are your values x_1, x_2, x_3 getting nearer to 0.70 or nearer to 4.30?

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