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

56 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 The kinetic energy, E joules, of a ball of mass m kg moving at v m/s is given by [3 marks]

$$E = \frac{1}{2}mv^2$$

$m = 0.65$ correct to 2 decimal places.
$v = 12$ correct to the nearest whole number.
Work out the lower bound for E. Give your answer correct to 3 significant figures.

Answer $E = \ldots$

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X2 Prove that the product of any two consecutive odd numbers is always 1 less than a multiple of 4. [3 marks]

X3 The point $P(\sqrt{7}, 3)$ lies on the circle with equation $x^2 + y^2 = 16$. [4 marks]
Find an equation of the tangent to the circle at P.
Give your answer in the form $ax + by = c$, where a, b and c are exact values.

Answer ...

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X4 Amir is asked to solve $20 + 3x - 2x^2 > 0$ [4 marks]

He writes the answer $x < -\frac{5}{2}$ or $x > 4$.

Show that Amir is wrong and find the correct solution.

You must show all your working.

Answer .....

X5 The functions f and g are such that

$$f(x) = \frac{2}{x-1},\ x \neq 1 \qquad g(x) = \frac{x+2}{x},\ x \neq 0$$

(a) Show that $fg(x) = x$ [3 marks]

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(b) Hence write down $g^{-1}(x)$. [1 mark]

Answer $g^{-1}(x) = \ldots$

Total for X5: 4 marks

X6 The curve C has equation $y = x^2 - 4x$. [5 marks]

C is translated by the vector $\begin{pmatrix} k \\ 0 \end{pmatrix}$, where k is a constant.

The translated curve passes through the point $(5, 12)$.

Find the possible values of k.

You must show all your working.

Answer $k = \ldots$

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X7 OAB is a triangle.

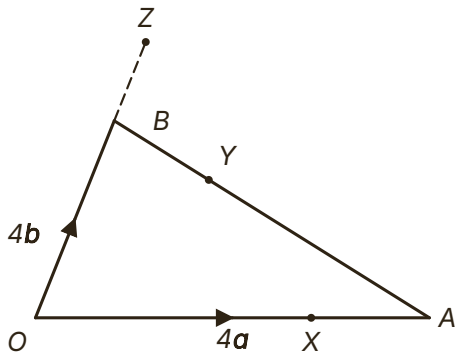
$\overrightarrow{OA} = 4\mathbf{a}$ and $\overrightarrow{OB} = 4\mathbf{b}$.

X is the point on OA such that $OX : XA = 3 : 1$.

Y is the point on AB such that $AY : YB = 3 : 1$.

The side OB is extended to the point Z so that $\overrightarrow{BZ} = \frac{1}{2}\mathbf{b}$.

Diagram NOT accurately drawn



(a) Prove that X, Y and Z lie on a straight line. [4 marks]

(b) Find the ratio $XY : YZ$. [1 mark]

Answer ⋯ : ⋯

Total for X7: 5 marks

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X8 A, B, C and D are points on a circle, centre O. [5 marks]

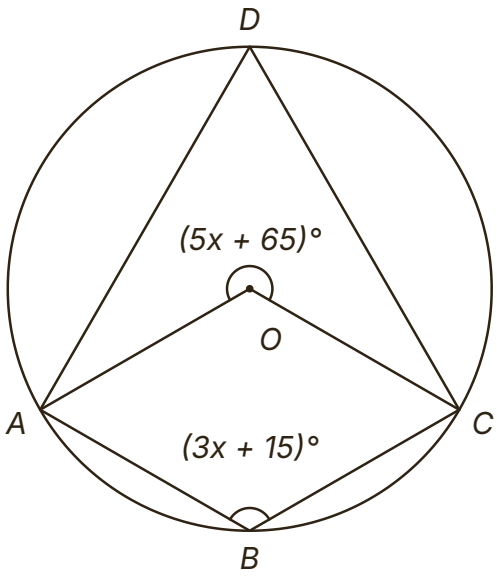
Angle $ABC = (3x + 15)^\circ$

Reflex angle $AOC = (5x + 65)^\circ$

Work out the size of angle ADC.

Give a reason for each stage of your working.

Diagram NOT accurately drawn



Answer Angle $ADC = \ldots^\circ$

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X9 Given that [5 marks]

$$\frac{x+7}{x^2-x-2} - \frac{a}{x-2} \equiv \frac{b}{x+1}$$

find the value of a and the value of b.

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

X10 Amira has £3000 in a savings account at the start of year 1.
At the end of each year, interest of 4% is added to the account and then Amira takes out £200.
The amount, £A_n, in the account after n years is given by

$$A_{n+1} = 1.04A_n - 200, \quad A_0 = 3000$$

(a) Work out the amount in the account after 3 years. [2 marks]

Answer £ ...

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(b) After how many years will the amount in the account first be less than £2000? [2 marks]

Answer ... years

(c) Amira wants the amount in the account to stay the same every year.
Find the amount she should have in the account at the start. [2 marks]

Answer £ ...

Total for X10: 6 marks

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X11 A cuboid has a square base. Each edge of the base has length $(1 + \sqrt{2})$ cm. [6 marks]

The volume of the cuboid is $(7 + 5\sqrt{2})$ cm³.

Show that the cuboid is a cube.

You must show all your working.

X12 The line with equation $y = kx - 5$ meets the curve with equation $y = 2x^2 + 3$ at exactly one point.

(a) Find the two possible values of k. [3 marks]

Answer $k = \ldots$ or $k = \ldots$

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(b) For each value of k, find the coordinates of the point where the line meets the curve. [3 marks]

Answer $(\ldots, \ldots)$ and $(\ldots, \ldots)$

Total for X12: 6 marks

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**	Write down the lower bound of m and the lower bound of v.
	Hint 2	Every part of the formula is multiplied, so the least value uses the least m and the least v.
	Hint 3	Square 11.5 first, then work out $\frac{1}{2} \times 0.645 \times 132.25$.
X2	**Hint 1**	Write two consecutive odd numbers using one letter.
	Hint 2	Multiply out the brackets.
	Hint 3	$(2n-1)(2n+1) = 4n^2 - 1$. Explain why $4n^2$ is a multiple of 4.
X3	**Hint 1**	The tangent is perpendicular to the radius OP. The gradient of OP is $\dfrac{3}{\sqrt{7}}$.
	Hint 2	The negative reciprocal of $\dfrac{3}{\sqrt{7}}$ is $-\dfrac{\sqrt{7}}{3}$. Use it with the point $(\sqrt{7}, 3)$.
	Hint 3	Multiply $y - 3 = -\dfrac{\sqrt{7}}{3}(x - \sqrt{7})$ by 3, use $\sqrt{7} \times \sqrt{7} = 7$, and collect the x and y terms on one side.
X4	**Hint 1**	Find the critical values first. Amir has them right.
	Hint 2	Test a value between the critical values, such as $x = 0$, in $20 + 3x - 2x^2$.
	Hint 3	With $-2x^2$ the graph opens downwards, so it is above the x-axis between $-\frac{5}{2}$ and 4, not outside them. Or multiply by -1 and reverse the inequality sign.
X5	**Hint 1**	Replace x in $f(x)$ with $\dfrac{x+2}{x}$.
	Hint 2	Write $\dfrac{x+2}{x} - 1$ as one fraction. The numerator is $x + 2 - x$.
	Hint 3	For (b): $fg(x) = x$ means that f takes every output of g back to where it started.

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X6

Hint 1 Translating by $\begin{pmatrix} k \\ 0 \end{pmatrix}$ replaces x by $x - k$.

Hint 2 The new curve is $y = (x-k)^2 - 4(x-k)$. Put $x = 5$ and $y = 12$ into it.

Hint 3 $(5-k)^2 - 4(5-k) = 12$ expands to a quadratic in k: $k^2 - 6k - 7 = 0$. Solve it; keep both solutions and check each one.

X7

Hint 1 $OX = 3\mathbf{a}$, so $\overrightarrow{XA} = \mathbf{a}$. Y is three quarters of the way from A to B.

Hint 2 Find $\overrightarrow{XY}$ by going $X \to A \to Y$, and $\overrightarrow{YZ}$ by going $Y \to B \to Z$. $\overrightarrow{YB}$ is one quarter of $\overrightarrow{AB}$.

Hint 3 $\overrightarrow{XY} = -2\mathbf{a} + 3\mathbf{b}$. Write $\overrightarrow{YZ}$ the same way and show that one is a number times the other. Say which point they share.

X8

Hint 1 Which angle at the centre stands on the same arc as angle ABC: the reflex angle or the other one?

Hint 2 The reflex angle AOC is twice angle ABC. Write this as an equation in x.

Hint 3 $5x + 65 = 6x + 30$. Find x and angle ABC, then use the cyclic quadrilateral $ABCD$ to find angle ADC.

X9

Hint 1 Factorise $x^2 - x - 2$ so that all the fractions can have the same denominator.

Hint 2 Over $(x-2)(x+1)$ the identity becomes $x + 7 - a(x+1) \equiv b(x-2)$.

Hint 3 This is true for every x. Put $x = 2$ to find a, or compare the coefficients of x and the constant terms.

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X10

Hint 1 Use the formula with $n = 0$ to find A_1, then use A_1 to find A_2, and so on.

Hint 2 For part (b), keep going until the amount drops below 2000; the year number is the n in A_n. For part (c), the amount staying the same means $A_{n+1} = A_n$.

Hint 3 For part (c), write $A = 1.04A - 200$ and solve for A: the interest each year, $0.04A$, must equal the £200 taken out.

X11

Hint 1 Volume = base area $\times$ height. Work out the base area, $(1 + \sqrt{2})^2$.

Hint 2 Height = volume $\div$ base area. Rationalise $\dfrac{7 + 5\sqrt{2}}{3 + 2\sqrt{2}}$ by multiplying the top and the bottom by $3 - 2\sqrt{2}$.

Hint 3 The denominator becomes $9 - 8 = 1$. Expand $(7 + 5\sqrt{2})(3 - 2\sqrt{2})$ and compare the height with the edge of the base.

X12

Hint 1 Set $2x^2 + 3$ equal to $kx - 5$ and rearrange to a quadratic equal to 0.

Hint 2 The line meets the curve once when $2x^2 - kx + 8 = 0$ has one repeated root, so it can be written as $2(x - a)^2$.

Hint 3 Expand $2(x - a)^2$ and compare: $2a^2 = 8$ and $k = 4a$. There are two values of a. For (b), put each value of k back into the quadratic, which is then a multiple of a perfect square.

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