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Form:

MATHS FUNDAMENTAL KNOWLEDGE QUIZ BOOKLET

Higher



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Unit 1: Area and Angles

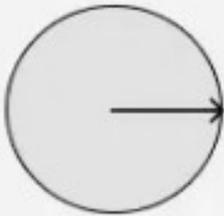
Definition/Question	Answer
1. Angles on a straight-line sum to	180
2. Angles in a triangle sum to	180
3. Angles around a point sum to	360
4. Angles in a quadrilateral sum to	360
5. Formula for calculating exterior angle of a polygon	$360 \div \text{no. of sides}$
6. Formula for calculating interior angle of a polygon	$180 - \text{exterior angle}$
7. Formula for calculating sum of angles in a polygon	$(n - 2) \times 180$
8. Formula for calculating area of rectangle or parallelogram	$\text{base} \times \text{height}$
9. Formula for calculating area of a triangle.	$\frac{\text{base} \times \text{height}}{2}$
10. Formula for calculating area of a trapezium.	$\frac{1}{2}(a + b) \times h$



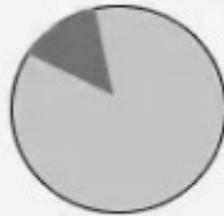
Unit 2: Properties of Circles

Calculate	Formula
1. Area of circle.	$\pi \times r^2$
2. Circumference of Circle.	$\pi \times d$
3. Length of an arc.	$\pi \times d \times \frac{\theta}{360}$
4. Area of a sector.	$\pi \times r^2 \times \frac{\theta}{360}$

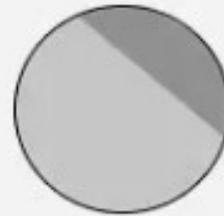
1. RADIUS



2. SECTOR



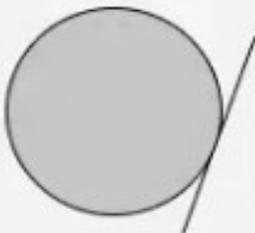
3. SEGMENT



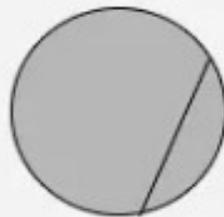
4. ARC



5. TANGENT



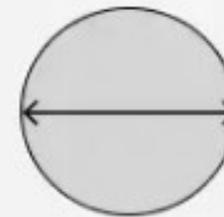
6. CHORD



7. CIRCUMFERENCE



8. DIAMETER



Unit 3: Properties of 3D Shapes

Question/Definition	Answer
1. A single flat surface of a 3D shape.	Face
2. The line segment that connects faces.	Edges
3. The corner of a 3D shape.	Vertices
4. A measurement of the 3D space occupied by a solid, liquid or gas.	Volume
5. Formula for Volume of a prism.	Area of cross section x length
6. Formula for Volume of a cylinder.	$\pi \times r^2 \times h$
7. I have 6 faces, 12 edges, 8 vertices.	Cube or Cuboid
8. I have 5 faces, 9 edges, 6 vertices.	Triangular prism
9. I have 3 faces, 2 edges and 0 vertices.	Cylinder
10. I have 2 faces, 1 edge, 1 vertex.	Cone

Unit 4: Probability

Definition/Question	Answer
1. The probabilities of all possible outcomes of an event always add up to	1 or 100%
2. How do we represent probabilities?	Fraction or Decimal
3. What is the estimated probability of an event happening called?	Relative frequency
4. How do you calculate the relative frequency of an event?	$\frac{\text{Number of times the event happened}}{\text{Total number of trials}}$
5. How can you improve the accuracy of an estimated probability?	Increase the number of trials
6. What should each branch in a tree diagram sum to?	1
7. How do you calculate the probability across branches in a tree diagram?	Multiply the probabilities
8. What does $A \cup B$ mean?	A or B
9. What does $A \cap B$ mean?	A and B, the intersection of the Venn diagram
10. What does A' mean?	The complement of A, not A.

Unit 5: Graphs

Question/Definition

Answer

1. The order of co-ordinates.

(x, y)

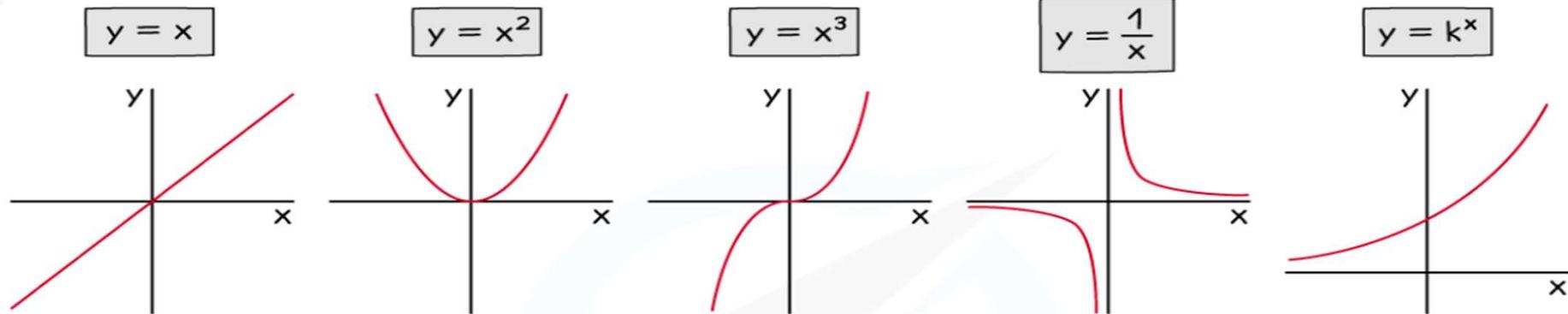
2. The equation for a straight line.

$y = mx + c$

3. Method to calculate the gradient of a straight-line graph.

$$\frac{y_2 - y_1}{x_2 - x_1}$$

Name the type of graph



4. Linear Graph

5. Quadratic

6. Cubic

7. Reciprocal

8. Exponential

9. Where a linear graph crosses the y-axis.

Y-intercept

10. How steep a line is.

Gradient

Unit 6: Quadratic Graphs

Definition/Question	Answer
1. A mathematical statement in which two expressions are connected by an equal sign.	Equation
2. What is the general equation of a quadratic graph?	$y = x^2 + bx + c$
3. What are the roots of a quadratic equation?	The x-intercept(s)
4. What is a turning point on a graph?	A maximum or minimum point
5. Describe a quadratic graph with a negative x^2 term.	\cap – shaped curve.
6. When using an iterative formula, what does a change of sign between two x-values tell you?	That the equation has a root between those two x-values
7. What should be labelled in a sketch of a quadratic graph?	The y-intercept, roots and turning point
8. Where is the line of symmetry on a quadratic graph?	On the vertical line that passes through the turning point.
9. If the quadratic graph has one x-intercept, what does this mean?	There is one real root.
10. If a quadratic graph has no x-intercepts, what does this mean?	There are no real roots.

Unit 7 :Index Laws

Definition/Question	Answer
1. What is the base of the index n^a	n
2. $n^a \times n^b$	n^{a+b}
3. $n^a \div n^b$	n^{a-b}
4. n^0	1
5. $\frac{n^a}{n^b}$	n^{a-b}
6. $(n^a)^b$	$n^{a \times b}$
7. $(2n^a)^b$	$2^b n^{a \times b}$
8. n^{-a}	$\left(\frac{1}{n}\right)^a$
9. $n^{\frac{1}{a}}$	$\sqrt[a]{n}$
10. $n^{\frac{a}{b}}$	$(\sqrt[b]{n})^a$



Unit 8: Statistical Diagrams

Definition/Question	Answer
1. The running total of frequencies	Cumulative Frequency
2. A graph using bars of varying widths and frequency density	Histogram
3. How do you calculate frequency density?	frequency \div class width
4. How do you plot points on a frequency polygon?	(midpoint, frequency)
5. How do you plot points on a cumulative frequency graph?	(endpoint, cumulative frequency)
6. How do you find the frequency from a histogram?	Find the area of the bars
7. Calculating an angle for a pie chart	$\frac{x}{total\ frequency} \times 360^\circ$
8. A diagram displaying the minimum value, LQ, median, UQ and maximum value	Box plot
9. Interquartile range (IQR)	Upper quartile – Lower quartile
10. To compare data sets what two things do you compare	Median and IQR



Unit 9: Proportion and Percentages

Definition/Question	Answer
1. A relationship between two variables where, as one increase the other also increases. $y=kx$	Direct Proportion
2. A relationship between two variables where, as one increase the other decreases $y=\frac{k}{x}$	Inverse Proportion
3. To find the value of one unit first	Unitary Method
4. Tells us how much of one currency you can exchange for another currency e.g. £1 = \$1.39	Exchange Rates
5. Calculator formula to calculate percentage of an amount	$\text{New amount} = \text{Orginal} \times \text{Multiplier}$
6. Formula to use when finding reverse percentages	$\text{Orginal} = \frac{\text{New Amount}}{\text{Mutiplier}}$
7. Formula for percentage change	$\frac{\text{Difference}}{\text{Orginal}} \times 100$
8. Calculate the percentage amount and multiply it by the number of periods that the money will be invested for.	Simple Interest
9. Money that is paid regularly as a percentages, this is usually by a bank when money is saved or borrowed	Interest rate
10. Interest that gets added regularly which changes the value of money each time.	Compound Interest

Unit 10: Sequences

Definition/Question	Answer
1. A pattern of numbers (or shape) which fit a certain rule	Sequence
2. A number in a sequence	Term
3. The rule of how to get from one number to the next number in the sequence	Term – to – term rule
4. Where a term is in a sequence	Position
5. The rule for how to work out a number in a sequence if you know its position (sometimes called position to term rule)	Nth Term
6. The terms increase or decrease by the same amount each time. Has an nth term $an+b$	Linear sequence
7. The terms go to the next by multiplying or dividing by the same value	Geometric Sequence
8. The terms in the sequence are found by adding the previous two terms. 1, 1, 2, 3, 5,...	Fibonacci Sequence
9. The first difference of the terms is not equal, but the second decrease is an equal increase or decrease. Has an nth term an^2+bn+c	Quadratic sequence
10. A sequence of numbers that are represented through a series of dots formed into equilateral triangles. 1, 3, 6, 10, ...	Triangular numbers



Unit 11: Congruence and Similar Shape

Definition/Question	Answer
1. Two shapes that are the same size and the same shape.	Congruent
2. If all the angles are the same size and the corresponding sides are in the same ratio in two shapes	Similar
3. What are the four rules that prove congruency in triangles?	ASA, SSS, SAS RHS
4. A transformation which changes the size of a shape	Enlargement
5. How much the shape has been enlarged by	Scale Factor
6. The longest corresponding length in two similar shapes divided by the shortest	Length scale factor
7. The largest area in two similar shapes divided by the smallest. Can also be found by squaring the length scale factor	Area scale factor
8. The largest volume in two similar shapes divided by the smallest. Can also be found by cubing the length scale factor	Volume Scale factor
9. How do you find the length scale factor given the area scale factor?	\sqrt{ASF}
10. How do you find the length scale factor given the volume scale factor?	$\sqrt[3]{VSF}$

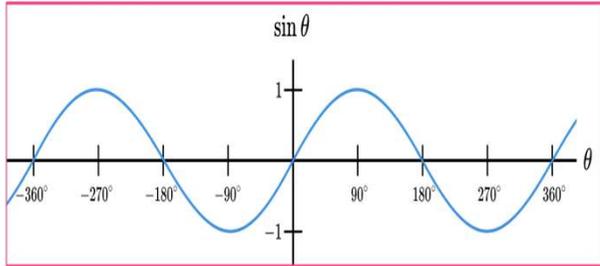


Unit 12 : Trigonometry (Y11)

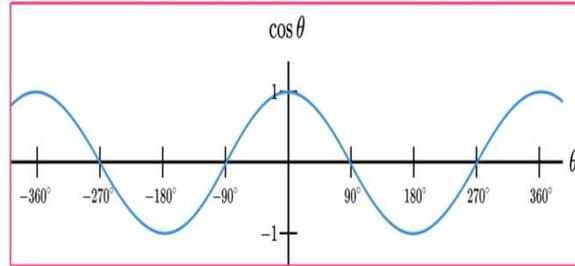
Definition/Question

Answer

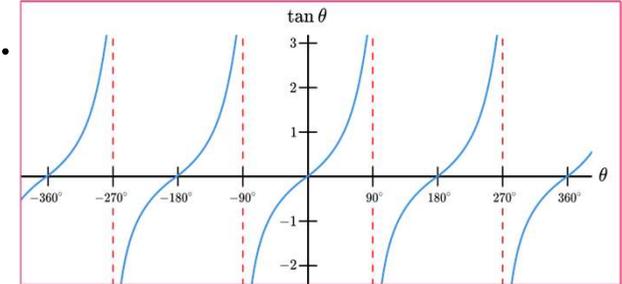
1.



2.



3.



4. In a right-angled triangle what lengths do you need to use Sine

Opposite and Hypotenuse

5. In a right-angled triangle what lengths do you need to use Cosine

Adjacent and Hypotenuse

6. In a right-angled triangle what lengths do you need to use Tangent

Opposite and Adjacent

7. What do you need to use Sine Rule

2 lengths and 2 angles (they should be opposite)

8. What do you need to use Cosine Rule

3 lengths and an angle

9. What do you need to use the trigonometric area formula

2 lengths and the included angle

10. Trig Exact Values

	0°	30°	45°	60°	90°
$\sin(\theta)$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos(\theta)$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan(\theta)$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	<i>undefined</i>

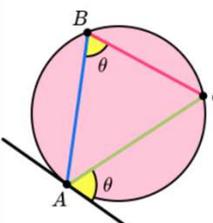
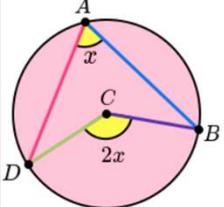
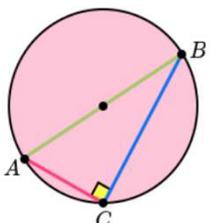
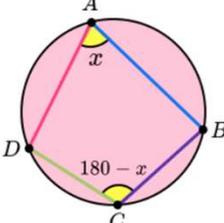
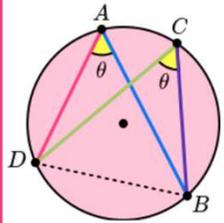
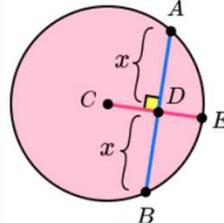
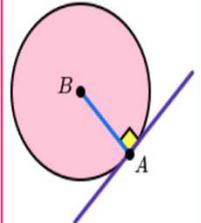
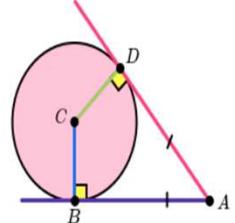


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Unit 13: Circle Geometry (Y11)

Definition/Question	Answer
1. The general equation of a circle with centre (0, 0)	$x^2 + y^2 = r^2$
2. The radius and tangents gradients are	Perpendicular
3. To find the perpendicular gradient	Find the negative reciprocal

<p>Alternate segment theorem</p>  <p>The angle that lies between a tangent and a chord is equal to the angle subtended by the same chord in the alternate segment.</p>	<p>Angle at the centre theorem</p>  <p>The angle at the centre is twice the angle at the circumference.</p>	<p>Angles in a semicircle</p>  <p>The angle in a semicircle is 90 degrees.</p>	<p>Cyclic quadrilateral</p>  <p>The opposite angles in a cyclic quadrilateral total 180°.</p>
<p>Angles in the same segment theorem</p>  <p>Angles in the same segment are equal.</p>	<p>Chord of a circle</p>  <p>The perpendicular from the centre of a circle to a chord bisects the chord (splits the chord into two equal parts).</p>	<p>Tangent of a circle</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;"> <p>Diagram A</p>  </div> <div style="border: 1px solid black; padding: 2px;"> <p>Diagram B</p>  </div> </div> <p>A. The angle between a tangent and radius is 90 degrees. B. Tangents which meet at the same point are equal in length.</p>	



Unit 14: Exam Technique

In a city

the number of shops and the number of restaurants are in the ratio 7 : 2
 the number of restaurants and the number of pubs are in the ratio 8 : 3

There are 30 pubs in the city.

How many shops are there in the city?

$$\begin{array}{l} R : P \\ \times 10 \left\{ \begin{array}{l} 8 : 3 \\ 80 : 30 \end{array} \right\} \times 10 \end{array}$$

80 restaurants

$$\begin{array}{l} S : R \\ \times 40 \left\{ \begin{array}{l} 7 : 2 \\ 280 : 80 \end{array} \right\} \times 40 \end{array}$$

$$7 \times 40 = 280$$

280 Shops

3 marks

The perimeter of a right-angled triangle is 108 cm.

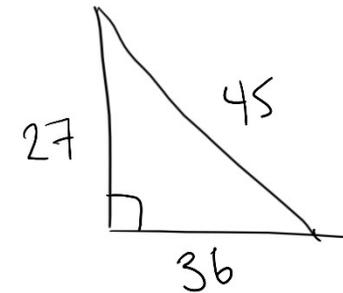
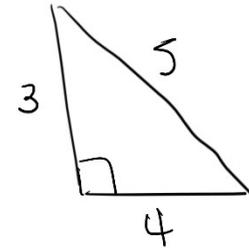
The lengths of its sides are in the ratio 3 : 4 : 5

Work out the area of the triangle.

$$\begin{array}{l} 3 + 4 + 5 = 12 \\ 108 \div 12 = 9 \end{array}$$

$$\begin{array}{l} \times 9 \left\{ \begin{array}{l} 3 : 4 : 5 \\ 27 : 36 : 45 \end{array} \right. \end{array}$$

$$\begin{aligned} \text{area} &= \frac{27 \times 36}{2} \\ &= 486 \text{ cm}^2 \end{aligned}$$



4 marks



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Unit 15: Exam Technique

(a) Write down the value of $25^{\frac{1}{2}}$

$$\sqrt{25} = 5$$

5

.....
(1)

(b) Write down the value of 32^0

1

.....
(1)

(c) Work out the value of $64^{-\frac{2}{3}}$

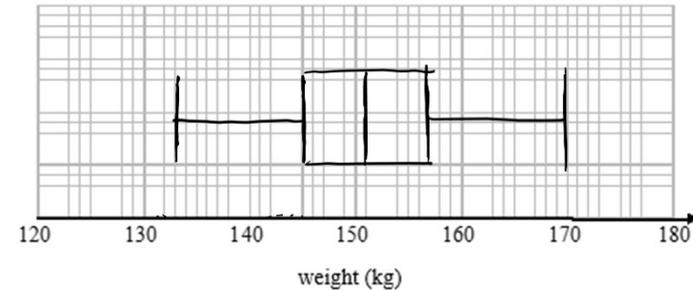
$$\left(\frac{1}{64}\right)^{\frac{2}{3}} = \left(\frac{1}{\sqrt[3]{64}}\right)^2 = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$$

.....
(2)

The table gives some information about the weights of 80 gorillas.

Least weight	133 kg
Greatest weight	170 kg
Lower quartile	145 kg
Upper quartile	157 kg
Median	151 kg

(a) Draw a box plot to represent this information.



(3)

(b) Work out an estimate for the number of these gorillas with a weight between 133 kg and 157 kg.

75%

.....
(2)



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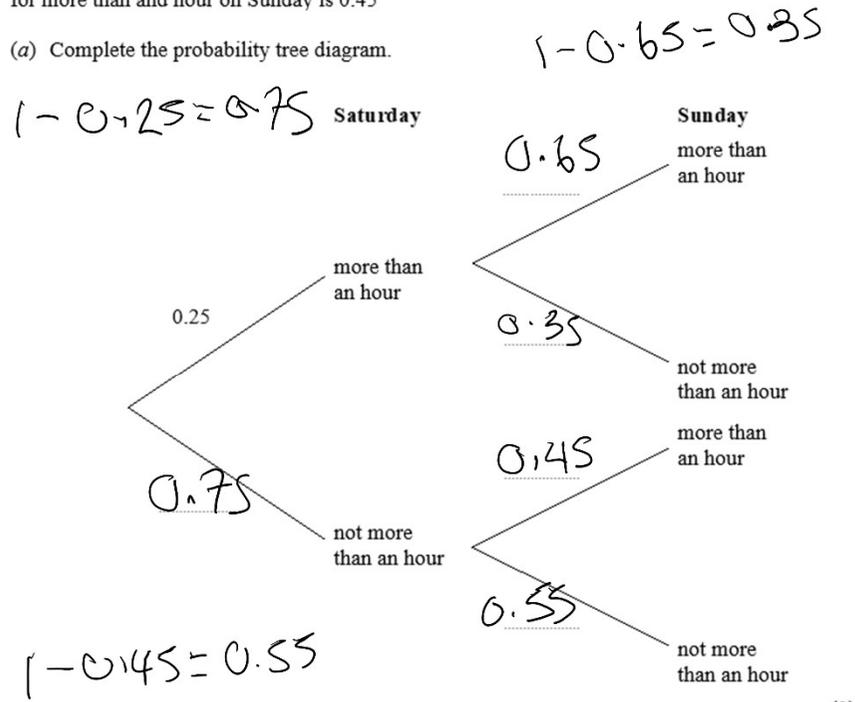
Unit 16: Exam Technique

A vicar is going to preach a sermon on both Saturday and on Sunday.
The probability that she will preach for more than an hour on Saturday is 0.25

If the vicar preaches more than an hour on Saturday, the probability that she will preach for more than an hour on Sunday is 0.65.

If she does **not** preach for more than an hour on Saturday, the probability that she will preach for more than an hour on Sunday is 0.45

(a) Complete the probability tree diagram.



(b) Find the probability that the vicar will preach for more than an hour on exactly one of the two days.

$$0.25 \times 0.35 + 0.75 \times 0.45$$

$$0.0875 + 0.3375 = 0.425$$

Simplify fully

$$\frac{2x^2 - 3x - 2}{2x^2 - 4x}$$

$$2 \times 2 = 4$$

$$\frac{1 \ 4}{2 \ 2}$$

factorise $2x^2 - 3x - 2$

$$= 2x^2 - 4x + x - 2$$

$$= 2x(x - 2) + 1(x - 2)$$

$$= (2x + 1)(x - 2)$$

factorise $2x^2 - 4x$

$$= 2x(x - 2)$$

$$\frac{(2x + 1)(x - 2)}{2x(x - 2)} = \frac{2x + 1}{2x}$$

3 marks



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Unit 17: Exam Technique

(a) Simplify $p^4 \times p^5$

$$p^{4+5} = p^9$$

$$p^9$$

(1)

(b) Simplify $(2ab^2)^3$

$$2^3 a^3 b^{2 \times 3} = 8a^3 b^6$$

$$8a^3 b^6$$

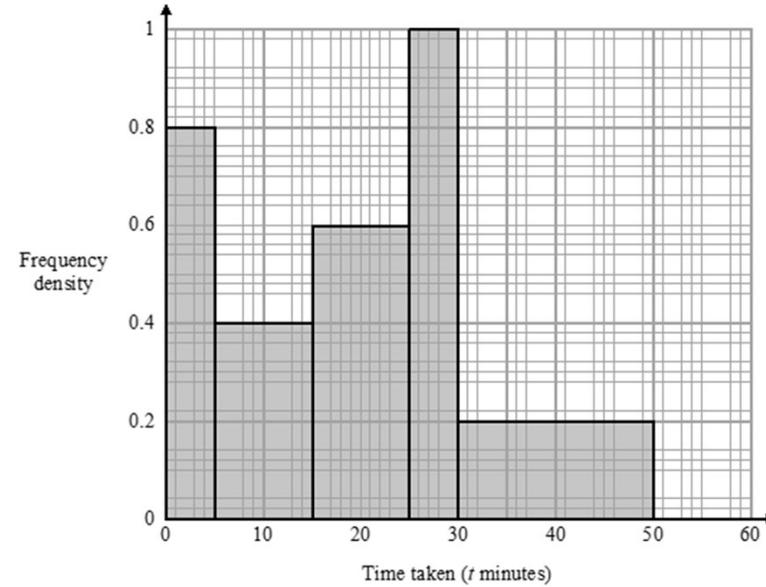
(2)

(c) Simplify $\frac{28p^6q^3}{7p^2q^2}$

$$(28 \div 7) p^{6-2} q^{3-2} = 4p^4q$$

(2)

The histogram shows information about the times taken by some students to run a race.



(a) Complete the frequency table for this information.

Time taken (t minutes)	Frequency
$0 < t \leq 5$	$0.8 \times 5 = 4$
$5 < t \leq 15$	$0.4 \times 10 = 4$
$15 < t \leq 25$	$0.6 \times 10 = 6$
$25 < t \leq 30$	$1 \times 5 = 5$
$30 < t \leq 50$	$0.2 \times 20 = 4$

(2)



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Unit 18: Exam Technique

Milton invests £15 000 in an account paying compound interest for 2 years.

In the first year the rate of interest is $x\%$

At the end of the first year the value of Milton's investment is £15 540

In the second year the rate of interest is $\frac{x}{2}\%$

What is the value of Milton's investment at the end of 2 years?

$$15000 \times M = 15540$$

$$M = \frac{15540}{15000} = 1.036$$

$$1.036 \times 100 = 103.6$$

$$103.6 - 100 = 3.6 = x$$

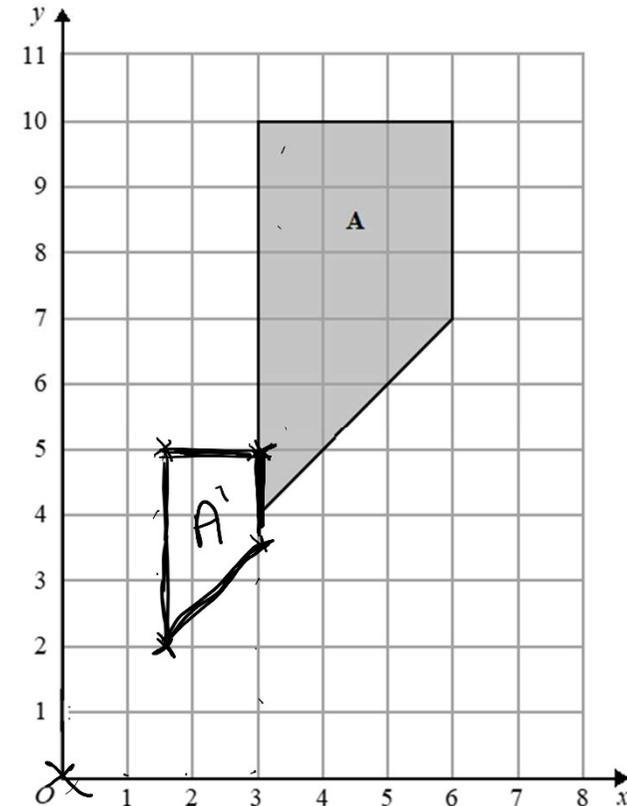
$$\frac{x}{2} = 3.6 \div 2 = 1.8$$

$$1.8 + 100 = 101.8 \quad 101.8 \div 100 = 1.018$$

$$15540 \times 1.018 = 15819.72$$

$$\text{£}15819.72$$

4 marks



Enlarge shape A by scale factor $\frac{1}{2}$, centre (0, 0).

2 marks



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Unit 19: Exam Technique (Y11)

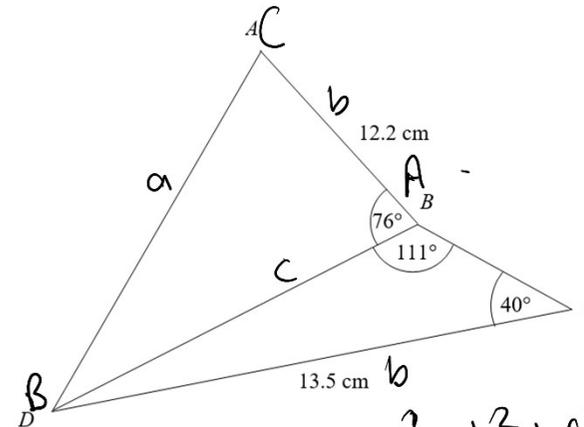
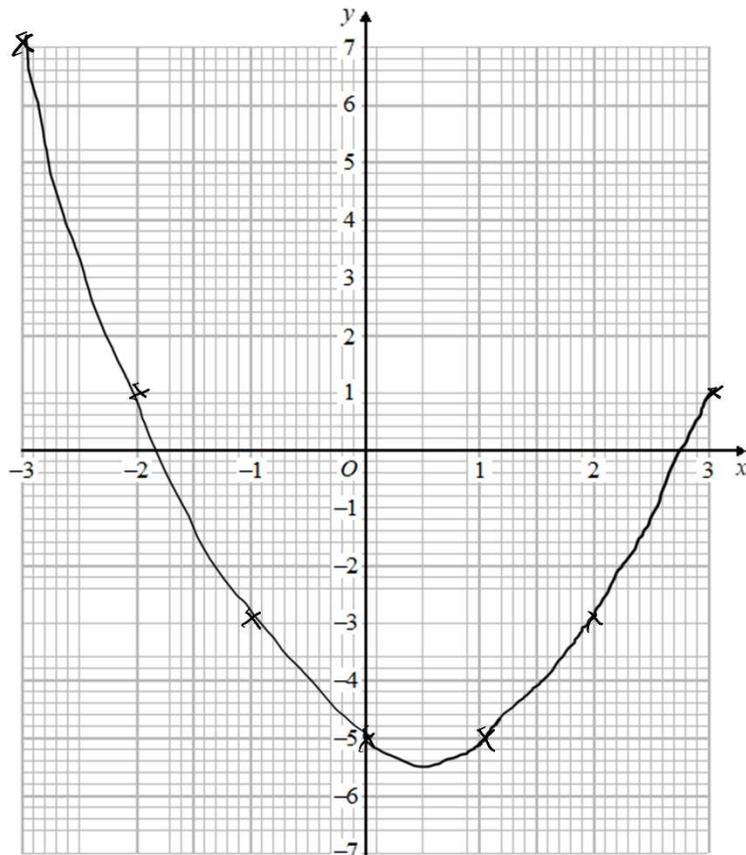
(a) Complete the table of values for $y = x^2 - x - 5$

x	-3	-2	-1	0	1	2	3
y	7	1	-3	-5	-5	-3	1

(2)

(b) On the grid, draw the graph of $y = x^2 - x - 5$ for values of x from -3 to 3.

(2)



Work out the length of AD .
Give your answer correct to 3 significant figures.

$$\frac{c}{\sin C} = \frac{b}{\sin B}$$

$$\frac{c}{\sin 40} = \frac{13.5}{\sin 111}$$

$$c = \frac{13.5 \sin 40}{\sin 111}$$

$$= 9.295002856$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$= 12.2^2 + 9.295^2 - 2 \times 12.2 \times 9.295 \cos 76$$

$$= 180.36959 \dots$$

$$a = \sqrt{180.3695 \dots}$$

$$= 13.430 \dots$$

$$= 13.4 \text{ cm}$$

5 marks

Unit 20: Exam Technique (Y11)

The functions f and g are such that

$$f(x) = 3x - 2 \quad \text{and} \quad g(x) = x^2 + 2$$

(a) Find $f^{-1}(x)$

$$x = 3y - 2 \quad \cdot \quad f^{-1}(x) = \frac{x+2}{3}$$

$$+2 \quad +2$$

$$x+2 = 3y$$

$$\div 3 \quad = 3$$

$$y = \frac{x+2}{3}$$

Given that $fg(x) = 2gf(x)$,

(b) show that $15x^2 - 24x + 8 = 0$

$$\begin{aligned} fg(x) &= 3(g(x)) - 2 \\ &= 3(x^2 + 2) - 2 \\ &= 3x^2 + 6 - 2 \\ &= 3x^2 + 4 \end{aligned}$$

$$\begin{aligned} gf(x) &= (f(x))^2 + 2 \\ &= (3x - 2)^2 + 2 \\ &= 9x^2 - 12x + 4 + 2 \\ &= 9x^2 - 12x + 6 \end{aligned}$$

$$3x^2 + 4 = 2(9x^2 - 12x + 6)$$

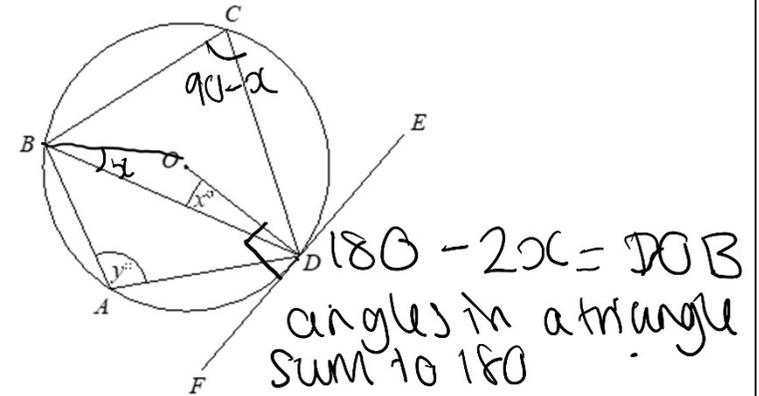
$$3x^2 + 4 = 18x^2 - 24x + 12$$

$$\begin{array}{r} -3x^2 \quad -3x^2 \\ 4 = 15x^2 - 24x + 12 \end{array}$$

$$\begin{array}{r} -4 \quad -4 \\ 0 = 15x^2 - 24x + 8 \end{array}$$

$$f^{-1}(x) = \frac{x+2}{3} \quad (2)$$

(5)



A, B, C and D are points on the circumference of a circle, centre O .
 FDE is a tangent to the circle.

(a) Show that $y - x = 90$

You must give a reason for each stage of your working.

$$\angle DCB = \frac{1}{2}(180 - 2x) = 90 - x$$

angles at centre double angles at circumference

$$y = 180 - (90 - x) = 180 - 90 + x = 90 + x$$

opposite angles in cyclic quadrilateral sum to 180

$$y - x = 90 + x - x = 90$$

$$y - x = 90$$

(3)



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