Maths Department

A Level Induction Booklet

CONTENTS

Chapter 1: FRACTIONS

Summary:

- Adding and subtracting fractions:
  - The denominator must be the same. Look for the lowest common denominator for all numbers.
  - If you have a mixed number turn them into improper fractions (top-heavy fractions).
  - Multiplying the denominators will give you a common multiple, but it may not be the lowest.
- Multiplying:
  - Make all mixed numbers into improper fractions.
  - Multiply the tops, and multiply the bottoms.
  - Always simplify if possible
- Dividing:
  - Make all mixed numbers into improper fractions.
  - KFC:
    - **K**eep the first fraction
    - **F**lip the second fraction
    - **C**hange the sign to a multiply
- Remember a whole number can be changed into a fraction by writing it over one.

#	Objectives:	R/A/G?	
1	Find equivalent fractions		
2	Simplify a fraction fully.		
3	Find a fraction of an amount.		
4	Write a mixed number as an improper fraction.		
5	Write an improper fraction as a mixed number.		
6	Add and subtract fractions, using a common denominator.		
7	Add and subtract mixed numbers.		
8	Multiply and divide fractions.		
9	Multiply and divide mixed numbers.		

Questions:

1) Write $7\frac{4}{9}$ as an improper fraction

2) Write $\frac{84}{7}$ as a mixed number

3) $\frac{7}{9} - \frac{2}{5}$

4) $\frac{5}{7} + \frac{3}{5}$

5) $\frac{3}{4} \times \frac{5}{6}$

6) $\frac{6}{7} \div \frac{2}{3}$

7) $6 \div \frac{2}{5}$

8) $2\frac{2}{3} \times 3\frac{3}{4}$

9) $4\frac{3}{5} \div 1\frac{1}{2}$

10) Celina and Zoe both sing in a band.

One evening the band plays for 80 minutes.
Celina sings for 65% of the 80 minutes.
Zoe sings for $\frac{5}{8}$ of the 80 minutes.

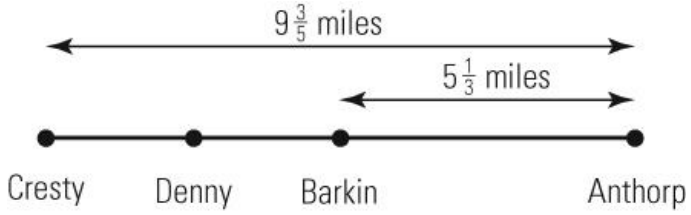
Celina sings for more minutes than Zoe sings.

Work out for how many more minutes.
You must show all your working.

11) Barkin is $5\frac{1}{3}$ miles west of Anthorp.

Cresty is $9\frac{3}{5}$ miles west of Anthorp.

Denny is exactly halfway between Barkin and Cresty.



How many miles is Denny west of Barkin?

Help:

Mymaths.co.uk > number > fractions > Improper and mixed fractions

Mymaths.co.uk > number > fractions > Adding and subtracting fractions

Mymaths.co.uk > number > fractions > Multiplying fractions

Mymaths.co.uk > number > fractions > Dividing fractions

Mymaths.co.uk > number > fractions > Mixed numbers

Chapter 2: LAWS OF INDICIES

Summary:

- $x^a \times x^b = x^{a+b}$
- $x^a \div x^b = x^{a-b}$
- $(x^a)^b = x^{ab}$
- $x^0 = 1$
- $x^{-a} = \frac{1}{x^a}$
- $x^{\frac{a}{b}} = \sqrt[b]{(x^a)}$
- $x^{-\frac{a}{b}} = \frac{1}{\sqrt[b]{(x^a)}}$

#	Objectives:	R/A/G?	
1	Use index laws to simplify the multiplication and division of powers, and the power of a power.		
2	Know that any number to the power of zero is 1.		
3	Understand and use negative powers.		
4	Find a power of a fraction.		
5	Understand and use simple fractional powers (e.g. ½, ¼).		
6	Understand and use harder fractional powers (e.g. ⅔, -½).		

Questions: simplify all of these as much as possible.

1) $7^3 \times 7^5$ **2)** $5^{12} \div 5^3$ **3)** 6^{-1}

4) $\frac{3^{11} \times 3^{-3}}{3^{-5}}$ **5)** $27^{\frac{2}{3}}$ **6)** $81^{-\frac{3}{4}}$

Help:

Mymaths.co.uk > number > powers and roots > indices 1

Mymaths.co.uk > number > powers and roots > indices 2

Mymaths.co.uk > number > powers and roots > indices 3

Mymaths.co.uk > number > powers and roots > indices 4

Chapter 3: SURDS

Summary:

- $\sqrt{(a \times b)} = \sqrt{a} \times \sqrt{b}$ e.g. $\sqrt{18} = \sqrt{(9 \times 2)} = \sqrt{9} \times \sqrt{2} = 3\sqrt{2}$
- $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ e.g. $\sqrt{\frac{12}{121}} = \frac{\sqrt{12}}{\sqrt{121}} = \frac{\sqrt{4} \times \sqrt{3}}{11} = \frac{2\sqrt{3}}{11}$
- $\frac{a}{\sqrt{b}} = \frac{a}{\sqrt{b}} \times \frac{\sqrt{b}}{\sqrt{b}} = \frac{a\sqrt{b}}{b}$ e.g. $\frac{5}{\sqrt{7}} = \frac{5}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{5\sqrt{7}}{7}$
- $a\sqrt{c} \pm b\sqrt{c} = (a + b)\sqrt{c}$ e.g. $4\sqrt{3} + 7\sqrt{3} = 11\sqrt{3}$
- $\frac{c}{a+b\sqrt{n}}$ multiply top and bottom by $a - b\sqrt{n}$
- $\frac{c}{a-b\sqrt{n}}$ multiply top and bottom by $a + b\sqrt{n}$

#	Objectives:	R/A/G?	
1	Simplify two surds that have been multiplied or divided.		
2	Simplify a single surd by taking out a factor that is a square number.		
3	Expand and simplify one or two brackets containing surds.		
4	Rationalise the denominator of a fraction.		

Questions:

1) Write $\sqrt{72}$ in the form $a\sqrt{b}$, where *a* and *b* are integers.

2) Simplify fully $(1+\sqrt{2})(4-\sqrt{2})$ Write your answer in the form $x + y\sqrt{2}$

3) Rationalize $\frac{12}{\sqrt{3}}$

4) Simplify fully $\frac{(5+\sqrt{3})(5-\sqrt{3})}{\sqrt{22}}$

Help:

Mymaths.co.uk > number > powers and roots > Surds 1

Mymaths.co.uk > number > powers and roots > Surds 2

Chapter 4: ALGEBRA

Summary:

- When substituting values into a formula use brackets to avoid mistakes, especially those involving negative numbers.
- Factorising:
  - ⇒ Factorising is to take out a common factor.
  - ⇒ This can be a number or a letter or both.
- Solving equations:
  - ⇒ If there are brackets always multiply out and collect like terms
  - ⇒ Move all unknowns to one side of the equation.
- Algebraic fractions:
  - ⇒ When you have equations with fractions you need to get rid of any fractions before solving.
  - ⇒ You can do this by multiplying every term by the lowest common multiple of the denominators.
  - ⇒ The lowest common multiple may be an expression (contains numbers and letters).
- Changing the subject:
  - ⇒ You need to move everything to leave the subject on it's own.
  - ⇒ You do this by doing the opposite of what is there, remembering to always do the same to both sides.
- Changing the subject of harder formulae:
  - ⇒ Multiply out all brackets
  - ⇒ Group all terms contain the letter you want as the subject on one side of the equation and all other terms on the other side.
  - ⇒ Factorise so the letter only appears once.
  - ⇒ Divide by everything in the bracket to get the letter on its own.
- Solving inequalities:
  - ⇒ Solving inequalities should be done in exactly the same way as solving normal equations. Just remember to always do the opposite to get rid of something.
  - ⇒ If there are more than one inequality sign then whatever you do to one section you must do to them all.
- Nth term rule:
  - ⇒ The n^{th} term of a sequence is always written in the form "?n + ?"
  - ⇒ The number in front of the n is the difference between the terms and the number after is the zero term, the term before the first one, which can be worked out by working backwards.
- Nth term rule for quadratic sequences:
  - ⇒ A quadratic nth term sequence has the general rule an^2+bn+c
  - ⇒ A is half of the second difference.
  - ⇒ Once you have found an^2, you need to subtract this from the original sequence, then find the nth term rule as normal for the new sequence and this will be the bn+c part.

#	Objectives:	R/A/G?	
1	Substitute numbers into an algebraic expression or formula.		
2	Factorise an expression by taking out a common factor.		
3	Solve simple linear equations, including those with brackets.		

4	Solve linear equations with unknowns on both sides of the equation.		
5	Solve linear equations with negative coefficients, or negative solutions.		
6	Solve linear equations involving two or more algebraic fractions.		
7	Change the subject of a simple equation (involving only the four basic operations).		
8	Change the subject of an equation involving a power of the subject.		
9	Change the subject of an equation where the subject appears more than once.		
10	Solve simple linear inequalities		
11	Write the nth term rule of a sequence algebraically, including quadratic sequences.		
12	Algebraic proof		

Questions:

1) Work out the value of $\frac{p(q-3)}{4}$ when p = 2 and q = -7

2) Factorise
a) $20a^2c + 30ac$ **b)** $25w^2y - 10wy^2$ **c)** $8ap + 12cp - 4p^2$

3) Solve
a) 5(x+3) = 3(x+9) **b)** 8(x-1) = 4(x+3) **c)** 2(9-x) = 3(x+16)

4) Solve

(a) $\frac{x+3}{2} + \frac{x+1}{4} = 10$ (b) $\frac{x+3}{10} + \frac{x-2}{5} = 2$ (c) $\frac{2x-1}{9} + \frac{x+2}{3} = 0$

5) Solve

(a) $\frac{3}{x+2} + \frac{2}{x} = 1$ (b) $\frac{2}{x+4} + \frac{1}{x+2} = 1$ (c) $\frac{4}{x+1} - \frac{3}{x-2} = 1$

6) Make x the subject
a) $\frac{x+t}{m} = 2c$ **b)** $x^3 - 4 = 5y$ **c)** $\frac{5cx}{b} = a$ **d)** $\sqrt[3]{\frac{x}{k}} = w$

7) Make m the subject
a) $5(m + y) = 4(m - 3y)$

b) $x = 4\pi m + am$

c) $y = \frac{m+4}{m+5}$

d) $\frac{3m+2}{c} = \frac{m+1}{a}$

8) Solve
a) 5y – 6 > 11 **b)** -3 < 2x +1 < 12 **c)** 3x + 5 > 2(x+1)

9) Find the nth term rule for each of these sequences
a) 8, 13, 18, 23, 28, … **b)** 31, 28, 25, 22, …
c) 8, 13, 24, 41, 64 … **d)** -8, 2, 16, 34, …

10)
a) Prove that (2n + 3)2 – (2n – 3)2 is a multiple of 8 for all positive integer values of n.
b) Prove, using algebra, that the sum of two consecutive whole numbers is always an odd number.

Help:

Mymaths.co.uk > Algebra > Expressions and formulae > Substitution 2

Mymaths.co.uk > Algebra > Algebra manipulation > Factorising quadratics 1

Mymaths.co.uk > Algebra > Algebra manipulation > Factorising quadratics 2

Mymaths.co.uk > Algebra > Algebra manipulation > Factorising linear

Mymaths.co.uk > Algebra > Equations linear > Equations 3 – both sides

Mymaths.co.uk > Algebra > Equations linear > Equations 4 – brackets

Mymaths.co.uk > Algebra > Equations linear > Equations 5 – fractions

Mymaths.co.uk > Algebra > Algebra manipulation > Cancelling algebraic fractions

Mymaths.co.uk > Algebra > Algebra manipulation > Adding algebraic fractions

Mymaths.co.uk > Algebra > Algebra manipulation > Multiplying algebraic fractions

Mymaths.co.uk > Algebra > Expressions and formulae > Rearranging 1

Mymaths.co.uk > Algebra > Expressions and formulae > Rearranging 2

Mymaths.co.uk > Algebra > Inequalities > Inequations

Mymaths.co.uk > Algebra > Sequences > Arithmetic sequences

Mymaths.co.uk > Algebra > Sequences > Quadratic sequences

Chapter 5: SIMULATENOUS EQUATIONS

Summary:

- Linear simultaneous equations:
  - Label both equations **A** and **B**
  - If necessary, multiply the equations so that the coefficient of one of the unknowns is the same.
  - Add or subtract the equations to eliminate that unknown. (**S**igns the **S**ame **S**ubtract!).
  - Once one unknown is found use substitution to find the other.
  - Check the answer by substituting both values back into the original equations.

- Quadratic simultaneous equations:
  - If there is an x^2 or y^2 term in a pair of simultaneous equations, you need to solve them using substitution.
  - Re-arrange the linear equation to make one letter the subject.
  - Substitute this new equation in, instead of either x^2 or y^2. Remember to put this into brackets and it will be the whole brackets squared.
  - Multiply out the brackets and rearrange the formula to form a quadratic.
  - Solve the quadratic to find one of the unknowns.
  - Substitute this value back into the original equation to find the other.
  - Check the answer by substituting both values back into the original equations.
  -

#	Objectives:	R/A/G?	
1	Solve two simultaneous equations by addition or subtraction where one unknown has the same coefficient in both equations.		
2	Solve two simultaneous equations by addition or subtraction where one or both of the equations must first be multiplied.		
3	Set up and solve a pair of simultaneous equations from a worded problem and interpret the solution in context.		
4	Find the intersection of two linear equations by using simultaneous equations.		
5	Solve simultaneous equations where one equation is linear and one is quadratic.		

Questions:

1)

$$3x + 5y = 19$$
$$4x - 2y = -18$$

2)

$$3x + 4y = 200$$
$$2x + 3y = 144$$

3)

$$6x - 2y = 33$$
$$4x + 3y = 9$$

4)

$$x^2 + y^2 = 29$$
$$y - x = 3$$

5)

$$y - 2x = 3$$
$$x^2 + y^2 = 18$$

6)

$$x - 2y = 1$$
$$x^2 + y^2 = 13$$

Help:

Mymaths.co.uk > Algebra > Equations - quadratic > Quadratic simultaneous equations

Chapter 6: SOLVING QUADRATIC EQUATIONS

Summary:

- A quadratic equation has the form $ax^2 + bx + c = 0$
- Factorising:
  - Always easier when a=1. To find values to go into brackets you need two values that multiply to make c and add to make b. List the factors of c and take care if there are negatives involved.
  - If a>1 then list the factors of c put these into the brackets and use trial and error to see which combination of values gives you the correct quadratic when expanded back out.
  - Once you have factorised one of the brackets must be equal to zero. Use this to solve for the two value of x.
- Difference of two square:
  - This is a special case when b=0 and c is a square number. In this case the $x^2 + c = 0$ becomes $(x+\sqrt{c})(x-\sqrt{c}) = 0$
- Completing the square:
  - If written in the completed square form the quadratic equation will be written as $(x + p)^2 + q$
  - The minimum point of a graph is at (-p,q)
  - Use this formula to complete the square

$$x^2 + 2bx + c = (x + b)^2 - b^2 + c$$

  - Once you have completed the square you can rearrange the equation to solve. Remember that when you square root both side there will be a $\pm$ in front of the square root sign. This is what will give you the two values of x.
- Quadratic formula:
  - $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
  - Make sure your quadratic equation is equal to zero.
  - Write down your values of a, b and c.
  - Use brackets when you are substituting negative numbers.
  - Show what you have substituted into the formula.
  - Simplify what is under the square root and write this down.
  - The $\pm$ symbol means you need to do two calculations.
    - How many solutions?
    - If $b^2 - 4ac$ is negative, there are no solutions.
    - If $b^2 - 4ac = 0$, there is one solution.
    - If $b^2 - 4ac > 0$, there are two solutions.
    -

#	Objectives:	R/A/G?	
1	Solve a quadratic equation by factorising.		
2	Solve a quadratic equation by completing the square.		
3	Solve a quadratic equation by using the quadratic formula.		
4	Solve equations involving algebraic fractions by converting them into a quadratic.		

Questions: Factorise and solve:

1) $x^2 + 3x + 2 = 0$ **2)** $6x^2 - 5x - 4 = 0$ **3)** $x^2 - 64 = 0$

4) $3x^2 + x = 10$ **5)** $5x^2 - 4x - 28 = 0$

Solve these giving your answer to 2 decimal places:

6) $3x^2 + 7x - 13 = 0$ **7)** $6x^2 + 17x - 39 = 0$

Solve:

8) Write $x^2 + 10x + 3$ in the form $(x+a)^2 + b$, where a and b are constants.

b) Hence find the minimum point of $y = x^2 + 10x + 3$

9) Write $x^2 + 4x - 12$ in the form $(x+a)^2 + b$

b) Hence solve $x^2 + 4x - 12 = 0$

Help:

Mymaths.co.uk > Algebra > Equations - quadratic > Quadratic equations 1

Mymaths.co.uk > Algebra > Equations - quadratic > Quadratic equations 2

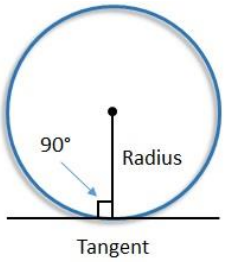
Mymaths.co.uk > Algebra > Equations - quadratic > Completing the square

Mymaths.co.uk > Algebra > Equations - quadratic > Quadratic formula

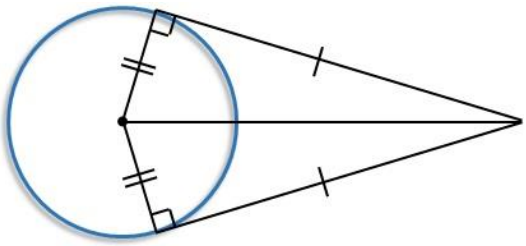
Chapter 7: CIRCLE THEOREMS

Summary:

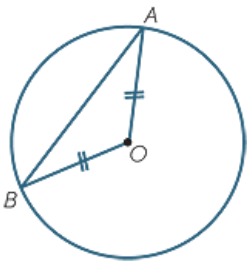
- Circle facts:
  - The angle between a radius and a tangent is 90°.



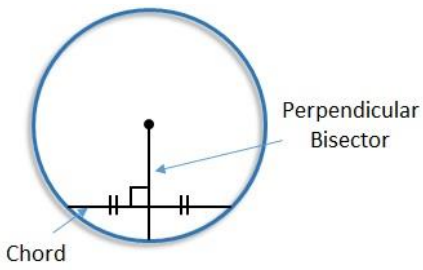
⇒ Two tangents which meet at a point outside a circle are the same length.



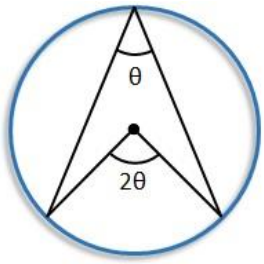
⇒ A triangle which has one vertex at the centre of a circle and two vertices on the circumference is an isosceles triangle (each short side is a radius, so they are the same length).



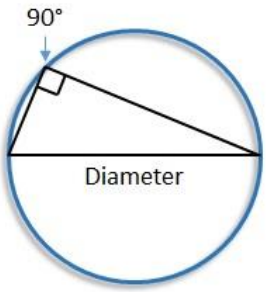
- Circle theorems:
  ⇒ The perpendicular from a chord to the centre of a circle bisects the chord at 90°.



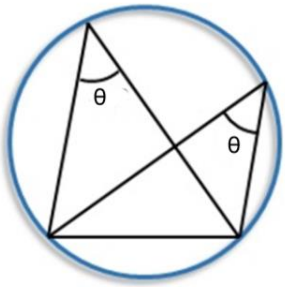
⇒ The angle at the centre of a circle is twice the angle on the circumference.



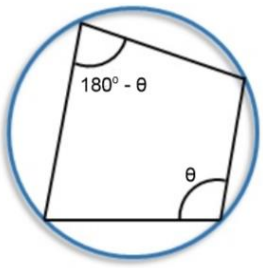
⇒ The angle in a semicircle is 90°.



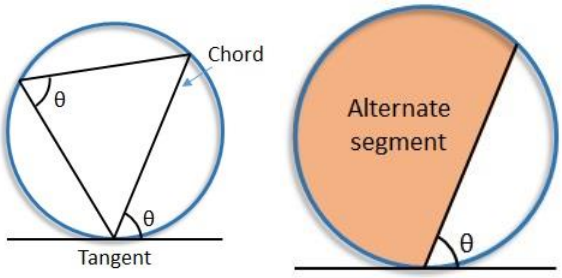
⇒ Angles in the same segment are equal.



⇒ Opposite angles in a cyclic quadrilateral add up to 180°.



⇒ The angle between a tangent and a chord is equal to the angle in the alternate segment (Alternate segment theory).



#	Objectives:	R/A/G?	
1	Use the definition of a tangent to find missing angles on a diagram.		
2	Use the definition of a radius to find missing angles on a diagram.		
3	Know, and use, the fact that two tangents from the same point will be equal lengths.		
4	Describe the reasons used when finding missing angles in diagrams involving circles.		
5	Know, and use, the fact that the perpendicular from a chord to the centre of a circle bisects the chord.		
6	Know, and use, the fact that the angle at the centre of the circle is twice the angle on the circumference.		
7	Know, and use, the fact that the angle in a semicircle is 90^0.		
8	Know, and use, the fact that angles in the same segment are equal.		
9	Know, and use, the fact that opposite angles in a quadrilateral add up to 180^0.		
10	Know, and use, the alternate segment theorem.		

Questions:

1)

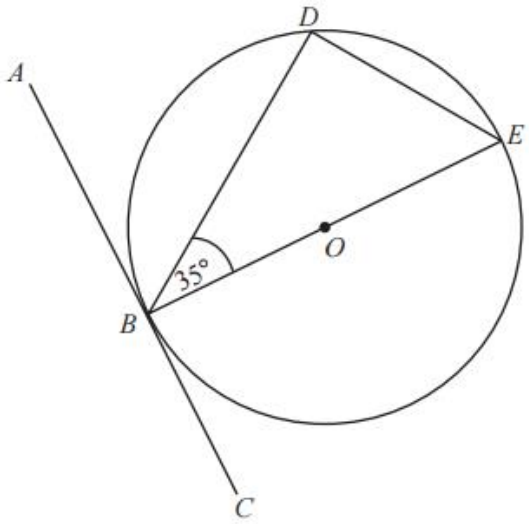


Diagram **NOT** accurately drawn

B, *D* and *E* are points on a circle centre *O*.
ABC is a tangent to the circle.
BE is a diameter of the circle.
Angle *DBE* = 35°.

a) Find ABD giving reasons for your answer.

b) Find DEB giving reasons for your answer.

2)

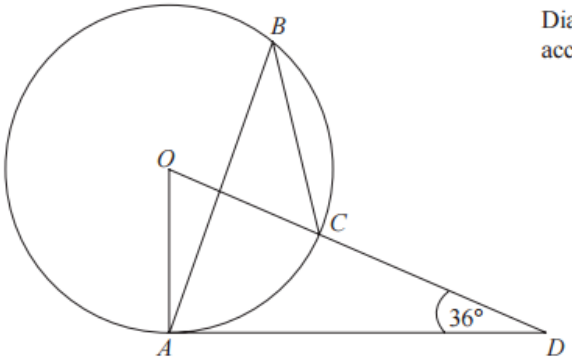


Diagram **NOT** accurately drawn

The diagram shows a circle centre O.
A, B and C are points on the circumference.

DCO is a straight line.
DA is a tangent to the circle.

a) Find AOD, giving reasons for your answer.

b) Find ABC, giving reasons for your answer.

3)

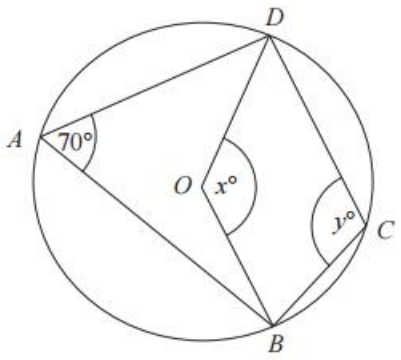


Diagram **NOT** accurately drawn

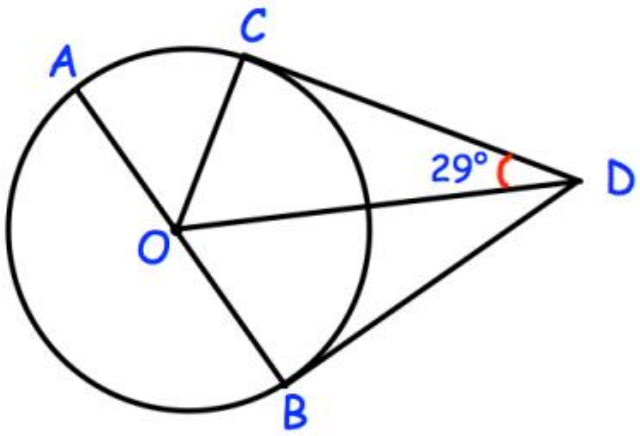
In the diagram, A, B, C and D are points on the circumference of a circle, centre O.
Angle $BAD = 70°$.
Angle $BOD = x°$.
Angle $BCD = y°$.

a) Find x, giving reasons for your answer.

b) Find y, giving reasons for your answer.

4)

A, B and C are points on the circumference of a circle with centre O.



AOB is a diameter of the circle.
CD and BD are tangents to the circle.
Angle CDO = 29°

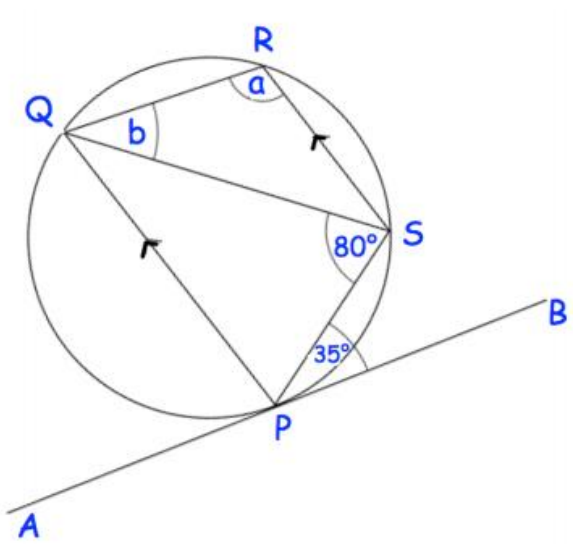
Work out the size of angle AOC.
Give reasons for each stage of your working.

5)

a) Find QRS, giving reasons for your answer.

b) Find RQS, giving reasons for your answer.

PQRS is a cyclic quadrilateral.
APB is a tangent to the circle at P.
PQ is parallel to SR.
Angle SPB = 35° and angle PSQ = 80°



Help:

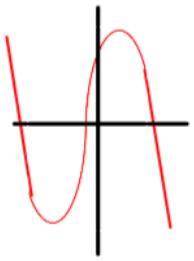
Mymaths.co.uk > Shape > Circle theorems > Circle theorems

Mymaths.co.uk > Shape > Circle theorems > Circle theorem proof

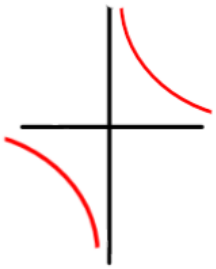
Chapter 8: TRANSFORMATIONS OF GRAPHS

Summary:

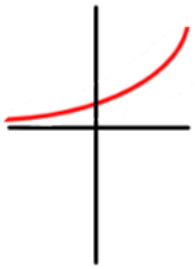
- Cubic:
  - $y = ax^3 + bx^2 + cx + d$
  - Has a maximum and a minimum point.
  - Ends of the graph go in opposite directions.
  - Cuts the y-axis at d.



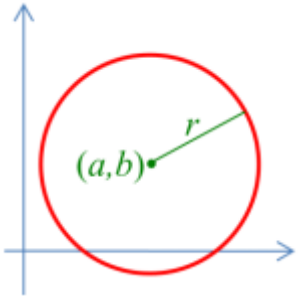
- Reciprocals:
  - $y = k/x$
  - Has no maximum or minimum point.
  - Has two parts in diagonally opposite quadrants
  - Does not touch either axis.



- Exponentials:
  - $y = a^x$
  - Are always above the x-axis.
  - Cross the y-axis at (0,1)

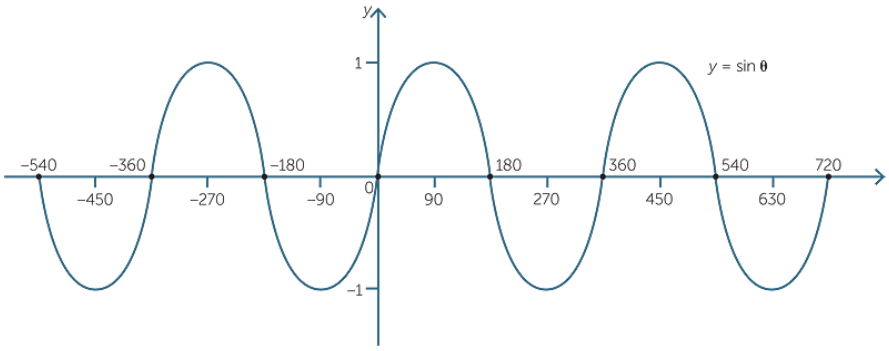


- Circles:
  - ⇒ The equation of a circle with centre (a,b) and radius r is $(x - a)^2 + (y - b)^2 = r^2$

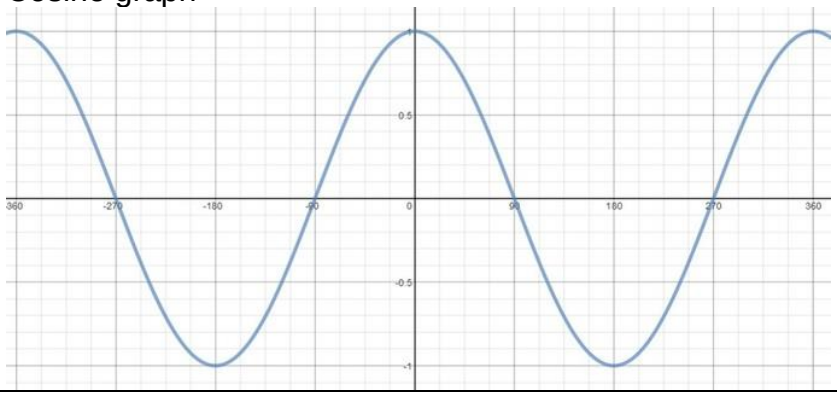


- y = f(x) + C Moves up or down by C.
- y = f(x + C) C > 0 moves it left C < 0 moves it right/
- y = Cf(x) C > 1 stretches it in the y-direction 0 < C < 1 compresses it.
- y = f(Cx) C > 1 compresses it in the x-direction 0 < C < 1 stretches it.
- y = −f(x) Reflects it about x-axis.

- y = f(-x) Reflects it about the y-axis.
- Sine graph:



- Cosine graph



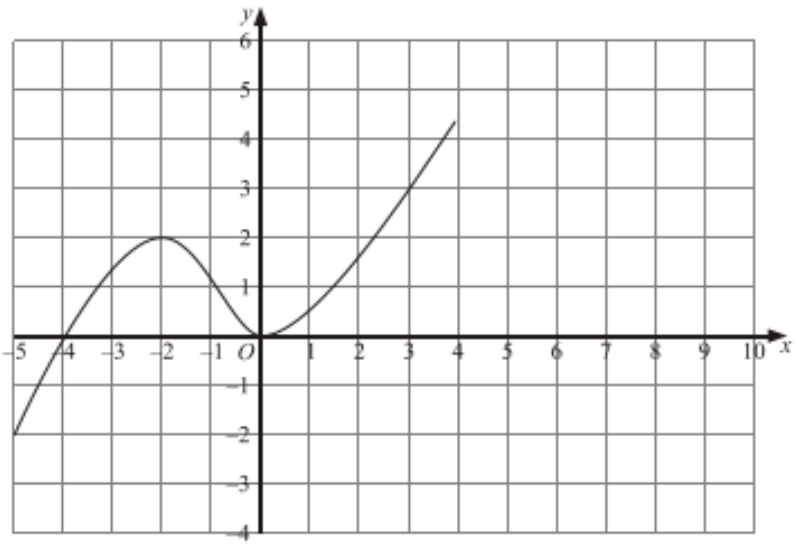
#	Objectives:	R/A/G?	
1	Plot, and recognise the general shape of, a cubic graph.		
2	Plot, and recognise the general shape of, a reciprocal graph.		
3	Plot, and recognise the general shape of, a circular graph.		
4	Plot, and recognise the general shape of, the graphs of sin *x* and cos *x*.		
5	Use any graph to find an approximate solution to an equation.		
6	Given the graph *f(x)*, sketch the graph of *f(x) + a*		
7	Given the graph *f(x)*, sketch the graph of *f(x + a)*		
8	Given the graph *f(x)*, sketch the graph of *af(x)*		
9	Given the graph *f(x)*, sketch the graph of *f(ax)*		
10	Given the graph *f(x)*, sketch the graph of *-f(x)*		
11	Given the graph *f(x)*, sketch the graph of *f(-x)*		
12	Apply transformations to the graphs of *sin x* and *cos x*		

Questions:

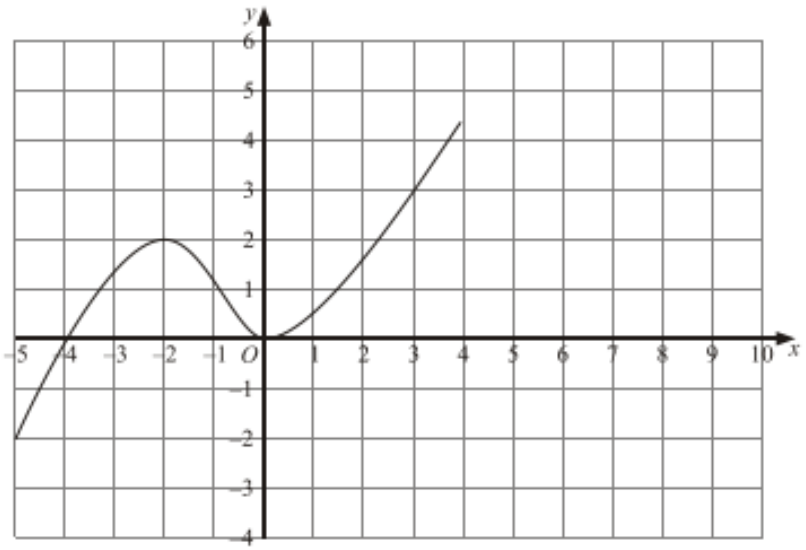
1)

The graph of $y = f(x)$ is shown on the grids.

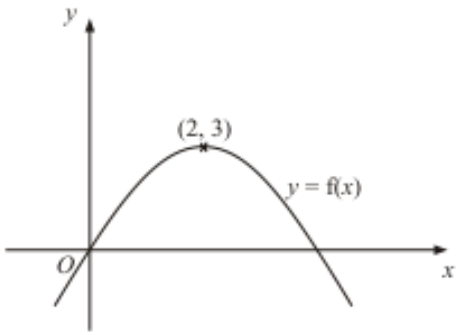
(a) On this grid, sketch the graph of $y = f(x) + 2$



(b) On this grid, sketch the graph of $y = -f(x)$



2)



The diagram shows part of the curve with equation $y = f(x)$.
The coordinates of the maximum point of this curve are (2, 3).

Write down the coordinates of the maximum point of the curve with equation

(a) $y = f(x - 2)$

(..... , ...)

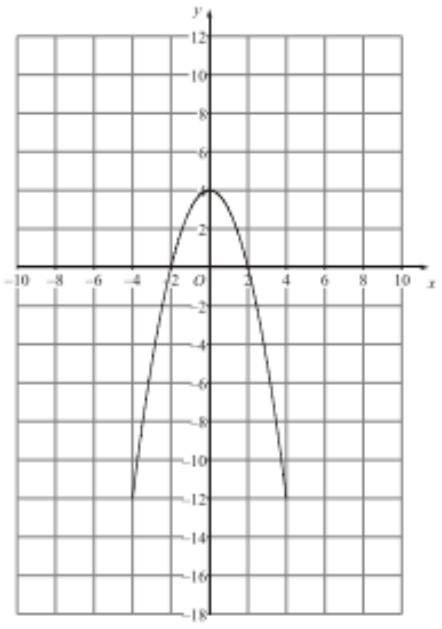
(b) $y = 2f(x)$

(..... , ...)

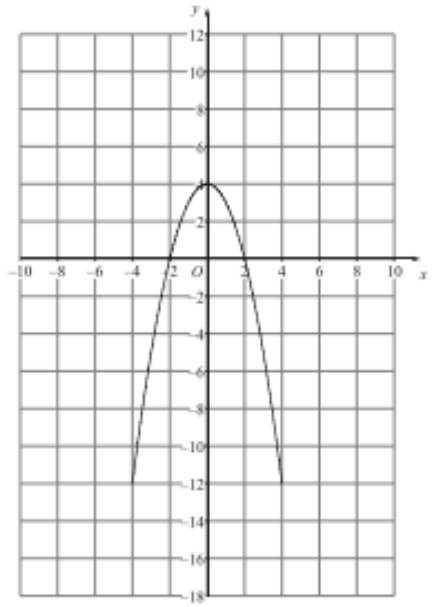
3)

The graph of $y = f(x)$ is shown on the grids.

(a) On this grid, sketch the graph of $y = f(x) - 4$

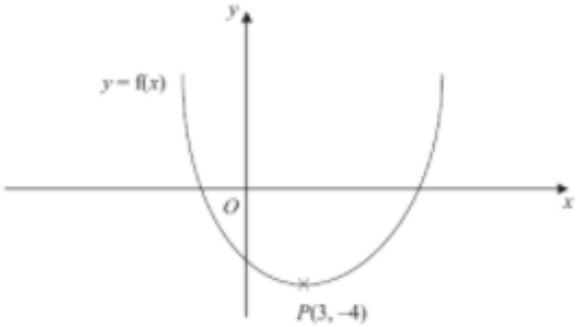


(b) On this grid, sketch the graph of $y = f(\frac{1}{2}x)$.



4)

This is a sketch of the curve with the equation $y = f(x)$.
The only minimum point of the curve is at $P(3, -4)$.



(a) Write down the coordinates of the minimum point of the curve with the equation $y = f(x - 2)$.

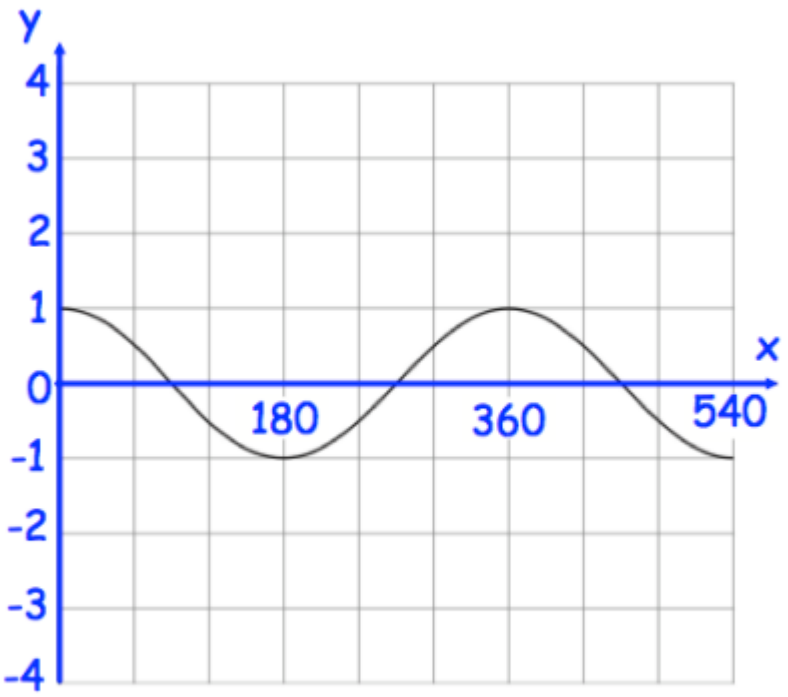
(..... , ...)
(2)

(b) Write down the coordinates of the minimum point of the curve with the equation $y = f(x + 5) + 6$

(..... , ...)
(2)

5)

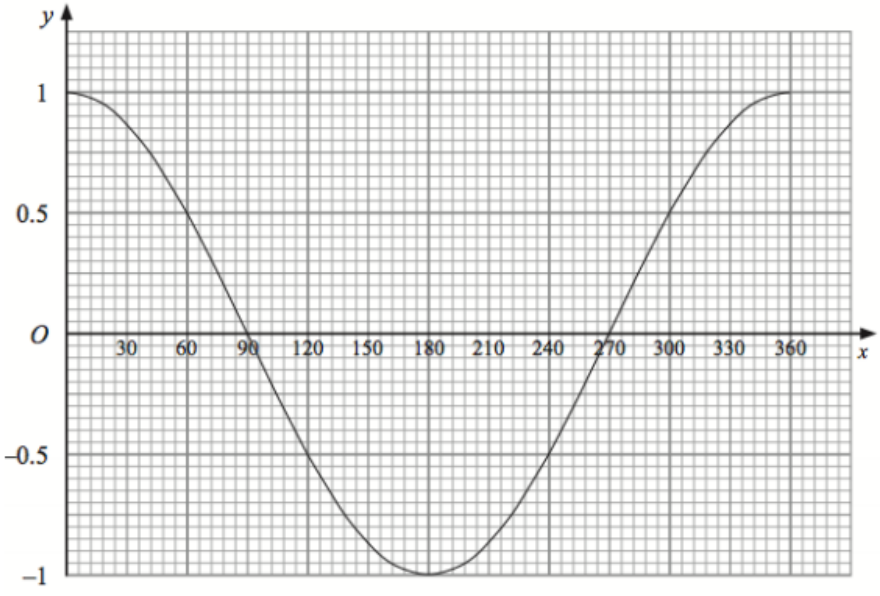
Shown below is the graph of y = cos x



On the grid, sketch the graph of y = 3 + cos x for values of x from 0° to 540°

6)

13. Shown below is the graph of y = cos x



On the grid, sketch the graph of y = cos(x – 90°) for values of x from 0° to 360°

7)

Describe the transformation that maps the curve with equation $y = \sin(x)$ onto the curve with equation

(a) $y = -\sin(x)$

.....

.....

(2)

(b) $y = 1 + \sin(x)$

.....

.....

(2)

(c) $y = \sin(x - 30°)$

.....

.....

(2)

Help:

Mymaths.co.uk > Algebra > graphs > Sketching cubic graphs

Mymaths.co.uk > Algebra > graphs > Reciprocals

Mymaths.co.uk > Algebra > graphs > Exponentials

Mymaths.co.uk > Algebra > graphs >Recognising graphs

Mymaths.co.uk > Algebra > graphs > Equations of circles

Mymaths.co.uk > Algebra > graphs > Transforming graphs 1

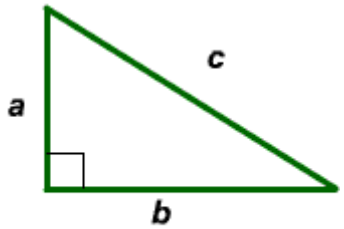
Mymaths.co.uk > Algebra > graphs > Transforming graphs 2

Mymaths.co.uk > Shape > Trigonometry > Sine and Cosine graphs

Chapter 9: Geometry

Summary:

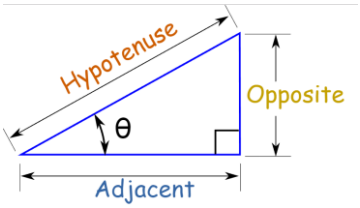
- Pythagoras' theorem:



$a^2 + b^2 = c^2$

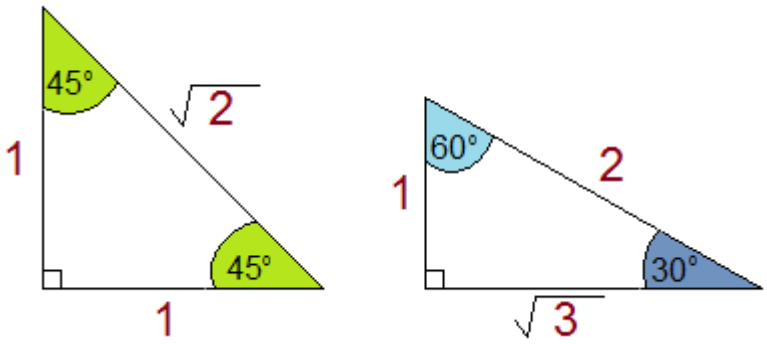
⇒ Pythagoras' theorem will only work for right angled triangles.
⇒ When labelling the triangle c is always the hypotenuse. It doesn't matter which way round a and b are.
⇒ Once labelled substitute in value you are given and solve.
⇒ Remember that you may not always be given the triangle to start. You may have to create one yourself by splitting a square or making one on a graph between two coordinates.

- Trigonometry:



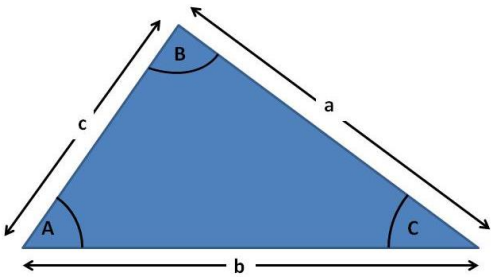
⇒ Label the sides, crossing out the one with no information.
⇒ Choose the correct ratio using SOHCAHTOA
⇒ Substitute in value you have been given
⇒ Solve to find either missing length or missing angle.

- Exact values:
  ⇒ Use the special triangles to find the exact values using normal trigonometry.



	0°	30°	45°	60°	90°
sin θ	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
tan θ	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	$\pm\infty$

- Advanced trigonometry (non right-angled triangles):



$$\frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC} \quad \text{or} \quad \frac{SinA}{a} = \frac{SinB}{b} = \frac{SinC}{c}$$

$$a^2 = b^2 + c^2 - 2bcCosA \quad \text{or} \quad CosA = \frac{b^2+c^2-a^2}{2bc}$$

$$A = \frac{1}{2}abSinC$$

⇒ Remember to label the triangle correctly. Also remember basic angle facts, if you are given two angles you can work out the third as angles in a triangle add up to 180º.

⇒ Sine rule:
- 2 angles and 2 sides
- Sides and angles must be opposite each other.

⇒ Cosine rule:
- 1 angle and 3 sides.
- When labelling take care to label the what you are looking for correctly. Don't just take any labels from the question, always relabel it yourself.

⇒ Area of a triangle:
- Used to find the area.

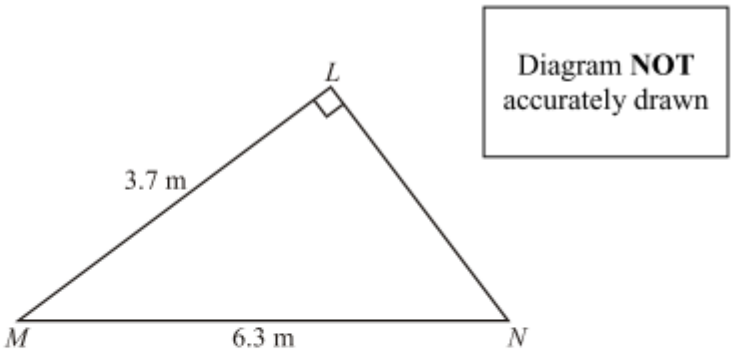
- Vectors:

⇒ Remember when proving that two vectors are parallel they must be a multiple of the other.

#	Objectives:	R/A/G?	
1	Use Pythagoras' theorem to find a missing side length in a right angled triangle.		
2	Calculate the length of a line between two points on a grid.		
3	Use trigonometry to find missing sides or angles in a right angled triangle.		
4	Know exact value to sin, cos and tan at key angles (0, 30, 45, 60 and 90 degrees).		
5	Use the sine rule to find a missing side in a non-right-angled triangle.		
6	Use the sine rule to find a missing angle in a non-right-angled triangle.		
7	Use the cosine rule to find a missing side in a non-right-angled triangle.		
8	Use the cosine rule to find a missing angle in a non-right-angled triangle.		
9	Find the area of a scalene triangle using two lengths and the angle between them.		
10	Solve geometrical problems involving vectors (including use of midpoints and ratios).		
11	Write a geometric proof involving vectors.		

Questions:

1)



Angle $MLN = 90°$.
$LM = 3.7$ m.
$MN = 6.3$ m.

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

2)

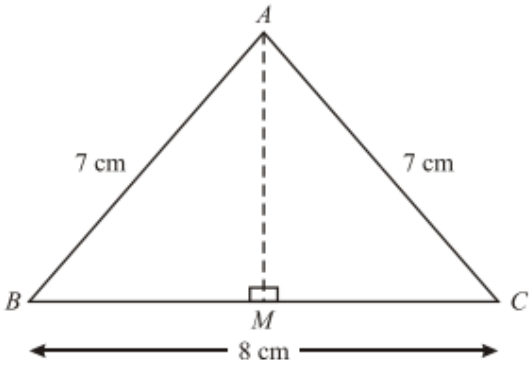
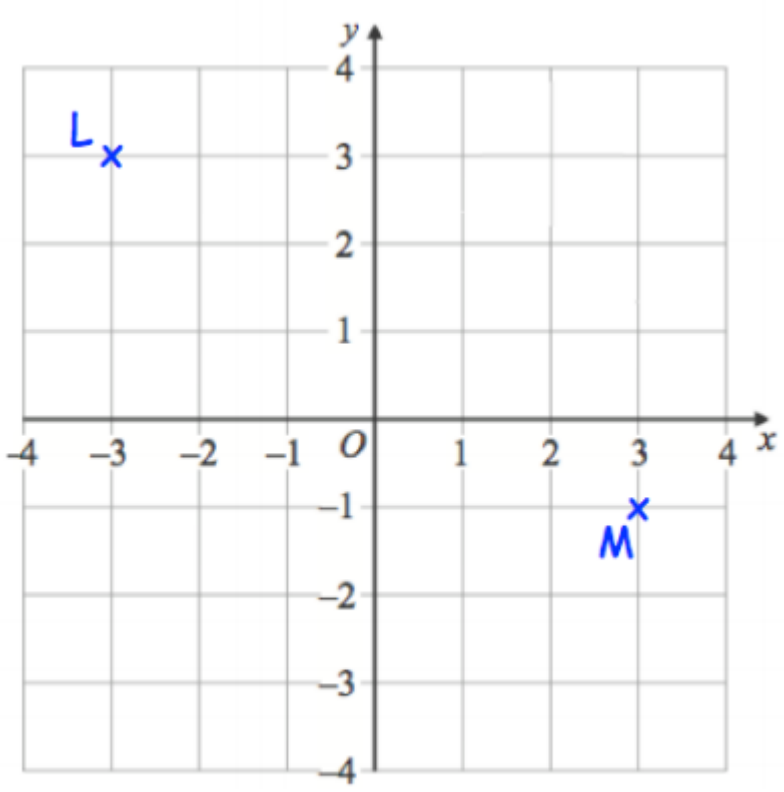


Diagram **NOT** accurately drawn

Work out the length, in centimetres, of AM.
Give your answer correct to 2 decimal places.

3)



Work out the distance between the coordinates L and M.

4)

Calculate the size of angle a in this right-angled triangle.
Give your answer correct to 3 significant figures.

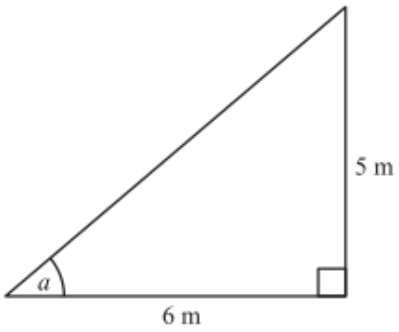


Diagram **NOT** accurately drawn

.....

(3 marks)

5)

The diagram shows a quadrilateral $ABCD$.

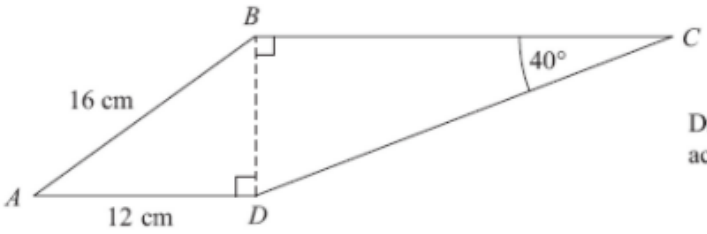


Diagram **NOT** accurately drawn

$AB = 16$ cm.
$AD = 12$ cm.
Angle $BCD = 40°$.
Angle ADB = angle $CBD = 90°$.

Calculate the length of CD.
Give your answer correct to 3 significant figures.

6)

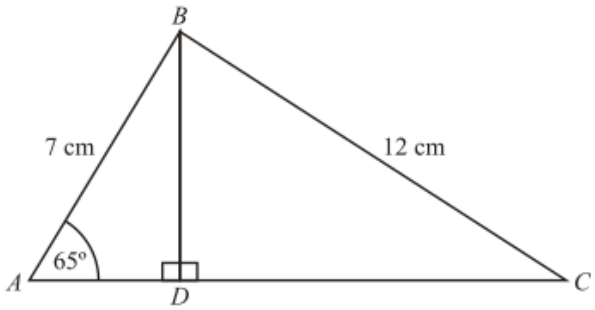


Diagram **NOT** accurately drawn

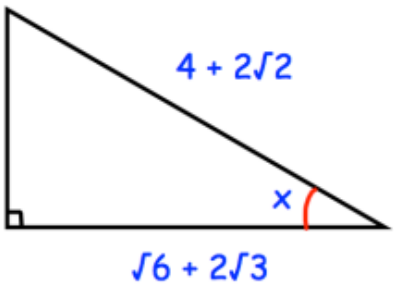
ABC is a triangle.
ADC is a straight line with BD perpendicular to AC.
$AB = 7$ cm.
$BC = 12$ cm.
Angle $BAD = 65°$.

Calculate the length of AC.
Give your answer correct to 3 significant figures.

7) Find the exact value of Sin(45°)Cos(30°)

8)

Below is a right angled triangle.



Show that angle x = 30°
Include all your working.

9)

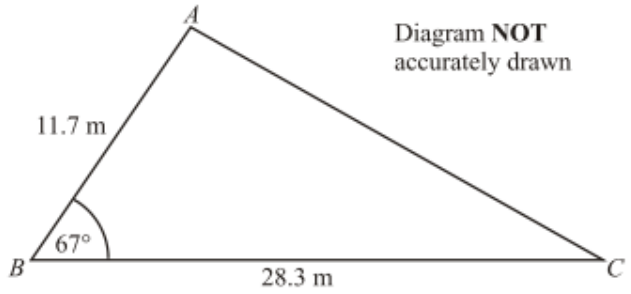


Diagram **NOT** accurately drawn

$AB = 11.7$ m.
$BC = 28.3$ m.
Angle $ABC = 67^0$.

Calculate the length of AC.
Give your answer correct to 3 significant figures.

10)

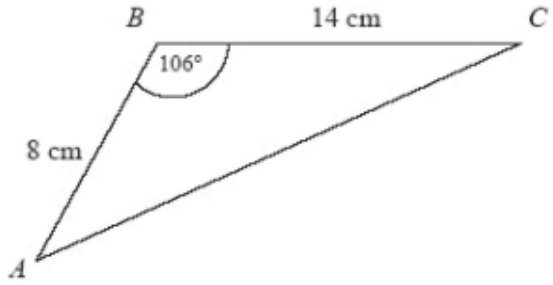


Diagram **NOT** accurately drawn

ABC is a triangle.

$AB = 8$ cm

$BC = 14$ cm

Angle $ABC = 106$ °

Calculate the area of the triangle.

Give your answer correct to 3 significant figures.

11)

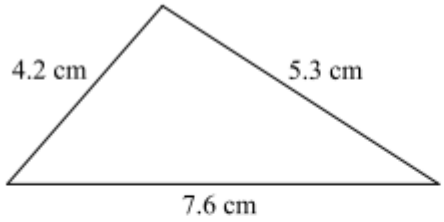


Diagram **NOT** accurately drawn

The lengths of the sides of a triangle are 4.2 cm, 5.3 cm and 7.6 cm.

(a) Calculate the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.

12)

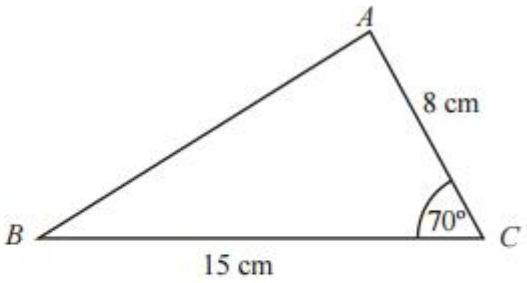


Diagram **NOT** accurately drawn

In triangle ABC,
$AC = 8$ cm,
$BC = 15$ cm,
Angle $ACB = 70°$.

Calculate angle ABC

13)

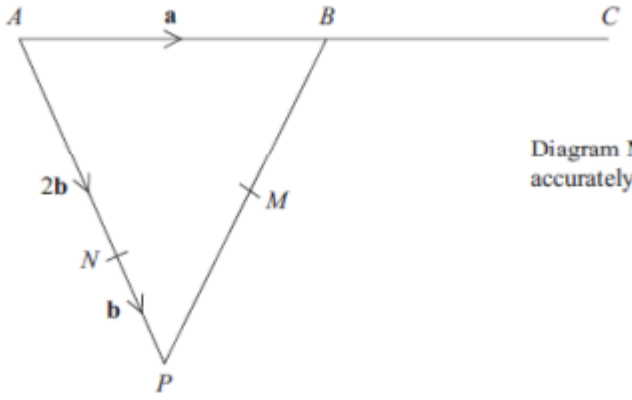


Diagram **NOT** accurately drawn

APB is a triangle.
N is a point on *AP*.

$\overrightarrow{AB} = \mathbf{a}$ $\overrightarrow{AN} = 2\mathbf{b}$ $\overrightarrow{NP} = \mathbf{b}$

(a) Find the vector $\overrightarrow{PB}$, in terms of **a** and **b**.

.....

(1)

B is the midpoint of *AC*.
M is the midpoint of *PB*.

*(b) Show that *NMC* is a straight line.

(4)

(5 marks)

14)

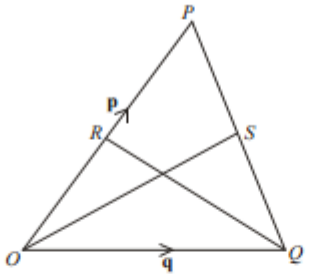


Diagram **NOT** accurately drawn

OPQ is a triangle.

R is the midpoint of OP.

S is the midpoint of PQ.

$\overrightarrow{OP} = p$ and $\overrightarrow{OQ} = q$

(i) Find $\overrightarrow{OS}$ in terms of p and q.

$\overrightarrow{OS}$ = ...

(ii)Show that RS is parallel to OQ.

Help:

Mymaths.co.uk > Shape > Pythagoras > Pythagoras

Mymaths.co.uk > Shape > Trigonometry > Missing angles

Mymaths.co.uk > Shape > Trigonometry > Missing sides

Mymaths.co.uk > Shape > Trigonometry > Special angles

Mymaths.co.uk > Shape > Trigonometry > Sine rule

Mymaths.co.uk > Shape > Trigonometry > Cosine rule sides

Mymaths.co.uk > Shape > Trigonometry > Cosine rule angles

Mymaths.co.uk > Shape > Trigonometry > Trig area of a triangle

Mymaths.co.uk > Shape > Vectors > Vectors 1

Mymaths.co.uk > Shape > Vectors > Vectors 2

Chapter 10: Statistics

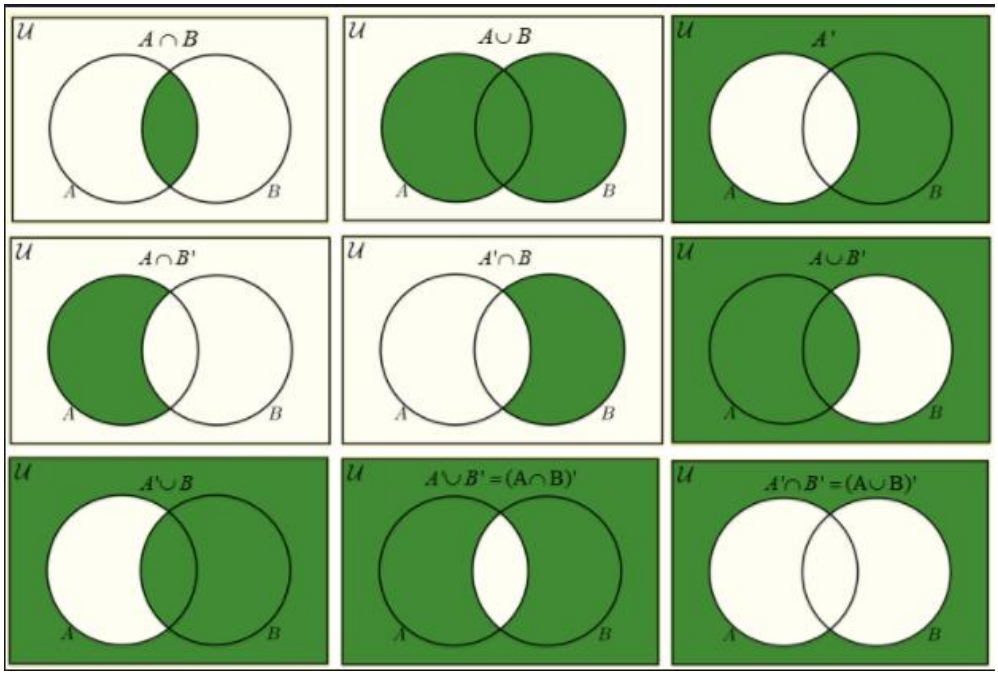
Summary:

Time taken (m minutes)	Frequency
$0 < m \leq 10$	3
$10 < m \leq 20$	8
$20 < m \leq 30$	11
$30 < m \leq 40$	9
$40 < m \leq 50$	9

- Grouped frequency tables can mean a number of different things (you may need to add extra columns):
  - ⇒ Frequency polygon – Plot in middle of range
  - ⇒ Cumulative frequency – Running total
  - ⇒ Mean from frequency table – midpoint x frequency
  - ⇒ Histogram:
    - Class width
    - Frequency density
- Tree diagrams
  - ⇒ Tree diagrams show all the possible outcomes from a series of events and their probabilities. These probabilities can be written as fractions or decimals
  - ⇒ Look out for the words REPLACE or PUT BACK in the questions.
  - ⇒ WITH REPLACEMENT: probabilities stay the same
  - ⇒ WITHOUT REPLACEMENT: first probability stays the same while the others change.
- Probability rules
  - ⇒ P(A) = Probability of A
  - ⇒ P(A') = Probability of not A
  - ⇒ $x \in A$ = x is an element of A
  - ⇒ $x \notin A$ = x is not an element of A
  - ⇒ $\emptyset$ = empty set i.e. nothing in it
  - ⇒ Mutually exclusive events
  - ⇒ P(A∩B) = P(A) + P(B)
  - ⇒ For events that aren't mutually exclusive
  - ⇒ P(A∩B) = P(A) + P(B) – P(A∪B)
- Histogram:
  - ⇒ No gaps between bars (continuous data)
  - ⇒ Area of each bar represents the frequency
  - ⇒ Vertical axis is always frequency density
  - ⇒ Bars can be different widths
  - ⇒ Frequency = frequency ÷ class width
- Mean from frequency tables
  - ⇒ Can be discrete or continuous data
  - ⇒ If there is a range take the middle value
  - ⇒ Add columns for midpoint (if needed) and fx

⇒ Mean = $\frac{\varepsilon fx}{\varepsilon f}$

- Venn Diagrams:
  ⇒ Used to show frequencies in probability questions.



#	Objectives:	R/A/G?	
1	Find averages and range from a frequency table (discrete data).		
2	Find estimates of averages from a grouped frequency table (continuous data).		
3	Use a probability tree diagram to find probabilities involving two successive events with replacement.		
4	Use a probability tree diagram to find probabilities involving two successive events without replacement.		
5	Use the probability 'AND' and 'OR' rules.		
6	Use Venn diagrams		
7	Construct a histogram with uneven intervals to represent a continuous set of data.		

Questions:

1)

Andy did a survey of the number of cups of coffee some pupils in his school had drunk yesterday.

The frequency table shows his results.

Number of cups of coffee	Frequency
2	1
3	3
4	5
5	8
6	5

(a) Work out the number of pupils that Andy asked. .....

(2)

(b) Work out the mean number of cups of coffee drunk. .....

(3)

(5 marks)

2)

80 people work in Jenny's factory.
The table shows some information about the annual pay of these 80 workers.

Annual pay (£x)	**Number of workers**
$10\,000 < x \leq 14\,000$	32
$14\,000 < x \leq 16\,000$	24
$16\,000 < x \leq 18\,000$	16
$18\,000 < x \leq 20\,000$	6
$20\,000 < x \leq 40\,000$	2

Write down the modal class interval.

.....

(1)

Find the class interval that contains the median.

.....

(2)

Work out an estimate for the mean annual pay.

.....

(3)

Why is your answer to part (c) and estimate?

.....

.....

.....

(1)

(7 marks)

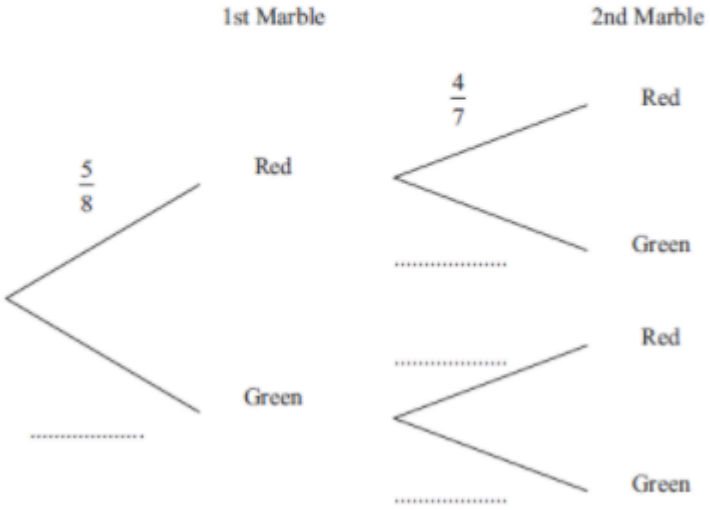
3)

There are only red marbles and green marbles in a bag.
There are 5 red marbles and 3 green marbles.

Dwayne takes at random a marble from the bag.
He does not put the marble back in the bag.

Dwayne takes at random a second marble from the bag.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Dwayne takes marbles of different colours.

.....

(3)

(5 marks)

4)

Carolyn has 20 biscuits in a tin.

She has

12 plain biscuits
5 chocolate biscuits
3 ginger biscuits

Carolyn takes at random two biscuits from the tin.

Work out the probability that the two biscuits were **not** the same type.

5)

There are 5 red pens, 3 blue pens and 2 green pens in a box.

Gary takes at random a pen from the box and gives the pen to his friend.
Gary then takes at random another pen from the box.

Work out the probability that both pens are the same colour.

6)

A = {p, r, a, g, u, e}

B = {p, a, r, i, s}

C = {b, u, d, a, p, e, s, t}

List the members of the set

(i) $A \cap B$

.....

(ii) $B \cup C$

.....

(2)

(*b*) D = {r, o, m, e}

E = {l, i, s, b, o, n}

F = {b, e, r, l, i, n}

Put one of the letters D, E or F in the box below to make the statement correct.

$$A \cap \square = \varnothing$$

Explain your answer.

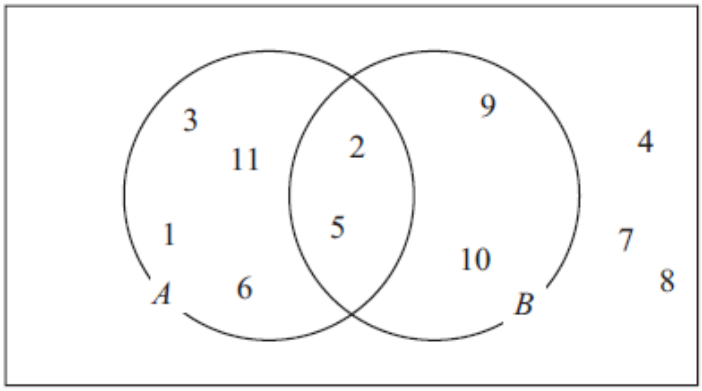
.....

(1)

(Total 3 marks)

7)

Venn diagram shows the numbers 1 to 11



(a) Work out P ($A \cup B$)

.....

(2)

(b) Work out P (B')

.....

(2)

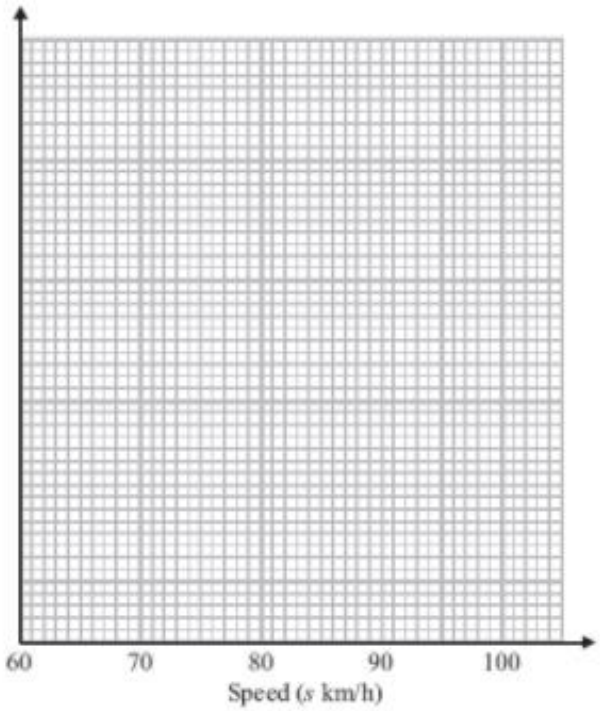
(Total 4 marks)

8)

The table gives some information about the speeds, in km/h, of 100 cars.

Speed(s km/h)	Frequency
$60 < s \leq 65$	15
$65 < s \leq 70$	25
$70 < s \leq 80$	36
$80 < s \leq 100$	24

(a) On the grid, draw a histogram for the information in the table.



(3)

(b) Work out an estimate for the number of cars with a speed of more than 85 km/h.

.....

(2)

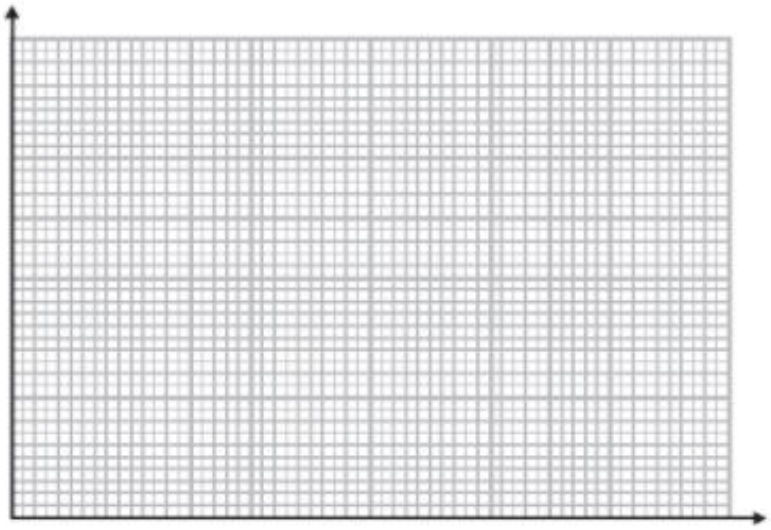
(5 marks)

9)

The table gives information about the heights, h metres, of trees in a wood.

Height (h metres)	Frequency
$0 < h \leq 2$	7
$2 < h \leq 4$	14
$4 < h \leq 8$	18
$8 < h \leq 16$	24
$16 < h \leq 20$	10

Draw a histogram to show this information.



(3 marks)

Help:

Mymaths.co.uk > Data > Processing data > Mean from frequency tables

Mymaths.co.uk > Data > Processing data > Mean from grouped data 1

Mymaths.co.uk > Data > Processing data > Mean from grouped data 2

Mymaths.co.uk > Data > Presenting data > Making tree diagrams

Mymaths.co.uk > Data > Presenting data > Histograms

Mymaths.co.uk > Data > Probability > Venn diagrams 1 & 2

Mymaths.co.uk > Data > Probability > The OR rule

Chapter 11: Velocity time graphs

Summary:

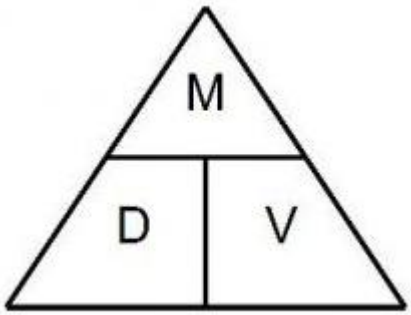
- Speed, distance and time:

Distance = Speed x Time

$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$

$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$

  - ⇒ Most common unit are m/s, km/h, mph. Make sure your units match up and give units with your answer
- Density, mass and volume:



$\text{Density} = \frac{\text{mass}}{\text{volume}}$

$\text{Mass} = \text{density} \times \text{volume}$

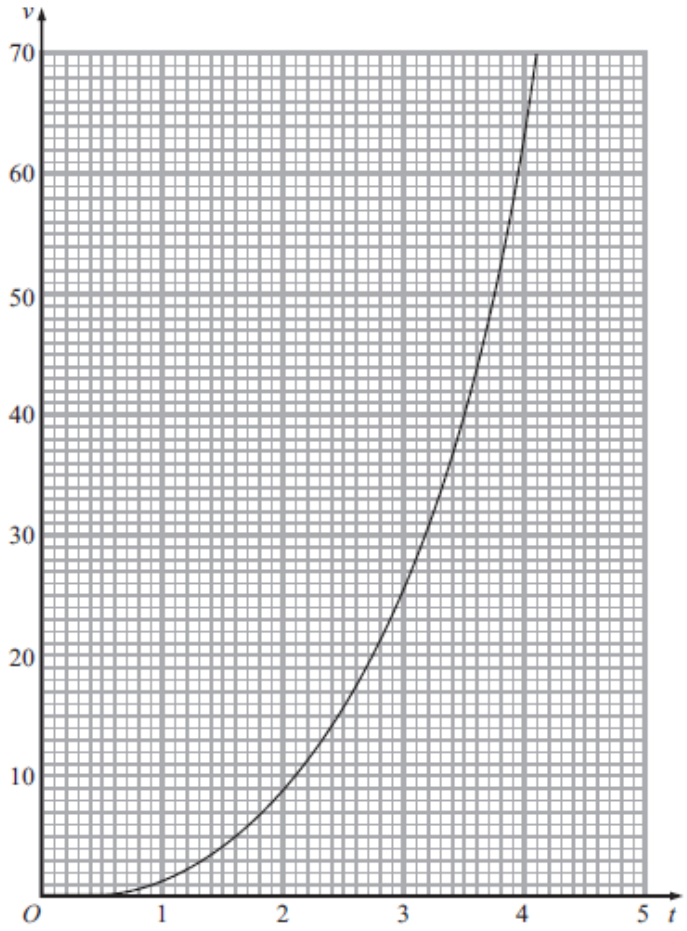
$\text{Volume} = \frac{\text{mass}}{\text{density}}$

  - ⇒ Most common units are g/cm^3 and kg/m^3. Make sure your units match up and are in your answer.
- Velocity time graphs:
  - ⇒ Gradient = acceleration
  - ⇒ Gradients of curves
    - You can estimate the gradient to a curve at a given point by drawing a tangent to the curve at that point.
    - Acceleration = Change in velocity/change in time
  - ⇒ Area underneath = distance travelled
  - ⇒ Areas under cruves:
    - You can estimate the area under curves by drawing trapeziums in equal intervals underneath the graph.

#	Objectives:	R/A/G?	
1	Solve problems involving speed, distance, and time.		
2	Solve problems involving density, mass and volume.		
3	Interpret areas under graphs and gradients of graphs in real life contexts. (e.g.recognise that area under a velocity-time graph represents displacement).		

Questions:

1) The graph shows the velocity, v metres per second, of a rocket at time t seconds.



(a) Find an estimate for the rate of change of the velocity of the rocket at $t = 2$

..... m/s²

(3)

(b) Find an estimate for the distance travelled by the rocket in the first 4 seconds.

Use 4 strips of equal width.....m

(3)

(Total 6 marks)

2)

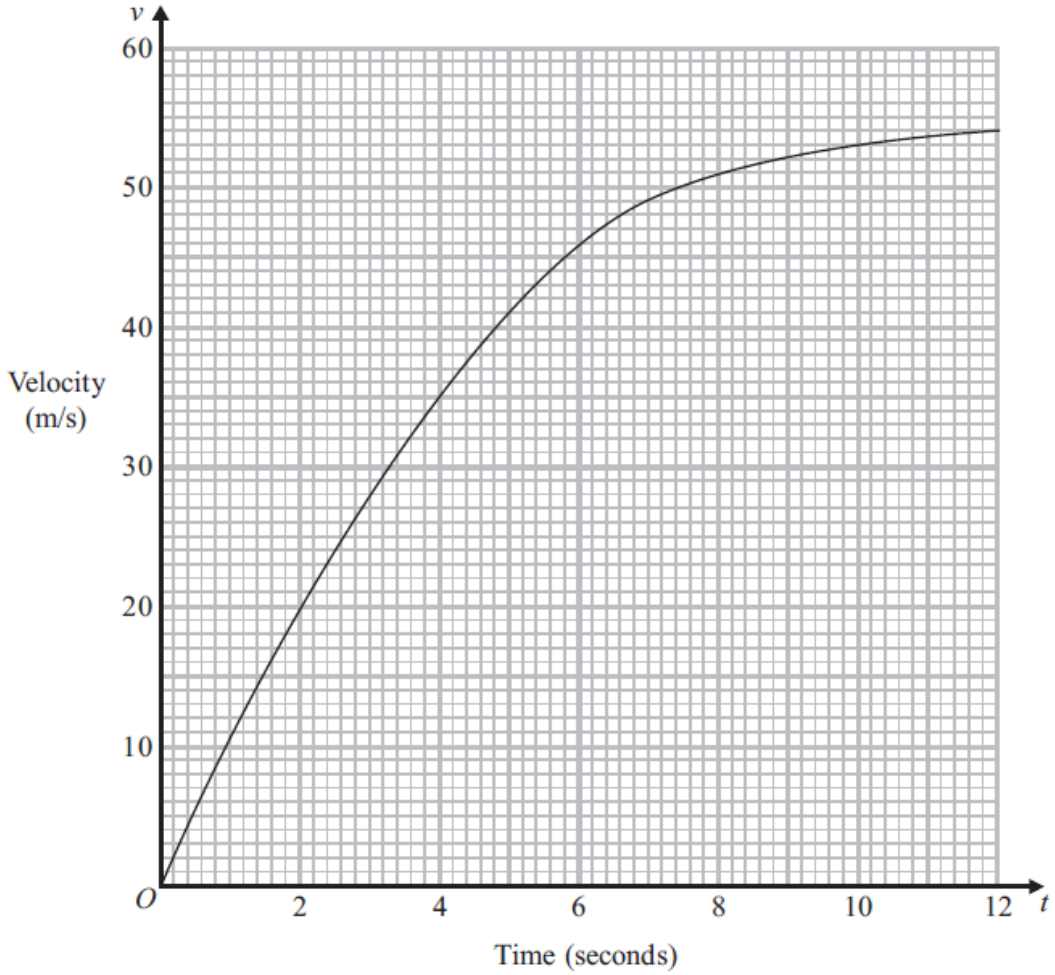
rachutist jumps out of a plane.

This graph shows information about the velocity, v m/s, of the parachutist t seconds after he jumped.

(a) Work out an estimate for the acceleration of the parachutist when $t = 8$

..... m/s^2

(3)



(b) Work out an estimate for the distance the parachutist falls in the first 6 seconds.

..... m

(3)

3)

Peter goes for a walk.
He walks 15 miles in 6 hours.

(a) Work out Peter's average speed.
Give your answer in miles per hour.

..... **(2)**

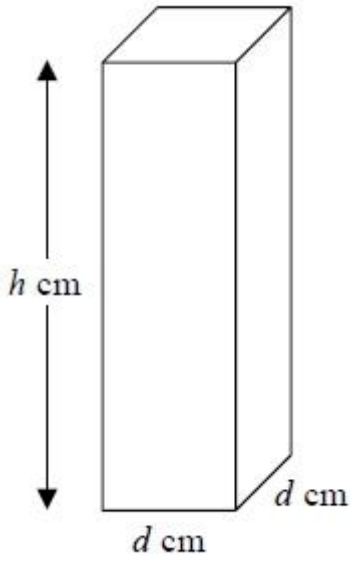
5 miles = 8 km.
Sunita says that Peter walked more than 20 km.

***** (b) Is Sunita right?
You must show all your working.

(2)

(Total for Question is 4 marks)

4) Here is a solid bar made of metal.



The bar is in the shape of a cuboid.
The height of the bar is h cm.
The base of the bar is a square of side d cm.

The mass of the bar is M kg.

d = 8.3 correct to 1 decimal place.
M = 13.91 correct to 2 decimal places.
h = 84 correct to the nearest whole number.

Find the value of the density of the metal to an appropriate degree of accuracy.
Give your answer in g/cm^3.

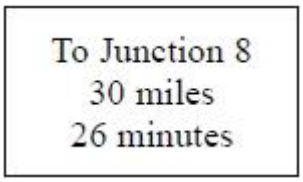
You must explain why your answer is to an appropriate degree of accuracy.

(Total for question = 5 marks)

6)

Axel and Lethna are driving along a motorway.

They see a road sign.
The road sign shows the distance to Junction 8
It also shows the average time drivers take to get to Junction 8



The speed limit on the motorway is 70 mph.

Lethna says

"We will have to drive faster than the speed limit to drive 30 miles in 26 minutes."

Is Lethna right?
You must show how you get your answer.

(Total for question = 3 marks)

7) The diagram shows a metal bar in the shape of a prism.

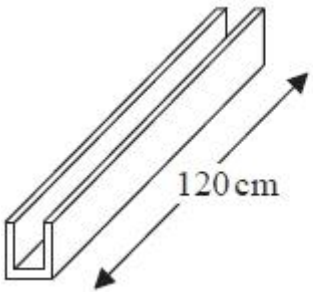


Diagram **NOT** accurately drawn

The length of the metal bar is 120 cm.
The cross section of the metal bar is shown below.

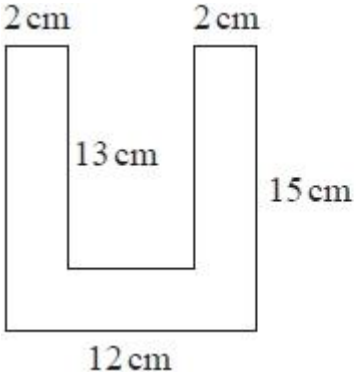


Diagram **NOT** accurately drawn

All corners are right angles.

The metal bar is made from steel with density 8 g/cm^3.

Sean has a trolley.
The trolley can carry a maximum mass of 250kg.

How many metal bars can the trolley carry at the same time?
You must show your working.

.....

(Total for question = 5 marks)

Help:

Mymaths.co.uk > Number > Ratio and proportion > Converting compound measures

Mymaths.co.uk > Shape > Measures > Speed

Mymaths.co.uk > Shape > Measures > Density

Mymaths.co.uk > Algebra > Graphs > Tangents and chords of curves

Mymaths.co.uk > Algebra > Graphs > Area under a curve

Answers:

Chapter 1:

1. $\frac{67}{9}$
2. 12
3. $\frac{17}{45}$
4. $1\frac{11}{35}$
5. $\frac{5}{8}$
6. $1\frac{2}{7}$
7. 15
8. 10
9. $3\frac{1}{15}$
10. 2 minutes
11. $2\frac{2}{15}$

Chapter 2:

1. 7^8
2. 5^9
3. $\frac{1}{6}$
4. 3^{13}
5. 9
6. $\frac{1}{27}$

Chapter 3:

1. $6\sqrt{2}$
2. $2 + 3\sqrt{2}$
3. $4\sqrt{3}$
4. $\sqrt{22}$

Chapter 4:

1. -5
2.
    a. 10ac(2a+3)
    b. 5wy(5w-2y)
    c. 4p(2a+3c-p)
3.
    a. x=6
    b. x=5
    c. x=-6
4.
    a. x=11
    b. x=7
    c. x=1
5.

a. x=4 or x=-1
b. x=0 or x=-3
c. No solutions

6.
a. $x = 2cm - t$
b. $x = \sqrt[3]{5y + 4}$
c. $x = \frac{ab}{5c}$
d. $x = kw^3$

7.
a. $m = -17y$
b. $m = \frac{x}{4\pi + a}$
c. $m = \frac{4-5y}{y-1}$
d. $m = \frac{c-2a}{3a-c}$

8.
a. $y > \frac{17}{5}$
b. $-2 < x < \frac{11}{2}$
c. $x > -3$

9.
a. 5n+3
b. 34-3n
c. $3n^2$-4n+9
d. $2n^2$+4n-14

10.
a. 24n As 24 is in the 8 times table any multiple of 24 will also be in the 8 times table.
b. 2n+1 Any number multiplied by 2 will become even, all even numbers add 1 become odd.

Chapter 5:

1. x=-2, y=5
2. x=24, y=32
3. x=4.5, y=-3
4. x=-5, y=-2 or x=2, y=5
5. x=-3, y=-3 or x=$\frac{3}{5}$, y=$\frac{21}{5}$
6. x=-3, y=-2 or x=$\frac{17}{5}$, y=$\frac{6}{5}$

Chapter 6:

1. x=-1 or x=-2
2. x=$\frac{4}{3}$ or x=$-\frac{1}{2}$
3. x=8 or x=-8
4. x=-2 or x=$\frac{5}{3}$
5. x=-2 or x=$\frac{14}{5}$
6. x=1.22 or x=-3.55
7. x=-4.33 or x=1.50
8.
a. $(x + 2)^2 - 22$
b. $(-5, -22)$

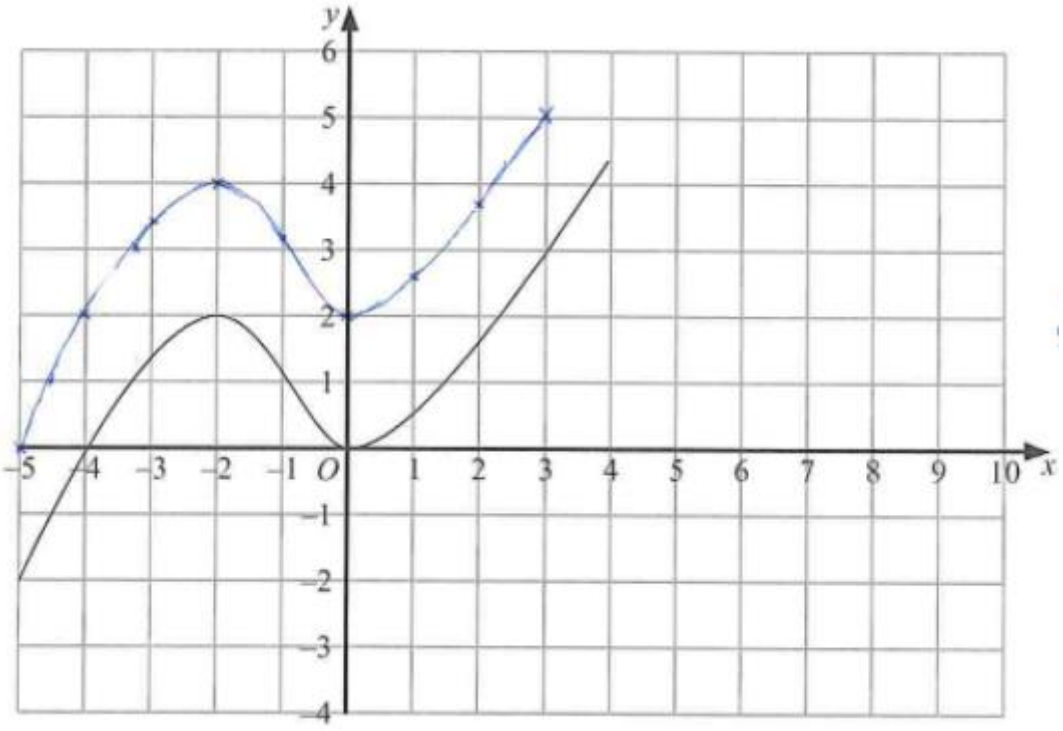
9.
   a. $(x+2)^2 - 16$
   b. x=2 or x=-6

Chapter 7:

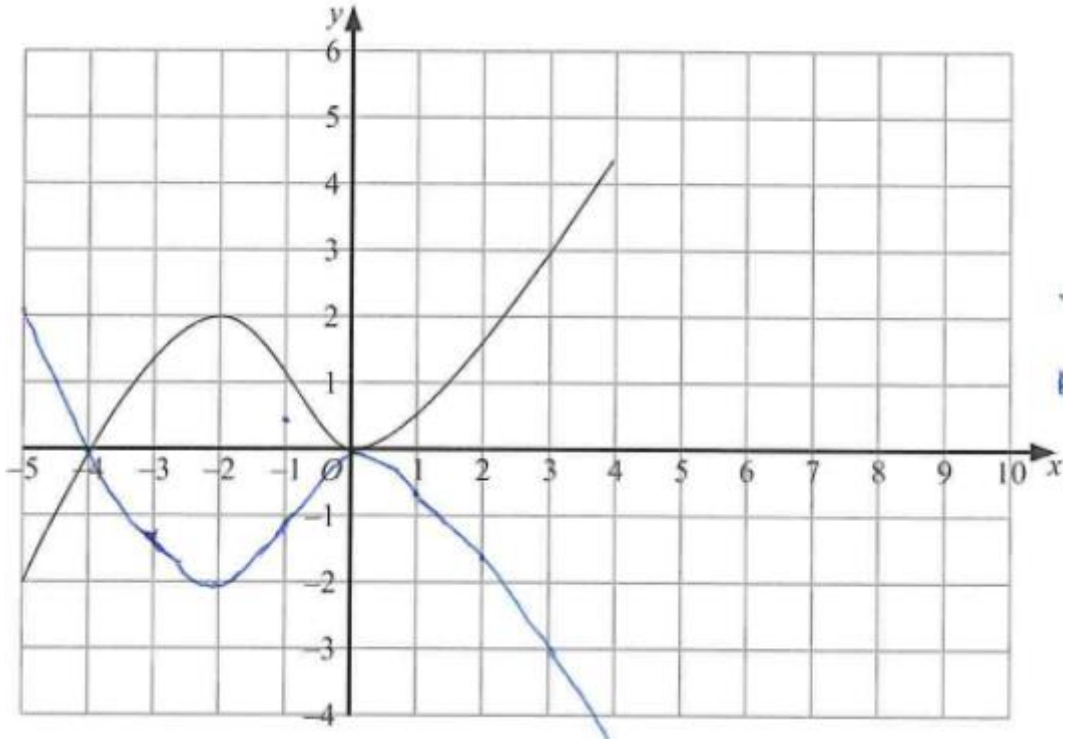
1.
   a. ABD=55º Angles between the radius and tangent are 90º.
   b. DEB=55º BDE=90º angles in a semi circle are 90º, angles in a triangle add up to 180º.
2.
   a. AOD=54, OAD=90º Angles between the radius and tangent are 90º, angles in a triangle add up to 180º.
   b. ABC=27º, the angle subtended at the centre is twice the angle subtended at the circumference.
3.
   a. x=140º, the angle subtended at the centre is twice the angle subtended at the circumference.
   b. y=110º, Opposite angles in a cyclic quadrilateral add up to 180º.
4.
   a. AOC=58º,)CD=90º Angles between the radius and tangent are 90º, COD=61º angles in a triangle add up to 180º, COD=BOD, AOC=58º angles on a straight line add up to 180º.
5.
   a. QRS=115º, PQS=35º alternate segment theory, QPS=65º angles in a triangle add up to 180º, QRS=115º opposite angles in a cyclic quadrilateral add up to 180º.
   b. RQS=30º, RSQ=35º alternate angles are equal, QRS=115º as shown in part a, RQS=30º angles in a triangle add up to 180º.

Chapter 8:

1.
   a.



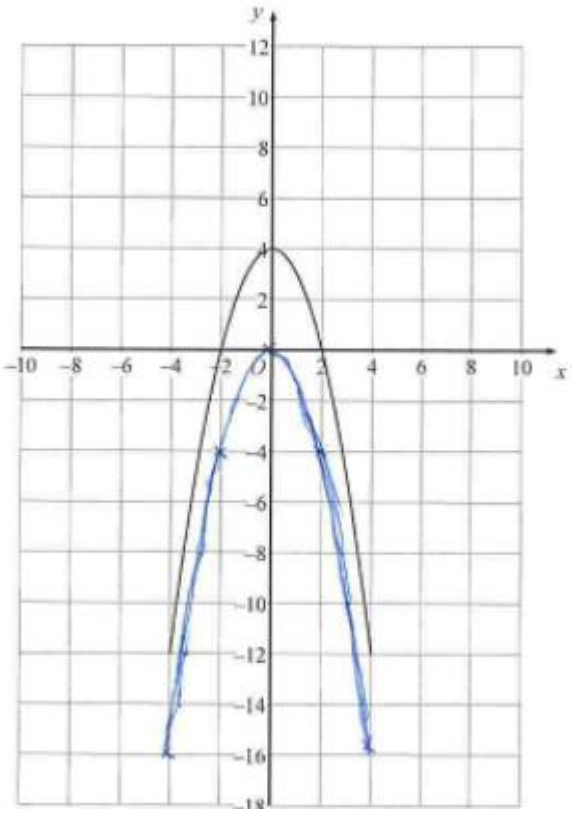
b.

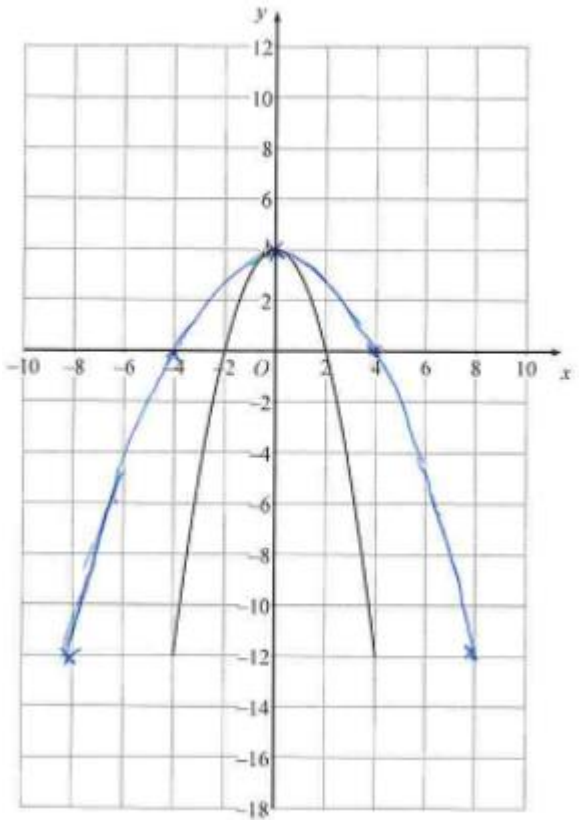


2.

a. (4,3)
b. (2,6)

3.

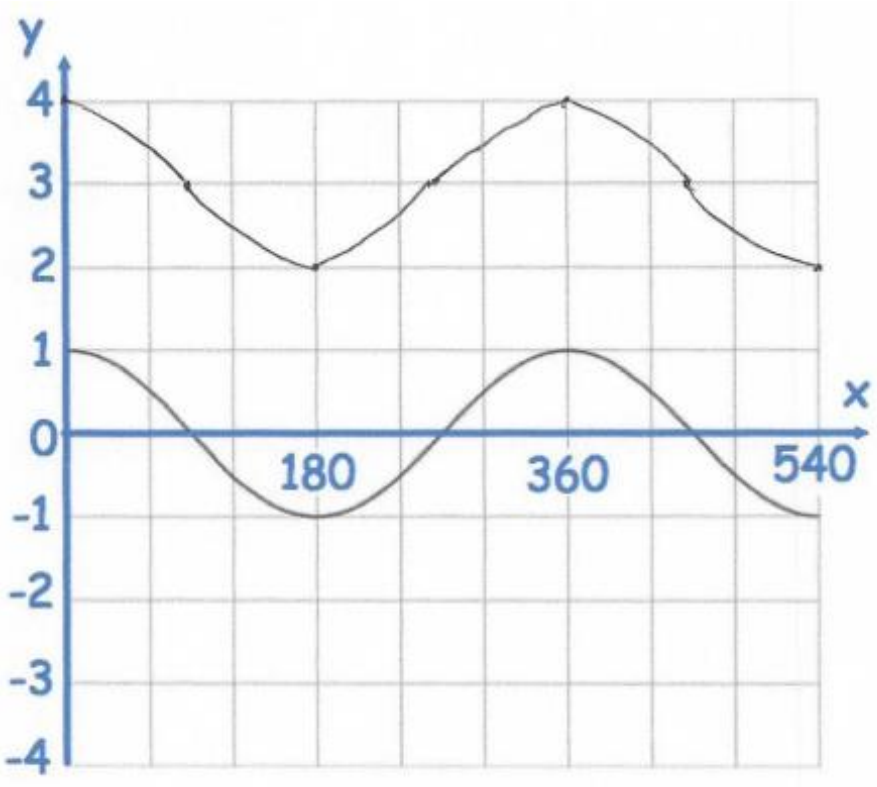




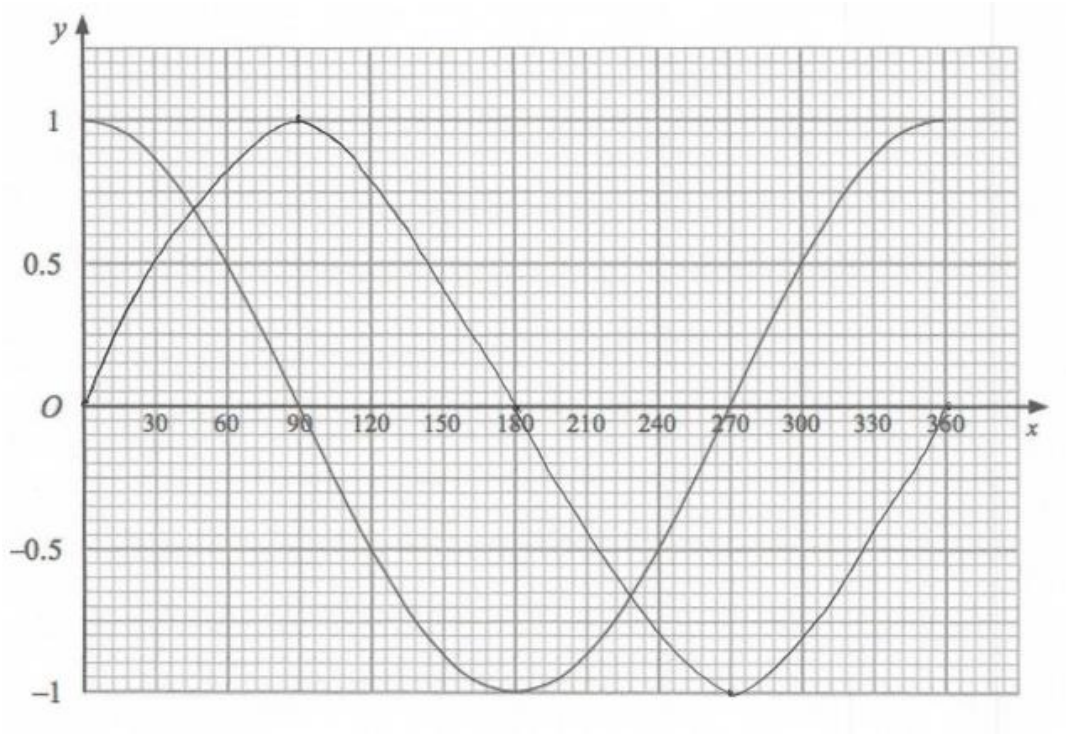
4.

a. (5,-4)
b. (-2,2)

5.



6.



7.

a. Reflection with mirror line of the x axis.
b. Translation by $\begin{pmatrix}0\\1\end{pmatrix}$
c. Translation by $\begin{pmatrix}30\\0\end{pmatrix}$

Chapter 9:

1. 5.10
2. 5.74
3. 7.21
4. 39.8°
5. 16.5
6. 13.1
7. $\frac{\sqrt{6}}{4}$
8. $Cosx = \frac{\sqrt{6}+2\sqrt{3}}{4+2\sqrt{2}} \times \frac{4-2\sqrt{2}}{4-2\sqrt{2}}$

$$Cosx = \frac{4\sqrt{6} - 2\sqrt{12} + 8\sqrt{3} - 4\sqrt{6}}{16-8}$$

$$Cosx = \frac{-2\sqrt{12} + 8\sqrt{3}}{8}$$

$$Cosx = \frac{-4\sqrt{3} + 8\sqrt{3}}{8}$$

$$Cosx = \frac{4\sqrt{3}}{8}$$

$$Cosx = \frac{\sqrt{3}}{2}$$

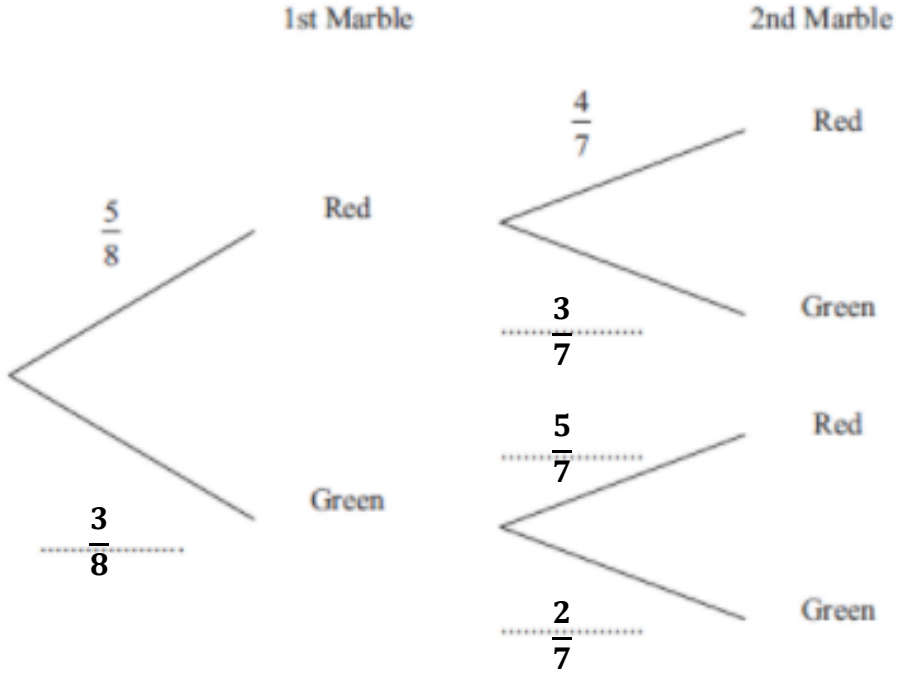
$Cos30 = \frac{\sqrt{3}}{2}$ as required.

9. 26.1
10. 53.8
11. 32.1

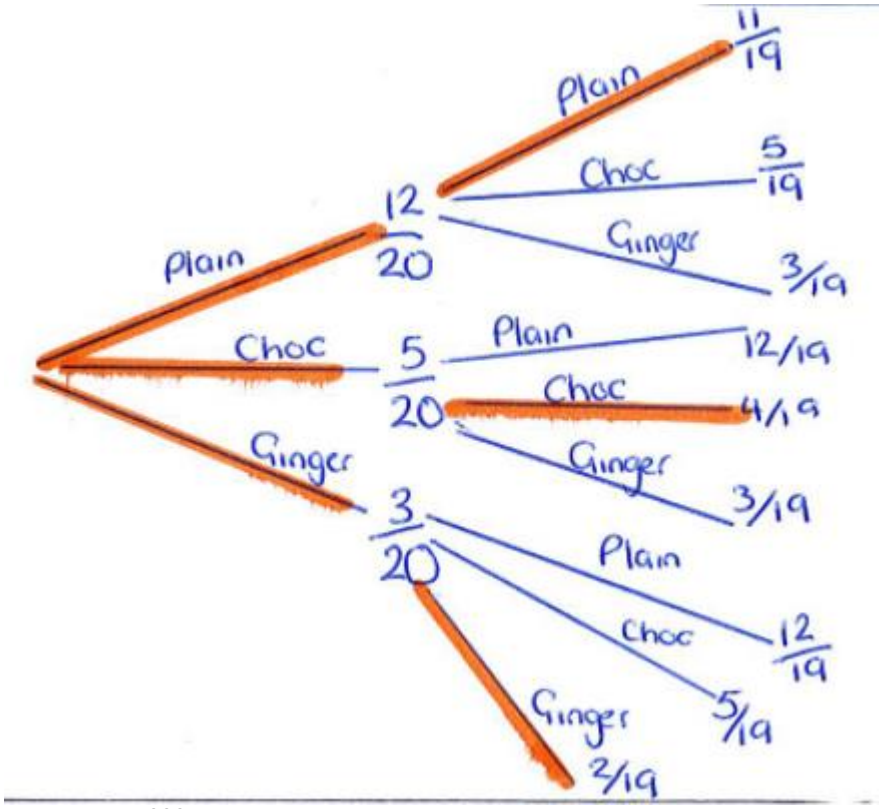
12. 31.5°
13.
    a. $a - 3b$
    b. NC = 2a-2b = 2(a-b)
    MC = $\frac{1}{2}$(a-3b) + a = $\frac{3}{2}$(a-b)
    NC and MC are parallel and share a common point of m therefore NMC is a straight line.
14.
    a. OS = $\frac{1}{2}$(p+q)
    b. RS = $\frac{1}{2}$p + $\frac{1}{2}$(p-q) = $\frac{1}{2}$q which is a multiple of OQ therefore they are parallel.

Chapter 10:

1.
    a. 22
    b. 4.59
2.
    a. 10,000 < x ≤ 14,000
    b. 14,000 < x ≤ 16,000
    c. £14,875
    d. Because you are taking the midpoint so you don't know the exact values.
3.

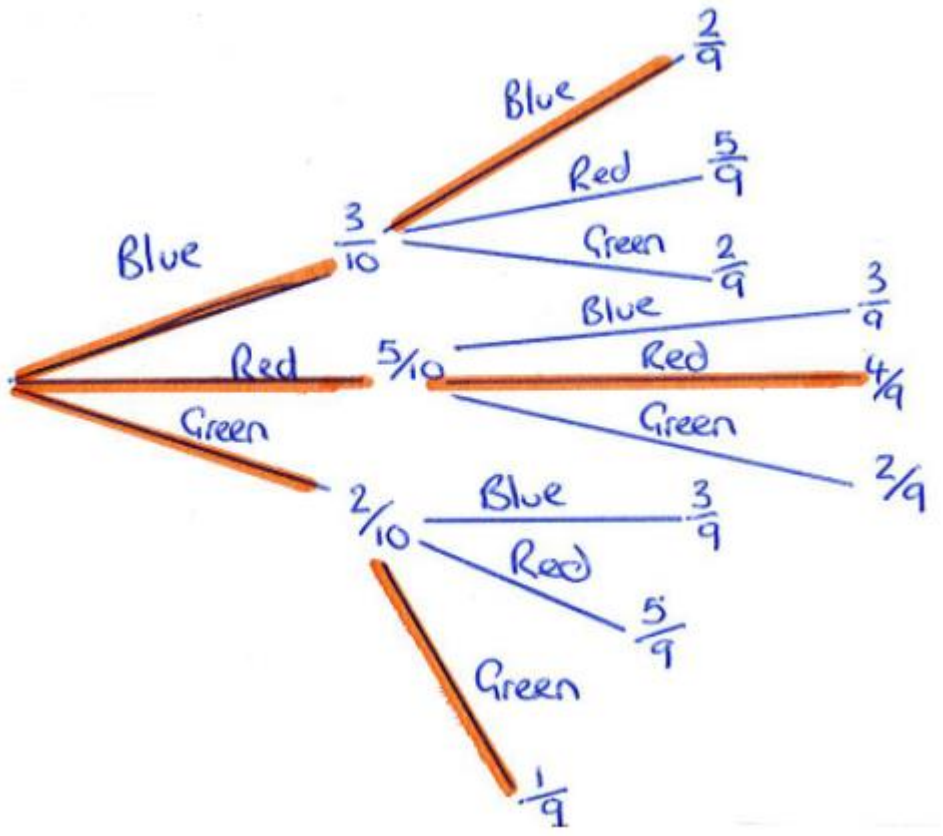


    a.
    b. $\frac{15}{28}$
4.



Answer = $\frac{222}{380}$

5.



Answer = $\frac{14}{45}$

6.

a.

i. p, r, a

ii. p, a, r, i, s, b, u, d, e, t

b. E Prague and Lisbon have no common letters.

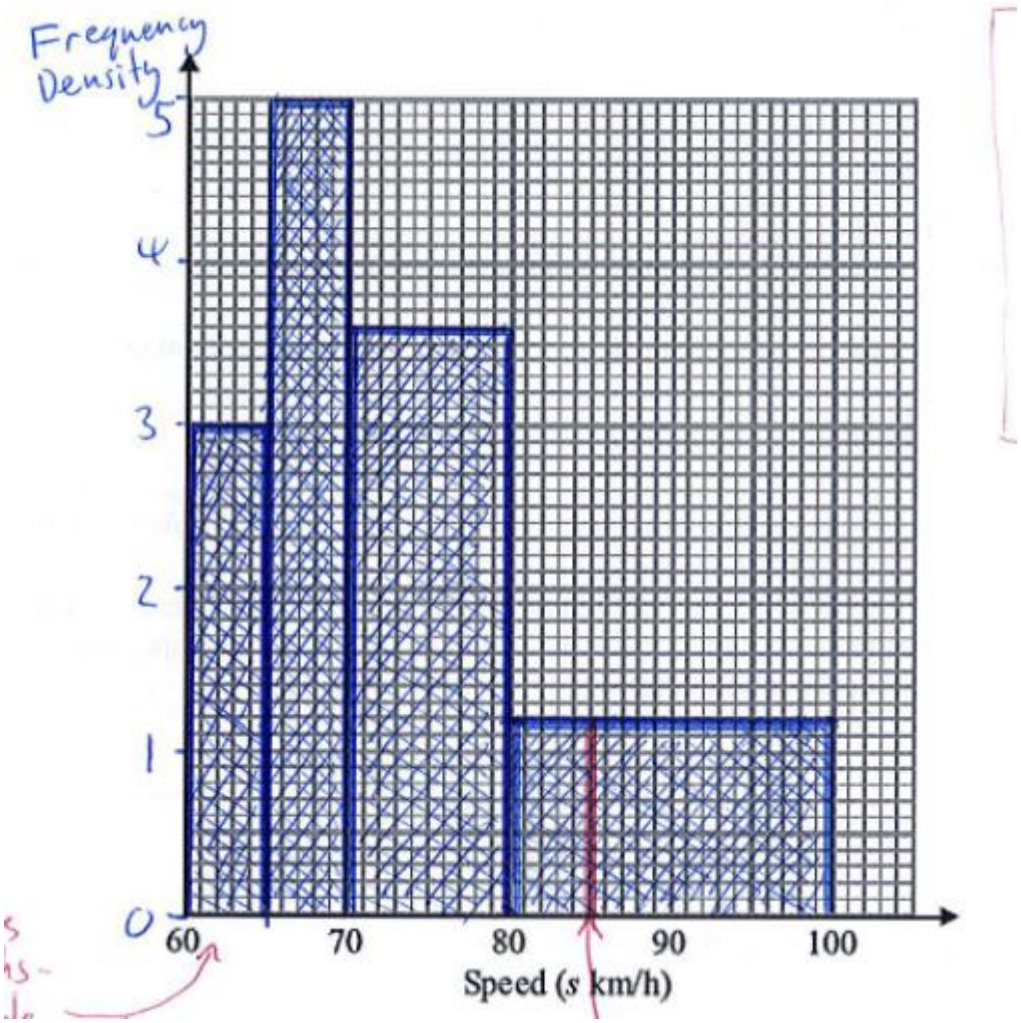
7.

a. 1, 2, 11, 6, 5, 2, 9, 10

b. 1, 2, 3, 4, 5, 6, 7, 8, 11

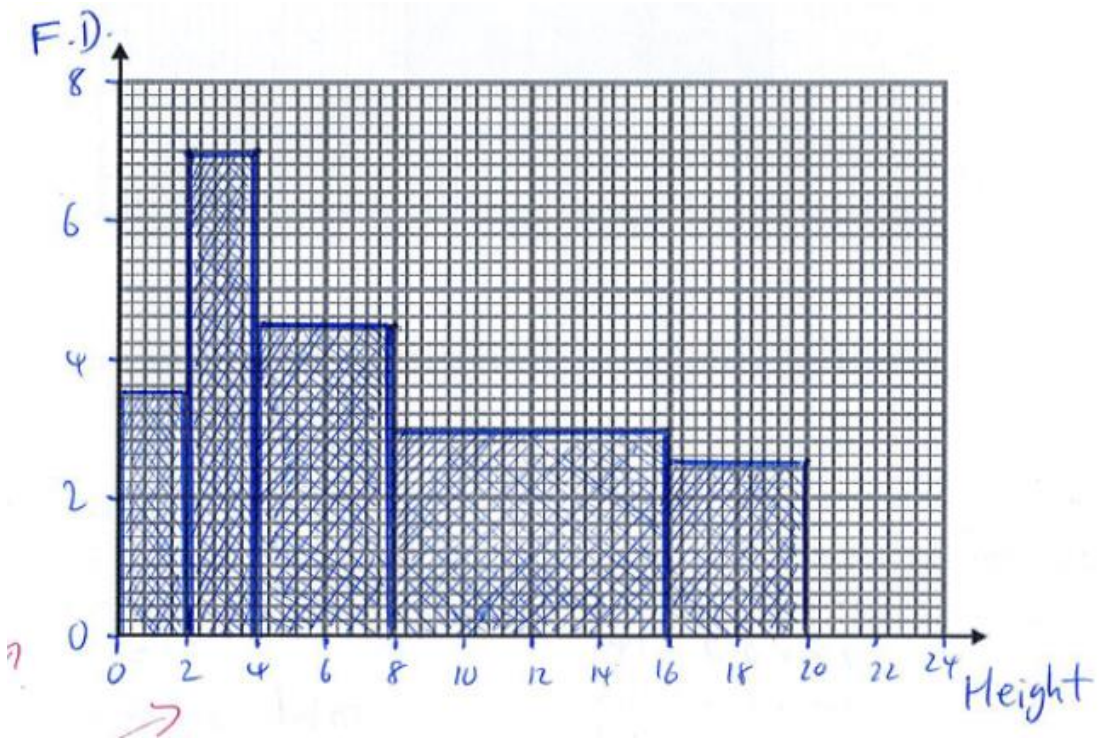
8.

a.



b. 18

9.



Chapter 11:

1.
   a. 11m/s^2 (Accept 9-14)
   b. 66.5m ($\pm$1)
2.
   a. 1.25-1.75m/s^2
   b. 156m
3.
   a. 2.5mph
   b. 15miles=24km so yes Sunita is right.
4. 2.4g/cm^3
   Upper limit = 2.468 g/cm^3, Lower limit = 2.36 g/cm^3
5. Will take 25.7 minutes
   Or
   At 70mph they will travel 30.3miles
   Or
   To do this they need a speed of 69.2mph
6. 3 bars