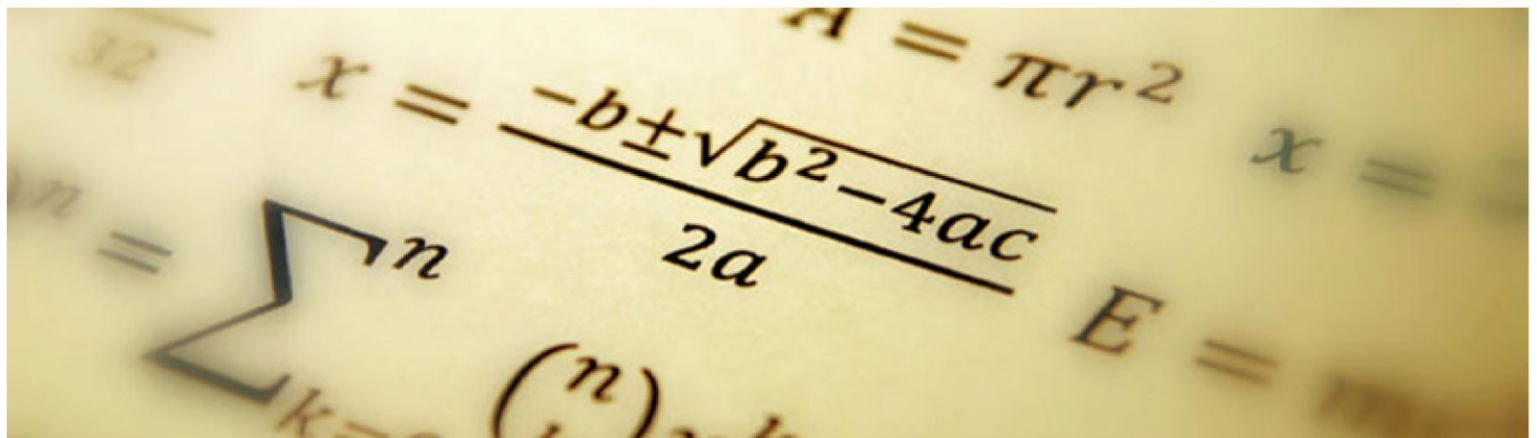


THE
DUSTON ^{TDS} ₄₋₁₉
SCHOOL

Knowledge Organiser *Maths*

Year 10 - Term 3

Additional Maths

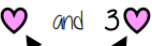





Contents of Study

Lesson	Topic
1	What is the correct algebraic notation?
2	How can we write expressions into their simplest form?
3	How can we replace letters with numbers to evaluate an expression?
4	How can we replace letters with numbers to evaluate an expression?
5	How can I expand single brackets?
6	How many degrees are there on a straight line, round a point and in a triangle?
7	What am I looking for to calculate angles in parallel lines?
8	What am I looking for to calculate angles in parallel lines?
9	What are the angle properties of quadrilateral shapes?
10	How can I calculate the angles in a polygon with more than 4 sides?
11	How can I calculate the angles in a polygon with more than 4 sides?
12	How can we expand single brackets when there is more than one of them in the question?
13	How can we expand single brackets when there is more than one of them in the question?
14	How can I factorise using common factors in algebra?
15	How can I factorise using common factors in algebra?

Like and unlike terms

Like terms are those whose variables are the same

 and $3 \times$  are like terms
 the variable is the same

 and $3 \times$  are unlike terms
 the variables are NOT the same

Examples and non-examples

Like terms

$y, 7y$
 $2x^2, x^2$
 $ab, 10ba$
 $5, -2$

Un-like terms

$y, 7x$
 $2x^2, 2c^2$
 $ab, 10a$
 $5, -2t$

Note here ab and ba are commutative operations, so are still like terms

Equivalence

Check equivalence by substitution

e.g. $m=10$

$$\begin{array}{r}
 5m \\
 5 \times 10 \\
 = 50
 \end{array}
 \qquad
 \begin{array}{r}
 2 \times 2m \\
 2 \times (2 \times 10) \\
 = 2 \times 20 \\
 = 40
 \end{array}
 \qquad
 \begin{array}{r}
 7m - 3m \\
 (7 \times 10) - (3 \times 10) \\
 = 70 - 30 \\
 = 40
 \end{array}$$


Equivalent expressions

Repeat this with various values for m to check

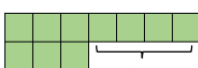
$5m$



$2 \times 2m$

 } $4m$

$7m - 3m$

 } $4m$

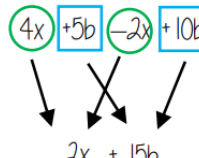
Collecting like terms \equiv symbol

The \equiv symbol means equivalent to

It is used to identify equivalent expressions

Collecting like terms

Only like terms can be combined

$$4x + 5b - 2x + 10b$$


Common misconceptions

$$2x + 3x^2 + 4x \equiv 6x + 3x^2$$

Although they both have the x variable, x^2 and x terms are unlike terms so can not be collected

Addition/ Subtraction with indices

Coefficient

Power

$$\underbrace{5}_{\text{Term}} x^{\underbrace{2}_{\text{Term}}} + \underbrace{4}_{\text{Term}} x^{\underbrace{4}_{\text{Term}}}$$

Expression



Each square represents x^2 and each cube represents x^4

Only similar terms can be simplified
If they have different powers, they are unlike terms

$$5x^2 + 2x^2 \longrightarrow \text{7 squares} \longrightarrow 7x^2$$

$$5x^2 + 6x^4 - 3x^2 + x^4 \longrightarrow \text{2 squares and 7 cubes} \longrightarrow 2x^2 + 7x^4$$

Multiply expressions with indices

$$\begin{aligned}
 4b \times 3a \\
 \equiv 4 \times b \times 3 \times a \\
 \equiv 4 \times 3 \times b \times a \\
 \equiv 12ab
 \end{aligned}$$

$$\begin{aligned}
 5t \times 9t \\
 \equiv 5 \times t \times 9 \times t \\
 \equiv 5 \times 9 \times t \times t \\
 \equiv 45t^2
 \end{aligned}$$

$$\begin{aligned}
 2b^4 \times 3b^2 \\
 \equiv 2 \times b \times b \times b \times b \times 3 \times b \times b \\
 \equiv 2 \times 3 \times b \times b \times b \times b \times b \times b \\
 \equiv 6b^6
 \end{aligned}$$

There are often misconceptions with this calculation but break down the powers

Addition/ Subtraction laws for indices

Addition/ Subtraction laws for indices

$$3^5 \times 3^2 \longrightarrow 3^7$$

$$= (3 \times 3 \times 3 \times 3 \times 3) \times (3 \times 3)$$

Addition law for indices

$$a^m \times a^n = a^{m+n}$$

$$3^5 \div 3^2 \longrightarrow 3^3$$

$$\frac{3 \times 3 \times 3 \times \cancel{3} \times \cancel{3}}{\cancel{3} \times \cancel{3}} \longrightarrow \frac{3^3}{3^0} \longrightarrow \frac{3^3}{1}$$

Subtraction law for indices

$$a^m \div a^n = a^{m-n}$$

$$\frac{5a^3b^2}{15ab^6} \longrightarrow \frac{\cancel{5} \times \cancel{a} \times \cancel{a} \times \cancel{a} \times \cancel{b} \times \cancel{b}}{3 \times \cancel{5} \times \cancel{a} \times \cancel{b} \times \cancel{b} \times \cancel{b} \times \cancel{b} \times \cancel{b} \times \cancel{b}} \longrightarrow \frac{a^2}{3b^4}$$

Cross cancelling factors shows cancels the expression

$$\left. \begin{array}{l} 23a^7y^2 \\ 5db^6 \end{array} \right\} \text{This expression cannot be divided (cancelled down) because there are no common factors or similar terms}$$

Basic angle rules and notation R

Acute Angles
 $0^\circ < \text{angle} < 90^\circ$

Obtuse
 $90^\circ < \text{angle} < 180^\circ$

Reflex
 $180^\circ < \text{angle} < 360^\circ$

Right Angles
 90°

Right angle notation

Straight Line
 180°

Vertically opposite angles
 Equal

Angles around a point
 360°

The letter in the middle is the angle
 The arc represents the part of the angle

Angle Notation: three letters ABC
 This is the angle at B = 113°

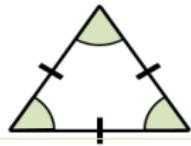
Line Notation: two letters EC
 The line that joins E to C

Alternate/ Corresponding angles

Because alternate angles are equal the highlighted angles are the same size

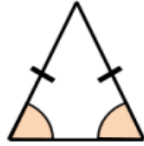
Because corresponding angles are equal the highlighted angles are the same size

Equilateral Triangle



- 3 equal sides
- 3 equal angles (60°)
- 2 sets of parallel sides
- 3 lines of symmetry

Isosceles Triangle



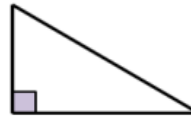
- 2 equal sides
- 2 equal angles
- 1 line of symmetry

Scalene Triangle



- 0 equal sides
- 0 equal angles
- 0 lines of symmetry

Right-angle Triangle



- 1 right angle

Co-interior angles

Because co-interior angles have a sum of 180° the highlighted angle is 110°

As angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

Sum of angles at a point

The sum of angles around a point is 360°

Find angle BOE

$90^\circ + 33^\circ + 92^\circ = 205^\circ$

$360^\circ - 205^\circ$

BOE = 155°

Angle notation - 90°

Angle notation - find this missing angle

$360^\circ - 67^\circ = 293^\circ$

Sum of angles on a straight line

Adjacent angles that share a common point on a line add up to 180°

Find angle XWY

$72^\circ + 42^\circ = 114^\circ$

$180^\circ - 114^\circ = 66^\circ$

Vertically opposite angles

Angle JNM is vertically opposite to angle KNL

$JNM = KNL$

Vertically opposite angles are the same

Other angle rules still apply
 Look for straight line sums and angles around a point

Form equations with information from diagrams:

$2x - 12 = 42$

$2x = 54$

$x = 27^\circ$

Sum of angles in triangles

Sum of interior angles in a triangle = 180°

The two base angles will be the same size

Look at triangle notation
 This indicates an isosceles triangle

$\therefore 180 - 43 = 137$

$137 \div 2 = 68.5^\circ$

A triangle can only have ONE right angle

Have a go!
 Tearing the corners from triangles forms a straight line which is therefore 180°

Sum of angles in quadrilaterals

Sum of interior angles in a quadrilateral = 360°

Convex Quadrilateral

Concave Quadrilateral

Interior Angles

A quadrilateral is made up of two triangles - the sum of interior angles is the same as two triangles:
 $180^\circ + 180^\circ = 360^\circ$

Interior angles are those that make up the perimeter (outline) of the shape

Properties of Quadrilaterals



Square

All sides equal size
All angles 90°
Opposite sides are parallel



Parallelogram

Opposite sides are parallel
Opposite angles are equal
Co-interior angles



Rectangle

All angles 90°
Opposite sides are parallel



Trapezium

One pair of parallel lines



Rhombus

All sides equal size
Opposite angles are equal



Kite

No parallel lines
Equal lengths on top sides
Equal lengths on bottom sides
One pair of equal angles

Sum of exterior angles

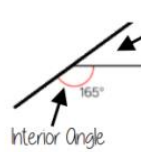
Exterior angles all add up to 360°



Exterior Angles

Are the angle formed from the straight-line extension at the side of the shape

Using exterior angles



Exterior Angle

Interior angle + Exterior angle = straight line = 180°
Exterior angle = $180 - 165 = 15^\circ$

Number of sides = $360^\circ \div$ exterior angle
Number of sides = $360 \div 15 = 24$ sides

Sum of interior angles

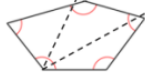
$$(\text{number of sides} - 2) \times 180$$

Interior Angles

The angles enclosed by the polygon



$$\text{Sum of the interior angles} = (5 - 2) \times 180$$



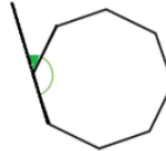
This shape can be made from three triangles
Each triangle has 180°

$$\text{Sum of the interior angles} = 3 \times 180 = 540^\circ$$

This is an **irregular** polygon
- the sides and angles are different sizes

Remember this is **all** of the interior angles added together

Missing angles in regular polygons



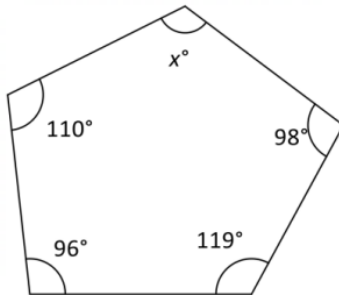
$$\text{Exterior angle} = 360 \div 8 = 45^\circ$$

$$\text{Interior angle} = \frac{(8-2) \times 180}{8} = \frac{6 \times 180}{8} = 135^\circ$$

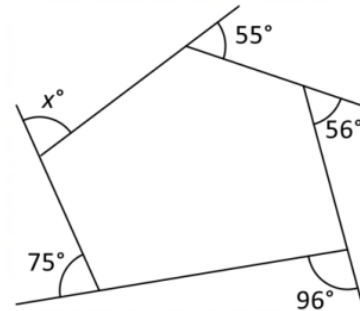
Exterior angles in regular polygons = $360^\circ \div$ number of sides

Interior angles in regular polygons = $\frac{(\text{number of sides} - 2) \times 180}{\text{number of sides}}$

Calculate x



Calculate x



The sum of the interior angles of a polygon with n sides is

$$(n - 2) \times 180^\circ$$

The sum of the exterior angles of any polygon is 360°

$$5 \text{ sided polygon : sum of interior angles} = (5 - 2) \times 180 = 540^\circ$$

$$x^\circ + 98^\circ + 119^\circ + 96^\circ + 110^\circ = 540^\circ$$

$$x^\circ + 423^\circ = 540^\circ$$

$$x = 117^\circ$$

$$x^\circ + 96^\circ + 56^\circ + 55^\circ + 72^\circ = 360^\circ$$

$$x^\circ + 282^\circ = 360^\circ$$

$$x = 78^\circ$$

'Expand' means
'Multiply out'

Multiply single brackets $3(2x + 4)$

$6x + 12$

Different representations of $3(2x+4) = 6x + 12$

Example Expand

$$\begin{aligned} & 5(3x + 4) \\ &= 5 \times 3x + 5 \times 4 \\ &= 15x + 20 \end{aligned}$$

	$3x$	$+4$
5	$15x$	$+20$

Multiple single Brackets

$$\begin{aligned} & 2(3x + 1) + 3(x + 5) \\ &= 6x + 2 + 3x + 15 \\ &= 9x + 17 \end{aligned}$$

Expand the
bracket(s) first

Example

$$\begin{aligned} & 3(2x - 1) - 4(3x - 2) \\ &= 6x - 3 - 12x + 8 \\ &= -4x + 5 \end{aligned}$$

$-4 \times -2 = (+)8$

$-3 + 8 = (+)5$

Expanding a double bracket

Method 1 - "smiley face"

Draw loops between each pair and multiply the two values at the end of the loops together

$$(2x + 4)(3x + 5)$$

$$2x \times 3x = 6x^2$$

$$4 \times 3x = 12x$$

$$2x \times 5 = 10x$$

$$4 \times 5 = 20$$

So $6x^2 + 22x + 20$

Method 2 - Separate the brackets

In this method we split the pair of brackets back into single ones

$$(2x + 4)(3x + 5)$$

$$= 2x(3x + 5) + 4(3x + 5)$$

$$= 6x^2 + 10x + 12x + 20$$

$$= 6x^2 + 22x + 20$$

Method 3 - Grid

Set the expansion out as a multiplication grid

$$(2x + 4)(3x + 5)$$

	$3x$	$+5$
$2x$	$6x^2$	$10x$
$+4$	$12x$	20

So $6x^2 + 22x + 20$

Factorise into a single bracket $8x + 4$



The two values multiply together (also the area) of the rectangle

$$8x + 4 \equiv 4(2x + 1)$$

Note:
 $8x + 4 \equiv 2(4x + 2)$
This is factorised but the HCF has not been used

Factorise $4a + 20$

$$\begin{aligned} &= 4 \times a + 4 \times 5 \\ &= 4(a + 5) \end{aligned}$$

The highest common factor of 4 and 20 is 4

Factorise $25a - 45$

$$\begin{aligned} &= 5 \times 5a - 5 \times 9 \\ &= 5(5a - 9) \end{aligned}$$

The highest common factor of 25 and 45 is 5

Factorise $18x^2 - 27x$

$$9x \times 2x - 9x \times 3$$

$$9x(2x - 3)$$

The highest common factor of 18 and 27 is 9. x is the highest common factor of x^2 and x

The highest common factor is $9x$

Factorise $12x^2yz - 27xz$

$$3xz \times 4xy - 3xz \times 9$$

$$3xz(4xy - 9)$$

The highest common factor of 12 and 27 is 3. xz is the highest common factor of x^2yz and xz

The highest common factor is $3xz$

Factorising Double Brackets

Check your signs!

$$x^2 + bx + c = (x + \quad)(x + \quad)$$

$$x^2 + 10x + 16 = (x + 8)(x + 2)$$

$$x^2 - bx + c = (x - \quad)(x - \quad)$$

$$x^2 - 10x + 16 = (x - 8)(x - 2)$$

$$x^2 \pm bx - c = (x + \quad)(x - \quad)$$

$$x^2 + 6x - 16 = (x + 8)(x - 2)$$

$$x^2 - 6x - 16 = (x + 2)(x - 8)$$

Factorise $x^2 + 9x + 20$

We need 2 numbers that

$$x^2 + 9x + 20$$

have a sum of (+)9
 $4 + 5 = 9$

have a product of (+)20
 $4 \times 5 = 20$

$$x^2 + 9x + 20 = (x + 4)(x + 5)$$

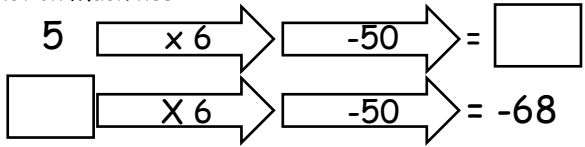
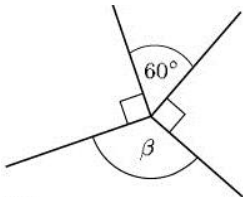
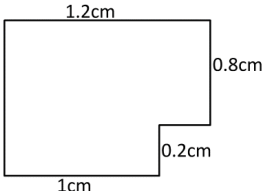
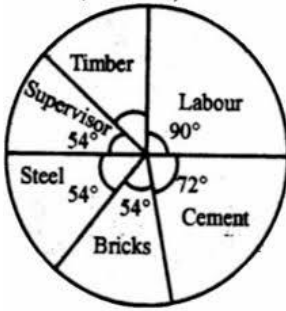
Factorise $x^2 + x - 42$

Sum of (+)1
 $-6 + 7 = 1$

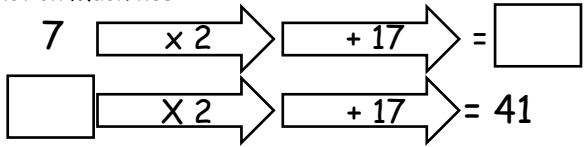
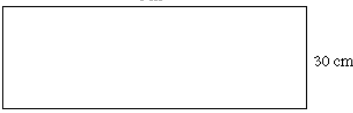
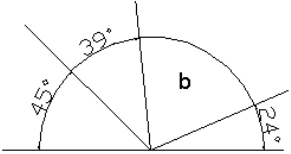
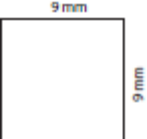


















product of -42
 $-6 \times 7 = -42$

$$x^2 + x - 42 = (x - 6)(x + 7)$$

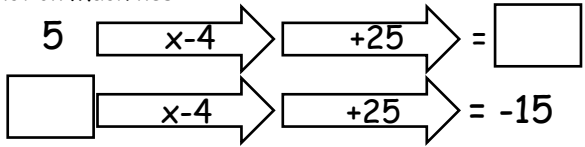
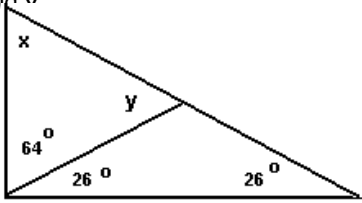
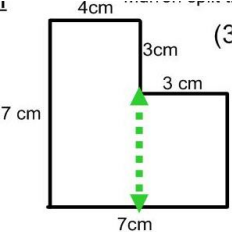
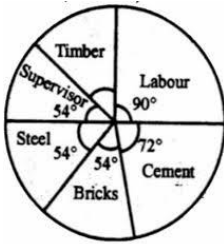
Mixed Homework Sheet 7

<p>1. $3 + 5 \times 7 - 8$</p>	<p>2. Function Machines</p> 
<p>3. The ratio of male to female birds in a bird cage was 5:2. For every 45 males there are _____ females.</p>	<p>4. If a square has sides of 1cm each, what is the area of the square in millimetres?</p>
<p>5. What is the probability of getting a 7 after rolling a single die numbered 1 to 6?</p>	<p>6. Mr Smith kept a record of the number of absences for each student in his class for one term. Here are his results. 0 0 0 8 4 5 5 3 2 1 Work out the mean.</p>
<p>7. Express 96 as a product of it's prime factors.</p>	<p>8. What is the nth term rule of the following sequence 12, 8, 4, 0, -4, -8</p>
<p>9. If I need 75ml of milk to make 15 pancakes, how much milk do I need to make 28 pancakes?</p>	<p>10. Calculate the size of angle β</p> 
<p>11. Five people took part in a sponsored swim. The number of lengths they completed were 16, 11, 8, 8, and 14. What is the median number of lengths completed?</p>	<p>12. A fair die is rolled 180 times, how many times would I expect it to either land on a 3 or a 5.</p>
<p>13. Order the following from smallest to largest: $\frac{2}{3}, \frac{3}{5}, \frac{13}{15}, \frac{2}{5}$</p>	<p>14. Find the value of the following expression if $a = 2$, $b = 5$ and $c = 9$. $c - b + a$</p>
<p>15. What is the perimeter of the shape?</p> 	<p>16. You have a deck of cards. Find the probability of drawing a red card on the first draw, replacing it and drawing a red card on the second draw.</p>
<p>17. Increase £270 by 25%</p>	<p>18. Solve the following equation: $4x + 8 = 16$</p>
<p>19. What is 10,500g in kg?</p>	<p>20. The pie chart shows the what costs are involved building a house. What fraction of the total is labour?</p> 
<p>Total: /20</p>	<p>Personal Target:</p>

Mixed Homework Sheet 8

<p>1. $12 \div 4 + 6 \times 2^2$</p>	<p>2. Function Machines</p> 														
<p>3. At the malt shop the ratio of hotdogs sold to hamburgers sold was 7:5. For every _____ hamburgers sold there were 65 hotdogs sold.</p>	<p>4. What is the area of the rectangle?</p> 														
<p>5. What is the probability of choosing the letter i from the word probability?</p>	<p>6. Peter rolled a 6-sided dice ten times. Here are his scores. 3 2 4 6 3 3 4 2 5 4 Work out the median of his scores.</p>														
<p>7. What is the highest common factor of 31 and 124?</p>	<p>8. What are the missing terms in this sequence? 1, __, 7, 9, __, 13, __</p>														
<p>9. If I need 4kg of cement to make 32kg concrete, how much cement do I need to make 96kg of concrete?</p>	<p>10. Calculate the size of angle b.</p> 														
<p>11. What is the difference between the mean and the median of the following set of numbers: 10, 32, 10, 11, 7</p>	<p>12. Cards are randomly selected from a pack of cards and each then replaced before the next choice. Out of 65 choices how many times would I expect to pick a king?</p>														
<p>13. Order the following from smallest to largest: $\frac{3}{7}$, $\frac{1}{2}$, 0.49, 0.2</p>	<p>14. Find the value of the following expression if $a = 2$, $b = 5$ and $c = 9$. $4a + bc$</p>														
<p>15. What is the difference between the area and perimeter of the following square?</p> 	<p>16. You have a deck of cards. Find the probability of drawing a 4 through 7 on the first draw, replacing it and drawing a Spade card on the second draw</p>														
<p>17. The prices of all the televisions in a shop are to be increased by 8%. Calculate the new price of a television that originally cost £150</p>	<p>18. Solve the following equation: $14 = -2x$</p>														
<p>19. What is 48cm in mm?</p>	<p>20. If 8 red boxes were sold on Tuesday, add a key to the pictogram to make it correct.</p> <table border="1" data-bbox="802 1697 1441 1980"> <thead> <tr> <th>Days</th> <th>Number of Red-Boxes Sold</th> </tr> </thead> <tbody> <tr> <td>Monday</td> <td></td> </tr> <tr> <td>Tuesday</td> <td></td> </tr> <tr> <td>Wednesday</td> <td></td> </tr> <tr> <td>Thursday</td> <td></td> </tr> <tr> <td>Friday</td> <td></td> </tr> <tr> <td>Saturday</td> <td></td> </tr> </tbody> </table>	Days	Number of Red-Boxes Sold	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday	
Days	Number of Red-Boxes Sold														
Monday															
Tuesday															
Wednesday															
Thursday															
Friday															
Saturday															
<p>Total: /20</p>	<p>Personal Target:</p>														

Mixed Homework Sheet 9

<p>1. $4 \times (3 + 6)$</p>	<p>2. Function Machines</p> 
<p>3. For every 8 Wii games Sarah owned she had 4 PS3 games. What is her ratio of Wii games to PS3 games?</p>	<p>4. A rectangle has a perimeter of 24 cm and an area of 32 cm^2. What are the lengths of the shorter side and longer side?</p>
<p>5. What is the probability of choosing a queen, a king or an ace from a standard deck of playing cards?</p>	<p>6. What is the range of the following set of data? 12 1 10 1 9 3 4 9 7 9</p>
<p>7. What is the lowest common multiple of 15 and 12?</p>	<p>8. What is the nth term rule of the following sequence? 1, 3, 5, 7, 9, 11</p>
<p>9. If the exchange rate is $\text{£}1 = \text{€}1.38$, and I had $\text{€}490$ to change back to pounds, how many pounds would I get?</p>	<p>10. Find the size of angles x and y.</p> 
<p>11. The weights of six dogs in kilograms are; 12.1, 14.3, 10.8, 14.0, 10.7 and 15.5. Calculate the mean weight to one decimal place.</p>	<p>12. Cards are randomly selected from a pack of cards and each then replaced before the next choice. Out of 65 choices how many times would I expect to pick a picture card?</p>
<p>13. Order the following from smallest to largest: $\frac{4}{5}, \frac{11}{20}, \frac{9}{10}, \frac{3}{4}$</p>	<p>14. Find the value of the following expression if $a = 2$, $b = 5$ and $c = 9$. $4(a + b)$</p>
<p>15. What is the area of the shape below?</p> 	<p>16. You have a deck of cards. Find the probability of drawing a face card that is red.</p>
<p>17. Decrease $\text{€}400$ by 18%</p>	<p>18. Solve the following equation: $-3 + 2x = 11$</p>
<p>19. What is 48cm in m?</p>	<p>20. The pie chart below shows costs when building a house. What angle is required for timber, and if the total cost of the build was $\text{£}25000$, how much did the timber cost?</p> 
<p>Total: /20</p>	<p>Personal Target:</p>