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Question 1

round all the figures to 1 significant figure and we have

$\frac{2000 \times 3}{0.5}$

to get rid of the decimals on the bottom multiply the numerator and denominator (top and bottom) by 10

$\frac{2000 \times 3 \times 10}{0.5 \times 10} = \frac{2000 \times 30}{5} = 2000 \times 6 = 12000$

Question 2

$P - Q = (x(y + 2)) - (xy + 2)$

expand brackets

$xy + 2x - xy - 2$

group terms

$2x - 2$

factorise

$2(x - 1)$

Question 3

a) A cylinder is a type of prism. Volume of prism is given in formulae sheet as area of cross section x length. In this case area of cross section is area of a circle of radius 10 and length is 2

$\pi r^2 \times l = 3.14 \times 10^2 \times 2 = 6.28 \times 100 = 628 cm^3$

b) one litre is $1000cm^3$ so to find the number of litres divide 628 by 1000 to give 0.628 litres

Question 4

a)

5^0	5^1	5^2	5^3	5^4	5^5	5^6	5^7
1	5	25	125	625	3125	15625	78125

b) 15625 = 5^6, 78125 = 5^7 so 15625 x 78125 = 5^6 x 5^7 = 5^{13} (when we multiply we add the powers)
x = 13

c) 78125 = 5^7, 625 = 5^4, 5 = 5^1
$\frac{78125}{625 \times 5}$ = $5^7 \div (5^4 \times 5^1) = 5^7 \div 5^5$ (when we divide we subtract the powers)
= 5^2 = 25

Question 5

a) 1st term is (4 x 1) – 9 = 4 – 9 = -5
2nd term is (4 x 2) – 9 = 8 – 9 = -1
3rd term is (4 x 3) – 9 = 12 – 9 = 3
4th term is (4 x 4) – 9 = 16 – 9 = 7

b) the difference between any two consecutive terms is always 4 so the difference between these two terms will also be 4

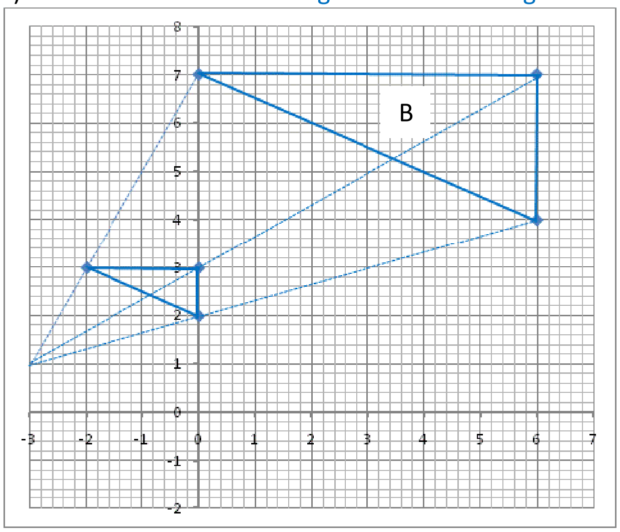
c) if the nth term is 391 then 4n – 9 = 391
add n to both sides
4n = 400
divide both sides by 4
n = 100

d)if 29 were a term in the sequence then there would be an n that would fit 4n – 9 = 29
add 9 to both sides
4n = 38
but if we divide both sides by 4 we don't get a whole number for n
n = 9.5 this is impossible since n must be a whole number
so 29 is not in the sequence

Question 6

a) Rotation 90^0 anti-clockwise (or 270^0 clockwise) about centre (6,2)

b) This is still called an enlargement even though we are reducing the size of the triangle.



It helps to draw the tram lines (dashed lines) in (joining each corresponding point back to the centre of enlargement) as this helps you to be sure you have done the enlargement correctly.

Question 7

a)

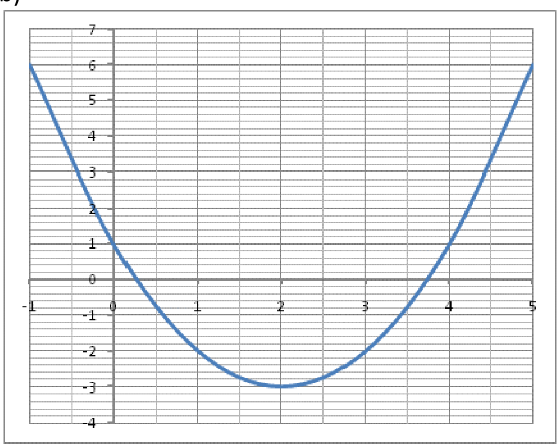
x	-1	0	1	2	3	4	5
y	6	1	-2	-3	-2	1	6

It is a good idea to first try to reproduce one of the values given so that you can be sure you properly understand what to do

when x =1, y = 1^2 - (4 x 1) + 1 = 1 – 4 + 1 = -2

when x = 4, y = 4^2 – (4 x 4) + 1 = 16 – 16 + 1 = 1

b)



c) the equation $x^2 - 4x + 1 = 0$ is just the same as y =0 (as y = $x^2 - 4x + 1$)

if we see where our graph crosses the line y = 0 (which is just the x axis) we can see that as it crosses this line twice there must be two solutions

Question 8

a) the number of left handed boys will be 0.2 x 480 = 2 x 48 = 96

the number of left handed girls will be 0.3 x 520 = 3 x 52 = 156

the total number of left handed students is 96 + 156 = 252

b) the total number of children in the school is 480 + 520 = 1000

the total number of left handed children is 252 (from a) above)

so the probability that a student is left handed is 252 ÷ 1000 = 0.252 (this can be left as a fraction as $\frac{252}{1000} = \frac{126}{500} = \frac{63}{250}$)

Question 9

a) if two triangles (or indeed any two shapes) are mathematically similar then the angles will be the same. Angle YXZ = angle BAC = 18^o. Angles in a triangle add up to 180^o. The two angles that we have are 29^o and 18^o and they add up to make 47^o. Angle XYZ = $180^o - 47^o = 133^o$

b) the two corresponding sides we have are 3 and 2. We are trying to get to the bigger triangle so we want the scale factor to be $\frac{3}{2}$ (as opposed to $\frac{2}{3}$).

XY = $\frac{3}{2}$ x 3.6 = 3 x 1.8 = 5.4cm

Question 10

a)we can solve by elimination or by substitution

<u>Elimination</u>

if we multiply the second equation by 2 we will have the same number of x in both equations (alternatively we could have multiplied the second equation by 3 and had the same number of y in both equations)

$4x - 3y = 13$ (eq^n 1)(unchanged)

$2x + y = 4$ (eq^n 2) x2 gives us $4x + 2y = 8$ (eq^n 3)

Subtract eq^n 1 from eq^n 3 (eq^n 3 – eq^n 1) to make the x disappear (we could have taken eq^n 1 – eq^n 3 but we would have ended up with a negative number for y)

$2y - -3y = 8 - 13$

$5y = -5$

divide both sides by 5

$y = -1$

substitute this value of y back into eq^n 1

$4x - (3 \times -1) = 13$

$4x - -3 = 13$

$4x + 3 = 13$

Subtract 3 from both sides

$4x = 10$

Divide both sides by 4

$x = 2.5$

we now have x = 2.5 and y = -1. To check put them both back into eq^n 2 ((2x2.5) + -1 = 5 -1 = 4✓)

<u>Substitution</u>

rearrange the second equation so that y is the subject.

$y = 4 - 2x$

substitute this value for y into the first equation to give

$4x - (3 \times (4 - 2x) = 13$

$4x - (12 - 6x) = 13$

$4x - 12 + 6x = 13$

group terms

$10x - 12 = 13$

add 12 to both sides

$10x = 25$

divide both sides by 10
$x = 2.5$
now put this value for x back into the equation y = 4 – 2x
y = 4 – (2 x 2.5)
y = 4 – 5 = -1
we now have x = 2.5 and y = -1. To check put them both back into eq^n 2 ((2x2.5) + -1 = 5 -1 = 4✓)

b) i) we need to find two numbers that multiply to make 30 and add to make -13. Those two numbers could be -3 and -10 so we have
$(x – 3)(x – 10)$
ii) we can use our answer to i) and set $(x – 3)(x – 10) = 0$
if two numbers multiply to make 0 then either one of them must be equal to 0. We have $x – 3 = 0$ so $x = 3$ or $x – 10 = 0$ so $x = 10$
$x = 3$ or $x = 10$

Question 11

a) p + q = 3 x 10^2 + 3 x 10^{-2}
we can't add these two numbers as they are because they have different powers of 10. We must first adjust one of them to be the same power as the other.
3 x 10^2 = 3 x 10^{4-2} = 3 x 10^4 x 10^{-2} = 30,000 x 10^{-2}
Now we can add them
30,000 x 10^{-2} + 3 x 10^{-2} = 30,003 x 10^{-2} = 3.0003 x 10^2 (= 300.03)

b) p ÷ q
we divide the ordinary numbers 3 ÷ 3 to get 1 and subtract the powers to get 2 - - 2 = 4
we have 1 x 10^4 (= 1000)

Question 12

a) a four point moving average is appropriate here because the bills come four times a year

b) we add up the first four points and divide by four
(33.50 + 27.00 + 19.20 + 16.30)÷ 4 = 96 ÷ 4 = £24

c) we add up the four points (starting from the second point) and divide by 4
(27.00 + 19.20 + 16.30 + 27.50) ÷ 4 = 90 ÷ 4 = £22.50

Question 13

to get rid of the fractions go through and multiply by 4 (and then by the 3)

multiply by 4

$(2x - 1) + \frac{4(x+2)}{3} = 8$

multiply by 3

$3(2x - 1) + 4(x + 2) = 24$

expand brackets

$6x - 3 + 4x + 8 = 24$

group terms

$10x + 5 = 24$

subtract 5 from both sides

$10x = 19$

divide both sides by 10

$x = 1.9$

Question 14

Age (years)	10 – 24	25 - 44	45 - 60	61+	Total
Number of members	150	198 (note 3)	132 (note 2)	120	600
Number in sample	25 (note 1)	33 (note 4)	22	20	100

We can see from the 61+ group that we need to divide the total number of members by 6 to get the number in the sample (120 ÷ 20 = 6). To work the other way we need to multiply the number in the sample by 6 to get the number of members. Also the total number of members must add up to 600.

Note 1 150 ÷ 6 = 25
Note 2 22 x 6 = 132
Note 3 600 – (150 + 132 + 120) = 600 – 402 = 198
Note 4 198 ÷ 6 = 33

To check: the number in the sample should add up to 100 (600 ÷ 6 = 100) (25 + 33 + 22 + 20 = 100✓)

Question 15

$5^{-2} = 1/5^2 = \frac{1}{25}$

$100^{0.5} = \sqrt{100} = 10$

$5^{-2} \times 100^{0.5} = \frac{1}{25} \times 10 = \frac{10}{25} = \frac{2}{5}$

Question 16

a) i) Shape ABCD is a quadrilateral and fits exactly into a circle so is called a cyclic quadrilateral.
Opposite angles in a cyclic quadrilateral add up to 180^o.
$x + (2x - 15) = 180$
$x + 2x - 15 = 180$
group terms
$3x - 15 = 180$

ii) angle at the centre is twice the angle at the circumference. $y = 2x$
we have $3x - 15 = 180$
add 15 to both sides
$3x = 195$
divide both sides by 3
$x = 65$
now $y = 2x$
$y = 2 \times 65 = 130^o$

b) by the alternate segment theorem angle ABC = angle PCA = 57^o
triangle AOB is an isosceles triangle (as OA and OB are both radii of the circle). Hence we can calculate angle ABO as $(180 - 98) \div 2 = 82 \div 2 = 41^o$
angle OBC = angle ABC – angle ABO = $57 - 41 = 16^o$

Question 17

$(\sqrt{27} + 3)(\sqrt{6} - \sqrt{2}) = (\sqrt{27} \times \sqrt{6}) - 3\sqrt{2} + 3\sqrt{6} - (\sqrt{27} \times \sqrt{2})$

$= (\sqrt{3} \times \sqrt{3} \times \sqrt{3} \times \sqrt{2} \times \sqrt{3}) - 3\sqrt{2} + 3\sqrt{6} - (\sqrt{3} \times \sqrt{3} \times \sqrt{3} \times \sqrt{2})$
$= 9\sqrt{2} - 3\sqrt{2} + 3\sqrt{6} - 3\sqrt{6}$
$= 6\sqrt{2}$

Question 18

Let the probability of event A occurring = p (P(A) = p)
Therefore, the probability of even B occurring = 2p (P(B) = 2p)
The probability of both A and B occurring is P(A) x P(B) = p x 2p = $2p^2$ (as A and B are independent P(A and B) = P(A) x P(B))
We are given that the probability of both A and B occurring is $\frac{9}{32}$ so $2p^2 = \frac{9}{32}$
divide both sides by 2
$p^2 = \frac{9}{64}$
square root both sides
$p = \frac{3}{8}$

Question 19

To find X. Consider the small and medium containers
We have two corresponding measurements of 12 and 24. We want to find the missing value for the smaller container so we need $\frac{12}{24}$ (as opposed to $\frac{24}{12}$). Our linear scale factor is $\frac{12}{24}$ = ½
However we want the scale factor for the area so we must square our linear scale factor.
$(½)^2$ = ¼ so area X = ¼x 500 = 125 cm^2

To find Y. Consider the small and the large containers
We have two corresponding measurements of 12 and 36. We want to find the missing value for the larger container so we need $\frac{36}{12}$ (as opposed to $\frac{12}{36}$). Our linear scale factor is $\frac{36}{12}$ = 3
However we want the scale factor for the volume so we cube our linear scale factor
3^3 = 27 so volume Y = 27 x 400 = 10,800 cm^3

Question 20

a) We have to work backwards to get x as the subject
square both sides
$\frac{a}{x+b} = c^2$
to get rid of x from the bottom, multiply both sides by $(x + b)$
$a = c^2 \times (x + b)$
divide both sides by c^2
$a/c^2 = x + b$
subtract b from both sides
$\frac{a}{c^2} - b = x$
rewrite with x first
$x = \frac{a}{c^2} - b$
b) we can either recognise that this is completing the square:
if we can see this then we will know that p is 2 x -5 = -10
so we have
$x^2 - 10x + 17$
when we complete the square we have
$(x-5)^2 - (-5)^2 + 17 = (x-5)^2 - 25 + 17 = (x-5)^2 - 8$

So p = -10 and q = -8

However if we don't recognise this as completing the square, we can still work this out
expand both sides
$x^2 + px + 17 = (x-5)(x-5) + q$
$x^2 + px + 17 = x^2 - 5x - 5x + 25 + q = x^2 - 10x + 25 + q$
comparing coefficients
p = -10 and 17 = 25 + q
p = -10 and q = -8

Question 21

a) i) $\overrightarrow{OC}$ = $\overrightarrow{OA}$ + $\overrightarrow{AC}$ = 4a + 6b

ii) $\overrightarrow{AB}$ = $\overrightarrow{AO}$ + $\overrightarrow{OB}$ = -4a + 3b

b) $\overrightarrow{OD}$ = $\overrightarrow{OB}$ + $\overrightarrow{BD}$ = 3b + ⅓$\overrightarrow{BA}$ = 3b - ⅓$\overrightarrow{AB}$ = 3b - ⅓(-4a + 3b) =
3b + $\frac{4a}{3}$ - b = $\frac{4a}{3}$ + 2b

c) $\overrightarrow{OD} = \frac{4a}{3}$ + 2b and $\overrightarrow{OC}$ = 4a + 6b
we can write one as a multiple of the other
$\overrightarrow{OC}$ = 3 x $\overrightarrow{OD}$ so we can conclude that they are on a straight line (also the length from O to C is 3 times the length from O to D)

Question 22

a) the graph has been reflected in the x axis
y = -cos x

b) the graph has been translated by 1 unit in the negative y direction
y = -1 + cos x = (cos x) - 1 (be careful that this is not the same as y = cos (x – 1))

c)the graph has been translated by 90^o in the negative x direction
y = cos (x + 90^o)
this is also the same as a translation of 270^o in the positive x direction so y = cos (x – 270^o) and is also the same as y = -sin$x$

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