

**AQA 3301**  
**Summer 2004**  
**HIGHER SOLUTIONS**  
**Paper 1 (Non – calculator) Solutions**

1.

This question is guiding you to find the LCM of 2, 5 and 8 → In other words what is the first number that appears in all three times tables?

→ 40

2.

(a)  $w^{6+2} \rightarrow w^8$

(b)  $x^{3-5} \rightarrow x^{-2}$

(c) Bracket to a power → Multiply the powers →  $y^{3 \times 2} \rightarrow y^6$

3.

$\frac{300 \times 4}{0.2} \rightarrow \frac{1200}{0.2}$ , think of 0.2 as a fraction →  $\frac{1200}{\frac{1}{5}}$ , when you divide by a fraction

it's the same as multiplying by it upside down →  $1200 \times \frac{5}{1} = 6000$

4.

(a) Formula 2

(b) You are looking for an area here → If you ignore  $\pi$  then formula 1 would give you a length and formula 3 is impossible, hence formula 2 gives an area

5.

(a)  $1.75 \times 10^6$

(b)  $8.2 \times 10^{-3}$

(c) The power,  $-2$  simply indicates the decimal place has to move backwards 2 places → 0.049

(d) Think of 0.1 as  $\frac{1}{10}$ , hence when you divide by a fraction, it's the same as multiplying by it upside down →  $2.6 \times 10^5 \times 10^{(1)} = 2.6 \times 10^6$

6.

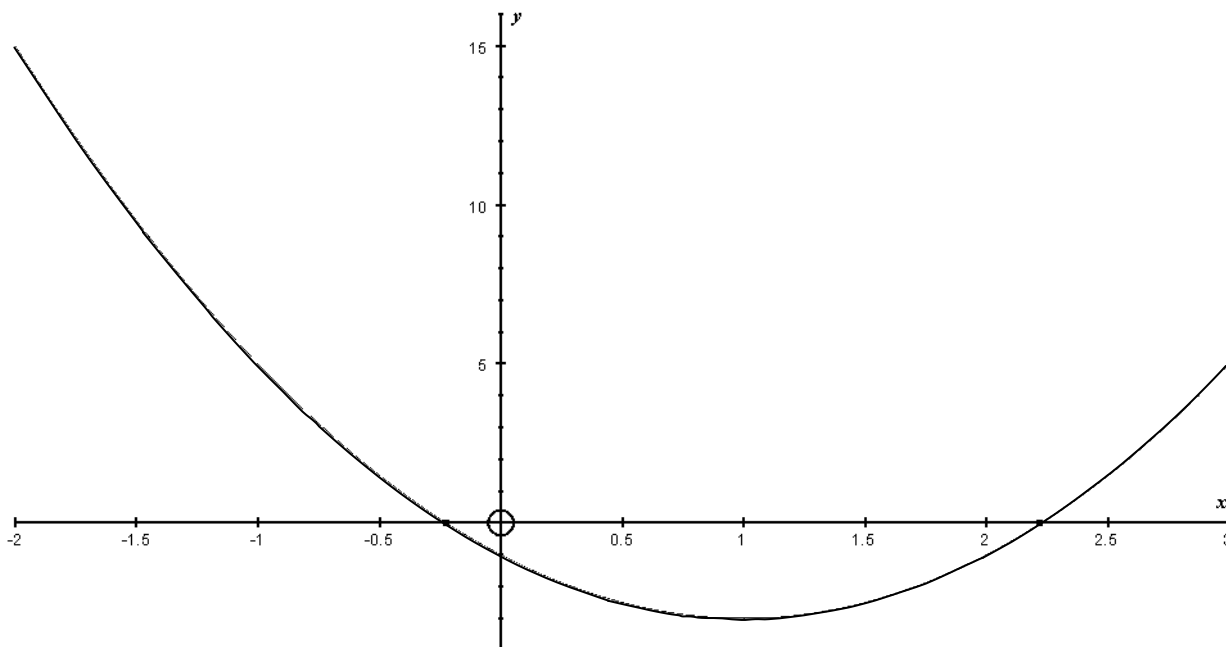
Get all the  $p$ 's on one side →  $5p = t - 40 \rightarrow p = \frac{t-40}{5} \rightarrow p = \frac{1}{5}t - 8$

7.

(a)

$x$	-2	-1	0	1	2	3
$y$	15	$2(-1)^2 - 4(-1) - 1 = 5$	-1	-3	-1	5

(b) See graph



(c)(i) Solutions can be found where the curve meets the line  $y = 0$  which is the  $x$  axis

(ii) The other solution is about  $-0.2$

8.

(a)

Distance travelled, $d$ (km)	Frequency	Midpoint	$m.p \times f$
$0 < d \leq 2$	12	$\frac{1}{2}(2-0) = 1$	$1 \times 12 = 12$
$2 < d \leq 4$	18	3	54
$4 < d \leq 6$	10	5	50
$6 < d \leq 8$	8	7	56
$8 < d \leq 10$	2	9	18
	$\Sigma 50$		$\Sigma 190$

$$\text{Mean distance} \rightarrow \frac{\Sigma(m.p \times f)}{\Sigma \text{Frequency}} \rightarrow \frac{190}{50} \rightarrow \frac{19}{5} \rightarrow 3\frac{4}{5}$$

(b)(i) The median will be at the  $\frac{n^{\text{th}} + 1}{2}$  position  $\rightarrow \frac{51}{2} = 25.5^{\text{th}}$  position

$\rightarrow$  Draw a line from 25.5 on the  $c.f$  axis and read of the value where it hits the curve

$\rightarrow$  About 3.4

(ii) The I.Q range can be worked out as follows  $\rightarrow \frac{3(n+1)}{4}$  position  $-\frac{1(n+1)}{4}$  position

About the  $38.25^{\text{th}}$  position  $-\text{the } 12.75^{\text{th}}$  position  $\rightarrow$  Draw lines across and read off the two values  $\rightarrow 5.6 - 2.2 = 3.4\text{km}$

9.

(a) Using pythagoras,  $h^2 = a^2 + b^2 \rightarrow 15^2 = 10^2 + b^2 \rightarrow b^2 = 15^2 - 10^2$

$$\rightarrow b = \sqrt{225 - 100} \rightarrow b = \sqrt{125} \rightarrow b = \sqrt{25 \times 5} \rightarrow b = 5\sqrt{5}$$

(b) Compare the ratios to work out PR  $\rightarrow$

$$10 : 25 \text{ AB:PQ}$$

$$15 : ? \text{ AC:PR}$$

How do you get from 10 to 25? By multiplying by 2.5, so multiply 15 by 2.5

to find PR  $\rightarrow 15 \times 2.5 = 37.5$

(c) DE is the opposite, you have the adjacent length, hence use TAN  $\rightarrow \text{Tan}50 = \frac{\text{opp}}{\text{adj}}$

$$\rightarrow 1.192 = \frac{\text{DE}}{10} \rightarrow \text{DE} = 1.192 \times 10$$

$$\rightarrow 11.92\text{cm}$$

10.

First graph  $\rightarrow C : y = x^2 - 2$

Second graph  $\rightarrow D : y = x^3$

Third graph  $\rightarrow B : 2x + 3y = 12$

11.

If the lines are perpendicular then both the gradients when multiplied together must equal  $-1 \rightarrow$  If we call the gradient of the first line  $m_1$  and the gradient of the perpendicular

line  $m_2$  then  $m_1 m_2 = -1 \rightarrow \frac{2}{3} m_2 = -1 \rightarrow m_2 = -\frac{1}{\frac{2}{3}} \rightarrow m_2 = -\frac{3}{2}$

Now we know part of the equation of the perpendicular line  $\rightarrow y = -\frac{3}{2}x + c$

$\rightarrow$  Substitute the co-ordinates given in the question to find 'c'  $\rightarrow 5 = -\frac{3}{2}(0) + c$

hence 'c' will equal 5  $\rightarrow y = -\frac{3}{2}x + 5$

12.

(a) Say  $0.\dot{5}\dot{8} = x$ , then  $\dot{5}\dot{8}.585858... = 100x \rightarrow 100x - x = 58 \rightarrow 99x = 58$

$$\text{hence } x = \frac{58}{99}$$

(b) Say  $0.\dot{1}\dot{5}\dot{8}\dot{5}\dot{8}\dot{5}\dot{8}... = x$  then  $10x = 1.\dot{5}\dot{8}\dot{5}\dot{8}\dot{5}\dot{8}... \rightarrow 1000x = 158.\dot{5}\dot{8}\dot{5}\dot{8}...$

$$\rightarrow 990x = 157 \rightarrow x = \frac{157}{990}$$

13.

(a) Look at the triangle PQR, angle QPR must be  $\frac{180-116}{2} = 32^\circ$  as it is an isosceles triangle  $\rightarrow$  Angle QSR will also equal  $32^\circ$  as it is in the same segment (formed by arc QR)

(b) Angle BAC is the angle at the circumference, and using the theorem that the angle at the centre is twice the angle at the circumference  $BOC = 58 \times 2 \rightarrow 116^\circ$

(c) To help make this part of the question easier, draw the radius connecting O and A  $\rightarrow$  The tangent will meet this radius at  $90^\circ$ , hence angle BAC =  $90 - 74 \rightarrow 16^\circ$  and from this information angle OAC =  $58 - 16 \rightarrow 42^\circ$ . Now you can see that OCA must also be  $42^\circ$  as the triangle OAC is isosceles

14.

If the curve goes through  $-3$  and  $5$  on the  $x$  axis then it is true to say

$$y = (x+3)(x-5) \rightarrow \text{expand the brackets to find } b \text{ and } c \rightarrow y = x^2 - 2x - 15$$

$$\rightarrow b = -2, c = -15$$

15.

How do you work out the perimeter of a circle?  $\rightarrow 2\pi r$ , what you are also doing here

is multiplying  $2\pi r$  by  $\frac{360}{360}$  because you want the perimeter of the entire circle. In this

question you are only concerned with  $80^\circ$  of the circle  $\rightarrow 2\pi r \times \frac{80}{360}$

$\rightarrow 2\pi(9) \times \frac{2}{9}$ , the 9's will cancel with each other leaving  $4\pi$  but don't forget to

add the two radii  $\rightarrow 4\pi + 18$

16.

(a) To factorise an equation when  $a > 1$ , use the 'splitting the middle term' method

→ Which two numbers multiply to make 6? ( $2 \times 3$ ) and add to make 5? → 2 and 3

→  $2n^2 + 2n + 3n + 3$ , now look at the equation in two parts

$2n^2 + 2n$  → what's common?  $2n$ , so take it out →  $2n(n+1)$

$3n + 3$  → what's common? 3, so take it out →  $3(n+1)$

Now you can see you have a common bracket, the other bracket in your answer

will consist of the values outside the common bracket →  $(2n+3)(n+1)$

(b) If you notice that the number 253 can be made up by substituting  $n = 10$  into the equation,  $2n^2 + 5n + 3$  → so substituting  $n = 10$  into  $(2n+3)(n+1)$  will give the product of 253 as two prime factors →  $23 \times 11$

17.

(a) • The number chosen from each sub-group must be proportional to the size of the sub-group

• Selection from each sub-group must be representative

(b) For each group, you will have to multiply the "number of people" by  $\frac{50}{400}$

→ which can be cancelled down to  $\frac{1}{8}$  → Take for example group 0–12 years,

$35 \times \frac{1}{8} = 4.375$ , which would be rounded down to 4.

Age (years)	0–12	13–24	25–40	41–60	61+
Number of people	35	58	125	103	79
Strata	<b>4</b>	<b>7</b>	<b>16</b>	<b>13</b>	<b>10</b>

18.

(a)(i) Which two numbers add to make  $-10$  and multiply to make  $+25$ ? → 5 and 5

→  $(x-5)(x-5)$

(ii) The only difference is that  $x$  has been replaced with  $y-3$  →  $(y-3-5)(y-3-5)$

→  $y = 8$  and  $y = 8$

(b)  $\frac{(x+3)(x-3)}{x(x+3)}$  ← Difference of two squares

→  $\frac{x-3}{x}$

19.

(a)(i) Even  $\times$  odd = Even

(ii) The  $2n$  will always be even, so adding 1 onto an even number will always make  $2n+1$  odd

(b)  $(2n+1)(2n+1) \rightarrow$  Using FOIL, (First, Outer, Inner, Last)  $\rightarrow 4n^2 + 2n + 2n + 1$   
 $\rightarrow 4n^2 + 4n + 1$

(c) You may not realise it, but all the sub-parts of this question will help you answer it  $\rightarrow$  First of all, the question says.. "the square of any odd number", part (a)(ii) is an

odd number, so if we square it and subtract one, we end up with  $4n^2 + 4n$

$\rightarrow$  If we factorise this we get,  $4n(n+1) \rightarrow$  The  $4n$  bit is always even and a multiple of 8, the  $n+1$  will always make it "one more than a multiple of 8"

20.

(a) The value of  $a$  will be half of the number attached to  $x \rightarrow a = 3$

$$\rightarrow x^2 + 6x - 3 = (x+3)^2 + b$$

$$\rightarrow x^2 + 6x - 3 = x^2 + 6x + 9 + b$$

$$\rightarrow b = -12$$

(b) Now we know that  $x^2 + 6x - 3$  can also be written as  $(x+3)^2 - 12 = 0$

$$\rightarrow (x+3)^2 = 12 \rightarrow x+3 = \pm\sqrt{12} \rightarrow x = \pm\sqrt{12} - 3 \rightarrow x = \pm\sqrt{4 \times 3} - 3$$

$$\rightarrow x = \pm 2\sqrt{3} - 3$$

21.

Breaking strain (kg)  $\rightarrow$  UB = 5350, LB = 5250

Weights (kg)  $\rightarrow$  UB = 105, LB = 95

The maximum number of crates before the crane breaks has to be thought of as follows  $\rightarrow$  Say the breaking strain is less than 5300, say it is the lowest it could be at 5250 and then think that the crates will be the heaviest they could be at 105kg

$$\rightarrow 105 \times ? = 5250 \rightarrow ? = \frac{5250}{105} \rightarrow ? = 50$$

22.

P(2 pass, 1 Fail)  $\rightarrow 0.6 \times 0.6 \times 0.4$ , however don't forget this could happen in 3

different ways  $\rightarrow 3(0.6^2 \times 0.4)$

$$\rightarrow \frac{54}{125}$$

23.

(a)(i)  $a + b$

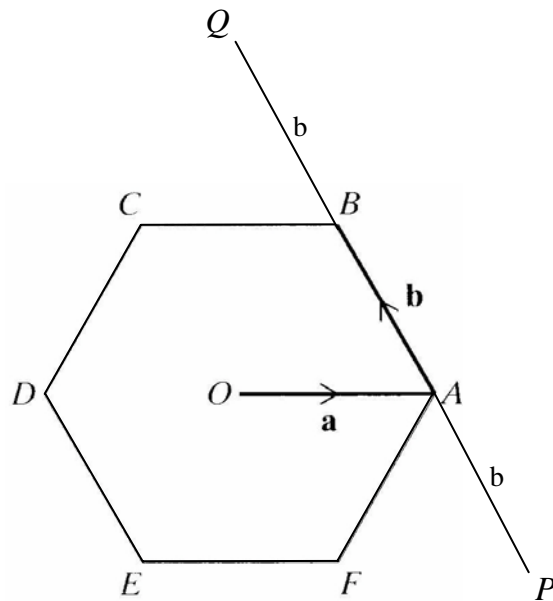
(ii)  $CB, DO$  and  $EF$  are the same as  $OA \rightarrow b - a$

(iii)  $DE$  is parallel to  $AB$  so the vector is the same  $\rightarrow \overrightarrow{EC} = \overrightarrow{ED} + \overrightarrow{DA} + \overrightarrow{AC}$

$\rightarrow b + 2a + b - a$

$\rightarrow 2b + a$

(b) See diagram  $\rightarrow 3b$



**END OF PAPER 1 SOLUTIONS**