AQA **GCSE Mathematics (3301)**

Higher Tier

Model Answers

In general, the number of significant figures in an answer should not exceed the number of significant figures in the input data, or if this data has differing numbers of significant figures, the data with the lowest number of significant figures.

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Paper 1 - 3301/1H, 4 June 2003

Question 1

$$(n-2) \times 180 = 162n$$

$$180n - 360 = 162n$$

$$18n = 360$$

$$n = 20$$

Question 2

Expression is approximate to

$$\frac{50 \times 5}{10^2}$$

$$= \frac{250}{100} = 2.5$$

Question 3

C and D

Question 4

Between 150 m and 250 m from B draw two arcs of 3cm and 5cm from B using compasses

nearer to A than C draw a wide arc from A and from C such that they cross each other twice, once either side of a line connecting AC. Connect the points where they cross and this will be the line equidistant between A and C.

more than 100m from the path Construct a line parallel to the path and 2 cms away.

Question 5

(a)

$$12y^2 - 8y$$

$$4y(3y - 2)$$

(b)

$$-6 \leq 3n < 13$$

$$-2 \leq n < \frac{13}{3}$$

So required values of n are

$$-2, -1, 0, 1, 2, 3, 4$$

(c)

$$(2xy^2)^3$$

$$= 2^3x^3(y^2)^3$$

$$= 8x^3y^6$$

Question 6

(a)

$$a = 2, b = 3$$

Hint: Since you know b is prime, work thru the primes from the bottom to find an appropriate value. $2^3 = 8$ *and 8 does not divide into a so that is not the right answer.* $3^3 = 27$ *which does divide 54 by 2, and 2 is a prime number.*

(b)

54	135
2.27	3.45
2.3^3	$3^2.15$
	$3^3.5$

So H.C.F.

$$= 3^3 = 27$$

Question 7

(a) *Something like, for example*

How often do you read for pleasure?

with appropriate responses like, for example -

daily, weekly, etc.

(b) The sample suggests that the fraction of pupils who read comics is

$$\frac{16}{50} = \frac{8}{25}$$

Therefore the estimate of pupils in the entire school who read comics is

$$\frac{8}{25} \times 1000 = 320$$

Question 8

(a)

$$7.2 \times 10^6 \ g$$

(b)

$$6 \times 10^{-4}\ g$$

(c) No of grains of sand

$$= \frac{7.2 \times 10^6}{6 \times 10^{-4}}$$

$$= \frac{7.2}{6} \times 10^{10}$$

$$= 1.2 \times 10^{10}$$

Question 9

(a)

$$4(m+3) + 3(2m-5)$$

$$4m + 12 + 6m - 15$$

$$10m - 3$$

(b)

$$2x + 3y = 9 \quad (1)$$

$$3x + 2y = 1 \quad (2)$$

(1) *times* 3

$$6x + 9y = 27 \quad (3)$$

(2) *times* 2

$$6x + 4y = 2 \quad (4)$$

(3) - (4)

$$5y = 25$$

$$y = 5$$

Substituting this into (1)

$$2x + 3(5) = 9$$

$$2x = -6$$

$$x = -3$$

(c) (i)

$$x^2 + 6x - 16$$

$$(x+8)(x-2)$$

(ii)

$$(x+8)(x-2) = 0$$

Either

$$x + 8 = 0 \Rightarrow x = -8$$

or

$$x - 2 = 0 \Rightarrow x = 2$$

Question 10

(a) First Spin 0.7 needs to be added to bottom branch

Second Spin Likewise add 0.7 to the bottom branch of the top half. The bottom half needs 0.3 on the top branch and 0.7 on the bottom branch

(b) Identify the relevant branches - there is only one branch, i.e. the 'top' one.

Multiply along this branch

$$0.3 \times 0.3 = 0.09$$

which is the answer

Question 11

(a)

$$11^0 = 1$$

(b)

$$8^{\frac{2}{3}} = (8^{\frac{1}{3}})^2 = 2^2 = 4$$

(c)

$$6^{-2} \times 144^{0.5}$$

$$= \frac{1}{6^2} \times 12$$

$$= \frac{1}{36} \times 12$$

$$= \frac{1}{3}$$

Question 12

(a) Calculating the gradient from the coordinates of B and A

$$\frac{11-3}{-4-0} = \frac{8}{-4} = -2$$

(b)

$$y = -2x + 3$$

(c)

$$y = \frac{1}{2}x + 3$$

Question 13

(a)

$$5 < t \leq 20 : 21$$

$$30 < t \leq 60 : 33$$

(b) T = 64 minutes

100 shoppers in total. Require the top 20 in the 'highest' bracket, which contains 25 people. Since the bracket encompasses 20 mins, an estimate would correspond to the top 16 minutes of this period, i.e time above 60 + 4 = 64m

Question 14

(a) (i)

$$40^\circ$$

(ii) Since opposite angles of a cyclic quadrilateral equal 180°

$$y = 180 - 40 = 140^\circ$$

(b) Since AD and CD are tangents, then the angles at A and C are both right angles. The other angle in both triangles equals 50°, so angle ABC will equal $2 \times 50 = 100^\circ$

(c) By the alternate segment theorem

$$\angle BDA = 32^\circ$$

alternate angles gives

$$\angle DBC = 32^\circ$$

since this is in an isosceles triangle

$$\angle BDC = 32^\circ$$

therefore

$$\angle DCB = 116^\circ$$

since opposing angles in a cyclic quadrilateral sum to 180

$$\angle BAD = 64^\circ$$

Question 15

(a)

$$W \alpha \sqrt{P}$$

$$W = k\sqrt{P}$$

When W=12, P=16

$$12 = k\sqrt{16}$$

$$k = \frac{12}{\sqrt{16}} = \frac{12}{4} = 3$$

so

$$W = 3\sqrt{P}$$

(b)

$$W = 3\sqrt{25} = 3 \times 5 = 15$$

(c)

$$21 = 3\sqrt{P}$$

$$\sqrt{P} = \frac{21}{3} = 7$$

$$P = 49$$

Question 16

(a)

$$\sqrt{12} + \sqrt{27}$$

$$\sqrt{4 \times 3} + \sqrt{9 \times 3}$$

$$\sqrt{4}\sqrt{3} + \sqrt{9}\sqrt{3}$$

$$2\sqrt{3} + 3\sqrt{3}$$

$$5\sqrt{3}$$

So

$$a = 5$$

(b)

$$(\sqrt{2} + \sqrt{8})^2$$

$$2 + \sqrt{2}\sqrt{8} + \sqrt{2}\sqrt{8} + 8$$

$$10 + 2(\sqrt{2}\sqrt{8})$$

$$10 + 2(\sqrt{2}\sqrt{2 \times 4})$$

$$10 + 2(\sqrt{2}\sqrt{2}\sqrt{4})$$

$$10 + 8 = 18$$

Question 17

Probability both pick toffees

$$= \frac{5}{10} \times \frac{4}{9} = \frac{20}{90}$$

Probability both pick chocolates

$$= \frac{3}{10} \times \frac{2}{9} = \frac{6}{90}$$

Probability both pick mints

$$= \frac{2}{10} \times \frac{1}{9} = \frac{2}{90}$$

Probability they pick sweets of the same type

$$= \frac{20}{90} + \frac{6}{90} + \frac{2}{90} = \frac{28}{90} = \frac{14}{45}$$

Question 18

(a) (i)

$$\vec{BA} = \vec{OA} - \vec{OB}$$

$$= \mathbf{a} - 2\mathbf{b}$$

(ii)

$$\vec{MQ} = \vec{MB} + \vec{BQ}$$

$$= \vec{MB} + \frac{1}{3}\vec{BA}$$

$$= \mathbf{b} + \frac{1}{3}(\mathbf{a} - 2\mathbf{b})$$

$$= \frac{1}{3}\mathbf{a} + \frac{1}{3}\mathbf{b}$$

$$= \frac{1}{3}(\mathbf{a} + \mathbf{b})$$

(iii)

$$\begin{aligned}\vec{OP} &= \vec{OB} + \vec{BP} \\ &= 2\mathbf{b} + \frac{2}{3}(\mathbf{a} - 2\mathbf{b}) \\ &= \frac{2}{3}\mathbf{a} + \frac{2}{3}\mathbf{b} \\ &= \frac{2}{3}(\mathbf{a} + \mathbf{b})\end{aligned}$$

(b) From above, both $\vec{MQ}$ and $\vec{OP}$ are parallel, so OMQP is a trapezium

Question 19

(a) arc length

$$\begin{aligned}&= r\theta \\ &= 12 \times \frac{270}{360} \times 2\pi \\ &= 18\pi\end{aligned}$$

(b) if s = radius of base

$$2\pi s = 18\pi$$

$$s = 9cm$$

Question 20

(a) the same curve as original but shifted 45 degrees to the right

The coordinates of P are P(135,1)

(b) the same curve as original but all values doubled

The coordinates of P are P(90,2)

Question 21

$$\begin{aligned}&x^2 - 10x + 18 \\ &= (x-5)^2 - 25 + 18 \\ &= (x-5)^2 - 7\end{aligned}$$

So

$$a = 5,\ b = -7$$

Paper 2 - 3301/2H, 10 June 2003

Question 1

Using Pythagoras's Theorem

$$x^2 = 3^2 + 1.2^2$$

$$x^2 = 10.44$$

$$x = 3.2m$$

Question 2

There are '24' shares in all, so Laura receives

$$\frac{7}{24} \; of \; 12000$$

$$= \frac{7}{24} \times 12000$$

$$= £3500$$

Question 3

x	$\mathbf{x^3 + 7x}$	**Comment**
2	22	Too small
3	48	Too big
2.5	33.125	Too big
2.4	30.624	Too big
2.3	28.267	Too small
2.35	29.428	Too small

So answer is 2.4, to 1 decimal place

Hint : Remember to test down to the second decimal place. We had determined that the result lay between 2.3 and 2.4 but we needed to test 2.35 to decide whether it was to be rounded up or down when quoted to one decimal place.

Question 4

If we consider the original figure to correspond to 100%, then the figure of *£78.03* will correspond to 102%.

So the original figure

$$= 78.03 \times \frac{100}{102} = £76.50$$

Question 5

(a) Taking the mid-values of each range, the times will total to

$$(3\times3)+(5\times6)+(7\times7)+(9\times8)+(11\times5)+(13\times1) = 228$$

So estimate of mean

$$= \frac{228}{30} = 7.6mins$$

(b)

$$6 < t \leq 8$$

Question 6

$$\sin 33 = \frac{125}{x}$$

$$x = \frac{125}{\sin 33}$$

$$x = 229.5m$$

$$x = 230m \text{ to 3 sig figs}$$

Question 7

(a) (i) 27.383067

(ii) 27.4

(b)

$$(3.18 \times 10^5) \times (4.25 \times 10^3)$$

$$13.515 \times 10^8$$

$$= 1.3515 \times 10^9$$

Hint : In standard form, there is only one number to the left of the decimal point

Question 8

(a)

$$\frac{23 - 2x}{5} = 3$$

$$23 - 2x = 15$$

$$2x = 8$$

$$x = 4$$

(b)

$$3x + 8 < 29$$

$$3x < 21$$

$$x < 7$$

Question 9

(a)

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

(b) by extrapolation from the graph

$$(-2, -1)$$

Question 10

(a) (i)

$$2a^2 - a$$

$$a(2a - 1)$$

(ii) When a = -4.5, above expression becomes

$$-4.5(-10) = 45$$

(b)

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

$$4x^2 + 20x - 3x - 15$$

$$4x^2 + 17x - 15$$

(c) (i)

$$x^5 \times x^{-2} = x^{5-2} = x^3$$

(ii)

$$y^5 \div y^{-2} = y^{5-(-2)} = y^7$$

Question 11

$$w = x^2 + y$$

$$x^2 = w - y$$

$$x = \sqrt{w - y}$$

Question 12

Upper Quartile = 19 mins
Lower Quartile = 11 mins

So required limits are 11 mins and 19 mins

Question 13

$$x \leq 6$$

$$y \geq 0$$

$$y \leq \frac{x}{2}$$

Question 14

Let

$$x = 0.\dot{4}\dot{8}$$

$$100x = 48.\dot{4}\dot{8}$$

$$100x = 48 + x$$

$$99x = 48$$

$$x = \frac{48}{99} = \frac{16}{33}$$

Question 15

$$\angle A = \angle C \text{ alternate angles}$$

$$\angle B = \angle D \text{ alternate angles}$$

and opposite angles at E mean opposite angles of triangles are equal

Given that it is given that

$$AB = DC$$

Therefore triangles are congruent

Note: to prove congruence only actually need to show equality of two angles and one side

Question 16

(a)

$$\frac{(50 + 46 + 45)}{3} = 47$$

(b) No - trend shown by graph is to level off and not reach 25%

(c) Various factors possible, e.g. sample size, ages, social class, ages, location, etc.

Question 17

The length of line HF is given by

$$HF^2 = 12^2 + 5^2$$

$$HF^2 = 144 + 25 = 169$$

$$HF = 13$$

So from $\triangle$ DFH

$$\tan DFH = \frac{5}{13} = 0.3846$$

$$DFH = 21.04^\circ$$

Question 18

Need to find AB in diagram

$$AB^2 = 18^2 + 25^2 - 2(18)(25)(\cos 82)$$

$$AB = 28.70km$$

Question 19

Volume of sand

$$= \pi(3)^2 \times 4$$

$$= 36\pi$$

Volume of the cone

$$= \frac{1}{3}\pi(3)^2 \times 2$$

$$= 6\pi$$

Volume remaining in cyclinder after inversion

$$36\pi - 6\pi = 30\pi$$

This volume will occupy a cyclindrical shape of height h, such that

$$30\pi = \pi(3)^2 h$$

$$h = \frac{30}{9} = 3\frac{1}{3}$$

So x in the diagram will be

$$2 + 3\frac{1}{3} = 5\frac{1}{3}cm$$

Question 20

(a)

$$(x+4)^2$$

$$x^2 + 4x + 4x + 16$$

$$x^2 + 8x + 16$$

(b) Substituting for y in the circle equation

$$x^2 + (x+4)^2 = 36$$

$$x^2 + x^2 + 8x + 16 = 36$$

$$2x^2 + 8x - 20 = 0$$

$$x^2 + 4x - 10 = 0$$

(c)

$$x^2 + 4x - 10 = 0$$

$$x = \frac{-4 \pm \sqrt{4^2 - 4.1.(-10)}}{2}$$

$$= \frac{-4 \pm \sqrt{56}}{2}$$

$$= -2 \pm 3.742$$

$$= -5.74 \; or \; -1.74$$

Question 21

From

$$\pi r^2 h$$

If dimensions are increased by a half

$$\pi(\frac{3}{2}r)^2\frac{3}{2}h$$

$$\pi\frac{9}{4}r^2\frac{3}{2}h$$

$$\frac{27}{8}\pi r^2 h$$

So volume of larger bottle

$$= \frac{27}{8} \times 480 = 1620ml$$

Remember to insert the units

Question 22

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

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

$$x^2 - x - 2x - 2 = x^2 - 1$$

$$3x = -1$$

$$x = -\frac{1}{3}$$

Question 23

$$r - 3 = \pi(t - 2r)$$

$$r - 3 = \pi t - 2\pi r$$

$$r + 2\pi r = \pi t + 3$$

$$r(1 + 2\pi) = \pi t + 3$$

$$r = \frac{\pi t + 3}{1 + 2\pi}$$

Question 24

$$\frac{5x^2 + 14x - 3}{x^2 - 9}$$

$$\frac{(5x-1)(x+3)}{(x-3)(x+3)}$$

$$\frac{(5x-1)}{(x-3)}$$

Question 25

The upper limit of coffee that will be dispensed could be

$$130.5ml$$

The smallest size of cup could be

$$174.5ml$$

The upper volume limit of cartons could be

$$21.5ml$$

So maximum volume of liquid

$$= 130.5 + (2 \times 21.5) = 173.5ml$$

and this will be less than smallest size of cup, so liquid will never overflow

Paper 1 - 3301/1H, 11 November 2003

Question 1

(a)

$$2x^3 = 250$$

$$x^3 = 125$$

$$x = 5$$

(b)

$$75 = 3.25$$

$$= 3.5^2$$

Question 2

(a) The number of sticks goes up by 4 each time, so Diagram 5 has **21 sticks**

(b)

$$4n + 1$$

(c)

$$4n + 1 = 201$$

$$4n = 200$$

$$n = 50$$

i.e. 50th. diagram

Question 3

(a) (i)

$$\frac{153}{300} = \frac{51}{100}$$

(ii) Yes - For a fair dice, the expected values from 300 throws would be - red 150, blue 100 and green 50. The outcomes are compatible with these expected values

(b) The number of throws is too small to make definite conclusions.

Question 4

(a)

$$80 \times 1.75 = 140km$$

(b) The second stage will be 50 km
This will take 30 minutes

Average speed for second stage

$$= \frac{50}{0.5} = 100km/h$$

Question 5

Construct the 60° angle by

- Using A as the center draw a wide arc thru and above AD
- Using the point where this arc cuts AD as a new center, and using the same radius, mark off an arc intersecting the previous arc.
- Connect A and the point where these two arcs intersect.

Mark off 10 cms along this line

To drop a perpendicular at B

- Using B as the center, draw an arc intersecting AD in two places
- Using these two intersections, use each in turn to draw two new arcs below AD which intersect with each other.
- Connect this latter intersection with B

Question 6

(a) After two years, the account will contain

$$2500(1 + 0.1)^2$$

$$= 2500(1.1)^2$$

$$= 2500(1.21)$$

$$= £3025$$

Note : If you are uncertain about the above procedure, you can always calculate the final value differently, year by year

(b) *Easiest way would be*

$$1320 \times \frac{10}{11} = £1200$$

Question 7

(a)

$$(x-3)(2x+1)$$

$$2x^2+x-6x-3$$

$$2x^2-5x-3$$

(b)

$$x^2-7x-8$$

$$(x+1)(x-8)$$

Question 8

$$5x+3y=13 \quad (5)$$

$$3x+5y=3 \quad (6)$$

(5) × 3

$$15x+9y=39 \quad (7)$$

(6) × 5

$$15x+25y=15 \quad (8)$$

(8) - (7)

$$16y=-24$$

$$y=-1.5$$

Substituting this into (5)

$$5x-4.5=13$$

$$5x=17.5$$

$$x=3.5$$

Question 9

(a)

$$\cos x^\circ = \frac{BD}{15}$$

$$BD = 15\cos x^\circ$$

$$BD = 15\times\frac{2}{3} = 10cm$$

(b) Using Pythagoras

$$10^2 = 6^2 + BC^2$$

$$BC^2 = 10^2 - 6^2 = 100-36 = 64$$

$$BC = 8$$

So

$$\sin y^\circ = \frac{8}{10} = \frac{4}{5}$$

Question 10

$$x \geq 1$$

is the area to the right of, and including, the line x=1

$$y \geq x-1$$

is the area above, and including, the line y = x-1, which is a line at 45° crossing the y-axis at $y=-1$.

$$x+y \leq 7$$

is the area below, and including, a line connecting the y-axis at y=7 and the x-axis at x=7.

Question 11

(a) (i) Using Pythagoras

$$OP^2 = 3^2+1^2$$

$$OP^2 = 9+1=10$$

$$OP = \sqrt{10}$$

(ii)

$$x^2+y^2=10$$

(b) (i)

$$90^\circ$$

(ii)

$$\frac{1}{3}$$

(iii)

$$-3$$

(iv)

$$y-y_0 = -3(x-x_0)$$

$$y-1 = -3(x-3)$$

$$y = -3x+9+1$$

$$y = -3x+10$$

Question 12

(a) (i)

$$13$$

(ii)

$$1$$

(b)

$$\frac{1}{27} = \frac{1}{3^3}$$

so

$$x=-3$$

(c)

$$64^{\frac{1}{2}} = (4^3)^{\frac{1}{2}} = 4^{\frac{3}{2}}$$

so

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

Question 13

(a) Each bar of given width, each with height corresponding to frequency

(b) Need 30th. item (strictly speaking we need value of $\frac{1}{2}(30th + 31st)$)

So

$$700 + \frac{7}{10} \times 50 = 735mins$$

Question 14

Looking at t=2, h =10

Trying (A)

$$10 = k2 \Rightarrow k = 5$$

However this will not work for t=5, h=62.5

Trying (B)

$$10 = k2^2 \Rightarrow k = 2.5$$

for t = 5, h = 62.5

$$62.5 = 2.5 \times 5^2$$

which is valid

and fot t=6, h = 90

$$90 = 2.5 \times 6^2$$

which again is valid

So (B) fits the results

Question 15

(a) (i) The angle will be double the angle subtended at the circumference

$$100^\circ$$

(ii) Because it is a cyclic quadrilateral

$$y = 180 - 50 = 130^\circ$$

(b) (i) Because ABCD is a cyclic quadrilateral

$$9x + 3x = 180$$

$$12x = 180 \Rightarrow x = 15^\circ$$

(ii)

$$\angle DCA = 180 - 30 - 135 = 15^\circ$$

Since ACE is an isoceles triangle

$$\angle EAC = 180 - 2(15) = 150^\circ$$

So

$$\angle EAD = 150 - 30 = 120^\circ$$

Question 16

(a) (i)

$$(3 + \sqrt{7})^2$$

$$9 + 3\sqrt{7} + 3\sqrt{7} + 7$$

$$16 + 6\sqrt{7}$$

(ii) Substitute above result into LHS of given equation

$$(3 + \sqrt{7})^2 - 6(3 + \sqrt{7}) + 2$$

$$16 + 6\sqrt{7} - 18 - 6\sqrt{7} + 2$$

$$= 0$$

(b) Second solution is

$$3 - \sqrt{7}$$

because

$$3 + \sqrt{7} + 3 - \sqrt{7} = 6$$

Question 17

$$\frac{2}{5} \times P(red\ /Beth) = \frac{4}{15}$$

$$P(red\ /Beth) = \frac{4}{15}.\frac{5}{2} = \frac{2}{3}$$

P(red/Amy and not red/Beth)

$$= \frac{2}{5}.\frac{1}{3} = \frac{2}{15}$$

P(not red/Amy and red/Beth)

$$= \frac{3}{5}.\frac{2}{3} = \frac{6}{15}$$

P(not red/Amy and not red/Beth)

$$= 1 - \frac{4}{15} - \frac{2}{15} - \frac{6}{15} = \frac{3}{15} = \frac{1}{5}$$

Question 18

$$Graph\ A : y = (x - 3)^2$$

$$Graph\ B : y = (x + 3)^2$$

$$Graph\ C : y = -x^2$$

$$Graph\ D : y = -x^2 + 3$$

Question 19

$$\frac{x^2 - 16}{3x^2 + 10x - 8}$$

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

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

Question 20

(a) Volume of original cone

$$= \frac{1}{3}\pi(12^2)(10)$$

$$480\pi$$

Volume of cone cut off (with height 5cm)

$$= \frac{1}{3}\pi(6^2)(5)$$

$$= 60\pi$$

So volume of frustrum

$$= 480\pi - 60\pi = 420\pi$$

(b) For the cone

$$\frac{1}{3}\pi r^2(35) = 420\pi$$

$$r^2 = \frac{3 \times 420}{35} = 36$$

$$r = 6cm$$

Paper 2 - 3301/2H, 14 November 2003

Question 1

The largest angle is

$$\frac{7}{20} \times 360 = 126^\circ$$

Question 2

Perimeter

$$= \frac{2\pi r}{2} + 9 = \pi \times 4.5 + 9 = 14.1 + 9 = 23.1$$

Question 3

(a) Probability of vegetarian

$$= 0.28$$

(b) 320 constitutes a fifth of the ttal no. of pupils, so total no. of students

$$= 320 \times 5 = 1600$$

Question 4

(a)

$$5(2a - c) + 4(3a + 2c)$$

$$10a - 5c + 12a + 8c$$

$$22a + 3c$$

(b)

$$3(x - 2) = 5x - 5$$

$$3x - 6 = 5x - 5$$

$$2x = -1$$

$$x = -\frac{1}{2}$$

(c)

$$3x + 7 < 1$$

$$3x < -6$$

$$x < -2$$

Question 5

(a) D - the increase of height in both segments is a straight line, i.e. the height is proportional to time. The change from one 'segment' to the other is maybe smoother than expected but there is no other alternative offering two straight regions for the two separate segments of the bottle.

(b) Cylinder

Question 6

(a)

$$\frac{12 - y}{3} = 5$$

$$12 - y = 15$$

$$y = -3$$

(b)

$$\frac{2x + 1}{4} + \frac{4x + 1}{6} = 1$$

$$6(2x + 1) + 4(4x + 1) = 24$$

$$12x + 6 + 16x + 4 = 24$$

$$28x = 14$$

$$x = \frac{1}{2}$$

Question 7

Using Pythagoras's Theorem

$$OA^2 = 6^2 + 2.5^2$$

$$OA^2 = 36 + 6.25 = 42.25$$

$$OA = 6.5$$

Therefore

$$AB = 6.5 - 2.5 = 4cm$$

Question 8

(a)

$$\sin 48 = \frac{x}{5.1}$$

$$x = 5.1 \sin 48$$

$$= 3.8cm$$

Hint : Input data contains 1 decimal place at most, so answer should contain no more than one decimal place

(b) From above, height of PQRS is 3.8 cm

Area of PQRS

$$= 6.8 \times 3.8 = 25.84cm^2$$

Question 9

Consider three consecutive numbers

$$a, a+1, a+2$$

These sum to

$$3a + 3$$

which will always be divisible by 3

Question 10

$$u = \frac{t}{3} + 5$$

$$3u = t + 15$$

$$t = 3u - 15$$

Question 11

(a)

$$7 \times 10^9$$

(b)

$$0.0045$$

Hint : the index of -3 implies you shift the decimal point by three places - you just have to decide in what direction

(c)

$$\frac{2.7 \times 10^3}{3.375 \times 10^5}$$

$$= 0.8 \times 10^{-2}$$

$$= 8 \times 10^{-3}$$

Question 12

(a) (i) corresponding to 20 on the vertical scale, the median is

$$100$$

(ii) Corresponding to 10 on the vertical scale is

$$93$$

Corresponding to 30 on the vertical scale is

$$106$$

So the inter-quartile range is

$$106 - 93 = 13$$

(b) (i) George - who has a lower Inter-Quartile Range

(ii) Brian - who has the lowest median

Question 13

Let

$$x = 0.3\dot{1}\dot{5}$$

So

$$10x = 3.\dot{1}\dot{5}$$

$$1000x = 315.\dot{1}\dot{5}$$

therefore

$$1000x = 312 + 10x$$

$$990x = 312$$

$$x = \frac{312}{990} = \frac{52}{165}$$

Question 14

$$x^2 - 10x - 5 = 0$$

$$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4.1.(-5)}}{2}$$

$$x = 5 \pm \frac{\sqrt{100 + 20}}{2}$$

$$x = 5 \pm \frac{\sqrt{120}}{2}$$

$$x = 5 \pm 5.477$$

$$x = 10.48, -0.48$$

Question 15

Length becomes

$$25 + 2.5 = 27.5cm$$

Width becomes

$$10 + 2 = 12cm$$

So percentage increase

$$= \frac{(27.5 \times 12) - (25 \times 10)}{25 \times 10} \times 100 = 32\%$$

Question 16

$$s = \frac{1}{2}(10 + 11 + 9$$
$$= 15$$

Area
$$= \sqrt{15 \times 5 \times 4 \times 6}$$
$$= \sqrt{1800}$$
$$= 42.4cm^2$$

Question 17

To find the no. of kilowatt hours when costs become equal
$$9.60 + (n - 5) \times 1.30 = 1.5n$$
$$9.6 + 1.3n - 6.5 = 1.5n$$
$$0.2n = 3.1$$
$$n = 15.5$$
Above this figure Alpha gasCo becomes cheaper

Question 18

Volume of solid cube
$$= 20^3 = 8000cm^3$$
Volume of square hole
$$= 10 \times 10 \times 20 = 2000cm^2$$
Volume of that part of the circular hole which does not coincide with the square hole
$$2 \times 5(\pi(4^2)) = 160\pi$$
So volume reaining
$$= 8000 - 2000 - 160\pi = 5497.34cm^3$$

Question 19

(a) 43,57, 57,81 respectively
(b) various possibilities : sex of students, age etc.

Question 20

$$\frac{1}{x+1} + \frac{5x}{x-2} = 3$$
$$(x - 2) + 5x(x + 1) = 3((x + 1)(x - 2)$$
$$x - 2 + 5x^2 + 5x = 3x^2 - 3x - 6$$
$$2x^2 + 9x + 4 = 0$$
$$(2x + 1)(x + 4) = 0$$
So
$$2x + 1 = 0 \Rightarrow x = -\frac{1}{2}$$
and
$$x + 4 = 0 \Rightarrow x = -4$$

Question 21

Least distance would be 45m

Maximum speed would be 5.5 m/s

Corresponding time would be
$$\frac{45}{5.5} = 8.2s$$

Question 22

$$y = \frac{3x + 4}{x - 3}$$
$$(x - 3)y = 3x + 4$$
$$xy - 3y = 3x + 4$$
$$x(y - 3) = 3y + 4$$
$$x = \frac{3y + 4}{y - 3}$$

Question 23

P(black and black)
$$= \frac{5}{8}.\frac{4}{7} = \frac{5}{14}$$
P(white and white)
$$= \frac{3}{8}.\frac{2}{7} = \frac{3}{28}$$
Probilty of both balls being same color
$$= \frac{10}{28} + \frac{3}{28} = \frac{13}{28}$$

Question 24

(a) Minimum point of
$$y = x^2 - x - 6$$
is (0.5, -6.25)
so for
$$y = x^2 - x - 12$$
is (0.5, -12.25)
(b) equate the two equations
$$x^2 - x - 6 = x + 2$$
$$x^2 - 2x - 8 = 0$$

Question 25

Using given formula

$$\frac{1}{3} \times base\ area \times height = 100$$

$$\frac{1}{3}(25) \times height = 100$$

$$height = \frac{300}{25} = 12cm$$

Length (L) of a diagonal across base is given by

$$L^2 = 5^2 + 5^2 = 50$$

$$L = \sqrt{50}$$

set up a right-angled triangle consisting of height, half the diagonal across the base and side x, and use Pythagoras

$$x^2 = \left(\frac{\sqrt{50}}{2}\right)^2 + 12^2$$

$$x = 12.5cm$$