November 2017 paper 3

(1) a) $150 < h \leq 160$ 100 - 170 $\frac{80}{2} = 40$ B1

which interval contains 40th value

b) plot mid-point against frequency
join with straight lines C2

(2) London 1 L = 108.9 p or £1.089

US 1 gallon = $ 2.83

£ ⇄ $: ×1.46 / ÷1.46

gallons ⇄ Litres : ×3.785 / ÷3.785

- We must compare Like with Like
- I am choosing L in pence and so will change the US into L and pence

US

1 gallon : $ 2.83

3.785 L

$2.83 ÷ 1.46 = £1.93835.... P1

3.785 L : £1.93835

÷3.785 ↓ ↓ ÷3.785

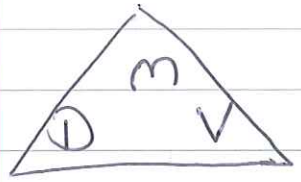
1 L : £0.512115..... P1

London 1 L = 108.9 p

US 1 L = 51.2 p

The petrol is better value for money in the US as it is 57.7 p cheaper per Litre C1

Question 3



$D = 19.3\ g/cm^3$

$m = 12500\ g$

$V =$

(12.5 kg x 1000) * M1

* notice density given in g/cm³ but Volume in kg change volume into grams

$$V = \frac{m}{D} = \frac{12500}{19.3} = 647.668\ldots$$

M1

$= 648\ cm^3$ (3sf) A1

Question 4

Blue : Green	Green : Red	
2 : 5	4 : 1	make Green same number
x4 x4	x5 x5	
8 : 20	20 : 5	P1

So now we have

Blue : Green : Red		
8 : 20 : 5		33 pens
x3 x3 x3	P1	x3
24 : 60 : 15		99 pens

this is less than 100

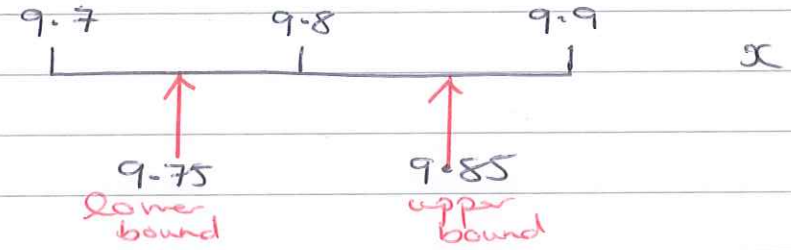
greatest possible number of Red pens is 15

A1

Question 5

a) $\frac{1}{1.6} = 0.625$ B1 ~~(or $\frac{5}{8}$)~~ "... answer as a decimal"

b)

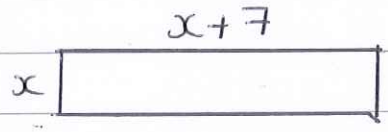


error interval

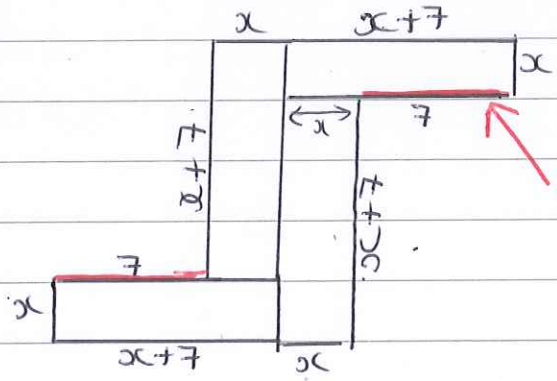
$9.75 \leq x < 9.85$ B1

B1

Question 6



P1



P1

P1

Perimeter $x + x+7 + x + x+7 + x + x+7 + x + x+7 + 7 + 7 = 70$

$8x + 42 = 70$

$8x = 28$

$x = 3.5$

A1

Area one rectangle $= 3.5 \times 10.5$

$= 36.75 \text{ cm}^2$

Area 8-sided shape $= 4 \times 36.75 \text{ cm}^2$

$= 147 \text{ cm}^2$ B1

Question 7

$(13.8 \times 10^{7}) \times (5.4 \times 10^{-12})$

$= 7.452 \times 10^{-4}$ M1

$= 0.0007452$

1 2 3 4

0.0007452 A1

Question 8

a) Mel's because she has carried out the most number of trials B1

b) Total number of trials = 150
Total number of point DOWN = 100
Total number of point UP = 50

	Lucy	Mel	Tom	Total
point DOWN	31	53	16	100
point UP	14	27	9	50
Total	45	80	25	150

$P(\text{point DOWN}) = \frac{100}{150} = \frac{2}{3}$

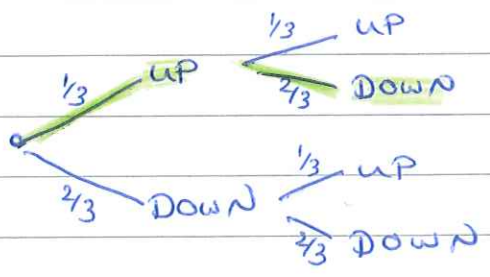
$P(\text{point UP}) = \frac{50}{150} = \frac{1}{3}$

$P(\text{point UP } 1^{st} \text{ AND point DOWN } 2^{nd})$

$= \frac{2}{3} \times \frac{1}{3}$ M1

$= \frac{2}{9}$ A1

could use a tree



Question 9

a) new boat £12 500

$n = 0$, $V = 12500$ $\qquad V = 12500 \times (0.85)^n$

$n = ?$, $V < \frac{12500}{2}$

After how many years is Jack's boat worth less than £6250

Use trial and improvement

try 5 years, $n = 5$, $\quad V = 12500 \times 0.85^5$

$= £5546.32 < £6250$

M1

try 4 years, $n = 4$, $\quad V = 12500 \times 0.85^4$

$= £6525.08 > £6250$

5 years A1

Could try a more ~~sg~~ systematic approach

$n = 1$, $V = 12500 \times 0.85^1 = £10\,625$

$n = 2$, $V = 12500 \times 0.85^2 = £9031.25$

$n = 3$, $V = 12500 \times 0.85^3 = £7676.56$

$n = 4$, $V = 12500 \times 0.85^4 = £6525.08$

$n = 5$, $V = 12500 \times 0.85^5 = £5546.32$

5 years

b) Interest R% of £5500

$= \frac{R}{100} \times 5500$

$= \frac{5500R}{100}$

$= 55R$ Interest

Tax 40% of 55R

$= 0.4 \times 55R$

$= 22R$ Tax

Interest − Tax = £79.20

$55R - 22R = 79.20$

$33R = 79.20$

$R = 2.4$

$R = 2.4\%$ P1 P1 A1

I seem to have missed Q10 ?!!!

Question 11

$n = 60$

a) Median ≈ 57 kg B1

b) He may not be correct as if the data was grouped we cannot be certain that the smallest was 40 kg and the biggest was 80 kg C1

c) UQ ≈ 63 kg C1 ∴ 25% of potatoes weigh more than 63 kg

d) 11 potatoes weigh more than 65 kg which is $\frac{11}{80} \times 100$ 13.75% ∴ less than 25% weigh more than 65 kg C1

Question 12

$P(\text{Red Red}) = 0.25 \times 0.6 = 0.15$

Let n represent the number of the times the spinner B spun

$$0.15 \times n = 24$$
$$0.15n = 24$$
$$n = 160 \quad M1$$

The spinner has been spun 160 times

$P(\text{White White}) = 0.75 \times 0.4 = 0.3$ M1

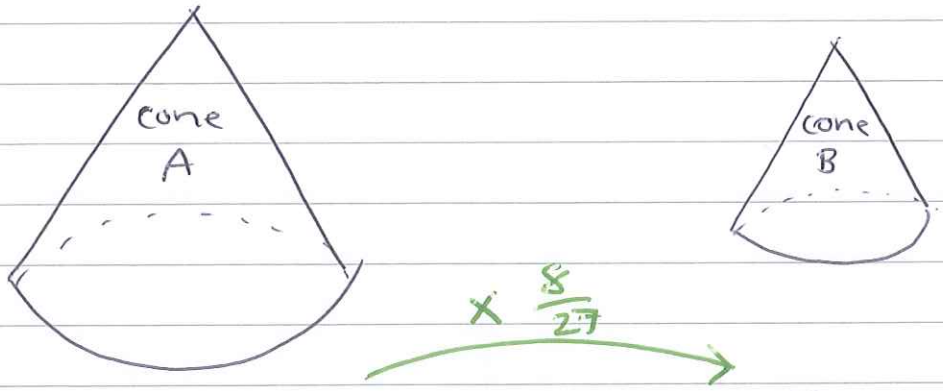
Number of times both land on white

$$\approx 0.3 \times 160$$
$$= \underline{48 \text{ times}} \quad A1$$

Question 13

$$x^2 + 6x - 7 \equiv (x+3)^2 - 9 - 7 \quad M1$$
$$= \underline{(x+3)^2 - 16} \quad A1$$

Question 14



Volume	27	:	8

Scale Factor of Volume $k^3 = \frac{8}{27}$

Scale Factor of Length $k = \sqrt[3]{\frac{8}{27}} = \frac{2}{3}$ M1

Scale Factor of Area $k^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$ M1

Surface Area of Cone A $= 297\ cm^2$

Surface Area of Cone B $= 297 \times \frac{4}{9}$ A1

$= \underline{132\ cm^2}$

Question 15

a) $x^3 + 7x - 5 = 0$

$x = 0, \quad (0)^3 + 7(0) - 5 = -5$
$x = 1, \quad (1)^3 + 7(1) - 5 = 3$ M1

change of sign therefore solution (or root) lies between $x=0$ and $x=1$ C1

b) $x^3 + 7x - 5 = 0$

$x^3 + 7x = 5$ C1
$x(x^2 + 7) = 5$

$x = \frac{5}{x^2+7}$ C1

c) $x_{n+1} = \frac{5}{x_n^2 + 7}$

$x_0 = 1$
$x_1 = 0.625$ M1
$x_2 = 0.67653$ M1
$x_3 = 0.67045$ A1

on calc

1 =

5
ANS x^2 + 7
=
=
=

d) Subs $x = 0.67045$ into $x^3 + 7x - 5$

to give -0.0054806 (5sf) M1

this is close to zero and therefore is a good answer. C1

Question 16

148 km 147.5 → 148.5
11.8 Litres 11.75 → 11.85 B1

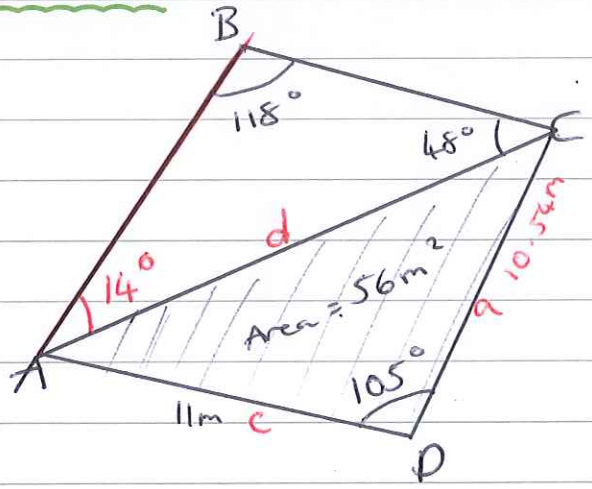
$$\text{Petrol consumption} = \frac{100 \times \text{Litres petrol}}{\text{km travelled}}$$

Lower bound $\frac{100 \times 11.75^{\text{small}}}{148.5_{\text{big}}} = 7.912$ L/km P1

upper bound $\frac{100 \times 11.85^{\text{big}}}{147.5_{\text{small}}} = 8.034$ L/km

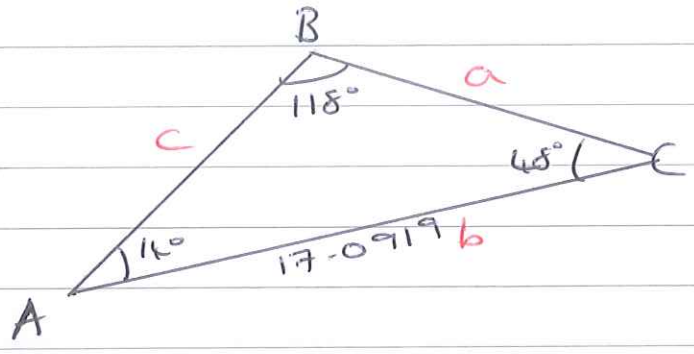
A1 Yes, Nathan could be wrong. It is possible that his car used more than 8 L/km as the upper bound for petrol consumption is 8.034 L/km

Question 17



Area ADC
$\frac{1}{2} ac \sin D = 56$
$\frac{1}{2}(c)(11)\sin 105 = 56$ P1
$5.3126\,CD = 56$
$CD = 10.54099$ P1

Cosine rule to find AC
$d^2 = a^2 + c^2 - 2ac\cos D$
$= 10.54^2 + 11^2 - 2(10.54)(11)\cos 105°$
$= 292.133$ P1
$AC = 17.0919$



$$\frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{17.0919}{\sin 118^\circ} = \frac{AB}{\sin 45^\circ}$$

$$\frac{17.0919}{\sin 118} \times \sin 45 = AB \quad \text{p1}$$

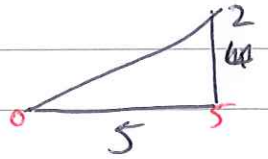
$$14.38563\ldots = AB$$

$AB = 14.4\text{m}$ (1dp) A1

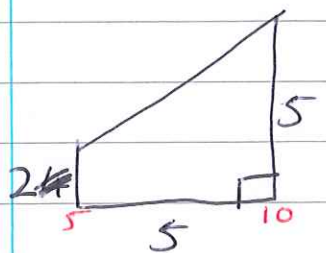
Question 18

(1) Distance travelled = Area under graph

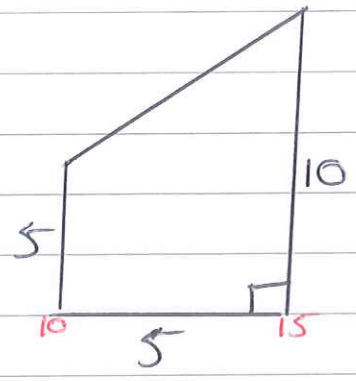
Each strip will be a trapezium (except 1st triangle)



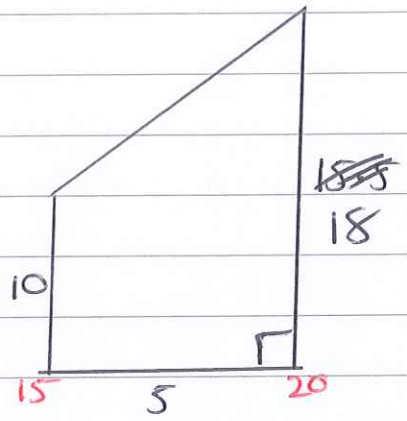
$\text{Area} = \frac{1}{2} \times 5 \times 2 = 5\text{m}$ m1



$\text{Area} = \frac{1}{2}(2+5) \times 5 = 17.5\text{m}$ ✓



Area $= \frac{1}{2}(5+10) \times 5 = 37.5\text{m}$ ✓



Area $= \frac{1}{2}(10+18) \times 5 = 70\text{m}$ ✓

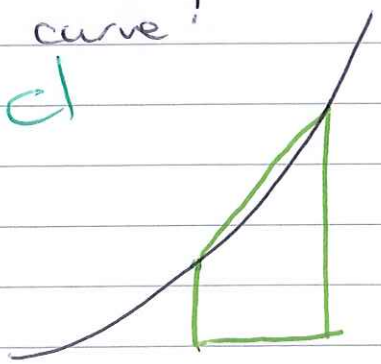
(i) Distance travelled in first 20 seconds

$= (5 + 17.5 + 37.5 + 70)$ m M1

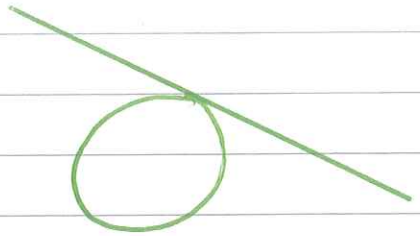
$= 130$ m A1

b) Overestimate

The trapezium strips are larger than the space under the curve' C1



Question 19



Line $x - 2y = 10$
circle $x^2 + y^2 = 20$

if the line is a tangent to the circle then when solving simultaneously $b^2 - 4ac = 0$
OR, there will only be one solution.

$x = 10 + 2y$

$(10 + 2y)^2 + y^2 = 20$ M1

$(10 + 2y)(10 + 2y) + y^2 = 20$

M1 $100 + 20y + 20y + 4y^2 + y^2 = 20$

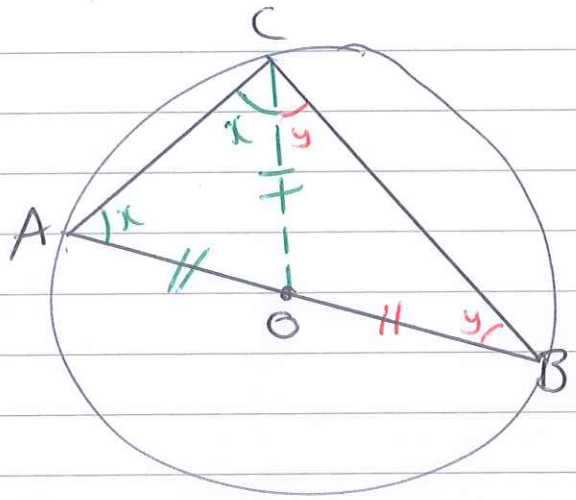
M1 $100 + 40y + 5y^2 = 20$ $\div 5$
$20 + 8y + y^2 = 4$ -4
$16 + 8y + y^2 = 0$
$y^2 + 8y + 16 = 0$
M1 $(y + 4)(y + 4) = 0$ perfect square
$(y + 4)^2 = 0$

$y + 4 = 0$
$y = -4$

$x = 10 + 2(-4)$
$= 10 - 8$
$= 2$

C1 There is only one solution, therefore $x - 2y = 10$ is a tangent to the circle $x^2 + y^2 = 20$ touching once at the point $(2, -4)$

Question 20



AO = OC since radii of circle

∴ AOC is an isosceles triangle with equal base angles x c1

OB = OC since radii of circle

∴ OCB is an isosceles triangle with equal base angles y

Angles in triangle ACB add up to 180°

$$\therefore \quad x + (x+y) + y = 180^\circ$$

$$2x + 2y = 180 \qquad c1$$

$$2(x+y) = 180$$

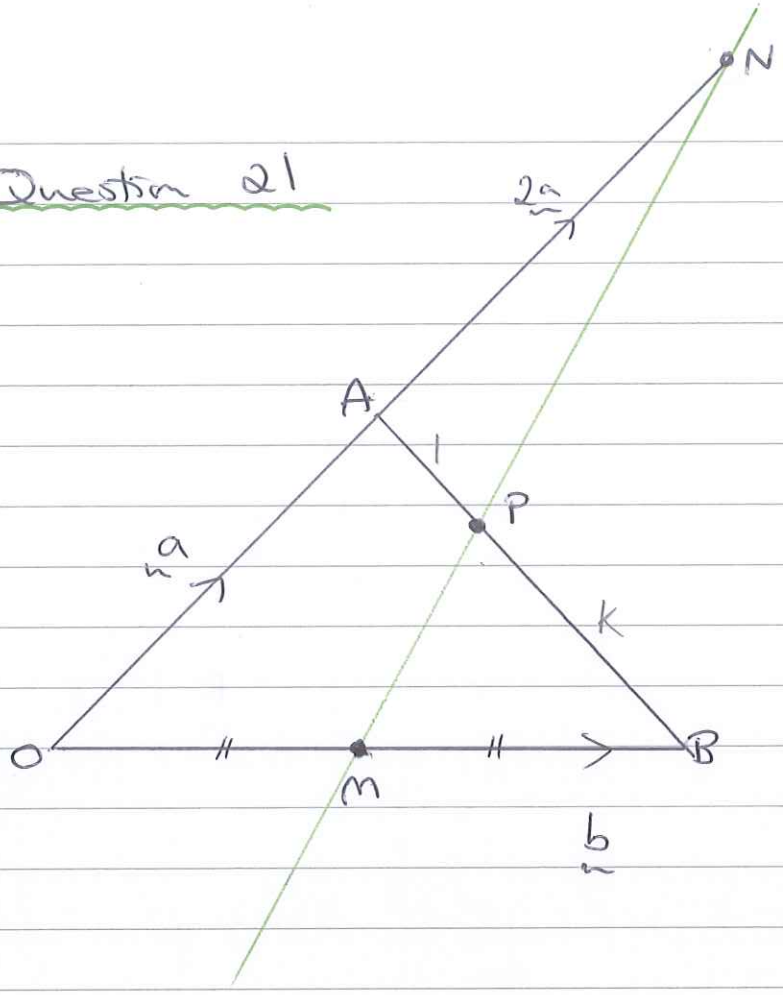
$$x + y = 90^\circ$$

Angle C = $x + y = 90^\circ$ c1

∴ Angle ACB = 90°

c1 reasons

Question 21



$\overrightarrow{AP} = k\overrightarrow{AB}$