1. $m = \dfrac{\sqrt{s}}{t}$ $s = 3.47$ correct to 3 significant figures

$t = 8.132$ correct to 4 significant figures

By considering bounds, work out the value of m to a suitable degree of accuracy.
Give a reason for your answer.

working out bounds ↘

$3.465 \leqslant s < 3.475$ (1)

$8.1315 \leqslant t < 8.1325$

$LB\ m = \dfrac{\sqrt{3.465}}{8.1325} = 0.2288903839$ (2) (1)

$UB\ m = \dfrac{\sqrt{3.475}}{8.1315} = 0.2292486243$

$x = \dfrac{\text{big number}}{\text{small number}}$

x will be a big number

$x = \dfrac{\text{small number}}{\text{big number}}$

x will be a small number

Highest degree of accuracy where UB and LB round to same number

Here round to 3dp so $m = 0.229$ (1)

Since both the LB and UB round to 0.229

B : G
2 : 5
(×4)
8 : 20

G : R
4 : 1
(×5)
20 : 5

8 + 20 + 5 = 33
3 × 33 = 99

B : G : R
8 : 20 : 5
(×3)
24 : 60 : 15

15

2. (a) Find the value of the reciprocal of 1.6
Give your answer as a decimal.

Let x be the reciprocal of 1·6

$x \times 1{\cdot}6 = 1$
$(\div 1{\cdot}6) \quad (\div 1{\cdot}6)$
$x = 0{\cdot}625$

0·625
(1)

Jess rounds a number, x, to one decimal place.
The result is 9.8

(b) Write down the error interval for x.

Range of numbers which will:
Round up to 9·8
$9{\cdot}75 \leqslant x$
Round down to 9·8
$x < 9{\cdot}85$

$9{\cdot}75 \leqslant x < 9{\cdot}85$
(2)

(Total for Question is 3 marks)

Answer to part c) = 0·670 448

$(0.670448)^3 + 7(0.670448) - 5 = -0.005\,494\,8$

Estimate is accurate because the substitution gives us a value close to 0 ✓

3. The petrol consumption of a car, in litres per 100 kilometres, is given by the formula

$$\text{Petrol consumption} = \frac{100 \times \text{Number of litres of petrol used}}{\text{Number of kilometres travelled}}$$

← UB

← LB

Nathan's car travelled 148 kilometres, correct to 3 significant figures.
The car used 11.8 litres of petrol, correct to 3 significant figures.

Nathan says,

"My car used less than 8 litres of petrol per 100 kilometres."

Could Nathan be wrong?
You must show how you get your answer.

Litres of Petrol

$11.489 \xrightarrow{\text{Round}} 11.85$

Kilometres Travelled

LB = 147·5 ✓

UB = 11·85

$$\text{Petrol Consumption} = \frac{100 \times 11.85}{147.5}$$ ✓

$= 8.0339$

Yes, Nathan could be wrong, because the maximum petrol consumption is 8·0339 ✓

(Total for Question is 3 marks)

4. Jackson is trying to find the density, in g/cm^3, of a block of wood.
The block of wood is in the shape of a cuboid.

He measures
the length as 13.2 cm, correct to the nearest mm
the width as 16.0 cm, correct to the nearest mm
the height as 21.7 cm, correct to the nearest mm

He measures the mass as 1970 g, correct to the nearest 5 g.

By considering bounds, work out the density of the wood.
Give your answer to a suitable degree of accuracy.

You must show all your working and give a reason for your final answer.

$m_U = 1972.5$ (1) $m_L = 1967.5$ $\frac{5}{2} = 2.5$g Mass = 1970 ± 2.5g

$V = l \times w \times h$ $V_U = l_U \times w_U \times h_U$ ← The product of larger numbers is a larger number

	3SF	UB	LB
l	13.2	13.25	13.15
w	16.0	16.05	15.95
h	21.7	21.75	21.65

$V_{UB} = 13.25 \times 16.05 \times 21.75$
$= 4\,625.4\ldots$

$V_{LB} = 45\,40.9\ldots$ (1)

$d = \frac{m}{V}$

greater numerator → $d_U = \frac{m_U}{V_L}$ ← lower denominator = largest value

$d_L = \frac{m_L}{V_U}$

$d_U = \frac{1972.5}{4540.9\ldots} = 0.4344\ldots$ $d_L = \frac{1967.5}{4\,625.4\ldots} = 0.4254\ldots$ (1)

0.43 g/cm^3 Both the upper and lower bounds for density round to 0.43 to 2 dp. (1)

(Total for Question is 5 marks)

5. Sally used her calculator to work out the value of a number y.

The answer on her calculator display began

8.3

Complete the error interval for y.

8.300004...

8.367928...

8.399918...

(1) (1)

$8.3 \leqslant y < 8.4$

(Total for Question is 2 marks)

6. $D = \dfrac{u^2}{2a}$

u = 26.2 correct to 3 significant figures

a = 4.3 correct to 2 significant figures

(a) Calculate the upper bound for the value of D.
Give your answer correct to 6 significant figures.
You must show all your working.

$26.15 \longleftarrow 26.2 \longrightarrow 26.25$ (1)

$4.25 \longleftarrow 4.3 \longrightarrow 4.35$

(1) U.B. for $D = \dfrac{(\text{U.B. for } u)^2}{2(\text{L.B. for } a)} = \dfrac{26.25^2}{2(4.25)}$

$= 81.06617647\ldots \approx 81.0662$ (6 s.f.) (1)

81.0662

(3)

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

(b) By considering bounds, write down the value of D to a suitable degree of accuracy.
You must give a reason for your answer.

(1)

D = 80 because the bounds are the same when rounded to the nearest ten. (1)

(2)

(Total for Question is 5 marks)

7. The length of a pencil is 128 mm correct to the nearest millimetre.

Complete the error interval for the length of the pencil.

(1) (1)

127.5 mm $\leqslant$ length $<$ 128.5 mm

	Tom : Adam	
Original	3 : 7	Total 240 stamps
New	3 : 5	Total 240 stamps

Seeing how many stamps Tom had originally and after the sale

(1) $\frac{240}{10} = 24$

Original → 3+7=10 $3 \times 24 = 72$ stamps

(1) $\frac{240}{8} = 30$

New → 3+5=8 $3 \times 30 = 90$ stamps (1)

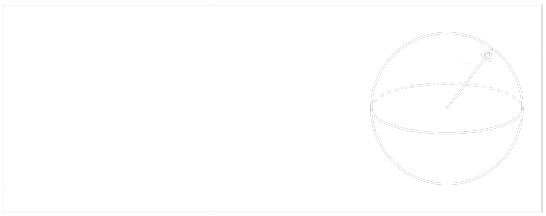
getting how many stamps '1' in the ratio is worth

90-72=18

(1)

finding how many stamps were sold

18



$d = 2r \Rightarrow r = \frac{d}{2}$

$r = \frac{8.4}{2} = 4.2\text{cm}$

Volume of sphere $= \frac{4}{3}\pi(4.2)^3 = 98.784\pi\ \text{cm}^3$ (1)

Volume of hemisphere $= \frac{1}{2} \times 98.784\pi$

$= 155.16954... = 155$ (3sf)

(1) 155

8. $d = \frac{1}{8}c^3$

$c = 10.9$ correct to 3 significant figures.

By considering bounds, work out the value of d to a suitable degree of accuracy.
Give a reason for your answer.

(1) $10.85 \leqslant C < 10.95$

let $C = 10.85$ (lower bound)

(1) $d = \frac{1}{8}(10.85)^3 = 159.66...$

(1) let $C = 10.95$ (upper bound)

$d = \frac{1}{8}(10.95)^3 = 164.11...$

both these values round to 160 (3sg)

$\therefore d \approx 160$ (1)

9. The time period, T seconds, of a simple pendulum of length l cm is given by the formula

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Katie uses a simple pendulum in an experiment to find an estimate for the value of g.

Here are her results.

$l = 52.0$ correct to 3 significant figures.
$T = 1.45$ correct to 3 significant figures.

Work out the upper bound and the lower bound for the value of g.
Use $\pi = 3.142$
You must show all your working.

$T = 2\pi\sqrt{\frac{l}{g}}$

$\frac{T}{2\pi} = \sqrt{\frac{l}{g}}$ (÷ 2π)

Square: $\frac{T^2}{(2\pi)^2} = \frac{l}{g}$

$\times(2\pi)^2$: $T^2 = \frac{l(2\pi)^2}{g}$

$\times g$: $gT^2 = l(2\pi)^2$

$\div T^2$: $g = \frac{l(2\pi)^2}{T^2}$ (1)

Work out upper and lower bounds of T and l

l: 51.9 (−0.1) | 52.0 (3sf) | 52.1 (+0.1)
51.95 | 52.05

l upper bound = 52.05
l lower bound = 51.95 (1)

t: 1.44 (−0.1) | 1.45 (3sf) | 1.46 (+0.1)
1.445 | 1.455

T upper bound = 1.455
T lower bound = 1.445

Big number / Small number = Big number

Small number / Big number = Small number

We are working out upper and lower bounds of...

$g = \frac{l(2\pi)^2}{T^2}$ → lower bound → $\frac{l \text{ lower bound}}{T \text{ upper bound}}$

$\frac{51.95(2\times3.142)^2}{1.455^2} = 969.0181643$ (1)

upper bound (1) ← $\frac{l \text{ upper bound}}{T \text{ lower bound}}$

$\frac{52.05(2\times3.142)^2}{1.445^2} = 984.3677853$

10. Freya writes down the value of x, correct to 1 decimal place.

She writes $x = 6.4$

Complete the error interval for x.

units . tenths

0000 6.4 0000

↳ 1 decimal place = 1 tenth = 0.1.

error interval = $\frac{1}{2}(0.1) = 0.05$.

$6.4 - 0.05 = 6.35$

$6.4 + 0.05 = 6.45$

(1) (1)

6.35 $\leqslant x <$ 6.45

(Total for Question is 2 marks)