GCSE (9-1) Mathematics

J560/06 Paper 6 (Higher Tier)

Question Set 2

1 Tom researches the weights of plant seeds.

- One poppy seed weighs 3×10^{-4} grams.
- 250 pumpkin seeds weigh 21 grams.
- One sesame seed weighs 3.64×10^{-6} kilograms.

Write the three types of seed in order according to the weight of one seed.
Write the lightest type of seed first.
You must show how you decide.

$\frac{21}{250} = 0.084\,g$ = pumpkin

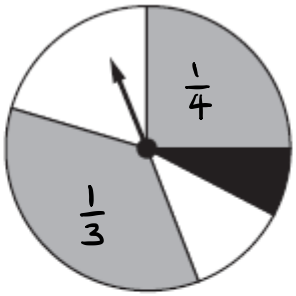
$3 \times 10^{-4} = 0.0003\,g$ = poppy

$3.64 \times 10^{-6}\,kg = 3.64 \times 10^{-6} \times 10^{3} = 3.64 \times 10^{-3}$

$= 0.00364\,g$ = sesame

poppy (lightest), sesame, pumpkin [4]

2 (a) **(a)** This spinner has two grey sections, two white sections and one black section.



Vlad says

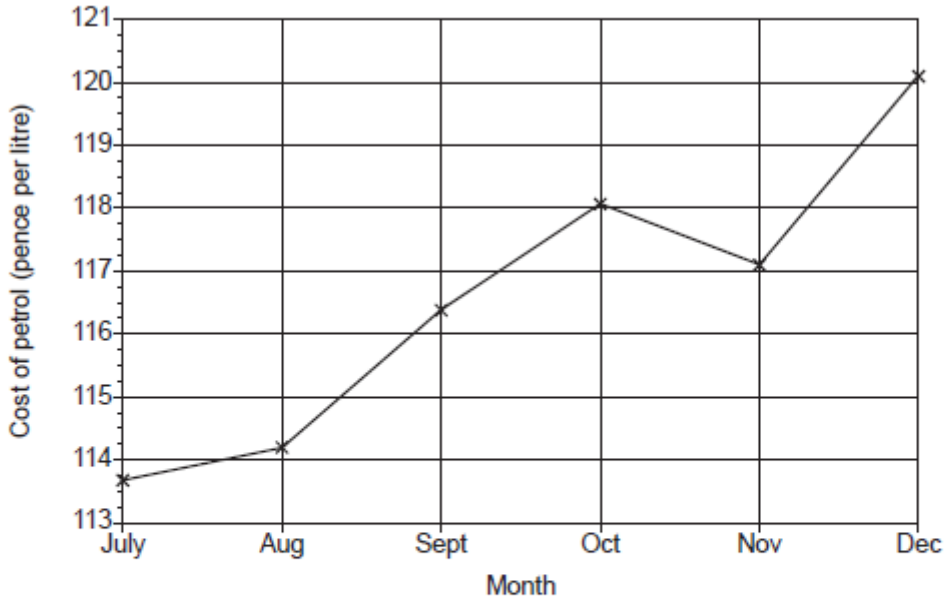
The probability of the spinner landing on black is $\frac{1}{5}$.

Explain why Vlad is not correct.

Grey section takes $\frac{7}{12}$ of the spinner $(\frac{1}{3} + \frac{1}{4})$ thus $\frac{5}{12}$ represents white and black sections. If we compare the $\frac{5}{12}$ with $\frac{1}{5}$, $\frac{1}{5}$ takes nearly half of $\frac{5}{12}$ $(\frac{5}{12} = \frac{25}{60}$ and $\frac{1}{5} = \frac{12}{60})$. But the black section takes less than a half of the $\frac{5}{12}$. [1]

(b)

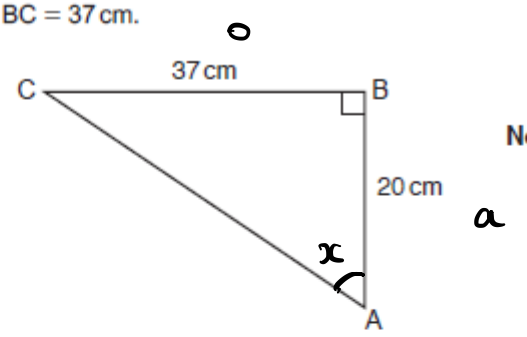
(b) The graph shows the cost of a litre of petrol for the last six months of 2017.



Explain why this graph is misleading.

The graph appears like the cost has increased along the trend between two consecutive months but that is not possible. Bar chart would be more appropriate here. **[1]**

3 ABC is a right-angled triangle.
AB = 20 cm and BC = 37 cm.



Not to scale

Calculate angle BAC.

$$\tan x = \frac{37}{20}$$

$$x = 61.61^\circ$$

61.61° **[3]**

4 A bag contains some counters.

- There are 300 counters in the bag.
- There are only red, white and blue counters in the bag.
- The probability of picking a blue counter is $\frac{23}{50}$.
- The ratio of red counters to white counters is 2 : 1.

Calculate the number of red counters in the bag.

blue : $p = \frac{23}{50}$ $\quad \frac{23}{\cancel{50}} \times \overset{6}{\cancel{300}} = 138$

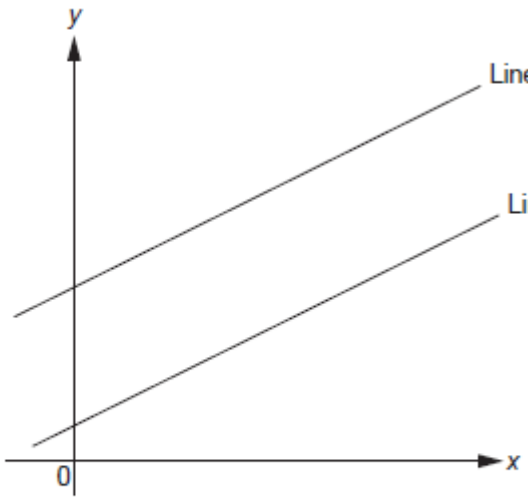
red : white = 2 : 1

red + white = 300 − 138 = 162

red : $\frac{2}{3} \times 162 =$ **108**

108 red counters [4]

5 The graph shows two parallel lines, Line A and Line B.



Not to scale

Line A has equation $y = 6x + 7$.
Line B passes through the point (4, 26).

Find the equation of Line B.

parallel means gradient of line A & B are same

$y = ax + b \longrightarrow y = 6x + b \Leftarrow$ Line B

(4, 26)

$26 = 6 \times 4 + b$

$26 = 24 + b$

$b = 26 - 24$

$b = 2$

Line B : $y = 6x + 2$

$y = 6x + 2$ [4]

6 (a) i You are given that

$270 = 3^3 \times 2 \times 5$ and $177147 = 3^{11}$

(a) (i) Find the lowest common multiple (LCM) of 270 and 177 147.
Give your answer using power notation and as an ordinary number.

LCM = $3^{11} \times 2 \times 5$

(a)(i) using power notation 1.77147×10^6

as an ordinary number 1771470 [2]

(a) ii (ii) Write 177 147 000 000 as a product of its prime factors.

$3^{11} \times 2 \times 5 \times 10^5 \rightarrow 2^5 \times 5^5$

$= 3^{11} \times 2^6 \times 5^6$

(ii) $3^{11} \times 2^6 \times 5^6$ [3]

(b) (b) $3^n = 177147 \times 9^5$.

Find the value of n.

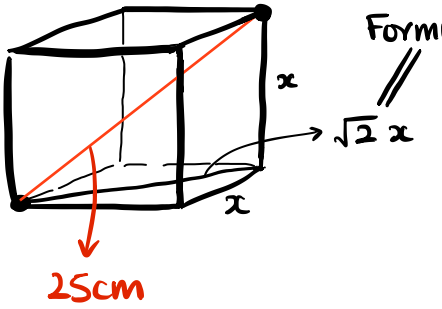
$3^n = 3^{11} \times 9^5 = 3^{11} \times (3^2)^5 = 3^{11} \times 3^{10}$

$3^n = 3^{21}$

(b) $n =$ 21 [3]

7 The length of the longest diagonal of a cube is 25cm.

Calculate the total surface area of the cube.



Formula $= \sqrt{3}x = 25$

$\frac{\sqrt{3}x}{\sqrt{3}} = \frac{25}{\sqrt{3}}$

$x = \frac{25}{3}\sqrt{3}$

$SA = x^2 \times 6 = \left(\frac{25}{3}\sqrt{3}\right)^2 \times 6$

$= \boxed{1250}$

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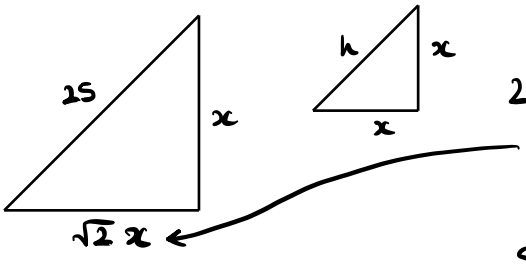
or



$x^2 + x^2 = h^2$

$2x^2 = h^2$

$h = \sqrt{2}x$

$x^2 + (\sqrt{2}x)^2 = 25^2$

$x^2 + 2x^2 = 625$

$3x^2 = 625$

$x^2 = \frac{625}{3}$

$x = \sqrt{\frac{625}{3}} = \frac{25}{3}\sqrt{3}$

$SA = (x \times x) \times 6$

$= \frac{25}{3}\sqrt{3} \times \frac{25}{3}\sqrt{3} \times 6$

$= \boxed{1250}$

1250 ..... cm^2 [5]

8 Solve by factorisation.

$5x^2 + 7x + 2 = 0$

sum = 7
product = 2

$5x \times 2 = 2$
$1x \times 1 = 5$

$(5x+2)(x+1) = 0$

$5x+2=0$ $\quad x+1=0$

$5x=-2$ $\quad x=-1$

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

$x =$ $-\frac{2}{5}$ or $x =$ -1 [3]

9 (a) (a) Show that the equation $x^4 - x^2 - 9 = 0$ has a solution between $x = 1$ and $x = 2$. [3]

$x=1$ $\quad 1^4 - 1^2 - 9 = -9$

$x=2$ $\quad 2^4 - 2^2 - 9 = 3$

$-9 < 0 < 3$

Since the curve of this equation is continuous, a value between 1 and 2 would cut the x-axis (when $y=0$).

(b) (b) Find this solution correct to 1 decimal place.
Show your working.

$x = 1.5 \quad 1.5^4 - 1.5^2 - 9 = -6.1875$

$x = 1.75 \quad 1.75^4 - 1.75^2 - 9 = -2.6836\ldots$

$x = 1.9 \quad 1.9^4 - 1.9^2 - 9 = 0.4221$

$x = 1.85 \quad 1.85^4 - 1.85^2 - 9 = -0.7089\ldots$

solution is between $x = 1.85$ and $x = 1.9$
thus if we round up $x = 1.9$

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or

$x^4 - x^2 - 9 = 0 \quad x^2 = A \quad A^2 - A - 9 = 0$

$a = 1 \quad b = -1 \quad c = -9$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = A$$

$$A = \frac{1 \pm \sqrt{1 - 4 \times 1 \times -9}}{2 \times 1}$$

(b) $x =$ 1.9 [4]

$$= \frac{1 \pm \sqrt{1 + 36}}{2}$$

$$= \frac{1 \pm \sqrt{37}}{2}$$

$= 3.5413$ or -2.5413

$x = \sqrt{A} = 1.88\ldots = 1.9$

10 Toy building bricks are available in two sizes, small and large.
The small and large bricks are mathematically similar.

A small brick has volume $8\,cm^3$ and width 2.1 cm.
A large brick has volume $15.625\,cm^3$.

Calculate the width of a large brick.

$8 : 15.625$

$1 : 1.95...$

$\sqrt[3]{1.95} = \frac{5}{4}$

V : V^3
SA : $SA^{'2}$
ℓ : ℓ'
difference gets cubed for volume

$2.1 \times \frac{5}{4} = \boxed{2.625}$ = width of large block

..... 2.625 ..... cm **[4]**

11 (a) At the start of 2018, the population of a town was 17 150.
At the start of 2019, the population of the town was 16 807.

It is assumed that the population of the town is given by the formula

$$P = ar^t$$

where P is the population of the town t years after the start of 2018.

(a) Write down the value of a.

$t = 0$ when 2018

$P = ar^0 = a = 17150$

(a) ..... 17150 ..... **[1]**

(b) (b) Show that $r = 0.98$. [1]

$P = 17150 r^{2019-2018} = 16807$

$17150 r = 16807$ $r = 0.98$

(c) (c) Show that the population is predicted to be less than 16 000 at the start of 2022. [2]

$P = 17150 r^{2022-2018} = 17150 r^4$

$= 17150 \times 0.98^4 = 15818.61...$

$15818 < 16000$

(d) (d) Use the formula to work out what the population might have been at the start of 2017.

$P = 17150 \times 0.98^{-1}$

$= 17500$

(d) 17500 [2]

Total Marks for Question Set 2: 50