GCSE MATHEMATICS

S21-C300

Non-Calculator Assessment Resource L

Higher Tier

Formula list

Area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

Volume of a sphere = $\frac{4}{3}\pi r^3$

Volume of a cone = $\frac{1}{3}\pi r^2 h$

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

1. *(a)* $120 = 2^3 \times 3^k \times 5$

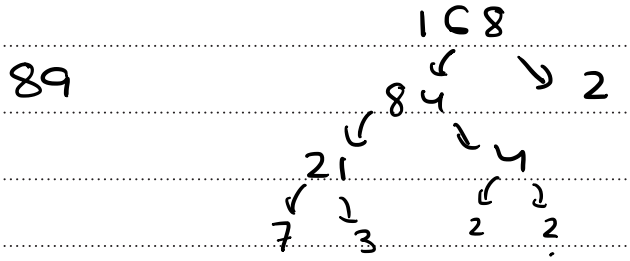
Find the value of k. [1]

$120 = 8 \times 3^k \times 5 = 40 \times 3^k$

$3 = 3^k$

$k = 1$

(b) Write 168 as a product of its prime factors. [2]



$168 = 7 \times 3 \times 2 \times 2 \times 2$

$= 7 \times 3 \times 2^3$

(c) *LoWatts Ltd* makes light bulbs that are identical in size.

They have regular orders from *Company A* for 120 light bulbs and from *Company B* for 168 light bulbs.

LoWatts Ltd uses one size of box to supply both *Company A* and *Company B*.
Each box used contains the same number of light bulbs and is full.
The number of boxes used is as few as possible.

How many light bulbs does each box hold? [3]

A: $120 = 5 \times 3 \times 8$

B: $168 = 7 \times 3 \times 8$

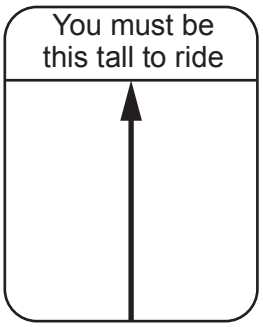
Highest common factor

One box = $3 \times 8 = 24$ light bulbs.

Company A needs 5 boxes

Company B needs 7 boxes

2. When Jenna was measured recently she was 127 cm tall, **correct to the nearest centimetre**.



For safety reasons, the minimum height for a person to ride the Big Coaster at a funfair in the USA is 50 inches.

You are given:
20 inches = 50·8 cm.

(a) Using the information given, decide whether it might possibly be safe, it is definitely safe, or it is definitely not safe for Jenna to ride the Big Coaster.

Might possibly be safe [✓] Definitely safe [ ] Definitely not safe [ ]

Show how you decide. [3]

20 inches = 50.8 50 inches = 127 cm
10 inches = 25.4

Jenna is between 126.5cm to 127.5 cm
Therefore it might be safe for Jenna as the minimum height she could be is only 0.5 cm off the minimum height.

(b) (i) State an assumption that you have made in your answer to part *(a)*. [1]

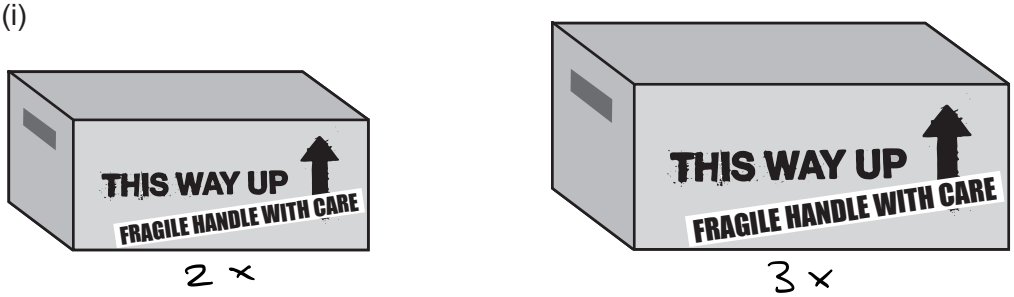
That 0.5 is not a significant difference.

(ii) Comment on the effect that your assumption has had on your decision. [1]

If 0.5cm is significant, then it is not safe for her to take the ride.

3. *(a)* Shabana is moving to a new house and is using boxes to pack.

(i)



Shabana has two mathematically similar packing boxes and says,

"The ratio of the lengths of two of my boxes is 2 : 3 so the ratio of their volumes must be 4 : 9."

Give a reason why Shabana is incorrect and state the correct ratio of the volumes. [2]

Reason ratio of volume is the ratio of the sides cubed

Correct ratio 8 : 27

(ii)

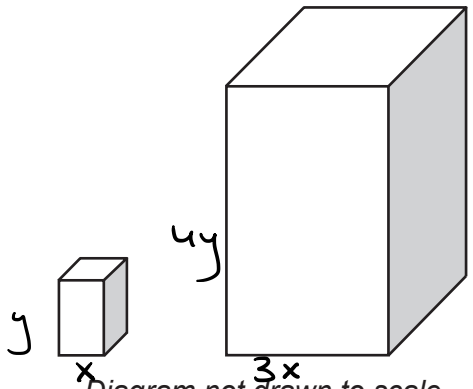


Diagram not drawn to scale

Shabana has two different square-based boxes where:

- the ratio of the lengths of the sides of the squares is 1 : 3,
- the ratio of their heights is 1 : 4.

How many of the small boxes can the large box hold? [2]

Volume of small box = x^2y

Volume of large box = $9x^2 4y$

$= 36x^2y$

$\frac{36x^2y}{x^2y}$ = 36 small boxes.

(b) Shabana's new house is further away from her workplace.
She estimates that there will be a 15% increase in the cost of getting to work.

From her old house, she:

- drove 945 miles per month,
- used petrol at the rate of 9 miles per litre,
- paid 120p per litre for petrol.

How much **more** will it cost her to get to work each month **after** she has moved? [4]

x105 ↓ 9 miles = 1L ↓ x105
945 miles = 105L

1L = 120p
105L = (120 x 105)p
= 12 600p
= £126

*costs 15% more having moved

$$\frac{126 \times 15}{100} = £18.90$$

Increased cost of getting to work £ 18·90

4. *(a)* Show that $\frac{\sqrt{63}}{\sqrt{7}}+\sqrt{147}+\sqrt{48}$ can be written in the form $a+b\sqrt{3}$, where a and b are integers. [3]

$\frac{\sqrt{9\times7}}{\sqrt{7}} + \sqrt{49\times3} + \sqrt{16\times3} = \frac{3\sqrt{7}}{\sqrt{7}} + 7\sqrt{3} + 4\sqrt{3}$

$= 3 + 11\sqrt{3}$

$a = 3, \quad b = 11$

(b)

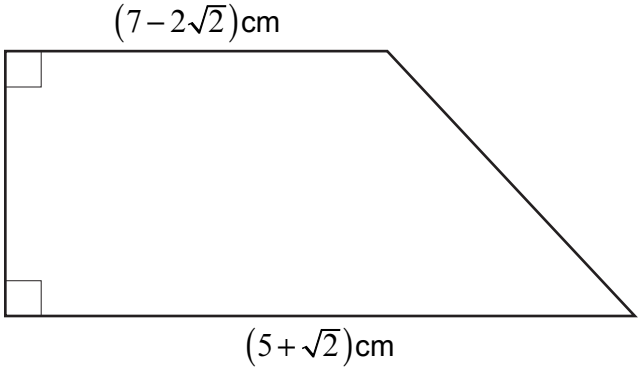


Diagram not drawn to scale

The area of this trapezium is $(6\sqrt{2}-1)\text{cm}^2$.

Find the height of the trapezium.
Give your answer in its simplest form. [5]

Area $= \frac{1}{2}(b+l)h$

$6\sqrt{2}-1 = \frac{1}{2}(5+\sqrt{2}+7-2\sqrt{2})h$.

$12\sqrt{2}-2 = (12-\sqrt{2})h$.

$\frac{12\sqrt{2}-2}{12-\sqrt{2}} \times \left(\frac{12+\sqrt{2}}{12+\sqrt{2}}\right)$ fail $= \frac{144\sqrt{2}+24-24-2\sqrt{2}}{144+2\sqrt{2}-2\sqrt{2}-2}$

$= \frac{142\sqrt{2}}{142} = \sqrt{2}$

5. Ravi needs to choose a 5-character passcode for a door lock.

He chooses to use 5 of these 7 characters:

1 9 6 7 R P #

Each chosen character is used only once.

(a) Find the number of different 5-character passcodes Ravi can make. [2]

$7 \times 6 \times 5 \times 4 \times 3 = 2520$

(b) Find the probability that Ravi's 5-character passcode starts with R and ends with P. [3]

$P(R) = \frac{1}{7}$, $P'(P) = \frac{5}{6} \times \frac{4}{5} \times \frac{3}{4}$ $P(P) = \frac{1}{3}$

$\therefore \frac{1}{7} \times \frac{5}{6} \times \frac{4}{5} \times \frac{3}{4} \times \frac{1}{8} = \boxed{\frac{1}{42}}$

or

R _ _ _ P

5 potential characters for 3 spaces

$5 \times 4 \times 3 = 60$ $\frac{60}{2520} = \boxed{\frac{1}{42}}$

6. Paula is baking biscuits for a charity fundraiser.
She makes biscuits in batches of 12.

Paula's weighing scales are accurate **to the nearest gram**.
She needs to weigh 8 grams of baking powder to make 12 biscuits.

She has 220 grams of baking powder, **correct to the nearest 10 grams**.
She has plenty of all the other ingredients she needs.

She plans to sell her biscuits at £2 for a pack of 3.

What is the greatest amount of money that Paula could raise for her charity?
You must show all your working. [6]

Batches of 12 :

weighing scales to nearest gram.

needs 8g powder → so measure 7.5g to 8.5g

220g to nearest 10 ∴ 215g – 225 g

Greatest amount

$\frac{225}{7.5}$ = 30 batches

30 x 12 = 360 biscuits

120 x (1 pack = 3 biscuits
120 packs = 360 biscuits) x 120

120 x £2 = £240