GCSE MATHEMATICS

S21-C300

With Calculator Assessment Resource J

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:

$$v = u + at$$

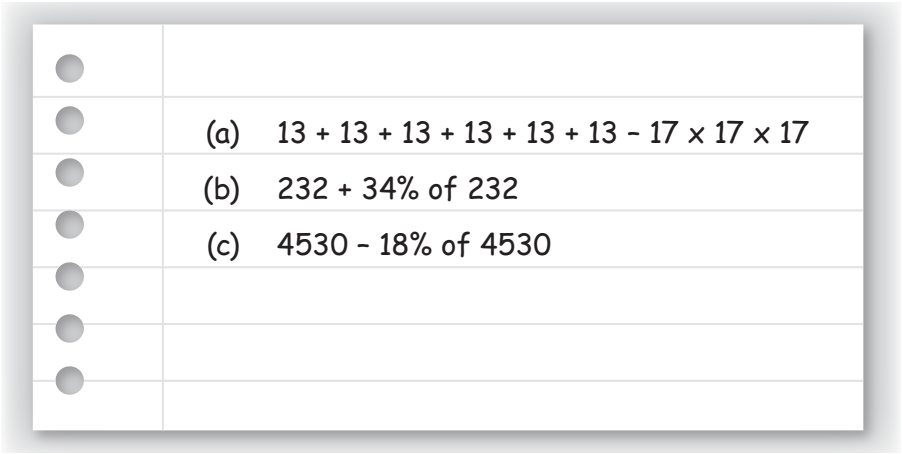
$$s = ut + \frac{1}{2}at^2$$

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

1. Harman has written some calculations he needs to work out for his homework.

Write down the calculation needed to work out each of the following using the fewest number of key presses. [4]

Give your answer to each question.



(a) $(6 \times 13) - (17^3) = -4885$

Answer: -4835

(b) 232×1.34

$= 310.88$

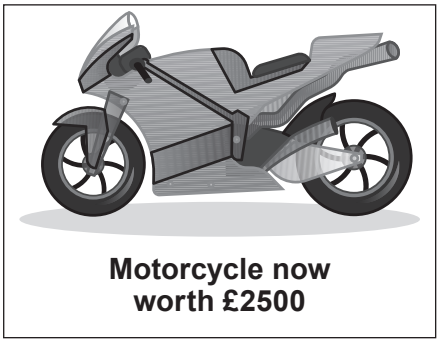
Answer: 310.88

(c) 4530×0.82

$= 3714.6$

Answer: 3714.6

2. *(a)* This motorcycle depreciates by 16% per annum.



Motorcycle now worth £2500

After how many whole years will this motorcycle be worth less than £1000?
You must show all your working. [3]

depreciates by 16% per annum

Start = 2500

$1000 > 2500(1 - 0.16)^t$

TRIAL + ERROR $t = 4 \rightarrow 1244.6784$

$t = 5 \rightarrow = 1045.52$

$t = 6 \rightarrow = 878.24$

6 years.

or

$0.4 > 0.84^t$

$\log 0.84^t < \log 0.4$

$t \log 0.84 < \log 0.4$

$t > \log\left(\frac{0.4}{0.84}\right)$

$t > 5.255$

$t = 6$

Motorcycle will be worth less than £1000 after 6 whole years.

(b) Rachela takes out a loan for £500 from an online loan company.
The interest rate is 325% per annum.

Rachela is thinking she would pay off the loan and interest in full after 3 years.
A friend correctly says,

"That is a very high rate of interest. You will owe over £30000."

Calculate the total amount Rachela would have to pay back after 3 years. [3]

£500 and interest 325% / year.

$500\left(1 + \frac{325}{100}\right)^3 = £38382$

3. A car travels at an average speed of 45 mph for 40 minutes.
The next part of the car's journey takes 25 minutes at an average speed of 60 mph.

Show that the average speed of the entire journey is just over 50 mph. [5]

(1) 45 mph for 40 minutes.

(2) 60 mph avg speed for 25 minutes

Speed = $\frac{\text{distance (m)}}{\text{time (h)}}$

$\therefore$ (1) $45 \times (40 \div 60) = 30$

(2) $60 \times (25 \div 60) = 25$

total distance $= 30 + 25 = 55$

total time $= 65$ minutes $= \frac{13}{12}$ h

$$\frac{55}{\left(\frac{13}{12}\right)} = 50.769 \approx 50.8 \text{ mph}$$

$50.8 > 50$

4. You are given that y is inversely proportional to x, and that $y = 124{\cdot}5$ when $x = 18$.

(a) Find a formula for y in terms of x. [3]

$y \propto \frac{1}{x} \rightarrow y = \frac{k}{x}$

when $y = 124{\cdot}5$, $x = 18$

$124{\cdot}5 = \frac{k}{18}$

$124{\cdot}5 \times 18 = k$

$k = 2241$

$y = \frac{2241}{x}$

(b) Use the formula you found in *(a)* to complete the following table. [2]

x	$\frac{1}{2}$	18	24·9
y	4482	124·5	90

$x = \frac{1}{2} \rightarrow y = \frac{2241}{1/2} = 2 \times 2241 = 4482$

$y = 90 \rightarrow 90 = \frac{2241}{x} \rightarrow x = \frac{2241}{90} = 24{\cdot}9$

5. You are given the following:

1 kg ≈ 2·2 pounds 1 pound = 16 ounces

In Keto's restaurant, steak is on the menu.

How much would it cost to order an 8-ounce steak in Keto's restaurant?
You must show all your working. [5]

16 ounces : 1 pound

8 ounce steak = $\frac{1}{2}$ pound of steak

1 kg ≈ 2.2 pounds

$\frac{1}{2.2}$ kg ≈ 1 pound

$\frac{\frac{1}{2.2}}{2}$ kg ≈ $\frac{1}{2}$ pound

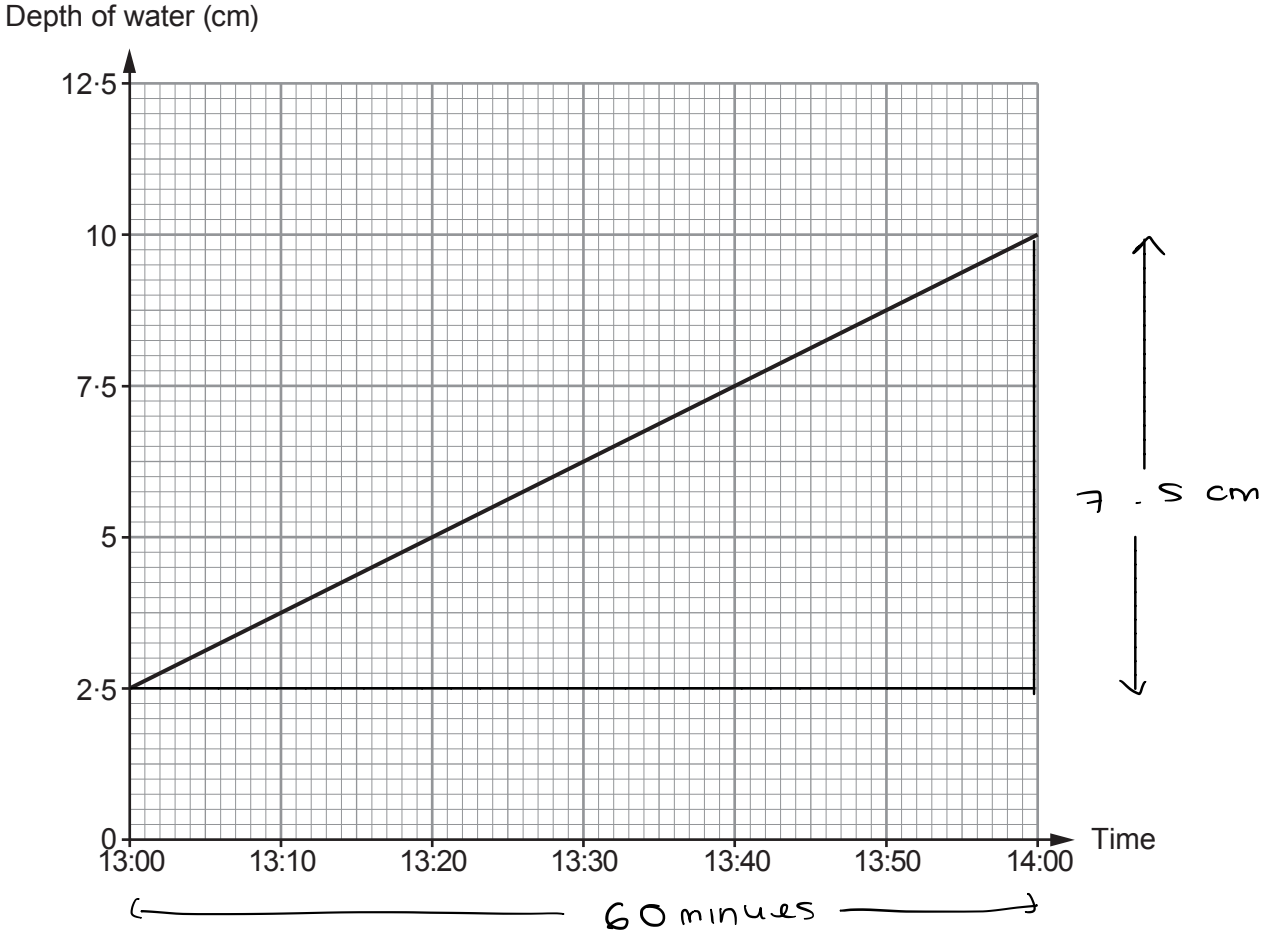
$\frac{5}{22}$ kg ≈ $\frac{1}{2}$ pound

$\frac{5}{22}$ kg = $\frac{2500}{11}$ g

$\frac{2500}{11} \div 100 = \frac{25}{11}$

$\frac{25}{11} \times £11 = £25$

6. The graph below shows the water level in a container from 13:00 to 14:00.



(a) Calculate the rate of the increase in the depth of water in the container.
Give your answer in cm/min. [2]

$\frac{y_2 - y_1}{x_2 - x_1} = \frac{7.5}{60} = \frac{1}{8} = 0.125$

Rate of increase 0.125 cm/min

(b) (i) If the depth of water in the container continues to rise at the same rate, what would be the height of the water in the container at 15:20? [1]

15:20 = 80 minutes from 14:00

so $10 + (0.125 \times 80) = 20$ cm

(ii) Why may it not be sensible to state the height of the water in the container at 17:00? [1]

As you will have to extrapolate the data so you can not be sure the rate of increase remains constant.

7. *(a)* The density of glass in a bottle is 2·4 g/cm^3.
The volume of glass used to make the bottle is 13·4 cm^3.

Calculate the mass of the glass bottle.
Give your answer in grams. [2]

density = mass / volume

mass = density × volume

= 2.4 × 13.4

= 32.16

≈ 32.2 (1dp)

Mass 32.2 g

(b) A force of 135 N is applied to an area of 3600 cm^2.

Calculate the pressure.
Give your answer in N/m^2. [3]

area of 3600 cm^2 is 0.36 m^2 ($\div 100^2$)

$P = \frac{F}{A}$

$P = \frac{135}{0.36} = 375$

Pressure 375 N/m^2

8. The driving theory test consists of 50 questions.
At least 43 of these questions must be answered correctly to pass the test.
For each question in the test, four possible answers are given. Only one of these answers is correct.

Waldo takes the test.
Waldo knows 78% of the facts assessed in the test.
For each question based on these facts he selects the correct answer.

On all other questions he randomly selects one of the four possible answers.

(a) A question is selected at random from the paper.
Calculate the probability that Waldo correctly answers the question. [4]

$\frac{78}{100_2} \times 50 = 39$ = correct $50 - 39 = 11$ ← randomly select the answer

P(correct answer) $= \frac{1}{4}$

$11 \times \frac{1}{4} = 2.75$ = correct by chance

P(correctly answers question) $= \frac{39 + 2.75}{50}$

$= \boxed{0.835}$

(b) Is Waldo likely to pass his driving theory test?

Yes ☐ No ☑

You must show all your working to support your answer. [2]

$\frac{43}{50} = 86\%$ for pass rate but the probability of Waldo answering a question correctly is 0.835.

$0.835 \times 50 = 41.75 < 43$

or $83.5\% < 86\%$

Thus unlikely to pass.