Problem of the Week: Week 4 (Sum1): Year 9: Compound Units

• Use compound units such as density to solve problems

Platinum puzzle

Platinum is a very rare metal, with a density of 21.5g/cm^3 .

Assuming that the world production has been about 110 tonnes for each of the past 50 years, and negligible before that, which of the following has a comparable volume to that of the total amount of platinum ever produced?

A: a shoe box,   B: a cupboard,   C: a house,   D: Buckingham Palace,   E: the grand Canyon

https://nrich.maths.org/5682

Solution:

Answer: a house

Estimating using the total weight in grams
110 tonnes × 50 years = 5500 tonnes
= 5 500 000 kg
= 5 500 000 000 g
21.5 g ≈ 22 g (22 and 55 both multiples of 11)

5 500 000 000 ÷ 22 = (55 ÷ 22) × 100 000 000
= 2.5 × 100 000 000
= 250 000 000

The platinum occupies 250 000 000 cm^3 = 250 m^3
= 10 m × 5 m × 5 m

Estimating using the volume of 1 kg
21.5 g is approximately 1 cm^3
1000 g is approximately 1 cm^3 ×50 = 50 cm^3
1000 kg is approximately 50 cm^3 × 1000 = 50 000 cm^3
110 tonnes is approximately 50 000 cm^3 × 110 = 5 500 000 cm^3
5 500 000 cm^3 = 5.5 m^3
So about 5.5 m^3 per year
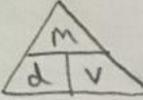5.5 m^3 × 50 years ≈ 250 m^3
250 m^3 = 10 m × 5 m × 5 m

Float?

The density of water is 0.997g/cm^3. If an object is less dense than water it floats. Will the following sink or float?
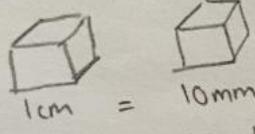
a)   An 8000mm^3 lump of carbon weighing 28g.

b)   A 0.16kg orange with a volume of 156cm^3

If a banana has a mass of 150g and floats, what can you say about its volume?

NCETM: secondary assessment materials

Solution:

density $=\dfrac{\text{mass}}{\text{volume}}$

a) $8000\,\text{mm}^3$

$1\,\text{cm} = 10\,\text{mm}$

$10 \times 10 \times 10 = 1000\,\text{mm}^3$

$1\,\text{cm}^3 = 1000\,\text{mm}^3$

so $8\,\text{cm}^3 = 8000\,\text{mm}^3$

$\dfrac{28}{8} = 3\cdot 5\,\text{g/cm}^3$ sink

b) $\dfrac{0\cdot 16}{156} = 0\cdot 001$ float

Banana Floats   density $=\dfrac{\text{mass}}{\text{volume}}$

$< 0\cdot 997 = \dfrac{150\text{g}}{?}$

Well $\dfrac{150}{150} = 1$ so it must be divided by a number
$> 150\,\text{cm}^3$