GCSE (9–1)
MATHEMATICS

Higher Check In - 3.02 Standard form

Do not use a calculator for questions 1-5.

1. Calculate $(1.2 \times 10^{-3}) \div 20^3$ giving your answer in standard form.

2. Each edge of a cube is (4×10^2) mm long. Find the volume of the cube in m^3, giving your answer in standard form.

3. Work out $\dfrac{1.5 \times 10^4}{2.3 \times 10^{-2} + 2.0 \times 10^{-3}}$, giving your answer in standard form.

4. How many times bigger is 20^3 compared to $(0.2)^3$? Give your exact answer in standard form.

5. Write the following expressions in order from smallest to largest.

$$\left(\frac{\left(2 \times 10^3\right) \times \left(6 \times 10^{-2}\right)}{3 \times 10^2} \right) \qquad \left(2 \times 10^{-2}\right)^3 \qquad \sqrt{\left(6.4 \times 10^{-5}\right)} \qquad \left(\frac{\left(6 \times 10^{-2}\right) \times \left(3 \times 10^4\right)}{1.8 \times 10^3} \right)$$

6. The UK population is rising by 7% each decade. In 2010 the UK population was 6.277×10^7. A newspaper headline in 2010 said, "UK population will be 72 million by 2030". Show that the headline is correct.

7. Alan works out $(3.2 \times 10^5) \div (8.0 \times 10^{-2})$ and gives the answer 4×10^2. Without doing the calculation, explain how you know the answer is wrong.

8. A bus company wants to buy a large quantity of fuel. Two companies are selling the fuel at the below prices.

Fuel Solutions	Value Fuels
3×10^3 dekalitres for £1239 (1 dekalitre = 10 litres)	1.2×10^3 hectolitres for £4980 (1 hectolitre = 100 litres)

   Which company is offering the best value for money? Show all your working.

9. A grain of sand has radius 3.1×10^{-3} mm. Use the formula for the volume of a sphere, $V = \dfrac{4 \times \pi \times r^3}{3}$, to estimate the number of grains of sand in a $1 \, m^3$ bag.

10. The Earth travels approximately 9.4×10^8 km in its orbit around the sun. Calculate the average speed of the Earth around the sun in metres per second.

Extension

The speed of light is 6.7×10^8 miles per hour.
Show that this is approximately the same as 3.0×10^5 m/s.
[1 mile = 1.609 km]

Answers

1. 1.5×10^{-7}

2. $6.4 \times 10^{-2} \, m^3$

3. 6×10^5

4. 1×10^6

5. $\left(2 \times 10^{-2}\right)^3 = 8 \times 10^{-6}$ [smallest]

$$\sqrt{\left(6.4 \times 10^{-5}\right)} = 8 \times 10^{-3}$$

$$\left(\frac{\left(2 \times 10^3\right) \times \left(6 \times 10^{-2}\right)}{3 \times 10^2}\right) = 4 \times 10^{-1}$$

$$\left(\frac{\left(6 \times 10^{-2}\right) \times \left(3 \times 10^4\right)}{1.8 \times 10^3}\right) = 1 \times 10^0 \text{ [largest]}$$

6. $6.277 \times 10^7 \times 1.07^2$ = 71 865 373 $\approx$ 72 million so it is correct to 2sf.

7. E.g. The divisor is much smaller than 3.2×10^5 so will go into it many times. However, the answer is smaller than 3.2×10^5 ($10^2 < 10^5$) so it cannot be correct.

   E.g. $10^5 \div 10^{-2} = 10^7$ so Alan's answer looks too small oe.

8. $\dfrac{1239}{3 \times 10^4} = 0.0413$ and $\dfrac{4980}{1.2 \times 10^5} = 0.0415$ oe. Fuel Solutions is better value at 4.13p per litre.

9. Number of grains of sand (N) = $\dfrac{\text{Total volume}}{\text{Volume of one grain}}$

$$N = \frac{\left(1 \times 10^3\right)^3}{\left(\dfrac{4 \times \pi \times \left(3.1 \times 10^{-3}\right)^3}{3}\right)} = 8.01 \times 10^{15} \text{ (3sf)}$$

10. $\dfrac{9.4 \times 10^8 \times 10^3}{365 \times 24 \times 60 \times 60} = 2.98 \times 10^4$ m/s (3sf)

Extension

$$\frac{6.7 \times 10^8 \times 1.609 \times 10^3}{60 \times 60} = 299\,452\,777.8 = 3.0 \times 10^8 \text{ m/s}$$

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AO1	1	Divide numbers in standard form			
AO1	2	Cube a number in standard form, ensuring answer in standard form			
AO1	3	Divide numbers in standard form			
AO1	4	Compare numbers using standard form			
AO1	5	Order numbers in standard form			
AO2	6	Calculate with standard form and percentage			
AO2	7	Use standard form in estimations			
AO2	8	Use a calculator to perform calculations with numbers in standard form			
AO3	9	Use standard form in standard unit measurement calculations			
AO3	10	Use standard form in compound unit measurement calculations			

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