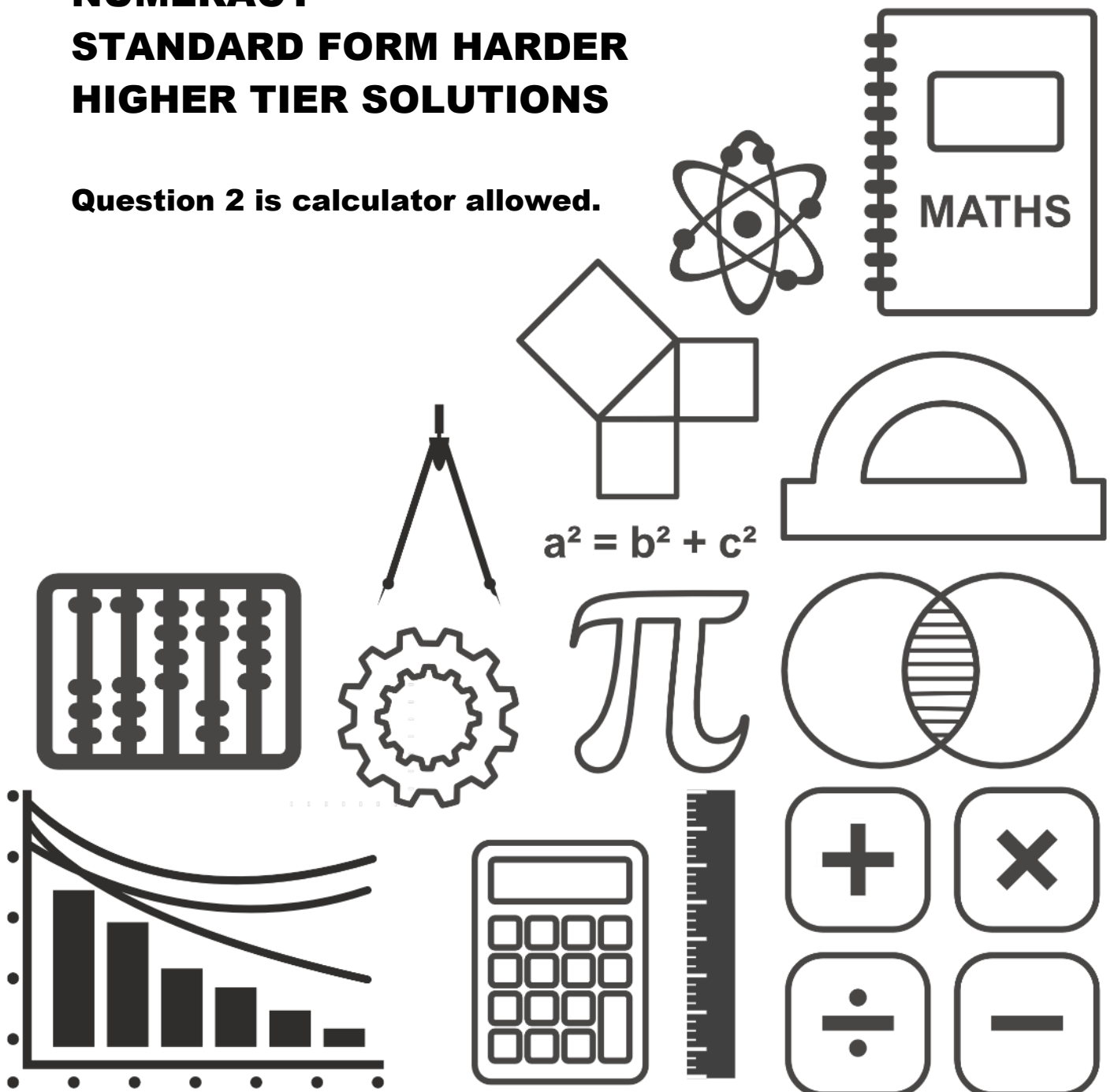


MATHSDIY

GCSE TOPIC BOOKLET NUMERACY STANDARD FORM HARDER HIGHER TIER SOLUTIONS

Question 2 is calculator allowed.



1. Astronomers use astronomical units (AU) to describe distances in our solar system. The distance between the Sun and the Earth is 1 AU. 1 AU is 1.496×10^8 km, correct to 4 significant figures.

- (a) The distance of Pluto from the Sun is 5.913×10^9 km, correct to 4 significant figures.

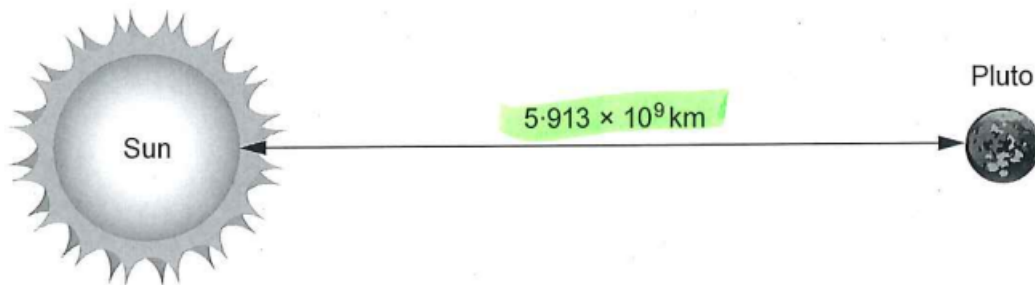


Diagram not drawn to scale

Siôn says that the distance of Pluto from the Sun is less than 50 AU.

Using suitable approximations, estimate the distance of Pluto from the Sun, in AU, to show that Siôn is correct.

You must show all your working.

$$\frac{5.913 \times 10^9}{1.496 \times 10^8} \approx \frac{6 \times 10^9}{1.5 \times 10^8} = \frac{60 \times 10^8}{1.5 \times 10^8}$$

$$= \frac{60}{1.5} = \frac{120}{3} \quad \begin{array}{r} 40 \\ 3 \overline{)120} \end{array}$$

$= 40$ Siôn is correct

- (b) A light year is the distance light travels in one year.

1 light year is approximately 63000 AU. $= 6.3 \times 10^4$

Estimate the length of a light year in km. Give your answer in standard form.

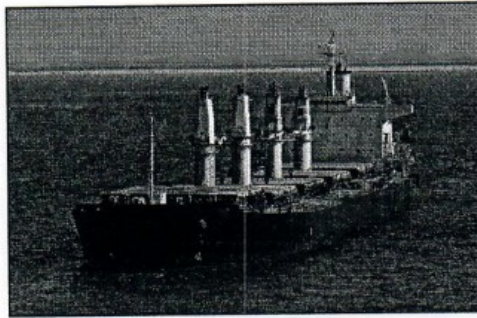
$$= 6.3 \times 10^4 \times 1.496 \times 10^8$$

$$\approx 6 \times 10^4 \times 1.5 \times 10^8$$

$= 9 \times 10^{12}$ km

2. Heledd is the captain of a cargo ship. She is planning her next voyage.

1 tonne = 1000 kg
1 kg = 1000 g



You must be MEGA CAREFUL with units in this question

Heledd has been employed to deliver 3×10^5 tonnes of sand.

Heledd needs to know the volume of the sand before the sand can be loaded on to the ship.

She has been given the following information about the sand:

Mass of a grain of sand	Volume of a grain of sand
1.2×10^{-3} grams	0.32 mm^3

(i) Calculate the number of grains of sand in 3×10^5 tonnes of sand. Give your answer in standard form. [3]

$$= \text{Total mass} \div \text{mass of 1 grain}$$

$$= 3 \times 10^{11} \div 1.2 \times 10^{-3}$$

$$= 2.5 \times 10^{14}$$

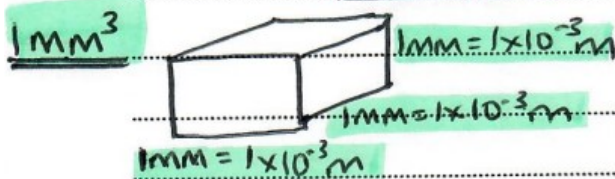
(Careful
 $3 \times 10^5 \text{ tonnes} = 3 \times 10^5 \times 1000 \times 1000 \text{ grams} = 3 \times 10^{11} \text{ grams}$)

(ii) Calculate the volume of the 3×10^5 tonnes of sand in m^3 . [3]

$$\text{Volume} = \text{Volume of 1 grain} \times \text{how many}$$

$$= 0.32 \times 2.5 \times 10^{14}$$

$$= 8 \times 10^{13} \text{ mm}^3$$



So, $1 \text{ mm}^3 = 1 \times 10^{-3} \times 1 \times 10^{-3} \times 1 \times 10^{-3} = 1 \times 10^{-9} \text{ m}^3$

$$\therefore \text{volume} = 8 \times 10^{13} \times 1 \times 10^{-9} = 80,000 \text{ m}^3$$