Exercise 17.3A

1 The mass of the Sun is 2×10^{30} kg.
The mass of the Earth is 6×10^{24} kg.
How many times heavier than the Earth is the Sun?

2 The mass of one atom of the element mercury is 3.3×10^{-22} g.
The mass of the planet Mercury is 3.3×10^{23} kg.
How many mercury atoms are there in 3.3×10^{23} kg?

3 The width of a plant cell is 60 micrometres.
A micrometre is 1×10^{-6} m (one millionth of a metre).
The diagram of a plant cell in a science textbook has width 3 cm.
How many times bigger is the diagram than the real plant cell?

4 A bumblebee weighs 5.2×10^{-5} kg.
An adult man weighs 70 kg.
A bumblebee can carry 75% of its weight.
How many bumblebees would it take to lift a man?
Give your answer in standard form to 3 sf.

5 The diameter of the Earth is 1.3×10^{4} km.
The diameter of the Moon is 3.5×10^{3} km.
The diameter of the Sun is 400 times greater than the diameter of the Moon.
How many times smaller is the diameter of the Earth than the diameter of the Sun?

6 The Earth is 1.496×10^{8} km from the Sun.
Mars is 2.279×10^{8} km from the Sun.
Find the minimum and maximum distances between Earth and Mars.

7 Light travels about 3×10^{8} metres per second.

a Find the time it takes for light to travel 1 metre.

b Find the distance light travels in 1 year.
Give your answers in standard form.

8 The mass of a proton is approximately 1800 times greater than the mass of an electron.
The mass of an electron is 9.11×10^{-31} kg.
A hydrogen atom contains one proton and one electron.
Find the mass of a hydrogen atom.
Give your answer in standard form.

9 The masses of the eight planets in our solar system are listed in the table.
The masses are given in kg.

Mercury	3.30×10^{23}
Venus	4.87×10^{24}
Earth	5.97×10^{24}
Mars	6.42×10^{23}
Jupiter	1.90×10^{27}
Saturn	5.68×10^{26}
Uranus	8.68×10^{25}
Neptune	1.02×10^{26}

Carrie calculated the total mass of the planets. Her answer is $7.686\,12 \times 10^{26}$ kg.

a Which planet did Carrie forget to include in her total?
Calculate the correct total mass.

b What percentage of the total mass does Earth account for?

Give your answer to two significant figures.

10 A gas giant is a large planet that is made up of gas and liquid.
The largest gas giant planets in our solar system are Jupiter and Saturn.
Jupiter has a radius of 6.99×10^{4} km and a mass of 1.90×10^{27} kg.
Saturn has a radius of 5.82×10^{4} km and a mass of 5.68×10^{26} kg.
Lamar claims that Jupiter is twice as dense as Saturn.
Do you agree? Explain your answer.

11 You are given these facts about the planet Venus.

- Venus orbits the Sun at a speed of 1.26×10^{5} km per hour.
- Venus is 1.08×10^{8} km from the Sun.
- Venus' orbit is approximately circular.
- A planet's year is the time it takes for the planet to orbit the Sun.
- Venus' day is 243 Earth days.

a Prove that Venus' day is longer than its year.

b How does the assumption that Venus' orbit is circular affect your answer to part **a**?

1 The mass of the Sun is 2×10^{30} kg.
The mass of the Earth is 6×10^{24} kg.
How many times heavier than the Earth is the Sun?

$$\text{Times heavier} = \frac{\text{Mass of Sun}}{\text{Mass of Earth}} = \frac{2 \times 10^{30}}{6 \times 10^{24}}$$

$$= 333,333$$

$$\text{or } 3.33 \times 10^{5} \text{ to 3 s.f.}$$

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3 The width of a plant cell is 60 micrometres.
A micrometre is 1×10^{-6} m (one millionth of a metre).
The diagram of a plant cell in a science textbook has width 3 cm.
How many times bigger is the diagram than the real plant cell?

$$\text{Times bigger} = \frac{0.03 \text{ m}}{1 \times 10^{-6} \text{ m}} = 30,000$$

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5 The diameter of the Earth is 1.3×10^{4} km.
The diameter of the Moon is 3.5×10^{3} km.
The diameter of the Sun is 400 times greater than the diameter of the Moon.
How many times smaller is the diameter of the Earth than the diameter of the Sun?

$$\frac{\text{Diameter of Sun}}{\text{Diameter of Earth}} = \frac{3.5 \times 10^3 \times 400}{1.3 \times 10^4}$$

$$= 107.69$$

$$= 108 \quad \text{to} \quad 3 \text{ s.f.}$$

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7 Light travels about 3×10^8 metres per second.

a Find the time it takes for light to travel 1 metre.

b Find the distance light travels in 1 year. Give your answers in standard form.

a) $\text{Time} = \frac{1}{3 \times 10^8} = 3.33 \times 10^{-9}$ s

to 3 s.f.

b) Distance in 1 year

$3 \times 10^8 \times 60 \times 60 \times 24 \times 365$

$= 9.4608 \times 10^{15}$ m

$= 9.46 \times 10^{15}$ m to 3 s.f.

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The masses are given in kg.

Mercury	3.30×10^{23}
Venus	4.87×10^{24}
Earth	5.97×10^{24}
Mars	6.42×10^{23}
Jupiter	1.90×10^{27} ✓
Saturn	5.68×10^{26}
Uranus	8.68×10^{25}
Neptune	1.02×10^{26}

Carrie calculated the total mass of the planets. Her answer is $7.686\,12 \times 10^{26}$ kg.

a Which planet did Carrie forget to include in her total?
Calculate the correct total mass.

b What percentage of the total mass does Earth account for?

Give your answer to two significant figures.

a) Add masses of all planets

$= 2.668612 \times 10^{27}$ kg

Subtract 7.68612×10^{26} kg

leaves 1.9×10^{27}

Jupiter is missing

b)

$$\frac{\text{Earth}}{\text{Total}} \times 100\ \%$$

$$\frac{5.97 \times 10^{24}}{2.668612 \times 10^{27}} \times 100$$

$0.2237\ \%$

$= 0.22\ \%$ to 2 s.f.

Finish even numbers for homework tonight