

From crude oil to plastics and fibres

Grade 8 science (Year 9 · Class 8) · Worksheet answers

Each answer gives the reasoning before the result, which is in bold. For evaluation problems accept any well-supported opinion that uses the evidence in the problem.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS1-3

Problem 1 Natural or synthetic?

1. Natural: **cotton, wool, latex**. Synthetic: **nylon, polyester, PVC**.
2. The usual starting resource is **crude oil**.

Problem 2 Put the stages in order

1. The order is **b, d, a, e, c**: crude oil, refinery separation, polymerisation, polythene, bag.
2. The stage is **(a) polymerisation**.

Problem 3 Key words

1. A monomer is a **small molecule that can join with others**.
2. A polymer is a **very long molecule made of many monomers joined in a chain**.
3. The reaction is **polymerisation**.

Problem 4 Property to use

1. (a) **waterproof and flexible**; (b) **does not melt when heated**; (c) **strong and does not rot**.
2. The pan handle, job **(b)**, needs a thermosetting plastic.

Problem 5 Pros and cons of bottles

1. Any two of: **light, unbreakable, cheap, waterproof**.
2. Any two of: **they last for centuries, they litter land and sea, they break into microplastics, they use oil to make**.

Problem 6 Float or sink figure

1. Chips **A and B** float, so their density is less than 1.00 g/cm³.
2. Chips **C and D** sink, so their density is more than 1.00 g/cm³.

Problem 7 Density of a chip

1. $\rho = 23 \text{ g} \div 20 \text{ cm}^3 = \mathbf{1.15 \text{ g/cm}^3}$.
2. 1.15 is more than 1.00, so it **sinks**.
3. It lies between polystyrene (1.05) and PET (1.38), so it is a denser plastic, closer to **PS or PET**.

Problem 8 Recycling rate

1. $120 \div 480 \times 100 = \mathbf{25 \%}$.
2. $480 \text{ kg} - 120 \text{ kg} = \mathbf{360 \text{ kg}}$.

Problem 9 Mass in a reaction

1. Mass is conserved, so the polythene has a mass of **56 g**.
2. The atoms are only rearranged: the same carbon and hydrogen atoms are joined into chains. None are created or destroyed.

Problem 10 Waste in a town

1. The largest share is **packaging, 40 %**.
2. $20 \% \text{ of } 800 \text{ t} = 0.20 \times 800 = \mathbf{160 \text{ t}}$.
3. $(25 \% + 20 \%) \text{ of } 800 \text{ t} = 0.45 \times 800 = \mathbf{360 \text{ t}}$.

Problem 11 Wool or fleece?

1. Any two of: **lighter, dries faster, cheaper, easy to wash**.
2. Wool is a natural material and does not release plastic fibres in the wash, so it is a **better choice for the environment**.
3. **Wool** is renewable, because sheep grow a new fleece every year.

Problem 12 Heating plastics

1. Strip **X** is the thermoplastic.
2. Strip **Y** suits a kettle handle.
3. A handle must stay rigid and not soften when hot, so a thermosetting plastic is safer.

Problem 13 Spot the errors

1. (a) Polythene is a **polymer**; ethene is the monomer. (b) **No atoms disappear**, so the masses are equal. (c) Polythene has a density of about 0.95 g/cm^3 , so it **floats at any size**.

Problem 14 Bag break-even

1. $1.2 \text{ kg} \div 0.04 \text{ kg} = \mathbf{30 \text{ bags}}$.
2. The cloth bag must be used **at least 30 times** to break even; any further use is a saving.

Problem 15 Counting chain units

1. There are **8 units**.
2. $8 \times 28 = \mathbf{224 \text{ atomic mass units}}$.
3. $1\,000 \times 28 = \mathbf{28\,000 \text{ atomic mass units}}$. Check $28 = 2 \times 12 + 4 \times 1$.

Problem 16 Plant output

1. $7.0 \text{ t} \times 24 = \mathbf{168 \text{ t}}$.
2. $168 \text{ t} = 168\,000\,000 \text{ g}$. Bags = $168\,000\,000 \div 8.0 = \mathbf{21\,000\,000 \text{ bags}}$.

Problem 17 Shed fibres

1. $0.4 \text{ g} \times 3 \times 52 = \mathbf{62.4 \text{ g}}$.
2. $62.4 \text{ g} \times 50\,000 = 3\,120\,000 \text{ g} = \mathbf{3.12 \text{ t}}$.
3. Wash less often, use a filter bag or choose natural fibres: **capture or avoid the fibres**.

Problem 18 Separating a mixture of plastics

1. **PP and PE** float in water.
2. **PS** (1.05) floats in 1.20 g/cm^3 solution.
3. **PET (1.38) and PVC (1.40)** both sink. Their densities differ by only 0.02 g/cm^3 , so another method is needed.

Problem 19 Bag ban

1. $124 \div 200 \times 100 = \mathbf{62 \%}$.
2. $31 \div 124 \times 100 = \mathbf{25 \%}$.
3. Bags are one quarter of the plastic litter, so a ban helps but does not solve the problem. Other items such as bottles and packaging also need action, and affordable reusable bags must be available. **A partial but useful step**.

Problem 20 Choosing a bottle plastic

1. Mass = density $\times$ volume: P $0.95 \times 40 = \mathbf{38 \text{ g}}$; Q $1.38 \times 40 = \mathbf{55.2 \text{ g}}$; R $1.05 \times 40 = \mathbf{42 \text{ g}}$.
2. Choose **P**: it is the lightest, it softens only at 120°C so it survives a hot car, and it is flexible, so it does not shatter if dropped. R is brittle and Q softens at 80°C .