

Applied Science Bridging Workbook

Biology · Chemistry · Physics

Answer Key

AQA Trilogy GCSE → Cambridge Advanced National in Applied Science

For teacher / student use

This answer key contains suggested answers for all three subjects. Many questions allow more than one acceptable response — accept any reasonable answer that demonstrates understanding of the relevant GCSE content.

About this booklet

This page summarises what is in the combined Science Bridging Workbook and the things to be aware of when using it with students. The workbook is divided into three parts — Biology, Chemistry and Physics — and this answer key follows the same structure.

Part 1 — Biology

What's in the workbook:

The biology part is 13 pages and contains four topic sections weighted by depth of overlap with the Cambridge unit:

Topic 1 — Cell structure and microscopy (5 pages, longest):

- Label diagrams for an animal cell, a plant cell and a bacterial cell
- Comparison table for structures found in animal vs plant cells; matching task linking structures to functions
- Differences between bacterial and plant cells; size calculations (μm , standard form)
- Identify four specialised cells (sperm, red blood cell, root hair, nerve) and explain their adaptations
- Definitions of tissue, organ and organ system
- Label a leaf cross-section; compare xylem and phloem; root hair cell adaptation
- Magnification calculations; advantages of electron microscopy

Part 2 — Chemistry

What's in the workbook:

The chemistry part is 13 pages and contains four topic sections weighted by depth of overlap:

Topic 1 — Atomic structure and the Periodic Table (longest):

- Sub-atomic particles table; label a lithium atom (Bohr-model diagram)
- Isotopes and relative atomic mass calculation; electron configurations (O, Na, Cl, Ca)
- Label a simplified periodic table (Group 1, Group 7, transition metals, Group 0)
- Trends and properties in Groups 0, 1 and 7; metals vs non-metals

Periodic table diagram (Topic 1, Q6): uses colour shading with a printed legend (blue = Group 1, yellow = Group 7, green = transition metals, purple = Group 0). Works in black and white but colour distinctions become greyscale shades.

Part 3 — Physics

What's in the workbook:

The physics part is 11 pages and contains three topic sections (the Cambridge unit covers physics in three topic areas, not four):

Topic 1 — Electricity (3.5 pages):

- Identify eight circuit symbols (cell, lamp, switch, resistor, voltmeter, ammeter, variable resistor, diode)
- Define current, p.d. and resistance; units table; $Q = It$ and $V = IR$ with calculations
- Series vs parallel comparison table with GCSE circuit diagrams
- Series resistance calculation; why household appliances are wired in parallel
- Power in circuits ($P = VI$) with a kettle energy calculation

General answer-key guidance:

Many questions allow more than one acceptable response. Accept any reasonable answer that demonstrates understanding of the relevant GCSE content. Where multiple valid answers exist, the answer key gives a few representative examples.

Part 1

Biology

Answers

Topic 1 — Cell structure and microscopy

Section A — Animal and plant cells

1. Animal cell labels:

- Top to bottom: Nucleus, Cell membrane, cytoplasm, ribosome, mitochondrion

2. Plant cell labels:

- Top to bottom: Nucleus, Cell membrane, cytoplasm, ribosome, mitochondrion, cell wall, chloroplast, vacuole.

3. Structures in animal/plant cells:

Structure	Animal cell?	Plant cell?
Cell membrane	Yes	Yes
Cell wall	No	Yes
Chloroplast	No	Yes
Cytoplasm	Yes	Yes
Mitochondrion	Yes	Yes
Nucleus	Yes	Yes
Permanent vacuole	No	Yes
Ribosome	Yes	Yes

4. Match cell structures to functions:

Structure	Function
Nucleus	Contains the genetic material that controls the cell.
Mitochondrion	The site of aerobic respiration.
Cell membrane	Controls what enters and leaves the cell.
Chloroplast	The site of photosynthesis (plants).
Ribosome	Where proteins are made.
Permanent vacuole	Contains cell sap and helps keep the cell rigid (plants).

Section B — Prokaryotic cells

5. Bacterial cell labels:

- Top to bottom: Cytoplasm, cell membrane, cell wall, DNA loop, Plasmid, Flagellum (on left)

6. Two differences between bacterial cells and plant cells (any two):

- Bacterial cells have no nucleus; plant cells do.
- Bacterial cells have a single DNA loop and plasmids; plant cells have chromosomes inside a nucleus.
- Bacterial cells have no chloroplasts; plant cells do.
- Bacterial cells have no mitochondria; plant cells do.
- Bacterial cells are much smaller than plant cells.
- Bacterial cell walls are not made of cellulose; plant cell walls are.

7. Size calculations:

- a) $1\ \mu\text{m} = 1 \times 10^{-6}\ \text{m}$ (= 0.000001 m)
- b) $20\ \mu\text{m} \div 1\ \mu\text{m} = 20$. The animal cell is approximately 20 times larger.

Section C — Specialised cells and tissues

8. Specialised cells (sample answers — accept any sensible feature):

Cell	Name	Example adaptation
A	Sperm cell	Has a long tail / flagellum so it can swim to the egg. (Or: many mitochondria for energy; acrosome containing enzymes to digest the egg's membrane.)
B	Red blood cell	Biconcave disc shape gives a large surface area for absorbing oxygen. (Or: no nucleus, so more room for haemoglobin.)
C	Root hair cell	Long projection (root hair) gives a large surface area for absorbing water and mineral ions from the soil.
D	Nerve cell (motor neurone)	Long axon to carry electrical impulses over long distances. (Or: myelin sheath to speed up impulse transmission; branched dendrites to make connections with other cells.)

9. Definitions:

- a) A tissue is a group of cells with a similar structure and function.
- b) An organ is an aggregation (group) of different tissues working together to perform a specific function.
- c) An organ system is a group of organs that work together to form a specific function within an organism.

Section D — Plant tissues

10. Leaf cross-section labels:

- Top to bottom, upper epidermis, palisade layer, spongy mesophyll, lower epidermis, guard cell, stoma

11. Xylem vs phloem:

Feature	Xylem	Phloem
Substance transported	Water and mineral ions	Dissolved sugars (e.g. sucrose)
Direction	Roots to stems and leaves (one direction, upwards)	Leaves to the rest of the plant (can be in different directions)

Name of process	Transpiration stream	Translocation
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12. Root hair cell adaptation (any one):

The long, thin root hair projection gives the cell a much larger surface area, which allows more water (by osmosis) and mineral ions (by active transport) to be absorbed from the soil at the same time.

Other acceptable answers: thin cell wall provides a short diffusion distance; lots of mitochondria provide the energy needed for active transport of mineral ions.

Section E — Microscopy**13.** Magnification calculations:

a) Magnification = $50 \div 0.05 = \times 1000$

b) Real length = $30 \div 15\,000 = 0.002\text{ mm} = 2\ \mu\text{m}$

14. Advantage of electron microscope (any one):

- Higher magnification, so smaller structures can be seen.
- Higher resolution / resolving power, so finer detail can be seen.
- Allows sub-cellular structures (e.g. ribosomes, internal structure of mitochondria) to be visible.

Part 2

Chemistry

Answers

Topic 1 — Atomic structure and the Periodic Table

Section A — Atomic structure

1. Sub-atomic particles table:

Particle	Relative charge	Relative mass	Where in the atom?
Proton	+1	1	In the nucleus
Neutron	0	1	In the nucleus
Electron	-1	Very small ($\approx 1/1836$, treat as 0)	Orbiting the nucleus in shells (energy levels)

2. Lithium atom labels:

- Centre (orange circle, 3p 4n): nucleus
- Single blue circle on the left: electron
- Inner dashed circle: inner shell (first energy level)
- Outer dashed circle: outer shell (second energy level)

3. Sodium $^{23}_{11}\text{Na}$:

- Atomic number = 11
- Mass number = 23
- 11 protons, 12 neutrons ($= 23 - 11$), 11 electrons.

4. Chlorine isotopes:

- Isotopes are atoms of the same element (same number of protons) but with different numbers of neutrons (so different mass numbers).
- Relative atomic mass = $(35 \times 75 + 37 \times 25) \div 100 = (2625 + 925) \div 100 = 3550 \div 100 = 35.5$

5. Electronic structures:

- Oxygen ($Z = 8$): 2, 6
- Sodium ($Z = 11$): 2, 8, 1
- Chlorine ($Z = 17$): 2, 8, 7
- Calcium ($Z = 20$): 2, 8, 8, 2

Section B — The Periodic Table

6. Periodic table labels:

- Blue (left) column with Li, Na, K: Group 1 (alkali metals)
- Yellow column with F, Cl, Br, I: Group 7 (halogens)
- Green block in the middle of period 4: transition metals
- Purple column on the right (He, Ne, Ar, Kr): Group 0 (noble gases)

7. Periodic table terms:

- A group.
- A period.
- Elements in the same group have the same number of electrons in their outer shell (outer-shell electrons). The number of outer-shell electrons determines how the atom reacts, so elements in the same group behave similarly.

8. Group 1 (alkali metals):

- 1 electron in the outer shell.
- Sodium floats on the water surface, fizzes vigorously, and may produce a flame. It moves around the surface as a small ball (it melts). Hydrogen gas is produced and an alkaline solution forms.

c) Reactivity increases going down Group 1. This is because the outer electron is in a shell further from the nucleus (and is shielded by more inner shells), so it is held less tightly. The outer electron is therefore more easily lost in reactions.

9. Group 7 (halogens):

a) 7 electrons in the outer shell.

b) Reactivity decreases going down Group 7.

c) Chlorine + potassium bromide → potassium chloride + bromine

10. Noble gases:

a) Noble gases have a stable (full) outer shell of electrons. They do not need to gain, lose or share electrons to become stable, so they don't form chemical bonds easily.

11. Metals vs non-metals:

Property	Metals	Non-metals
Position on periodic table	Left and centre / bottom	Right and top
Form positive or negative ions?	Positive ions (lose electrons)	Negative ions (gain electrons)
Conductors of electricity?	Good conductors	Generally poor conductors (graphite is an exception)

Part 3

Physics

Answers

Topic 1 — Electricity

Section A — Circuit symbols

1. Circuit symbols:

Letter	Component
A	Cell
B	Lamp
C	Switch (open)
D	Resistor
E	Voltmeter
F	Ammeter
G	Variable resistor
H	Diode

Section B — Current, potential difference and resistance

2. Definitions:

a) Electric current is the rate of flow of electric charge (the flow of electrons through a wire, or the flow of ions through an electrolyte).

b) Potential difference (voltage) is the energy transferred per unit charge between two points in a circuit. It is what 'pushes' the current around the circuit.

c) Resistance is a measure of how difficult it is for charge to flow through a component. The greater the resistance, the smaller the current for a given potential difference.

3. Units table:

Quantity	Unit	Unit symbol
Charge	coulomb	C
Current	ampere (or amp)	A
Potential difference	volt	V
Resistance	ohm	Ω

4. Charge equation:

$$\text{charge} = \text{current} \times \text{time} \quad (Q = I \times t)$$

5. Ohm's law:

$$\text{potential difference} = \text{current} \times \text{resistance} \quad (V = I \times R)$$

6. Charge calculation:

$$Q = I \times t = 3 \times 60 = 180 \text{ C}$$

7. Resistance calculation:

$$R = V \div I = 12 \div 0.5 = 24 \Omega$$

Section C — Series and parallel circuits

8. Series and parallel circuits identification:

Circuit A (single loop) is the series circuit. Circuit B (separate branches) is the parallel circuit.

9. Series vs parallel comparison:

Feature	Series circuit	Parallel circuit
Current	Same at all points in the circuit	Splits between branches (sum of branch currents equals total current)
Potential difference	Shared between components (sum equals total p.d. of supply)	Same across each component / branch (equal to the supply p.d.)
Adding another resistor	Total resistance increases	Total resistance decreases (becomes less than the smallest individual resistance)

10. Series resistance:

$$R_t = R_1 + R_2 = 4 + 6 = 10 \Omega$$

11. Why parallel for household appliances:

In a parallel circuit, each appliance gets the full mains voltage (so it works at the correct power), and each appliance can be switched on and off independently. If one appliance is switched off (or breaks), the others continue to work because the current can still flow through the other branches. In a series circuit, one broken appliance would break the whole circuit.

Section D — Power in circuits**12. Power equation:**

$$\text{power} = \text{potential difference} \times \text{current} \quad (P = V \times I)$$

13. Kettle calculation:

a) $P = V \times I = 230 \times 10 = 2300 \text{ W}$ (or 2.3 kW)

b) $E = P \times t = 2300 \times 120 = 276\,000 \text{ J}$ (or 276 kJ)