Vertex Academy

Year 10 Science workbook

20 worksheets · answers at the back

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Year 10 Science: Chemical bonding: ions, ionic bonds and covalent bonds

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Is N_2 a molecule, a compound, both or neither? Explain.

2. How many atoms of each element are in one formula unit of $Ca(OH)_2$?

3. Write the formula of the ion formed by potassium (2,8,8,1) and by sulfur (2,8,6).

4. Write the formula of magnesium oxide and of sodium carbonate.

5. Explain why chlorine atoms bond covalently in Cl_2 but ionically with sodium.

Fix the mistake

6. Correct this statement: "Chlorine gains an electron, so it becomes Cl^+."

7. Correct this statement: "Magnesium oxide is Mg_2O_2, because magnesium loses 2 and oxygen gains 2."

8. Correct this statement: "Calcium nitrate is $CaNO_{32}$."

9. Correct this statement: "Salt is made of NaCl molecules."

Year 10 Science: Naming compounds and balancing chemical equations

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Name K_2O, $CaSO_4$ and N_2O_4.

2. Write the formula for sulfur trioxide and for calcium chloride.

3. Balance: $Mg + HCl \rightarrow MgCl_2 + H_2$

4. Balance: $Na + Cl_2 \rightarrow NaCl$

5. A student heats magnesium ribbon in an open crucible and finds the mass increases. Does this disprove conservation of mass? Explain.

Fix the mistake

6. Correct this statement: "To balance $H_2 + O_2 \rightarrow H_2O$, I can change the water to H_2O_2."

7. Correct this statement: "$MgCl_2$ is magnesium dichloride."

8. Correct this statement: "CO_2 is monocarbon dioxide."

9. Correct this statement: "The open beaker got lighter, so some mass was destroyed in the reaction."

Year 10 Science: Combination reactions and combustion

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Write a balanced equation for calcium combining with oxygen, and say whether the product is ionic or covalent.

2. Balance the complete combustion of ethane: $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

3. A camping stove has a yellow, sooty flame. Name two products besides water and explain the cause.

4. Gas from a burning candle is bubbled through limewater, which turns milky. What does this show?

5. Why is burning magnesium classed as both combustion and combination?

Fix the mistake

6. Correct this statement: "Methane burns to make carbon dioxide and hydrogen."

7. Correct this statement: "Incomplete combustion makes carbon monoxide instead of water."

8. Correct this statement: "Burning magnesium gives off carbon dioxide and water like any fuel."

9. Correct this statement: "Balancing propane, I wrote $C_3H_8 + 5O \rightarrow 3CO_2 + 4H_2O$."

Year 10 Science: Decomposition and neutralisation reactions

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Write the word and balanced symbol equations for heating zinc carbonate.

2. Name the salt formed when magnesium oxide reacts with nitric acid.

3. Balance: $KOH + H_2SO_4 \rightarrow K_2SO_4 + H_2O$

4. Classify: $2KClO_3 \rightarrow 2KCl + 3O_2$

5. In a test, a student saw fizzing when acid was added to a white powder, but did not test the gas. Why can't they say for certain the powder was a carbonate, and what should they add to the method?

Fix the mistake

6. Correct this statement: "Heating copper carbonate gives copper and carbon dioxide."

7. Correct this statement: "A salt means sodium chloride."

8. Correct this statement: "Sodium hydroxide and hydrochloric acid make a salt and hydrogen gas."

9. Correct this statement: "Sulfuric acid makes sulfides."

Year 10 Science: Waves: oscillations, amplitude, wavelength and frequency

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A buoy rises and falls 12 times in one minute. What is the frequency of the waves, and their period?

2. On a diagram, 5 complete waves span 2.0 m. What is the wavelength?

3. A wave is 0.6 m from crest to trough. What is its amplitude?

4. Explain why a duck on a pond is not carried to the shore by ripples.

5. Why can astronauts on a spacewalk not hear an explosion nearby, even though they could see it?

Fix the mistake

6. Correct this statement: "Waves carry the water towards the beach."

7. Correct this statement: "A wave that is 1.6 m from trough to crest has an amplitude of 1.6 m."

8. Correct this statement: "30 waves in 10 s, so the frequency is 10 ÷ 30 = 0.33 Hz."

9. Correct this statement: "One wavelength is the distance from a crest to the next trough."

Year 10 Science: Transverse and longitudinal waves, sound and the EM spectrum

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Say whether each is transverse or longitudinal: a ripple on a pond, a sound wave, a light wave, a slinky pushed in and out.

2. A dog whistle makes sound at 34,300 Hz in air at 343 m/s. Find the wavelength, and explain why people cannot hear it.

3. A whale call in seawater (1,500 m/s) has a wavelength of 3.0 m. What is its frequency?

4. Explain why you can hear a train coming through the rail before you hear it through the air.

5. Put these in order from longest to shortest wavelength: X-rays, radio, visible light, microwaves.

Fix the mistake

6. Correct this statement: "Sound travels fastest in air, because there is less stuff in the way."

7. Correct this statement: "The echo returns after 0.80 s at 1,500 m/s, so the sea is 1,200 m deep."

8. Correct this statement: "A higher note travels faster than a low one."

9. Correct this statement: "A high-pitched sound is a loud sound."

Year 10 Science: Light, colour and uses of electromagnetic waves

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A microwave oven uses microwaves of frequency 2.45×10^{9} Hz. Find their wavelength.

2. Red light has a wavelength of 7.0×10^{-7} m. Find its frequency.

3. A green apple is seen under red light. What colour does it look, and why?

4. Which EM wave would you choose to (a) find a lost tramper at night, (b) check a broken arm, (c) send a text?

5. Why is light from a torch visible at the bottom of a clear pool, but bent where it enters the water?

Fix the mistake

6. Correct this statement: "100 MHz, so $\lambda = 3.0 \times 10^{8} \div 100 = 3{,}000{,}000$ m."

7. Correct this statement: "A red shirt looks red under any light, because red is its colour."

8. Correct this statement: "Light entering glass bends away from the normal."

9. Correct this statement: "Radio waves are a kind of sound wave."

Year 10 Science: Forces and acceleration: F = ma, inertia and force pairs

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A 1200 kg car has a net forward force of 3600 N on it. What is its acceleration?

2. A cyclist and bike have a total mass of 80 kg and accelerate at 1.5 m/s². What net force is acting?

3. A 2 kg trolley is pulled with 10 N while friction acts against it with 4 N. Find the net force and the acceleration.

4. A swimmer pushes on the pool wall with 300 N. What force does the wall put on the swimmer, and why does the wall not move noticeably?

5. A ball bearing is dropped into a tall tube of cooking oil. Its speed rises at first, then stays steady. Explain this using forces.

Fix the mistake

6. Correct this statement: "If something is moving, there must be a net force pushing it forward."

7. Correct this statement: "The trolley has a 100 N push, so a = 100 ÷ 40 = 2.5 m/s²."

8. Correct this statement: "Action and reaction forces cancel out, so nothing can accelerate."

9. Correct this statement: "In a tackle, the heavier player pushes harder on the lighter one."

Year 10 Science: Pressure in liquids and gases, depth and hydraulics

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A box weighing 240 N rests on a face of area 0.6 m². What pressure does it put on the floor?

2. Find the pressure from the water 5 m down in Lake Taupō. Fresh water has density 1000 kg/m³; use g = 9.8 N/kg.

3. Explain why a dam wall is built thicker at the bottom than at the top.

4. A hydraulic lift has a small piston of 0.0005 m² and a large piston of 0.05 m². A 40 N push is applied to the small piston. Find the output force and the mechanical advantage.

5. A student measures each jet from a holed bottle once, with a ruler held by hand. Suggest two improvements, and say whether each improves accuracy or reliability.

Fix the mistake

6. Correct this statement: "P = 600 ÷ 400 cm² = 1.5 Pa."

7. Correct this statement: "Pressure in water only pushes down."

8. Correct this statement: "The water pressure on a dam is bigger when the lake behind it stretches back further, even at the same depth."

9. Correct this statement: "A hydraulic jack gives you more energy than you put in."

Year 10 Science: Buoyancy: why things float or sink

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A block weighs 20 N in air and 14 N when completely underwater. What is the buoyant force?

2. A fishing float has a weight of 0.5 N and floats on a lake. What is the buoyant force on it, and why?

3. An object is fully underwater in the sea and displaces 0.003 m³ of seawater (density 1025 kg/m³). Find the buoyant force, using g = 9.8 N/kg.

4. A kayaker paddles from the Waikato River out into the sea at Port Waikato. Does the kayak sit higher or lower in the water at sea? Explain.

5. A student tests whether shape affects floating, using a different amount of plasticine for each shape. What is wrong with this test, and how would you fix it?

Fix the mistake

6. Correct this statement: "Heavy things sink and light things float."

7. Correct this statement: "The buoyant force is always equal to the object's weight."

8. Correct this statement: "The spring balance reading in water is the buoyant force."

9. Correct this statement: "0.46 kg of water is displaced, so the buoyant force is 0.46 N."

Year 10 Science: The water cycle part 1: Earth's spheres, the Sun and weather

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Water is inside the leaves of a kauri tree. Which sphere is it in?

2. A puddle dries up on a sunny afternoon. Name the change of state, and say whether energy is taken in or given out.

3. Explain why the equator is warmer than Antarctica, using the idea of sunlight being spread out.

4. Dry air is about 21% oxygen. About how many litres of oxygen are there in 100 L of dry air?

5. Use the storage table to explain why water in the atmosphere is replaced much faster than water in the oceans.

Fix the mistake

6. Correct this statement: "The steam from a kettle and the clouds in the sky are water vapour."

7. Correct this statement: "Condensation cools the air, because it happens when things are cold."

8. Correct this statement: "Precipitation is the change of state from gas to liquid."

9. Correct this statement: "The equator is hotter because it is closer to the Sun."

Year 10 Science: The water cycle part 2: evaporation, clouds and precipitation

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. What is the name for water vapour leaving a plant through its leaves?

2. Moist air is blown up over the Kaimai Range. Explain why clouds often form over the hills.

3. What is the difference between hail and sleet?

4. In the bowl model, what does the ice on the cling film represent, and what is one limitation of this part?

5. It rains somewhere on Earth every day, yet the total amount of water on Earth does not go up. Why not?

Fix the mistake

6. Correct this statement: "Water only evaporates when it is heated until it boils."

7. Correct this statement: "Rising air cools because it is moving further from the warm ground."

8. Correct this statement: "Hail is just frozen rain, so it only falls in cold weather."

9. Correct this statement: "Two dishes holding 100 mL each will dry at the same rate, because they hold the same amount."

Year 10 Science: Plate tectonics: plates, boundaries, earthquakes and volcanoes

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A plate moves 5 cm a year. How far does it move in 2 million years? Give your answer in km.

2. What type of boundary is the Alpine Fault mainly, and what mountain range has formed along it?

3. Why are there active volcanoes in the central North Island but not along the Alpine Fault?

4. Give the main reason most scientists rejected Wegener's continental drift at first, and what later evidence changed their minds.

5. A map shows a long line of earthquakes in the middle of the Atlantic Ocean, mostly shallow, with some volcanoes. What type of boundary is this, and why?

Fix the mistake

6. Correct this statement: "The plates float on a layer of liquid magma."

7. Correct this statement: "The Alpine Fault is a subduction zone, like the one under the North Island."

8. Correct this statement: "Volcanoes and earthquakes happen at every type of boundary."

9. Correct this statement: "480 km is 480 000 cm."

Year 10 Science: DNA, genes, chromosomes and proteins

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. One DNA strand reads G G A T C T. Write the partner strand.

2. Put these in order from largest to smallest: gene, nucleus, base, chromosome.

3. Name the protein type for each: antibody, amylase, keratin.

4. Is the number of petals on a flower discrete or continuous? What about the mass of a lamb at birth?

5. Give one strength and one limitation of a flat paper diagram of DNA.

Fix the mistake

6. Correct this statement: "The partner of A T G is A T G, or A pairs with G."

7. Correct this statement: "A chromosome is the same thing as a gene."

8. Correct this statement: "My height is 162 cm, a whole number, so height is discrete data."

9. Correct this statement: "Your phenotype is decided by your genes alone."

Year 10 Science: How genes and environment shape traits and variation

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Explain how a gene leads to hair being strong, using the word keratin.

2. Every cell in your body has the insulin gene. Why do only some cells make insulin?

3. A tuatara egg is incubated at a high temperature. Which sex is it most likely to hatch as, and is that caused by genes or environment?

4. Two cloned sheep have identical genes but different body mass. Suggest a reason.

5. Why did many scientists before 1944 think proteins, not DNA, carried inherited information?

Fix the mistake

6. Correct this statement: "Each trait, like height or eye colour, is controlled by one gene."

7. Correct this statement: "Skin cells make keratin because they have the keratin gene and other cells do not."

8. Correct this statement: "Two cloned sheep have the same genes, so they must look exactly the same."

9. Correct this statement: "A sheep that grew big on good pasture will pass its size on to its lambs."

Year 10 Science: The nervous system: brain, spinal cord and nerves

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Name the two parts of the central nervous system.

2. A gymnast keeps her balance on a narrow beam. Which brain region is mainly responsible?

3. Sort into voluntary or automatic: sneezing, texting a friend, your stomach churning food, choosing a lunch.

4. Name the stimulus and the sense organ that detects it when you hear a fire alarm.

5. In the ruler drop test, why should the dropper not count down before letting go?

Fix the mistake

6. Correct this statement: "The brainstem controls balance."

7. Correct this statement: "The spinal cord is part of the peripheral nervous system, because it runs down the back."

8. Correct this statement: "A nerve is one long nerve cell."

9. Correct this statement: "In the ruler drop, the stimulus is the eye."

Year 10 Science: Sensory neurons, motor neurons and the reflex arc

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Which type of neuron carries signals from the spinal cord to a muscle?

2. Name one effector that is a gland and the substance it releases.

3. You step on a sharp shell at the beach and lift your foot. Put these in order: motor neuron, receptor, effector, sensory neuron, spinal cord.

4. Why do you lift your foot before you feel the pain?

5. A student tests reaction time on one friend, once each, before and after an energy drink. Give two reasons the data is not reliable.

Fix the mistake

6. Correct this statement: "Sensory neurons carry the signal to the muscle."

7. Correct this statement: "In a reflex the brain decides very quickly what to do."

8. Correct this statement: "Effectors are always muscles."

9. Correct this statement: "Testing one friend ten times makes the result true for everyone."

Year 10 Science: Thermoregulation: how your body controls its temperature

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. What is normal human core body temperature, and which part of the brain controls it?

2. Explain how sweating cools the body.

3. Why do your fingers go pale and cold on a frosty morning?

4. Explain why thermoregulation is called negative feedback.

5. A runner's face turns red in a race. Name the process and explain how it helps.

Fix the mistake

6. Correct this statement: "Sweat cools you down because sweat is cold."

7. Correct this statement: "Shivering warms you up because your muscles rub together and make friction."

8. Correct this statement: "The skin decides when to sweat or shiver."

9. Correct this statement: "Negative feedback means the body's response is bad for it."

Year 10 Science: Water in ecosystems: soil, plants and transpiration

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Give three ways a plant uses the water its roots take up.

2. Why does a plant on a hot, windy day need more water from the soil?

3. Why can soil rich in organic matter support more life than sandy soil?

4. In the stream transect, which reading would you expect to change most after two weeks of heavy rain, and why?

5. Explain how overfishing of snapper can lead to the loss of a kelp forest.

Fix the mistake

6. Correct this statement: "Plants keep most of the water their roots take in and use it for photosynthesis."

7. Correct this statement: "Transpiration is the plant sweating out water through its roots."

8. Correct this statement: "Clay soil is the best soil because it holds the most water."

9. Correct this statement: "Water and nutrients flow through an ecosystem and are lost, the same as energy."

Year 10 Science: Decomposers, nutrient run-off and protecting waterways

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Name two kinds of microorganism that decompose dead material.

2. Why would plants in a forest eventually stop growing if all decomposers disappeared?

3. Explain why a lake can run out of oxygen after an algal bloom.

4. A farmer plants flax and native shrubs along a stream on her farm. Give two ways this helps the stream.

5. A survey finds many mayfly larvae at one site and almost none at another. What does this suggest about the two sites?

Fix the mistake

6. Correct this statement: "Worms are the main decomposers."

7. Correct this statement: "In eutrophication the algae use up all the oxygen in the lake."

8. Correct this statement: "Fertiliser run-off kills fish because it is poisonous."

9. Correct this statement: "Forests stop rain water from reaching rivers."

Answer key (for parents and tutors)

1. Is N_2 a molecule, a compound, both or neither? Explain.
   A molecule but not a compound: two atoms are bonded, but both are nitrogen, so it is an element.
2. How many atoms of each element are in one formula unit of $Ca(OH)_2$?
   1 calcium, 2 oxygen and 2 hydrogen, because the 2 outside the bracket doubles everything inside.
3. Write the formula of the ion formed by potassium (2,8,8,1) and by sulfur (2,8,6).
   K^+, since potassium loses its single valence electron; S^{2-}, since sulfur gains two to fill its shell.
4. Write the formula of magnesium oxide and of sodium carbonate.
   MgO, because +2 and −2 cancel one to one; Na_2CO_3, because two Na^+ are needed to cancel one CO_3^{2-}.
5. Explain why chlorine atoms bond covalently in Cl_2 but ionically with sodium.
   Two chlorine atoms both need to gain an electron, so they share a pair; sodium readily loses its outer electron, so it transfers to chlorine and the ions attract.
6. Correct this statement: "Chlorine gains an electron, so it becomes Cl^+."
   Electrons are negative, so gaining one makes Cl^-; only losing electrons, as metals do, makes a positive ion.
7. Correct this statement: "Magnesium oxide is Mg_2O_2, because magnesium loses 2 and oxygen gains 2."
   An ionic formula shows the simplest ratio of ions, and one Mg^{2+} already cancels one O^{2-}, so it is MgO.
8. Correct this statement: "Calcium nitrate is $CaNO_{32}$."
   It is $Ca(NO_3)_2$: the nitrate group goes in brackets so the 2 counts whole nitrate ions, not oxygen atoms.
9. Correct this statement: "Salt is made of NaCl molecules."
   Sodium chloride is an ionic lattice of separate Na^+ and Cl^- ions, and NaCl only gives their 1 : 1 ratio.

Answer key (for parents and tutors)

1. Name K_2O, $CaSO_4$ and N_2O_4.
   Potassium oxide (ionic, no prefixes); calcium sulfate (sulfate keeps its name); dinitrogen tetroxide (covalent: 2 N, 4 O).

2. Write the formula for sulfur trioxide and for calcium chloride.
   SO_3; $CaCl_2$, because one Ca^{2+} needs two Cl^-.

3. Balance: $Mg + HCl \rightarrow MgCl_2 + H_2$
   $Mg + 2HCl \rightarrow MgCl_2 + H_2$: two Cl on the right means two HCl, which also gives 2 H to match H_2.

4. Balance: $Na + Cl_2 \rightarrow NaCl$
   $2Na + Cl_2 \rightarrow 2NaCl$: Cl_2 forces 2NaCl, then 2Na balances sodium.

5. A student heats magnesium ribbon in an open crucible and finds the mass increases. Does this disprove conservation of mass? Explain.
   No. Oxygen atoms from the air combined with the magnesium to form magnesium oxide, so atoms were added from outside the system, none were created.

6. Correct this statement: "To balance $H_2 + O_2 \rightarrow H_2O$, I can change the water to H_2O_2."
   Only the numbers in front may change, because a new subscript makes a different substance (H_2O_2 is hydrogen peroxide), so the answer is $2H_2 + O_2 \rightarrow 2H_2O$.

7. Correct this statement: "$MgCl_2$ is magnesium dichloride."
   It is magnesium chloride, because ionic names never use prefixes: the charges of Mg^{2+} and Cl^- already fix the 1 : 2 ratio.

8. Correct this statement: "CO_2 is monocarbon dioxide."
   It is carbon dioxide, because mono is never put on the first element; a prefix goes there only for two or more atoms, as in dinitrogen monoxide.

9. Correct this statement: "The open beaker got lighter, so some mass was destroyed in the reaction."
   The carbon dioxide gas escaped into the room, so its atoms left the beaker; in a sealed flask the mass stays the same.

Answer key (for parents and tutors)

1. Write a balanced equation for calcium combining with oxygen, and say whether the product is ionic or covalent.
   $2Ca + O_2 \rightarrow 2CaO$; ionic, because calcium is a metal and oxygen a non-metal.
2. Balance the complete combustion of ethane: $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$
   $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$: 4 C, 12 H and 14 O on each side (doubling avoids a half O_2).
3. A camping stove has a yellow, sooty flame. Name two products besides water and explain the cause.
   Any two of soot (carbon), CO and CO_2; the burner is short of oxygen, so combustion is incomplete.
4. Gas from a burning candle is bubbled through limewater, which turns milky. What does this show?
   Carbon dioxide is a product, so the candle wax contains carbon.
5. Why is burning magnesium classed as both combustion and combination?
   It reacts with oxygen and releases heat and light (combustion), and two reactants form one product, magnesium oxide (combination).
6. Correct this statement: "Methane burns to make carbon dioxide and hydrogen."
   The hydrogen atoms combine with oxygen, so burning methane fully gives carbon dioxide and water.
7. Correct this statement: "Incomplete combustion makes carbon monoxide instead of water."
   Water still forms, because the hydrogen burns easily; only the carbon ends up as soot and carbon monoxide as well as some carbon dioxide.
8. Correct this statement: "Burning magnesium gives off carbon dioxide and water like any fuel."
   Magnesium contains no carbon or hydrogen, so the only product is magnesium oxide.
9. Correct this statement: "Balancing propane, I wrote $C_3H_8 + 5O \rightarrow 3CO_2 + 4H_2O$."
   Oxygen gas is always O_2, so the oxygen count of 10 atoms means $5O_2$.

Answer key (for parents and tutors)

1. Write the word and balanced symbol equations for heating zinc carbonate.
   zinc carbonate → zinc oxide + carbon dioxide; $ZnCO_3 \rightarrow ZnO + CO_2$, already balanced (1 Zn, 1 C, 3 O each side).
2. Name the salt formed when magnesium oxide reacts with nitric acid.
   Magnesium nitrate, $Mg(NO_3)_2$: magnesium from the base, nitrate from the acid.
3. Balance: $KOH + H_2SO_4 \rightarrow K_2SO_4 + H_2O$
   $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$: two K on the right needs 2KOH, which makes two waters.
4. Classify: $2KClO_3 \rightarrow 2KCl + 3O_2$
   Decomposition: one compound breaks into two simpler substances.
5. In a test, a student saw fizzing when acid was added to a white powder, but did not test the gas. Why can't they say for certain the powder was a carbonate, and what should they add to the method?
   Other reactions also fizz, for example a metal such as zinc with acid gives hydrogen. They should bubble the gas through limewater; turning milky would confirm CO_2 and so a carbonate.
6. Correct this statement: "Heating copper carbonate gives copper and carbon dioxide."
   It gives copper oxide and carbon dioxide, because the carbonate ion loses only one CO_2 and its third oxygen stays with the metal.
7. Correct this statement: "A salt means sodium chloride."
   A salt is any ionic compound made of a metal ion from the base and the negative ion from the acid, such as copper sulfate or magnesium nitrate.
8. Correct this statement: "Sodium hydroxide and hydrochloric acid make a salt and hydrogen gas."
   A hydroxide gives a salt and water, because the acid's H^+ joins the OH^-; hydrogen gas comes from an acid reacting with a metal.
9. Correct this statement: "Sulfuric acid makes sulfides."
   It makes sulfates, because the salt keeps the acid's SO_4^{2-} ion; a sulfide contains only S^{2-}.

Answer key (for parents and tutors)

1. A buoy rises and falls 12 times in one minute. What is the frequency of the waves, and their period?
   f = 12 ÷ 60 = 0.2 Hz; T = 1 ÷ 0.2 = 5 s.
2. On a diagram, 5 complete waves span 2.0 m. What is the wavelength?
   λ = 2.0 ÷ 5 = 0.4 m.
3. A wave is 0.6 m from crest to trough. What is its amplitude?
   0.3 m, because amplitude is half the crest-to-trough height.
4. Explain why a duck on a pond is not carried to the shore by ripples.
   Waves carry energy, not water: the water and the duck oscillate up and down in place as the energy passes under them.
5. Why can astronauts on a spacewalk not hear an explosion nearby, even though they could see it?
   Sound is a mechanical wave and needs particles to travel; space has almost none. Light needs no medium, so they can see it.
6. Correct this statement: "Waves carry the water towards the beach."
   The water only moves in small loops and stays roughly where it was; it is the energy that travels to the beach.
7. Correct this statement: "A wave that is 1.6 m from trough to crest has an amplitude of 1.6 m."
   Amplitude is measured from the rest line to a crest, so it is half of that, 0.8 m.
8. Correct this statement: "30 waves in 10 s, so the frequency is 10 ÷ 30 = 0.33 Hz."
   Frequency is waves divided by time, 30 ÷ 10 = 3 Hz; the 0.33 s is the period, the time for one wave.
9. Correct this statement: "One wavelength is the distance from a crest to the next trough."
   That is only half a wave; a wavelength is one complete wave, from a crest to the next crest.

Answer key (for parents and tutors)

1. Say whether each is transverse or longitudinal: a ripple on a pond, a sound wave, a light wave, a slinky pushed in and out.
   Transverse, longitudinal, transverse, longitudinal.
2. A dog whistle makes sound at 34,300 Hz in air at 343 m/s. Find the wavelength, and explain why people cannot hear it.
   λ = 343 ÷ 34,300 = 0.01 m (1 cm); 34,300 Hz is above the 20,000 Hz limit of human hearing.
3. A whale call in seawater (1,500 m/s) has a wavelength of 3.0 m. What is its frequency?
   f = 1,500 ÷ 3.0 = 500 Hz.
4. Explain why you can hear a train coming through the rail before you hear it through the air.
   Steel is stiff, so sound travels in it about 17 times faster than in air.
5. Put these in order from longest to shortest wavelength: X-rays, radio, visible light, microwaves.
   Radio, microwaves, visible light, X-rays.
6. Correct this statement: "Sound travels fastest in air, because there is less stuff in the way."
   Sound is fastest in solids, because tightly bonded particles pass each push on to their neighbours much faster than far-apart gas particles.
7. Correct this statement: "The echo returns after 0.80 s at 1,500 m/s, so the sea is 1,200 m deep."
   The sound went down and back up, so halve the distance: the sea is 600 m deep.
8. Correct this statement: "A higher note travels faster than a low one."
   In one medium every sound has the same speed; a higher frequency just means a shorter wavelength, since v = fλ.
9. Correct this statement: "A high-pitched sound is a loud sound."
   Frequency sets the pitch and amplitude sets the loudness, so a high note can be quiet and a low note can be loud.

Answer key (for parents and tutors)

1. A microwave oven uses microwaves of frequency 2.45×10^9 Hz. Find their wavelength.
   $\lambda = 3.0 \times 10^8 \div 2.45 \times 10^9 \approx 0.12$ m (12 cm).

2. Red light has a wavelength of 7.0×10^{-7} m. Find its frequency.
   $f = 3.0 \times 10^8 \div 7.0 \times 10^{-7} \approx 4.3 \times 10^{14}$ Hz.

3. A green apple is seen under red light. What colour does it look, and why?
   Black (or very dark): a green apple absorbs red light, and there is no green light for it to reflect.

4. Which EM wave would you choose to (a) find a lost tramper at night, (b) check a broken arm, (c) send a text?
   (a) infrared, with a thermal camera detecting body heat; (b) X-rays, which bone stops; (c) microwaves, used by cellphones.

5. Why is light from a torch visible at the bottom of a clear pool, but bent where it enters the water?
   Clear water transmits light, so it reaches the bottom; light slows down entering water, so a ray at an angle refracts towards the normal.

6. Correct this statement: "100 MHz, so $\lambda = 3.0 \times 10^8 \div 100 = 3{,}000{,}000$ m."
   Convert to hertz first: 100 MHz is 1.0×10^8 Hz, so $\lambda = 3.0$ m.

7. Correct this statement: "A red shirt looks red under any light, because red is its colour."
   The dye only reflects red light, so under green light there is nothing for it to reflect and it looks black.

8. Correct this statement: "Light entering glass bends away from the normal."
   Light slows down entering glass or water, so it bends towards the normal, and away from it only when it comes back out into air.

9. Correct this statement: "Radio waves are a kind of sound wave."
   Radio waves are EM waves that travel at the speed of light, even through space; a radio only turns them into sound with its speaker.

Answer key (for parents and tutors)

1. A 1200 kg car has a net forward force of 3600 N on it. What is its acceleration?
   $a = F \div m = 3600 \div 1200 = 3\ m/s^2$.
2. A cyclist and bike have a total mass of 80 kg and accelerate at 1.5 m/s^2. What net force is acting?
   $F = ma = 80 \times 1.5 = 120\ N$.
3. A 2 kg trolley is pulled with 10 N while friction acts against it with 4 N. Find the net force and the acceleration.
   Net force = 10 − 4 = 6 N, so $a = 6 \div 2 = 3\ m/s^2$ in the direction of the pull.
4. A swimmer pushes on the pool wall with 300 N. What force does the wall put on the swimmer, and why does the wall not move noticeably?
   300 N pushing the swimmer away from the wall (the reaction force); the wall is fixed to the ground and the whole Earth, so its mass is huge and its acceleration is too small to notice.
5. A ball bearing is dropped into a tall tube of cooking oil. Its speed rises at first, then stays steady. Explain this using forces.
   Weight pulls the ball down; the oil pushes up with drag (and a small buoyant force). Drag grows with speed until the upward forces equal the weight, the net force is zero and the ball falls at a steady terminal velocity.
6. Correct this statement: "If something is moving, there must be a net force pushing it forward."
   An object moving at a steady velocity has zero net force on it; a net force changes the velocity, it is not needed to keep it.
7. Correct this statement: "The trolley has a 100 N push, so $a = 100 \div 40 = 2.5\ m/s^2$."
   $F = ma$ uses the net force, so take away the friction first: $(100 - 20) \div 40 = 2\ m/s^2$.
8. Correct this statement: "Action and reaction forces cancel out, so nothing can accelerate."
   The two forces in a pair act on different objects, so they never cancel; only forces on the same object combine into a net force.
9. Correct this statement: "In a tackle, the heavier player pushes harder on the lighter one."
   The forces on the two players are equal and opposite; the lighter player is thrown back more because the same force on less mass gives more acceleration.

Answer key (for parents and tutors)

1. A box weighing 240 N rests on a face of area 0.6 m². What pressure does it put on the floor?
   P = 240 ÷ 0.6 = 400 Pa.
2. Find the pressure from the water 5 m down in Lake Taupō. Fresh water has density 1000 kg/m³; use g = 9.8 N/kg.
   P = 1000 × 9.8 × 5 = 49 000 Pa = 49 kPa from the water (about 150 kPa in total with the air above).
3. Explain why a dam wall is built thicker at the bottom than at the top.
   Pressure in a liquid increases with depth, so the water pushes hardest on the bottom of the wall, which needs to be strongest there.
4. A hydraulic lift has a small piston of 0.0005 m² and a large piston of 0.05 m². A 40 N push is applied to the small piston. Find the output force and the mechanical advantage.
   Pressure = 40 ÷ 0.0005 = 80 000 Pa; output force = 80 000 × 0.05 = 4000 N; mechanical advantage = 4000 ÷ 40 = 100.
5. A student measures each jet from a holed bottle once, with a ruler held by hand. Suggest two improvements, and say whether each improves accuracy or reliability.
   For example: repeat each measurement three times and average (reliability); clamp the ruler in place and keep the water topped up to the same level (accuracy).
6. Correct this statement: "P = 600 ÷ 400 cm² = 1.5 Pa."
   Area must be in m² for pascals, and 1 cm² is 0.0001 m², so 400 cm² is 0.04 m² and P = 15 000 Pa.
7. Correct this statement: "Pressure in water only pushes down."
   At any point in a fluid the pressure pushes equally in all directions, which is why water squirts sideways out of a hole in a bottle.
8. Correct this statement: "The water pressure on a dam is bigger when the lake behind it stretches back further, even at the same depth."
   Liquid pressure depends only on depth and density (P = ρgh), so how far the lake stretches back makes no difference.
9. Correct this statement: "A hydraulic jack gives you more energy than you put in."
   It multiplies force, but the small piston has to move much further than the large one, so no extra energy is made.

Answer key (for parents and tutors)

1. A block weighs 20 N in air and 14 N when completely underwater. What is the buoyant force?
   20 − 14 = 6 N.
2. A fishing float has a weight of 0.5 N and floats on a lake. What is the buoyant force on it, and why?
   0.5 N, because a floating object has balanced forces, so the buoyant force equals its weight.
3. An object is fully underwater in the sea and displaces 0.003 m^3 of seawater (density 1025 kg/m^3). Find the buoyant force, using g = 9.8 N/kg.
   Mass of seawater = 1025 × 0.003 = 3.075 kg; buoyant force = 3.075 × 9.8 ≈ 30 N.
4. A kayaker paddles from the Waikato River out into the sea at Port Waikato. Does the kayak sit higher or lower in the water at sea? Explain.
   Higher: seawater is denser, so the kayak needs to displace a smaller volume to get a buoyant force equal to its weight.
5. A student tests whether shape affects floating, using a different amount of plasticine for each shape. What is wrong with this test, and how would you fix it?
   Mass (and so weight) is not controlled, so any difference could be due to mass instead of shape; use the same mass of plasticine for every shape and change only the shape.
6. Correct this statement: "Heavy things sink and light things float."
   What matters is whether the buoyant force can balance the weight, which depends on density, so a huge steel ship floats while a small pebble sinks.
7. Correct this statement: "The buoyant force is always equal to the object's weight."
   That is only true when it floats; the buoyant force always equals the weight of fluid displaced, which for a sinking object is less than its own weight.
8. Correct this statement: "The spring balance reading in water is the buoyant force."
   The reading in water is what the balance still has to hold up, so the buoyant force is the weight in air minus that reading.
9. Correct this statement: "0.46 kg of water is displaced, so the buoyant force is 0.46 N."
   Mass must be turned into weight, so the force is 0.46 × 9.8 ≈ 4.5 N; kilograms are not newtons.

Answer key (for parents and tutors)

1. Water is inside the leaves of a kauri tree. Which sphere is it in?
   The biosphere (living things).
2. A puddle dries up on a sunny afternoon. Name the change of state, and say whether energy is taken in or given out.
   Evaporation; energy is taken in from the Sun and the ground.
3. Explain why the equator is warmer than Antarctica, using the idea of sunlight being spread out.
   At the equator the Sun's rays arrive nearly straight on, so the energy is concentrated on a small area; near the poles the rays arrive at a low angle, so the same energy is spread over a much larger area (and passes through more air), heating each square metre less.
4. Dry air is about 21% oxygen. About how many litres of oxygen are there in 100 L of dry air?
   About 21 L.
5. Use the storage table to explain why water in the atmosphere is replaced much faster than water in the oceans.
   The atmosphere holds a tiny amount of water that stays about 9 days before falling as precipitation, while the oceans hold a huge amount that stays about 3000 years on average.
6. Correct this statement: "The steam from a kettle and the clouds in the sky are water vapour."
   Water vapour is an invisible gas; steam and clouds are tiny liquid droplets that formed when vapour condensed.
7. Correct this statement: "Condensation cools the air, because it happens when things are cold."
   Cooling starts condensation, but condensation itself gives out energy and warms the air; it is evaporation that takes energy in and cools.
8. Correct this statement: "Precipitation is the change of state from gas to liquid."
   That change is condensation; precipitation is water or ice falling from clouds, with no change of state needed.
9. Correct this statement: "The equator is hotter because it is closer to the Sun."
   The difference in distance is tiny; the equator is hotter because the Sun's rays arrive nearly straight on, so the same energy lands on a smaller area.

Answer key (for parents and tutors)

1. What is the name for water vapour leaving a plant through its leaves?
   Transpiration.
2. Moist air is blown up over the Kaimai Range. Explain why clouds often form over the hills.
   The air is forced to rise; higher up the pressure is lower, so it expands and cools; once it cools to its dew point the water vapour condenses into droplets, forming cloud.
3. What is the difference between hail and sleet?
   Hail is lumps of ice built up in layers as strong updraughts in a thunderstorm carry them up and down; sleet is a mix of rain and snow, or snow that has partly melted as it falls.
4. In the bowl model, what does the ice on the cling film represent, and what is one limitation of this part?
   The cold air high in the atmosphere where vapour condenses; a limitation is that real air cools mainly by rising and expanding, not by touching something cold.
5. It rains somewhere on Earth every day, yet the total amount of water on Earth does not go up. Why not?
   Water is not created by rain; rain is water that evaporated earlier. The total is fixed and just keeps cycling, so precipitation is balanced by evaporation and transpiration.
6. Correct this statement: "Water only evaporates when it is heated until it boils."
   Evaporation happens from the surface at any temperature, just faster when the water is warm, the air is dry and windy, and the surface is large.
7. Correct this statement: "Rising air cools because it is moving further from the warm ground."
   It cools because the air pressure is lower higher up, so the rising air expands, and expanding air cools.
8. Correct this statement: "Hail is just frozen rain, so it only falls in cold weather."
   Hail grows in layers as strong thunderstorm updraughts carry ice up and down through the cloud, so it often falls in summer storms.
9. Correct this statement: "Two dishes holding 100 mL each will dry at the same rate, because they hold the same amount."
   The wider dish dries faster, because more of its particles are at the surface where they can escape.

Answer key (for parents and tutors)

1. A plate moves 5 cm a year. How far does it move in 2 million years? Give your answer in km.
   5 × 2 000 000 = 10 000 000 cm = 100 000 m = 100 km.
2. What type of boundary is the Alpine Fault mainly, and what mountain range has formed along it?
   Transform (with some pushing together); the Southern Alps.
3. Why are there active volcanoes in the central North Island but not along the Alpine Fault?
   Under the central North Island the Pacific Plate is subducting, and water from it helps the mantle melt to make magma; the Alpine Fault is mostly plates sliding past each other with no plate sinking beneath, so little magma forms.
4. Give the main reason most scientists rejected Wegener's continental drift at first, and what later evidence changed their minds.
   He could not explain what force moved the continents; seafloor mapping, mirror-image magnetic stripes and young rock at mid-ocean ridges showed seafloor spreading, giving a mechanism.
5. A map shows a long line of earthquakes in the middle of the Atlantic Ocean, mostly shallow, with some volcanoes. What type of boundary is this, and why?
   Divergent (the Mid-Atlantic Ridge): plates are moving apart, magma rises to make new crust, and the quakes are shallow because the lithosphere there is thin and hot.
6. Correct this statement: "The plates float on a layer of liquid magma."
   The mantle under the plates is solid rock that flows very slowly; the only liquid layer is the outer core, far deeper.
7. Correct this statement: "The Alpine Fault is a subduction zone, like the one under the North Island."
   The Alpine Fault is mainly a transform boundary where the plates slide past each other, which is why it has big earthquakes but no volcanoes.
8. Correct this statement: "Volcanoes and earthquakes happen at every type of boundary."
   Earthquakes happen at all three, but volcanoes form where plates collide by subduction or move apart, and hardly ever at transform boundaries.
9. Correct this statement: "480 km is 480 000 cm."
   1 km is 1000 m and 1 m is 100 cm, so 1 km is 100 000 cm and 480 km is 48 000 000 cm.

Answer key (for parents and tutors)

1. One DNA strand reads G G A T C T. Write the partner strand.
   C C T A G A, because G pairs with C and A pairs with T.
2. Put these in order from largest to smallest: gene, nucleus, base, chromosome.
   Nucleus, chromosome, gene, base: a nucleus holds chromosomes, a chromosome carries many genes, and a gene is a sequence of bases.
3. Name the protein type for each: antibody, amylase, keratin.
   An antibody defends against disease, amylase is an enzyme that speeds up digestion of starch, keratin is a structural protein.
4. Is the number of petals on a flower discrete or continuous? What about the mass of a lamb at birth?
   Petal number is discrete, since you cannot have 5.3 petals. Birth mass is continuous, since it can be any value such as 4.27 kg.
5. Give one strength and one limitation of a flat paper diagram of DNA.
   Strength: base pairs and their order are easy to read. Limitation: it is flat, so it hides the double helix twist.
6. Correct this statement: "The partner of A T G is A T G, or A pairs with G."
   A always pairs with T and C with G, so the partner of A T G is T A C.
7. Correct this statement: "A chromosome is the same thing as a gene."
   A chromosome is one long DNA molecule carrying hundreds to thousands of genes, and each gene is just one section of it.
8. Correct this statement: "My height is 162 cm, a whole number, so height is discrete data."
   Height is continuous because any value in between is possible; rounding a measurement does not make it discrete.
9. Correct this statement: "Your phenotype is decided by your genes alone."
   Phenotype comes from genes and environment together, which is why identical twins can differ in weight.

Answer key (for parents and tutors)

1. Explain how a gene leads to hair being strong, using the word keratin.
   The gene holds the code for keratin; the cell reads it and builds keratin, a tough protein that forms hair, so the protein produces the trait.
2. Every cell in your body has the insulin gene. Why do only some cells make insulin?
   The gene is switched on only in certain pancreas cells; in other cells it is switched off, so no insulin is made there.
3. A tuatara egg is incubated at a high temperature. Which sex is it most likely to hatch as, and is that caused by genes or environment?
   Male, because warmer nests tend to produce males; it is the environment (temperature), not a sex chromosome.
4. Two cloned sheep have identical genes but different body mass. Suggest a reason.
   A difference in environment, such as one had better pasture or more food, or one was sick.
5. Why did many scientists before 1944 think proteins, not DNA, carried inherited information?
   Proteins come in many more forms than DNA's four bases suggested, so proteins seemed better able to carry complex information until experiments showed otherwise.
6. Correct this statement: "Each trait, like height or eye colour, is controlled by one gene."
   Most traits are controlled by many genes adding small effects, which is why height varies smoothly; only a few, such as ABO blood group, depend mainly on one gene.
7. Correct this statement: "Skin cells make keratin because they have the keratin gene and other cells do not."
   Almost every cell has the same genes; skin cells make keratin because that gene is switched on in them and off in most other cells.
8. Correct this statement: "Two cloned sheep have the same genes, so they must look exactly the same."
   Genes set a range, and differences in food, health and surroundings can still give the clones different traits such as body mass.
9. Correct this statement: "A sheep that grew big on good pasture will pass its size on to its lambs."
   Changes caused by the environment are not written into the DNA in sperm and eggs, so the lambs inherit only the parent's genes.

Answer key (for parents and tutors)

1. Name the two parts of the central nervous system.
   The brain and the spinal cord.
2. A gymnast keeps her balance on a narrow beam. Which brain region is mainly responsible?
   The cerebellum, which coordinates movement and balance.
3. Sort into voluntary or automatic: sneezing, texting a friend, your stomach churning food, choosing a lunch.
   Automatic: sneezing, stomach churning food. Voluntary: texting a friend, choosing a lunch.
4. Name the stimulus and the sense organ that detects it when you hear a fire alarm.
   The stimulus is sound; the ear detects it.
5. In the ruler drop test, why should the dropper not count down before letting go?
   A countdown lets the catcher predict the moment, so you measure guessing rather than reaction; the drop must come without warning to measure the true reaction time.
6. Correct this statement: "The brainstem controls balance."
   The cerebellum coordinates movement and balance; the brainstem runs automatic functions such as breathing and heart rate.
7. Correct this statement: "The spinal cord is part of the peripheral nervous system, because it runs down the back."
   The spinal cord is part of the central nervous system with the brain; the peripheral nervous system is the nerves outside them.
8. Correct this statement: "A nerve is one long nerve cell."
   A nerve is a bundle of many neurons wrapped together, like a cable holding many wires.
9. Correct this statement: "In the ruler drop, the stimulus is the eye."
   The stimulus is the change, the ruler starting to fall; the eye is the sense organ whose receptors detect it.

Answer key (for parents and tutors)

1. Which type of neuron carries signals from the spinal cord to a muscle?
   A motor neuron.
2. Name one effector that is a gland and the substance it releases.
   For example sweat glands release sweat, salivary glands release saliva, or adrenal glands release adrenaline.
3. You step on a sharp shell at the beach and lift your foot. Put these in order: motor neuron, receptor, effector, sensory neuron, spinal cord.
   Receptor, sensory neuron, spinal cord, motor neuron, effector.
4. Why do you lift your foot before you feel the pain?
   It is a reflex: the signal goes through the spinal cord straight to the motor neuron, while the signal to the brain that produces the feeling of pain arrives slightly later.
5. A student tests reaction time on one friend, once each, before and after an energy drink. Give two reasons the data is not reliable.
   Any two: only one person was tested, only one trial was done in each condition, practice from the first test could make the second faster, and the friend knew about the drink and might try harder.
6. Correct this statement: "Sensory neurons carry the signal to the muscle."
   Sensory neurons carry signals in from receptors; motor neurons carry them out to effectors such as muscles.
7. Correct this statement: "In a reflex the brain decides very quickly what to do."
   A reflex arc passes through a relay neuron in the spinal cord with no conscious decision; the brain only finds out a moment later.
8. Correct this statement: "Effectors are always muscles."
   Effectors are muscles, which contract, and glands, which release substances such as sweat, saliva or adrenaline.
9. Correct this statement: "Testing one friend ten times makes the result true for everyone."
   Repeats make the result more reliable for that person, but people vary a lot, so you need to test many people before you can generalise.

Answer key (for parents and tutors)

1. What is normal human core body temperature, and which part of the brain controls it?
   About 37 °C, normally 36.5 to 37.5 °C; the hypothalamus.
2. Explain how sweating cools the body.
   Sweat glands release sweat, and as the water evaporates it takes thermal energy from the skin.
3. Why do your fingers go pale and cold on a frosty morning?
   Vasoconstriction narrows skin blood vessels, so less warm blood reaches the fingers and less heat is lost from them, keeping the core warm.
4. Explain why thermoregulation is called negative feedback.
   A change in temperature triggers responses that act against that change, returning temperature to normal, after which the responses stop.
5. A runner's face turns red in a race. Name the process and explain how it helps.
   Vasodilation: skin blood vessels widen, so more warm blood flows near the surface and more heat is lost to the air.
6. Correct this statement: "Sweat cools you down because sweat is cold."
   Sweat comes out at body temperature; it only cools you as it evaporates, taking thermal energy from the skin, so sweat that drips off does little.
7. Correct this statement: "Shivering warms you up because your muscles rub together and make friction."
   Shivering muscles contract rapidly, and the extra respiration needed for that releases thermal energy.
8. Correct this statement: "The skin decides when to sweat or shiver."
   Skin receptors only send information; the hypothalamus is the control centre, and it also has its own receptors that sense the temperature of the blood.
9. Correct this statement: "Negative feedback means the body's response is bad for it."
   Negative means the response acts against the change, so a rise in temperature triggers cooling and a fall triggers warming, bringing it back to normal.

Answer key (for parents and tutors)

1. Give three ways a plant uses the water its roots take up.
   Any three: photosynthesis, carrying dissolved minerals, keeping cells firm for support, cooling the leaves.
2. Why does a plant on a hot, windy day need more water from the soil?
   Transpiration is faster when it is hot and windy, so it loses more water from its leaves and must replace it through its roots.
3. Why can soil rich in organic matter support more life than sandy soil?
   Organic matter holds more water and nutrients, so more plants grow, which feeds more animals; sandy soil drains and dries quickly.
4. In the stream transect, which reading would you expect to change most after two weeks of heavy rain, and why?
   Soil moisture, especially further from the stream, because rain soaks the drier soil; the plant species take much longer to change.
5. Explain how overfishing of snapper can lead to the loss of a kelp forest.
   Snapper eat kina; with fewer snapper, kina numbers rise and they graze the kelp until only bare rock is left.
6. Correct this statement: "Plants keep most of the water their roots take in and use it for photosynthesis."
   Most of it is lost as water vapour through the stomata by transpiration; only a small fraction is used in photosynthesis.
7. Correct this statement: "Transpiration is the plant sweating out water through its roots."
   Transpiration is water evaporating from inside the leaves and escaping through the stomata, which pulls more water up the xylem from the roots.
8. Correct this statement: "Clay soil is the best soil because it holds the most water."
   Clay can become waterlogged and starve roots of air, so loam rich in organic matter, which holds water and still drains, suits most plants best.
9. Correct this statement: "Water and nutrients flow through an ecosystem and are lost, the same as energy."
   Energy is eventually lost as heat, but water and nutrients are recycled again and again between living things and their surroundings.

Answer key (for parents and tutors)

1. Name two kinds of microorganism that decompose dead material.
   Bacteria and fungi.
2. Why would plants in a forest eventually stop growing if all decomposers disappeared?
   Nutrients would stay locked in dead leaves and bodies instead of returning to the soil, so the soil would run out of nutrients.
3. Explain why a lake can run out of oxygen after an algal bloom.
   When the algae die, bacteria decompose them and use up dissolved oxygen as they respire.
4. A farmer plants flax and native shrubs along a stream on her farm. Give two ways this helps the stream.
   Any two: roots hold the banks and reduce erosion, plants trap sediment and take up nutrients from run-off, shade keeps the water cool, and it gives habitat.
5. A survey finds many mayfly larvae at one site and almost none at another. What does this suggest about the two sites?
   Mayfly larvae are sensitive to pollution and low oxygen, so the site with many is likely cleaner, and the site with almost none is likely polluted.
6. Correct this statement: "Worms are the main decomposers."
   Bacteria and fungi are the main decomposers; worms and slaters are detritivores that shred dead material so microorganisms can break it down faster.
7. Correct this statement: "In eutrophication the algae use up all the oxygen in the lake."
   Decomposer bacteria use up the oxygen as they respire while breaking down the dead algae; living algae release oxygen in daylight.
8. Correct this statement: "Fertiliser run-off kills fish because it is poisonous."
   The main harm is that the extra nutrients feed an algal bloom, and decomposing that bloom strips the dissolved oxygen fish need.
9. Correct this statement: "Forests stop rain water from reaching rivers."
   Forests slow the water so it soaks into the soil and reaches streams over days, which cuts floods and erosion, but the water still arrives.