Answers

p.12 — Distance, Displacement, Speed and Velocity

Q1 a) Any two from: e.g. speed / distance / mass / temperature ***[2 marks]***

b) Any two from: e.g. displacement / momentum / force / acceleration / velocity ***[2 marks]***

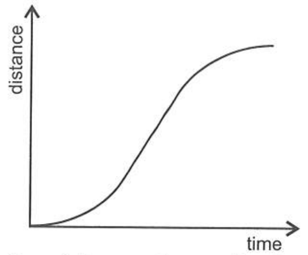
Q2 $s = d \div t = 200 \div 25$ ***[1 mark]*** = 8 m/s ***[1 mark]***

p.13 — Acceleration

Q1 u = 0 m/s, v = 5 m/s, $a = g$ = 10 m/s^2,
$x = (v^2 - u^2) \div 2a = (25 - 0) \div (2 \times 10)$ ***[1 mark]***
= 1.25 m ***[1 mark]***

p.14 — Distance/Time Graphs

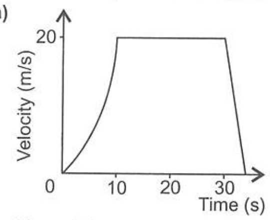
Q1 E.g.



[1 mark for a continuous line that initially curves upwards, and which curves downwards at the end until it becomes horizontal, 1 mark for a straight middle section.]

p.15 — Velocity/Time Graphs

Q1 a)



[1 mark for an upwards curved acceleration line to 20 m/s, 1 mark for a straight line representing steady speed, 1 mark for a straight line representing deceleration]

b) a = gradient of the line
= change in vertical ÷ change in horizontal
= (0 – 20) ÷ (34 – 30) ***[1 mark]***
= –20 ÷ 4 = –5 m/s^2
So the deceleration is 5 m/s^2 ***[1 mark]***

p.16 — Newton's First and Second Laws

Q1 $F = ma$ = (80 + 10) × 0.25 ***[1 mark]***
= 22.5 N ***[1 mark]***

p.17 — Weight and Circular Motion

Q1 a) $W = mg$ = 25 × 10 ***[1 mark]*** = 250 N ***[1 mark]***

b) W = 25 × 1.6 ***[1 mark]*** = 40 N ***[1 mark]***

p.18 — Investigating Motion

Q1 E.g. it removes human error for timings ***[1 mark]***

p.19 — Inertia and Newton's Third Law

Q1 An object with a smaller mass (in this case the empty trolley) will have a smaller inertial mass, so less force is needed to stop it ***[1 mark]***.

p.20 — Momentum

Q1 $p = mv$ = 60 × 3 ***[1 mark]*** = 180 kg m/s ***[1 mark]***

Q2 Before the gun fires the bullet, the total momentum is zero (neither the gun nor the bullet are moving) ***[1 mark]***. When the bullet leaves the gun, it has momentum in one direction ***[1 mark]***. The gun moves backwards, and has an equal but opposite momentum to the bullet ***[1 mark]***. This means that the total momentum after the bullet has been fired is still zero. Momentum has been conserved ***[1 mark]***.

p.21 — Changes in Momentum

Q1 First, convert quantities to the correct units:
58 g = 0.058 kg
11.6 ms = 0.0116 s ***[1 mark]***
$F = [(m \times v) - (m \times u)] \div t$
= [(0.058 × 34) – (0.058 × 0)] ÷ 0.0116 ***[1 mark]***
F = 170 N ***[1 mark]***

p.22 — Stopping Distances and Reaction Times

Q1 If you're tired, e.g. from a long journey, your reaction time is likely to be longer ***[1 mark]***, which would increase thinking distance and so stopping distance ***[1 mark]***. This would make an accident more likely if you needed to brake suddenly ***[1 mark]***.

p.23 — Stopping Safely

Q1 For the lorry to stop the energy in the lorry's kinetic energy store must equal the work done by the brakes.
$\frac{1}{2}mv^2 = Fd$ ***[1 mark]***
so $F = mv^2 \div 2d$ ***[1 mark]***
Estimate the mass of the lorry to be 30 000 kg (accept 15 000 - 45 000 kg) ***[1 mark]***
F = 30 000 × 16^2 ÷ (2 × 50) = 76 800
= 80 000 N (to 1 s.f.)
(accept 40 000 - 100 000 N to 1 s.f.) ***[1 mark]***

p.24 — Energy Stores

Q1 The change in height is 5 m.
So the energy transferred from the gravitational potential energy store is:
$\Delta GPE = m \times g \times \Delta h$ = 2 × 10 × 5 ***[1 mark]***
= 100 J ***[1 mark]***
This is transferred to the kinetic energy store of the object, so KE = 100 J ***[1 mark]***
KE = ½ × m × v^2 so v^2 = (2 × KE) ÷ m
= (2 × 100) ÷ 2 ***[1 mark]***
= 100 m/s^2
$v = \sqrt{100}$ = 10 m/s ***[1 mark]***

p.25 — Transferring Energy

Q1 Energy in the chemical energy store of the wood is transferred by heating to the thermal energy stores of the surroundings ***[1 mark]***. The rest of the energy is transferred away by light waves ***[1 mark]***.

p.26 — Efficiency

Q1 Useful energy transferred by device
= 500 – 420 = 80 J ***[1 mark]***

$$\text{Efficiency} = \frac{\text{useful energy transferred by device}}{\text{total energy supplied to device}}$$

= 80 ÷ 500 = 0.16 ***[1 mark]***
0.16 × 100 = 16% ***[1 mark]***

p.27 — Reducing Unwanted Energy Transfers

Q1 E.g. lubricate moving parts ***[1 mark]***.

p.28 — Energy Resources

Q1 Any two from: e.g. bio-fuels / wind power / the Sun/solar power / hydro-electricty / the tides ***[2 marks]***

p.29 — More Energy Resources

Q1 E.g. wind farms produce no pollution, which is much better for the environment than burning coal. They are also cheap to run, as there are no fuel costs and minimal running costs.
You would need a lot of space to put the wind farm on, as you need lots of turbines to get the same power as a coal power station. People nearby also might dislike the wind farm, because wind farms spoil the view and can be noisy.
[4 marks — 1 mark for each correct advantage, up to 2 marks, 1 mark for each correct disadvantage, up to 2 marks].

p.30 — Trends in Energy Resource Use

Q1 Any two from: e.g. building new power plants is expensive / people don't want to live near new power plants / renewable energy resources are less reliable than non-renewable energy resources / hybrid cars are more expensive than equivalent petrol cars ***[2 marks]***.

p.32 — Wave Basics

Q1 7.5 ÷ 100 = 0.075 m ***[1 mark]***
$v = f\lambda$, so $f = v \div \lambda$
= 0.15 ÷ 0.075 ***[1 mark]***
= 2 Hz ***[1 mark]***

p.33 — Measuring Waves

Q1 E.g. attach a signal generator to a dipper and place it in a ripple tank filled with water to create some waves ***[1 mark]***. Place a screen underneath the ripple tank, then turn on a strobe light and dim the other lights in the room ***[1 mark]***. Adjust the frequency of the strobe light until the ripples appear to freeze ***[1 mark]***. Measure the distance between the shadows on the screen beneath the tank — this is equal to the wavelength of the ripples ***[1 mark]***.

p.34 — Wave Behaviour at Boundaries

Q1 The light will bend away from the normal ***[1 mark]***.

p.35 — Sound

Q1 A sound wave enters the ear and causes the eardrum to vibrate ***[1 mark]***. These vibrations are transmitted through the ear ***[1 mark]*** and turned into electrical signals which are sent to your brain ***[1 mark]***.

p.36 — Ultrasound

Q1 $v = x \div t$,
so $t = x \div v$
= 2500 ÷ 1520 ***[1 mark]***
= 1.64... s ***[1 mark]***
This is the time it takes for the pulse to reach the seabed. To find the time taken for the sound to return to the submarine, you must double it.
1.64... × 2 = 3.28... = 3.3 s (to 2 s.f.) ***[1 mark]***

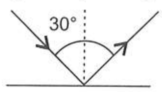
p.37 — Infrasound and Seismic Waves

Q1 S-waves can only travel through solids ***[1 mark]***. The S-waves can't travel though the centre of the Earth, so at least part of the Earth's core must be liquid ***[1 mark]***.

p.38 — Reflection

Q1 specular ***[1 mark]***

Q2



[1 mark for correct diagram showing straight, correctly drawn rays with consistent arrows and the normal, 1 mark for correct angle of incidence, 1 mark for correct angle of reflection]

p.39 — Investigating Refraction

Q1 a) Draw around a glass block onto a piece of paper. Shine a light ray from a ray box into the block ***[1 mark]***. Trace the incident ray and mark where the ray emerges from the block. Remove the block and join these up with a straight line ***[1 mark]***. Measure the angle of incidence and angle of refraction ***[1 mark]***.

b) So you can easily trace the light ray to measure the angle between the ray and the normal ***[1 mark]***.

p.40 — Visible Light and Colour

Q1 a) A cucumber looks green because it reflects green light ***[1 mark]***, but absorbs all other wavelengths (colours) of light ***[1 mark]***.

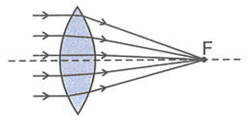
b) black ***[1 mark]***

p.41 — Lenses

Q1 a) The point where rays hitting the lens parallel to the axis meet ***[1 mark]***.

b) The point where light rays hitting the lens parallel to the axis appear to come from ***[1 mark]***.

Q2

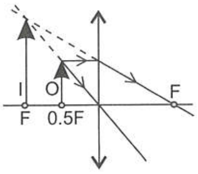


[1 mark for parallel lines being refracted and brought together as they pass through the lens, 1 mark for lines meeting at the principal focus (F)]

p.42 — Lenses and Ray Diagrams

Q1 virtual ***[1 mark]***

Q2



[1 mark for an image further away from the lense than 0.5F, 1 mark for an image where light rays cross, 1 mark for two correct light rays]

p.43 — Electromagnetic Waves

Q1 E.g. gamma rays are ionising so they can cause tissue damage and cancer, but visible light isn't ionising ***[1 mark]***. They carry more energy than visible light, so their potential for damage is higher ***[1 mark]***.

p.44 — Emitting and Absorbing EM Radiation

Q1 The bowl of ice cream is absorbing more power than it is radiating ***[1 mark]***. This causes an increase in the temperature of the bowl of ice cream ***[1 mark]***.

p.45 — EM Waves for Communication

Q1 They can pass easily through the Earth's watery atmosphere without being absorbed ***[1 mark]***.

p.46 — Microwaves and Infrared

Q1 Any three from: e.g. burglar alarms / thermal imaging / short range communication / cooking / optical fibres ***[3 marks]***

p.47 — More Uses of EM Waves

Q1 Any two from: e.g. fluorescent lamps / security pens / detecting forged bank notes / sterilising water ***[2 marks]***

Q2 E.g. you don't have to freeze it/cook it/preserve it to keep it fresher for longer ***[1 mark]***

p.49 — The Model of the Atom

Q1 a) The centre of an atom is a tiny, positively charged nucleus ***[1 mark]***. This is made up of protons and neutrons and is the source of most of the atom's mass ***[1 mark]***. Most of the atom is empty space ***[1 mark]***. Electrons orbit the nucleus at set energy levels ***[1 mark]***.

b) The radius of a nucleus is about 10 000 times smaller than the radius of the atom ***[1 mark]***.

p.50 — Electron Energy Levels

Q1 A positive ion is an atom that has lost one or more electrons ***[1 mark]***. A positive ion is formed when an outer electron absorbs enough energy that it leaves the atom ***[1 mark]***.

p.51 — Isotopes and Nuclear Radiation

Q1 E.g. a thin sheet of paper will absorb alpha particles ***[1 mark]***. Aluminium that's about 5 mm thick will absorb beta-minus particles ***[1 mark]***. Thick sheets of lead or many metres of concrete will absorb gamma rays ***[1 mark]***.

p.52 — Nuclear Equations

Q1 Beta-minus particle ***[1 mark]***

Q2 $^{219}_{86}\text{Rn} \rightarrow ^{215}_{84}\text{Po} + ^{4}_{2}\alpha$

[1 mark for correct layout, 1 mark for correct symbol for an alpha particle, 1 mark for total atomic and mass numbers being equal on both sides]

p.53 — Half-Life

Q1 The number of half-lives in 240 hours is
240 ÷ 60 = 4 half-lives ***[1 mark]***
Initial count = 480
after 1 half-life = 480 ÷ 2 = 240
after 2 half-lives = 240 ÷ 2 = 120
after 3 half-lives = 120 ÷ 2 = 60
after 4 half-lives = 60 ÷ 2 = 30
So the activity after 240 hours = 30 Bq ***[1 mark]***

p.54 — Background Radiation and Contamination

Q1 E.g. rocks ***[1 mark]***, cosmic rays ***[1 mark]*** and fallout from nuclear explosions ***[1 mark]***

p.55 — Uses of Radiation

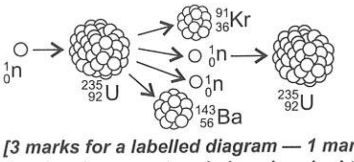
Q1 Alpha radiation is highly ionising so would damage cells in the body ***[1 mark]***. Alpha radiation can't penetrate through tissue, so it wouldn't be detected outside the body with the radiation detector ***[1 mark]***.

p.56 — PET Scanning and Radiotherapy

Q1 The patient is injected with a substance that contains a radioactive isotope ***[1 mark]***. This isotope decays and produces positrons which annihilate with nearby electrons and produce gamma rays ***[1 mark]***. These gamma rays are then detected outside of the body ***[1 mark]***. Areas of high metabolism (where there are lots of gamma rays produced) can indicate the presence of a cancerous tumour ***[1 mark]***.

p.57 — Nuclear Fission

Q1



[3 marks for a labelled diagram — 1 mark for showing a neutron being absorbed to cause splitting, 1 mark for a large nucleus splitting into two smaller nuclei, 1 mark for it producing a neutron that is absorbed by another large, unstable nucleus.]

p.58 — Nuclear Fusion and Nuclear Power

Q1 All nuclei have a positive charge, so when they are close they repel each other ***[1 mark]***. High pressures and temperatures are needed to overcome this electrostatic repulsion and fuse the two nuclei together ***[1 mark]***.

p.59 — The Solar System and Gravity

Q1 a) almost circular orbits around the Sun ***[1 mark]***

b) almost circular orbits around planets ***[1 mark]***

c) highly elliptical orbits around the Sun ***[1 mark]***

p.60 — Changing Ideas about the Universe

Q1 In the geocentric model, everything in our Solar System orbits the Earth. In the heliocentric model, everything orbits the Sun ***[1 mark]***.

Q2 E.g. the Big Bang theory puts a finite age on the Universe, whereas the Steady State theory assumes there is no beginning and no end to the Universe ***[1 mark]***.
In the Steady State theory, matter is constantly being created. In the Big Bang theory, all of the matter in the Universe occupied a small, dense region of space at the start of the Universe, which then 'exploded' outwards ***[1 mark]***.

p.61 — Red-shift and CMB Radiation

Q1 E.g. red-shift is where the light we see from distant galaxies appears at a lower frequency than we would expect ***[1 mark]***.

Q2 The Big Bang theory ***[1 mark]***

p.62 — The Life Cycle of Stars

Q1 E.g. a cloud of dust and gas (nebula) is attracted together by gravity, forming a protostar ***[1 mark]***. As the star gets denser, it gets hotter and hotter, until nuclear fusion of hydrogen nuclei starts to happen in its core ***[1 mark]***. This nuclear fusion provides an outward pressure to balance the force of gravity, so the star remains a stable size, as a main sequence star ***[1 mark]***. When the star runs out of hydrogen to fuse, it will expand and cool, becoming a red supergiant ***[1 mark]***. It begins to glow brightly again and expands and contracts several times until it explodes in a supernova ***[1 mark]***. The supernova throws dust and gas into space and leaves behind either a very dense core called a neutron star or a black hole if it is massive enough ***[1 mark]***.

p.63 — Looking Into Space

Q1 Any three from: e.g. move the telescope to a darker location / move the telescope to a higher location / use a telescope with a larger aperture / use a higher quality objective lens ***[3 marks]***.

p.65 — Energy Transfers and Systems

Q1 The wind does work on the windmill ***[1 mark]*** causing it to turn and transferring energy to the kinetic energy store of the windmill ***[1 mark]***.

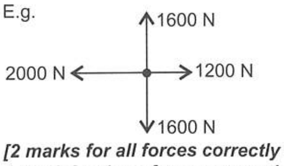
p.66 — Work Done and Power

Q1 $E = F \times d$ = 20 × 0.2 ***[1 mark]*** = 4 N ***[1 mark]***

Q2 $P = E \div T$ = 6000 ÷ 30 ***[1 mark]***
= 200 W ***[1 mark]***

p.67 — Forces

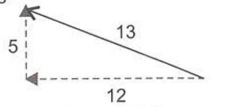
Q1 E.g.



[2 marks for all forces correctly drawn, 1 mark for three forces correctly drawn — weight and normal contact force arrows should be the same length, the arrow for the driving force should be longer than the weight arrow and the arrow for the resistive force should be shorter]

p.68 — Forces and Vector Diagrams

Q1 E.g.



Resultant force = 13 N
[1 mark for a correct scale drawing, 1 mark for correct resultant force]

p.69 — Moments

Q1 moment of a force = force × distance normal to the direction of the force
= 10 × 0.85 ***[1 mark]*** = 8.5 Nm ***[1 mark]***

p.71 — Current and Circuits

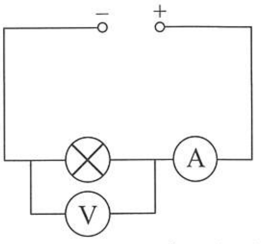
Q1 $Q = I \times t$, so
$t = Q \div I$ = 120 ÷ 2.5 ***[1 mark]***
= 48 s ***[1 mark]***

p.72 — Potential Difference and Resistance

Q1 $E = Q \times V$, so
$V = E \div Q$ = 360 ÷ 75 ***[1 mark]***
= 4.8 V ***[1 mark]***

p.73 — Investigating Components

Q1



[1 mark for a complete circuit with a variable d.c. power supply in series with a filament lamp, 1 mark for correct circuit symbols for all components, 1 mark for a voltmeter connected across the filament lamp and an ammeter connected in series with the filament lamp.]

p.74 — Circuit Devices

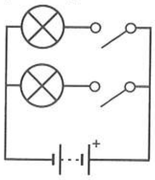
Q1 a) E.g. automatic night lights — a light automatically turns on when it gets dark ***[1 mark]***.

b) E.g. thermostats — the heating automatically turns on/off at a certain temperature ***[1 mark]***.

p.75 — Series and Parallel Circuits

Q1 0.5 A ***[1 mark]***

Q2 E.g.



[1 mark for the correct circuit symbols, 1 mark for two bulbs connected in parallel, 1 mark for both switches being on the same branches as the lamps]

p.76 — More on Series and Parallel Circuits

Q1 $R = 2 + 3 + 7 = 12\ \Omega$ ***[1 mark]***
$I = V \div R = 12 \div 12$ ***[1 mark]*** = 1 A ***[1 mark]***

p.77 — Energy in Circuits

Q1 $E = I \times V \times t = 8.0 \times 230 \times (60 \times 60)$ ***[1 mark]***
= 6 624 000 J ***[1 mark]***

p.78 — Power in Circuits

Q1 $E = P \times t = 250 \times (2 \times 60 \times 60)$
= 1 800 000 J ***[1 mark]***
$E = 375 \times (2 \times 60 \times 60)$ = 2 700 000 J ***[1 mark]***
So difference in the energy transferred is
2 700 000 – 1 800 000 = 900 000 J ***[1 mark]***

p.79 — Electricity in the Home

Q1 In alternating current supply, the movement of the charges is constantly changing direction ***[1 mark]***. In a direct current supply, the movement of the charges is only in one direction ***[1 mark]***.

p.80 — Fuses and Earthing

Q1 The live wire ***[1 mark]***.

p.82 — Static Electricity

Q1 As the jumper rubs against his shirt, a static charge builds up on the both the jumper and the shirt ***[1 mark]***. This is due to electrons being removed from one and being deposited onto the other ***[1 mark]***. The charge becomes large enough for electrons to 'jump' across the small air gap between the jumper and the shirt, causing sparks ***[1 mark]***.

p.83 — Uses and Dangers of Static Electricity

Q1 Any two from: e.g. photocopiers / reducing pollution/smoke / painting cars / electrostatic sprayers / spraying insecticide
[2 marks — 1 mark for each correct use]

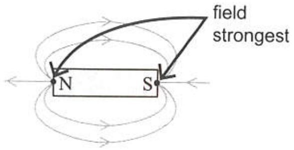
p.84 — Electric Fields

Q1

[1 mark for at least 8 straight lines at right angles to the surface, 1 mark for arrows on the lines pointing away from the sphere, 1 mark for lines equally spaced]

p.85 — Magnets and Magnetic Fields

Q1



[1 mark for at least two lines from north to south, 1 mark for an arrow on a line pointing from north to south, 1 mark for an indication of the field being strongest at the poles]

Q2 Put the magnet on a piece of paper and put a compass next to it, making a mark on the paper at each end of the needle ***[1 mark]***. Then move the compass so that the tail of the compass needle is where the tip of the needle was previously, and mark again where the needle is pointing ***[1 mark]***. Repeat this several times and then join up the markings for a complete sketch of a field line around the magnet ***[1 mark]***. Do this several times for different points around the magnet to get several field lines ***[1 mark]***.

p.86 — Permanent and Induced Magnets

Q1 Any three from: e.g. fridge doors / speakers / microphones / doorbells / cranes ***[3 marks]***

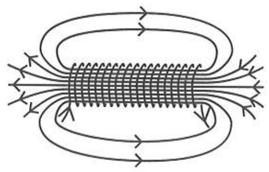
Q2 E.g. permanent magnets produce their own magnetic fields but induced magnets become magnets when they're in a magnetic field ***[1 mark]***. The force between an induced magnet and a permanent magnet is always attractive, but between two permanent magnets it can be attractive or repulsive ***[1 mark]***.

p.87 — Electromagnetism and the Motor Effect

Q1 Rearrange $F = B \times I \times l$
for the magnetic flux density, B:
$B = F \div (I \times l)$
$= 0.98 \div (5.0 \times 0.35)$ ***[1 mark]***
= 0.56 T (or N/Am) ***[1 mark]***

p.88 — Motors and Solenoids

Q1



[1 mark for tightly packed lines inside the coil, 1 mark for parallel lines inside the coil, 1 mark for field similar to a bar magnet outside of coil]

p.89 — Electromagnetic Induction in Transformers

Q1 $V_p \times I_p = V_s \times I_s = 320$ W
$I_p = 320 \div V_p = 320 \div 1.6$ ***[1 mark]***
= 200 A ***[1 mark]***

p.90 — Generators, Microphones and Loudspeakers

Q1 A coil of wire is attached to a paper cone and then placed over one pole of a permanent magnet (whilst being surrounded by the second pole) ***[1 mark]***. When a current flows through the wire, this causes a force which moves the cone forwards ***[1 mark]***. When the current is reversed, the force is reversed and the cone is moved backwards ***[1 mark]***. By changing the current, the cone can be made to vibrate, which vibrates the air around it to create a sound wave ***[1 mark]***.

p.91 — Generating and Distributing Electricity

Q1 $V_p \div V_s = N_p \div N_s$
$V_p = (N_p \div N_s) \times V_s$
$= (16 \div 4) \times 20$ ***[1 mark]*** = 80 V ***[1 mark]***

p.93 — Density

Q1 volume in m³ = $75 \div (100^3)$
$= 7.5 \times 10^{-5}$ m³ ***[1 mark]***
density = mass ÷ volume
$= 0.45 \div (7.5 \times 10^{-5})$ ***[1 mark]***
= 6000 kg/m³ ***[1 mark]***

Q2 First find the cube's volume:
$0.015 \times 0.015 \times 0.015 = 3.375 \times 10^{-6}$ m³
[1 mark]
The cube's density is 3500 kg/m³.
$m = \rho \times V = 3500 \times (3.375 \times 10^{-6})$ ***[1 mark]***
= 0.01181... kg = 12 g (to 2 s.f.) ***[1 mark]***

p.94 — Kinetic Theory and States of Matter

Q1 As a typical substance changes from solid to liquid to gas, its density will decrease ***[1 mark]*** as its mass will stay the same ***[1 mark]*** but its volume will increase as the particles have more energy to overcome the forces between them ***[1 mark]***.

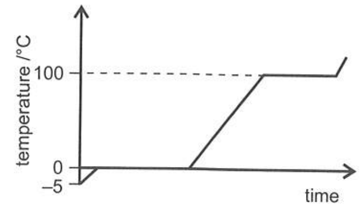
p.95 — Specific Heat Capacity

Q1 $\Delta Q = mc\Delta\theta$, so:
$\Delta\theta = \Delta Q \div (m \times c)$
$= 1680 \div (0.20 \times 420)$ ***[1 mark]***
= 20 °C ***[1 mark]***

Q2 E.g. measure the mass of an empty insulating container. Pour water into the container and measure the mass again. Use this to determine the mass of the water ***[1 mark]***. Using an immersion heater connected to a joulemeter, heat the water ***[1 mark]***. Use a thermometer to monitor the temperature of the water. Once the temperature of the water has increased by 10 °C, turn off the immersion heater ***[1 mark]***. Use the reading from the joulemeter and the equation $\Delta Q = mc\Delta\theta$ to find the specific heat capacity ***[1 mark]***.

p.96 — Specific Latent Heat

Q1



***[1 mark for showing the line as flat at 0 °C, 1 mark for showing the line as flat at 100 °C.
1 mark for drawing the line as straight, with a positive gradient, for temperatures below 0 °C, between 0 and 100 °C, and above 100 °C.]***

p.97 — Particle Motion in Gases

Q1 25 + 273 = 298 K ***[1 mark]***

Q2 When gas particles collide with the walls of their container, they exert a force on it ***[1 mark]***. Across many particles, this force acting on the container causes an outward pressure ***[1 mark]***.

Q3 $P_1V_1 = P_2V_2$, so when $V_1 = 3.5$ m³,
$P_1V_1 = 520 \times 3.5 = 1820$ ***[1 mark]***
When $V_2 = 1$ m³,
$P_2V_2 = P_2 \times 1 = 1820$ ***[1 mark]***,
so $P_2 = 1820$ Pa ***[1 mark]***

p.98 — Pressure, Temperature and Volume

Q1 Gas particles in the tyre exert a force on the plunger of the pump, so work must be done against this force to push down the pump ***[1 mark]***. This transfers energy to the kinetic energy stores of the gas particles, increasing their internal energy ***[1 mark]***. Temperature is a measure of the internal energy of the particles in a system, so this means the temperature of the gas (and therefore the tyre) increases ***[1 mark]***.

p.99 — Forces and Elasticity

Q1 $k = F \div x = 1 \div 0.02$ ***[1 mark]*** = 50 N/m ***[1 mark]***

p.100 — Investigating Elasticity

Q1 $E = \frac{1}{2}kx^2 = \frac{1}{2} \times 40 \times (0.025)^2$ ***[1 mark]***
= 0.0125 J ***[1 mark]***

p.101 — Fluid Pressure

Q1 $F = P \times A = 200\,000 \times 10$ ***[1 mark]***
= 2 000 000 N ***[1 mark]***

Q2 $P = h\rho g$ so $\rho = P \div gh$
$\rho = 450 \div (10 \times 0.05)$ ***[1 mark]***
ρ = 900 kg/m³ ***[1 mark]***

p.102 — Upthrust and Atmospheric Pressure

Q1 Wood is less dense than water ***[1 mark]***, which means that when a wooden object is placed in water, it can displace enough water to create an upthrust equal to the weight of the object ***[1 mark]***. So the upthrust equals the weight and it floats ***[1 mark]***.