P2a answers

Remember: Check which grade you are working at.

Page 111 See how it moves!

1 a i Travelling forward *(1)*; at a steady speed *(1)*

ii Stopped *(1)*

b Section C

c Curved line getting steeper *(2)*

2 a Average speed = $\frac{\text{total distance}}{\text{time}}$ *(1)*

$= \frac{90}{2}$ *(1)*

= 45 km/h *(1)*

b The coach will slow down at junctions / traffic lights *(1)*; and speed up on clear roads / or his speed is constantly changing *(1)*

Page 111 Speed isn't everything

3 a Speed *(1)*; in a certain direction *(1)*

b Speed is constant *(1)*; but the direction changes so velocity changes *(1)*

c Tension in the string stops the bung flying away *(1)*

4 a 0 m/s *(1)*

b Acceleration = $\frac{\text{change in speed}}{\text{time taken}}$ *(1)*

$= \frac{150}{0.5}$ *(1)*

= 300 m/s^2 *(1)*

P2a answers

Page 112 Velocity-time graphs

1 a i Steady speed *(1)*

ii Accelerating *(1)*

b Section D *(1)*

c The line would reach the x-axis *(1)*

2 a Draw tangent to curve at appropriate time *(1)*; gradient of the tangent is the speed at that time *(1)*

b Read value off the y-axis *(1)*

Page 112 Let's force it!

3 a i 400 N *(1)*

ii Accelerating *(1)*; forwards *(1)*

b Balanced *(1)*

c Steady speed *(1)*; forwards *(1)*

d Draw an arrow to repesent the size and direction of each force *(1)*; draw each arrow nose to tail and add another line to make complete a triangle *(1)*; this line represents the size + direction of the resultant force *(1)*

Page 113 Force and acceleration

1 a It increases

b Force = mass x acceleration *(1)*
= 20 x 4 *(1)*
= 80 N *(1)*

c Use the force meter to apply a known force *(1)*; and use the accelerometer to measure the resulting acceleration *(1)*; mass = $\frac{\text{force}}{\text{acceleration}}$ *(1)*

2 a Yes; it does prove this *(1)*; as force doubles, acceleration doubles *(1)*

b 4N reading *(1)*; doesn't follow the pattern *(1)*

Page 113 Balanced forces

3 a They are the same

b The tractor's force is bigger

c The force from the tractor is making the car accelerate *(1)*; as well as lifting the car from the ditch *(1)*

P2a answers

Page 114 Terminal velocity

1 a It increases *(1)*

b Top speed reached when forces balance *(1)*

c *(Any 3:)* Forward force gets greater as he accelerates *(1)*; Air resistance increases *(1)* because his speed increases *(1)* at his top speed, forces are balanced *(1)*

2 a Air resistance *(1)*

b Air resistance acts in the opposite direction to motion *(1)* and makes him decelerate *(1)*

c Larger surface area = slower speed *(1)*; some parachutes may be modified to reduce turbulence *(1)*

Page 114 Stop!

3 a Braking distance *(1)*; thinking distance *(1)*

b Slower reaction time / less experience / concentrating on car control not road conditions *(1)*

c The stopping distance is longer due to slower reaction time *(2)*

d The tread on tyres ensures that water on the road squirts out sideways *(1)*; so the rubber keeps in good contact with a wet road *(1)*; and maximises frictional forces *(1)*

Page 115 Moving through fluids

1 a As it falls it accelerates *(1)*; and the drag increases with speed until drag equals weight *(1)*

b It gets smaller *(1)* because the viscosity of the fluid is greater *(1)* (more drag at lower speeds)

c A liquid exerts a drag force: the falling marble displaces a greater mass of the honey compared with water *(1)*

Page 115 Energy to move

2 a Kinetic energy *(1)*; heat energy *(1)*

b Electrical energy *(1)*; heat energy *(1)*

3 a Spreads to surroundings / moving parts of car *(1)*; which become hotter *(1)*

b More work done *(1)*; against friction *(1)*

c Kinetic energy can transferred to the flywheel making it spin as the vehicle brakes *(1)*; when the vehicle needs to restart, the energy in a flywheel can immediately be used to generate electricity *(1)*

P2a answers

Page 116 Working hard

1 a 12 J

b Weight (allow gravity) *(1)*

c Work done = force x distance *(1)*
= 25 x 2 *(1)*
= 50 *(1)*

d Energy transferred equals distance travelled along the floor (overcoming friction) *(1)*; but there is now also a vertical component lifting the box against gravity *(1)*

Page 116 How much energy?

2 Andrea as has a large elastic harness attached to her when she does a bungee jump from the top of a bridge. As she jumps, the **gravitational potential** energy she has on the bridge changes into **kinetic** energy as she falls. At the bottom of the jump, the rope is fully extended and it has gained **elastic potential** energy. Eventually she stops moving because all the energy has spread as **thermal** /**heat** energy to the surroundings. *(4)*

3 a Energy something has because it is moving *(1)*

b Gravitational potential energy *(1)*; and a small amount of heat *(1)*

c kinetic energy = $^1/_2$ mv^2 *(1)*
= $^1/_2$ x 0.3 x 100 *(1)*
= 15 J *(1)*

Page 117 Momentum

1 a i Speed / mass *(1)*

ii Velocity / force *(1)*

b Momentum = mass x velocity *(1)*
= 0.5 x 8 *(1)*
= 4 kg m/s *(1)*

2 a Momentum = mass x velocity *(1)*
= 2 x 3 *(1)*
= 6 kg m/s *(1)*

b 6 kg m/s *(1)*

c Velocity = $\frac{\text{momentum}}{\text{mass}}$ *(1)*
= $\frac{6}{4}$ *(1)*
= 1.5 m/s *(1)*

Page 117 Off with a bang!

3 a Balloon moves one way *(1)*; air moves in the opposite direction *(1)*

b Total momentum equals zero *(1)*

c Momentum of balloon equals momentum of air so it stays at zero *(1)*

d i Swimmer pushes water backwards *(1)*; so she must move forwards *(1)*; to conserve momentum *(1)*

ii Water is pushed in one direction *(1);* and the swimmer spins in the opposite direction *(1)* to conserve momemtum *(1)*

P2a answers

Page 118 Keep it safe

1 a The force changes the velocity of the object *(1)*

b i Zero *(1)*

ii Same change in momentum *(1)*; but less force is felt *(1)*; because the change is spred over a longer time

c The crumple zones slow down the rate of change of momentum *(2)*

2 a Zero

b i Sarah's phone felt a smaller force due to longer time of impact / the carpet absorbs some KE *(1)*

ii Force $= \frac{\text{change in momentum}}{\text{time}}$ *(1)*

$= \frac{1}{0.02}$ *(1)*

= 50 N *(1)*

Page 118 Static electricity

3 a Electrons *(1)*

b Electrons are rubbed off the cloth *(1)* and onto the balloon *(1)* so there are more negative charges than positive charges *(1)*

c The two balloons move apart *(1)* because like charges repel *(1)*

Page 119 Charge

1 a Charges cannot move throughout insulators *(1)*; in conductors, charge can flow *(1)*

b i Electrons rubbed off the wool *(1)* cannot flow away / through the balloon *(1)*; so they build up in one place *(1)*

ii *(Any 3:)* The plaster of a wall is also an insulator; the charge on the balloon induces positive charge to move towards its surface; and attract the negatively charged balloon; and the negative charge in the wall is repelled away from the surface; this is called electrostatic induction

2 a Electric charge *(1)*

b Leave the electroscope uncharged; bring a comb near it *(1)*; if the comb is charged, the gold leaf will move away from the support *(1)*; if it is not charged – the gold leaf is unaffected *(1)*

Page 119 Van der Graaff generator

3 a Insulators / plastic *(1)*

b Belt moves / rubs against roller *(1)*; transferring electrons *(1)*

c To stop the charge flowing away through the bench / prevent discharge *(1)*

P2a answers

Page 120 Sparks will fly!

1 a The cloud's negative static charge induces a positive charge on the earthed lightning conductor *(1)*; this charge streams up towards the cloud *(1)*; discharging it and reducing the chance of a lightning strike *(1)*

b You see a spark *(1)*

c Earthing prevents build-up of charge *(1)*; in an oil refinery, volatile gases could ignite if there is a spark from a discharge *(1)*

2 a Opposite charges attract / the toner and the drum are oppositely charged *(1)*

b Negative charge *(1)*

3 a Electrons are rubbed off the paint particles *(1)*; as they rub on the sides of the spray gun *(1)*

b Paint droplets gain positive charge in the spray gun *(1)*; the car is earthed, so a negative charge is induced which attracts the paint droplets *(1)*

4 High voltage wires in the chimney are negatively charged *(1)*; air particles are ionised between the wires and positively charged air particles stay near the wires *(1)*; negatively charged particles are attracted to the earthed metal plates lining the chimney and pick up the ash and dust particles on their way *(1)*

P2b answers

Remember: Check which grade you are working at.

Page 122 Circuit diagrams

1 a Shine a light on it / cover it up *(1)*

b 2 *(1)*

c Fuse *(1)*

2 a Variable resistor *(1)*

b A slider is used to reduce the variable resistor's resistance *(1)*; this increases the current *(1)*; which increases the brightness *(1)*

c Can't control bulbs separately *(1)*; bulbs are dimmer *(1)*

d The energy the cell delivers *(1)* = the energy the components use *(1)*

Page 122 Resistance 1

3 a Flow of electrons

b Resistance of conductor is low *(1)*; resistance of insulator is high *(1)*

c Metals contain electrons that are free to move around but in plastics, the electrons cannot flow *(1)*

Page 123 Resistance 2

1 a Resistance increases if electrons *(1)*; have more collisions *(1)*; with nuclei *(1)*

b Different material have a different atomic structure / arrangement so there is a different chance of collisions with electrons

Page 123 Ohm's Law

2 a As voltage increases current increases *(1)*; voltages and current are directly proportional *(1)*

b 1.5 A *(1)*

c Resistance = $\frac{\text{voltage}}{\text{current}}$ *(1)*

$= \frac{6}{1.5}$ *(1)*

= 4 ohms *(1)*

d Type of metal *(1)*; temperature of wire *(1)*

e Temperature of wire increases / is not constant *(1)* so the resistance of the wire increases with voltage *(1)*

f 0 V *(1)*

P2b answers

Page 124 More components

1 a Heat it up / cool it down *(1)*

b More electrons are released *(1);* so the resistance falls *(1)*

c A digital thermometer *(1)*; includes a thermistor *(1)*; as the temperature changes, the resistance changes *(1)*

d It decreases

e Automatic light control systems use an LDR *(1)*; at night low light levels reduce the current and turns the lighting on in the morning the reverse happens *(1)*

Page 124 Components in series

2 a They are the same *(1)*

b 3 V *(1)*

c 1 1V; 2 1V; 3 1V *(1)*

d It doubles *(1)*

Page 125 Components in parallel

1 a 1.5 A *(1)*

b 3 V *(1)*

c 3 V *(1)*

d Can control bulbs separately/ each bulb is brighter than in a series circuit *(1)*

Page 125 The three-pin plug

2 a Plastic is an insulator (allow for safety) *(1)*

b If the fuse blows the current will stop *(1)*; it isolates the live wire *(1)*

c The cable consists of three metal wires *(1)*; each enclosed in plastic *(1)*; and held together in one plastic / insulating layer *(1)*

d It is double insulated / it has a plastic outer casing *(1)*; which means live parts cannot be touched *(1)*

P2b answers

Page 126 Domestic electricity

1 a Y *(1)*

b The current changes direction *(1)*; 50 times per second *(1)*

c (Cathode ray) Oscilloscope (or CRO) *(1)*

d Maximum of +230 volts *(1)*; decreases to 0V (Earth) and down to -230 volts *(1)*; then increases to 0V and back up to +230 V *(1)*

Page 126 Safety at home

2 a When the current was too big *(1)*; the fuse blew / melted / broke and broke the circuit *(1)*

b Different equipment uses different sizes of current *(1)*

c Radio double insulated / covered in plastic / no metal parts accessible (or vice versa for heater) *(1)*

d If the metal casing becomes live earth *(1)*; wire provides safe / low resistance route for charge to flow away *(1)* which blows the fuse *(1)*

e Responds more quickly *(1)* if there is a fault / responds to much lower current differences *(1)*

Page 127 Which fuse?

1 a i 3A *(1)*

ii It will blow / the fuse wire will melt *(1)*; if the current is higher than *(1)*; 13 A *(1)*

b i Current $= \frac{\text{power}}{230\text{ V}}$ *(1)*

$= \frac{2000}{230}$ *(1)*

= 8.7 A *(1)*

ii The fuse would melt / blow *(1)*; because the current was too large *(1);* so the equipment would stop working *(1)*

iii Charge $= \frac{\text{energy transformed}}{\text{p.d.}}$ *(1)*

$= \frac{2000}{230}$ *(1)*

= 8.69 Coulombs *(1)*

Page 127 Radioactivity

2 a i Neutron *(1)*

ii Neutron *(1)*; proton *(1)*

b Charged particle / atom which has lost / gained an electron *(1)*

c i 9 *(1)*

ii 5 *(1)*

iii 2 *(1)*

d i The number of neutrons in the nucleus *(1)*

ii The number of protons in the nucleus *(1)*

P2b answers

Page 128 Alpha, beta and gamma rays 2

1 a i The atom will decay / will not stay the same *(1)*

ii An isotope that is radioactive *(1)*

b Something that is ionising can knock electrons off nearby atoms *(1)*; leaving them as charged ions *(1)*

c Gamma rays have no mass or charges *(1)*; and so they are not very ionising *(1)*

d X = 95 *(1)*; Y = 237 *(1)*

Page 128 Background radiation 2

2 a Ionising radiation that *(1);* surrounds us all the time *(1)*

b Cosmic rays *(1)*

c Medical e.g. X-rays / fall-out from nuclear weapon testing/discharge from nuclear power / air travel *(1)*

d Natural sources *(1)*

3 a Granite is more radioactive than other rocks *(1)*; granite is only found in certain places *(1)*

b Yes *(1)*; *(Any 2:)* levels of radioactivity are low / have been naturally present for many years and can be reduced with vents / do not pose a great health risk

Page 129 Inside the atom

1 a Positively charged *(1);* central nucleus *(1);* surrounded by negatively charged electrons *(1)*

b i Some positive charged alpha particles are deflected during Rutherford's experiment *(1)*

ii Many alpha particles passed straight through *(1)*

iii Electrons are relatively easily removed from atoms, leaving charged ions *(1)*

c Like-charged protons repel each other (electric repulsion) *(1)*; neutrons do not feel this force *(1)*; the strong nuclear force attracts neutrons and protons keeping them together *(1)*

Page 129 Nuclear fission

2 a When one large nucleus splits into two or more smaller parts *(1)* releasing energy *(1)*

b Nuclear power stations / nuclear bombs *(1)*

c i 3 *(1)*

ii At each stage *(1)* a bigger number of nuclei get involved / each neutron produces more than one more neutron *(1)*

d The nucleus must be large and unstable for fission to be possible *(2)*

e There are two neutrons provided, but only one needed to trigger the reaction *(1)*

P2b answers

Page 130 Nuclear power station

1 a Nuclear fission *(1)*

b Graphite rods moderate (or slow down) neutrons *(1);* so that fuel nuclei will absorb them / control rods absorb the neutrons *(1)*

c Kinetic energy → electrical energy *(1)*

d i Heat is given out by nuclear fission which changes water into steam *(3)*

ii Steam spins the turbine which spins the generator *(2)*

e Some uranium is enriched and reused but *(1);* plutonium has to be disposed of safely e.g. underground *(1)*

Page 130 Nuclear fusion

2 a Two small nuclei join up forming a larger nucleus *(1)* releasing heat *(1)*

b In a star

c Helium *(1)*; energy *(1)*

d The heat and pressure is needed to overcome the strong forces *(1);* inside the atom which repel the positively charged nuclei *(1)*

e Scientists have so far reached the huge temperatures needed only for a fraction of a second *(1)*; the reaction is hard to control *(1)*