

# P1a answers

**Remember:**

Check which grade you are working at.

## Page 48 Heat energy

- 1 a** Travel at speed of light (1); travel through vacuum (1); travel in straight lines (1)
- b i** Drawing the curtains stops heat radiation coming into the house through the glass (2)
- ii** Paint the house white (1); white reflects heat (1); reduces heat transfers into the house (1)
- 2 a** The biscuits are cooler (1)
- b** The object's temperature measures (1); the average internal energy of all the particles (1)

## Page 48 Thermal radiation

**3**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
C	B	A	D

(4)

- 4 a** The temperature (1); number of particles (1)
- b** The ice cube is colder (1); it has less particles (1)
- c** The camera detects thermal radiation emitted by an object (1); the drink emits more thermal energy before the ice cube is added because it is warmer (1)

## Page 49 Conduction and convection

- 1 a** Heat conduction
- b** As each particle becomes warmer it vibrates more (1); the vibration is passed from particle to particle (1); and this transmits the energy (1)
- c** Free electrons carry heat energy quickly from one part of the substance to another (1); metals contain free electrons so they conduct heat well / glass has no free electrons so cannot conduct heat well (1)

**2**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
C	B	A	D

## Page 49 Heat transfer

- 3 a** D
- b** A
- c** B
- d** C

# P1a answers

## Page 50 Types of energy

- 1 a B
- b A
- c C
- d D

## Page 50 Energy changes

- 2 a Heat (1); sound (1)
- b It spreads to the surroundings making them warm up a bit (1)
- c Chemical energy from fuel changes into (gravitational) potential energy (1); and kinetic energy (1); and then into heat (in the brakes) (1); also wasted forms of energy: sound/heat (1)

3

1	2	3	4
D	C	B	A

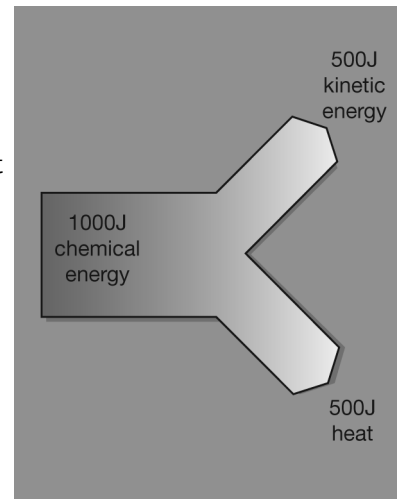
## Page 51 Energy diagrams

- 1 a Output (1); wasted (1)
- b As heat in moving energy parts (1)
- c Sankey diagram with one input which splits into two output arrows (1); equal width (1); input labelled 1000J, each output labelled 500J (1); input labelled chemical energy; output labelled kinetic energy and heat (1)

2

1	2	3	4
A	C	B	D

(4)



## Page 51 Energy and heat

- 3 a C (1)
- b A (1)
- c B (1)
- d D (1)

# P1a answers

## Page 52 Energy, work and power

- 1 a** Work done = force x distance (1)  
 = 500 x 60 (1)  
 = 30 000 J (1)
- b** Power =  $\frac{\text{work done}}{\text{time taken}}$  (1)  
 =  $\frac{30\,000}{75}$  (1)  
 = 400 W (1)
- c** (Any 2:) Efficiency measures the proportion of energy usefully transferred (1); The new lift wastes less energy doing the same work (1); more of the input energy is usefully transformed (1)
- d** The work done (Fxd) is the same in each case, but moving vertically lifts her through a smaller distance so the force must increase to compensate (2)

## Page 52 Efficiency

- 2 a** B (1)  
**b** A (1)  
**c** C (1)  
**d** D (1)

## Page 53 Using energy effectively

- 1 a** Turn off lights (1); use energy saver light bulbs (1)  
**b** It reduces heat losses through doors / windows / walls / floors (1)
- 2 a** Time taken for the savings (1); to match the costs (1)  
**b** (Any 3:) Annual savings are smallest (1); over several years in the same home, savings using other methods will be greater (1); over 10 years, draught proofing saves 150 - 45 = £105 but loft insulation saves more (1) £600 - 240 = £360 (1)  
**c** Expensive to install (1); only work if its sunny (1)

## Page 53 Why use electricity

- 3 a** B (1)  
**b** C (1)  
**c** A (1)  
**d** D (1)

# P1a answers

## Page 54 Electricity and heat

- 1 a** (Any 2:) Type of metal; thickness; length  
**b** A smaller current flows through the radio (1)  
**c** A higher rated fuse wire is thicker (1); so it can carry larger current before melting (1)
- 2 a** It drops to a very low value at low temperatures (1)  
**b** (Any 2:) Large resistance causes wires to heat up; but super conductors have such low resistance; the wires don't heat up so the energy losses are very low  
**c** Only effective at extremely low temperatures (also, cost) (1)

## Page 54 The cost of electricity

- 3 a** The energy transferred is 1200 J per second (2)  
 Energy used = power x time (1); the energy transferred is 1200J (1)  
**b**  $1.5 \times 1/4$  (1) = 0.375 kWh (1)
- 4 a** A (1)  
**b** D (1)  
**c** C (1)  
**d** B (1)

## Page 55 The National Grid

**1**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B	C	D	A

**2**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
D	A	C	B

- 3 a** Direct current (1)  
**b** Power stations supply alternating current (1); which changes direction 50 times a second (1)  
**c** High voltage means small current is needed (1); less energy is wasted as heat (1)

## Page 55 Generating electricity

- 4 a i** Wheels have kinetic energy which changes into electrical energy in the dynamo (1)  
**ii** Kinetic energy (1) → electrical energy (1)  
**b i** The moving magnet creates a current in the wire (1)  
**ii** There is more kinetic energy that can be changed into electrical energy (1)

# P1a answers

## Page 56 Power stations

1

1	2	3	4
B	D	C	A

- 2 a i Chemical energy → heat energy → kinetic energy (2)  
 ii Kinetic energy → electrical energy (1)
- b Combined cycle gas power stations use heat left in hot gases (1); to produce steam for a second cycle (1)
- c Waste energy is used to heat local buildings (1)
- d Methane gas is harvested from domestic waste and used as a fuel for gas power stations (2)

## Page 56 Renewable energy

- 3 a A barrage/dam is built across an estuary/river mouth (1); as tidal water moves in or out through pipes in the wall (1); it forces turbines in the pipes to spin (1)
- b Only a few suitable sites/floods local area/effect on local ecosystems / only available at certain times of day (1)
- c (Any 3:) Mirrors focus the Sun's rays onto a tower; this heats air which heats steam to run a turbine; mirrors focus the Sun's rays onto a tower; this heats pipes containing concentrated saline solution; and is used to generate steam to run a turbine

## Page 57 Electricity and the environment

- 1 a Release of greenhouse gases (1); causes acid rain (1)
- b (Any 2:) Wind turbines can be stand-alone; power lines from the National Grid are not needed; produce electricity directly from the wind
- 2 a i Coal (1)  
 ii Coal (1); nuclear (1)
- b Locate near consumers (1); near good transport network for fuel (1); near river or coast for cooling water (1)
- c If as it floods, vegetation dies and rots (1); rotting vegetations creates methane which is a greenhouse gas (1)

## Page 57 Making comparisons

3

1	2	3	4
B	A	D	C

(4)

- 4 a Cost of fuel (1); cost of building power stations (1)
- b New power stations will need to use fossil fuels more efficiently (1); so the new design will probably be more complicated (1); but they will use less fuel when generating electricity (1)
- c (Any 1:) Bacteria in sewage can be oxidised; this process releases electrons and protons; the bacteria and protons cluster round different electrodes which sets up a voltage

# P1b answers

**Remember:**

Check which grade you are working at.

## Page 59 Uses of electromagnetic radiation

1 a All travel at same speed (1); can travel through vacuum (1); travel in straight lines (1)

b 1 Microwave (1); 2 visible (1); 3 X-rays (1)

c

1	2	3	4
D	B	A	C

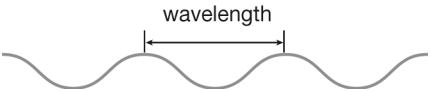
(4)

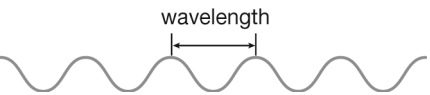
2

1	2	3	4
D	B	A	C

(4)

## Page 59 Electromagnetic spectrum 1

3 a  (1)

b  (2)

c As frequency increases, energy increases (1)

d They are the same (1)

## Page 60 Electromagnetic spectrum 2

1

1	2	3	4
B	C	D	A

(4)

2 a Transmitted (1)

b Absorbed (1)

c Reflected (1)

## Page 60 Waves and matter

3 a X-rays (1)

b X-rays pass through soft tissue (1); they are absorbed by bones (1); and detected / absorbed by photographic plate under the person (1)

c X-rays can ionise / damage cells (1)

4 a 300 000 000 m/s (1)

b Speed = frequency x wavelength (1)

c i 
$$\begin{aligned} \text{wavelength} &= \frac{\text{speed}}{\text{frequency}} \\ &= \frac{300\,000\,000}{300\,000} \\ &= 1000 \end{aligned} \quad (2)$$

ii 
$$\begin{aligned} \text{frequency} &= \frac{\text{speed}}{\text{wavelength}} \\ &= \frac{300\,000\,000}{0.3} \\ &= 10\,000\,000\,000 \text{ Hz} / 10\,000 \text{ MHz} \end{aligned} \quad (3)$$

# P1b answers

## Page 61 Dangers of radiation

1

1	2	3	4
A	D	C	B

(4)

2 a Ultraviolet (1)

b Sun burn (1); premature skin aging / wrinkling (1); skin cancer (1)

c Dark skin cells on the surface absorb the UV (1); so it does not penetrate(1); to more vulnerable cells under the surface (1)

d (Any 1:) Ultraviolet radiation, X-rays and gamma radiation all ionise atoms and molecules in living cells; damage to DNA may cause a mutation (change) in a gene; cells may mutate and grow into a cancerous tumour

## Page 61 Telecommunications

3 a Analogue (1)

b Infrared / visible pulses (1); carrying the information are sent down optic fibres to home (1)

c Disruption digging up roads / better alternatives e.g. satellite links (1)

d (Any 2:) Links possible to countries further away; information travels very rapidly; can reach remote areas; very clear signals possible

## Page 62 Fibre optics: digital signals

1 a Pulses of light (1); repeatedly reflect from the inside surface of the fibre (1)

b i



(3)

ii Total internal reflection (1)

c (Any 2:) More information can be stored; licences can be more compact; possibly easier to update

## Page 62 Radioactivity

2

1	2	3	4
A	D	B	C

(4)

3 a A, B (1)

b 6 (1)

c 14 (1)

d This is when particles or bursts of radiation are emitted from the nucleus (2)

# P1b answers

## Page 63 Alpha, beta and gamma rays 1

- 1 a Helium nucleus / 2 protons and 2 neutrons (1); emitted from nuclei (1)  
 b They cannot penetrate through skin (1)  
 c Smoke detector (1); localised destruction of cancer cells (1)  
 d (Any 2:) Gamma rays have no charge (1); and no mass (1); do not interact with atoms easily (1)
- 2 a Beta (1); alpha (1)  
 b Alpha and beta particles have opposite charges (1)

## Page 63 Background radiation 1

- 3 a C (1)  
 b B (1)  
 c A (1)  
 d D (1)
- 4 a It is detecting background radiation (1)  
 b Decay from a radioactive source is random (1)

## Page 64 Half-life

- 1 a D (1)  
*Note: the multiple choice options to C and D should be 'three quarters' instead of 'half'. This means the correct answer is D: about three quarters of the atoms will decay.*
- b A (1)  
 c B (1)  
 d C (1)
- 2 a The half-life of a radioisotope is the average time it takes (1); for half (1); of its atoms to decay (1) / its count rate to halve  
 b Organic materials / materials containing carbon (1)  
 c The radioactivity of the old arrow will be less (1); because more of the carbon atoms have decayed (1)  
 d Count rate has fallen to a quarter of its original value (1); the arrow is 2 half lives old (1) i.e. it is  $2 \times 5700$  years old = 11400 years old (1)

## Page 64 Uses of nuclear radiation

- 3 a Maintains quality of product stops wastage (1)  
 b Can't be detected through paper (1)  
 c Less radiation means the thickness is too big (1); so the rollers should come closer (1)

# P1b answers

## Page 65 Safety first

- 1 a D (1)  
 b B (1)  
 c A (1)  
 d C (1)

## Page 65 Searching space

- 2 a Large diameter (1); to collect more light (1)  
 b Telescope is in orbit / in space (1); and transmits images back to earth (1)  
 c (Any 2:) Less distortion due to pollution (1); better quality images; very large telescope so can collect very faint images (1)

3

1	2	3	4
D	A	B	C

(4)

## Page 66 Gravity

1

1	2	3	4
B	A	D	C

(4)

- 2 a Effect of gravity (1)  
 b The force of the earth's gravity is balanced by the forces due to the spacecraft's motion (1)

## Page 66 Birth of a star

3

1	2	3	4
C	A	D	B

- 4 a During fusion nuclei join together (1); which means nuclei get heavier, not lighter (1)  
 b The earth contains many heavier elements (1); that cannot be formed by fusion processes in a star the size of our Sun (1)

# P1b answers

## Page 67 Formation of the Solar System

- 1 a The dust was flung outwards (1)  
 b Rocks are heavier than dust particles (1); so are attracted more strongly to the Sun (1)  
 c The Northern Lights / Aurora borealis (1)

## Page 67 Life and death of a star

2

1	2	3	4
C	D	B	A

(4)

- 3 a The mass is lost as heat and light energy given out by the Sun (1)  
 b Red giant (1) → white dwarf (1) → black dwarf (1)  
 c Gravitational forces (1); radiation pressure (1)  
 d While they are balanced, the star is stable (1); if the core cools, radiation pressure falls and gravity is stronger (1); causing the star to collapse (or vice versa) (1)

## Page 68 In the beginning

- 1 a Billions of years ago (1)  
 b Universe began from a very small initial point that exploded apart in an instant (2)  
 c Quarks join to form atomic particles (1); these join to form hydrogen atoms (1); hydrogen fuses to form heavier atoms (1)  
 d It is the echo from the explosion (1); caused by the Big Bang (1)

## Page 68 The expanding Universe

- 2 a Light from a source moving away (1) is redder than expected / shifted to the red end of the spectrum (1)  
 b If light from a galaxy is red shifted, the galaxy is moving away (1)
- 3 a B (1)  
 b C (1)  
 c A (1)  
 d D (1)
- 4 a In future the Universe may start contracting (1) if its mass is above a critical limit (1); and eventually it will collapse in a Big Crunch (1)  
 b The Universe may continue expanding (1); stops expanding and stays at a constant size (1)