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

1	2	3	4
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

1	2	3	4
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

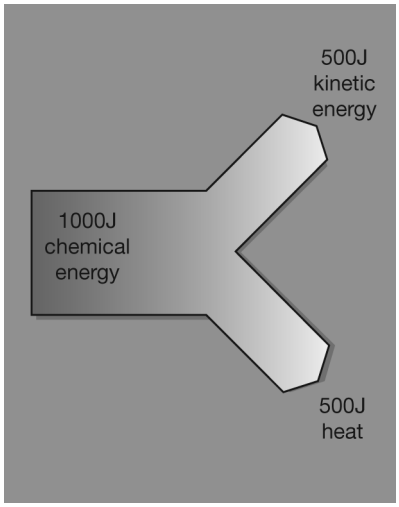
1	2	3	4
D	C	B	A

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 x $^1/_4$ *(1)* = 0.375 kWh *(1)*

4 a A *(1)*

b D *(1)*

c C *(1)*

d B *(1)*

Page 55 The National Grid

1

1	2	3	4
B	C	D	A

2

1	2	3	4
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)

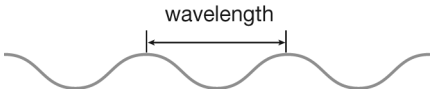
2

1	2	3	4
D	B	A	C

(4)

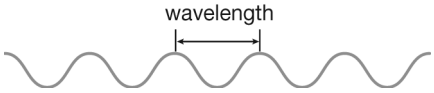
Page 59 Electromagnetic spectrum 1

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** $\text{wavelength} = \frac{\text{speed}}{\text{frequency}}$

$= \frac{300\,000\,000}{300\,000}$

$= 1000$

ii $\text{frequency} = \frac{\text{speed}}{\text{wavelength}}$ *(2)*

$= \frac{300\,000\,000}{0.3}$

$= 10\,000\,000\,000$ Hz /10 000 MHz *(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 x 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 comes 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)*