Cardinal Newman Catholic School

Holy Cross Catholic Multi Academy Company

YEAR 11

Summer 2024

Triple Science Practice Booklet

HIGHER TIER ONLY

AQA

Name:

For each Topic in Paper 1 there are 4/5 practice questions.

Remember they can ask you questions linked to all five topics.

How to use this booklet:

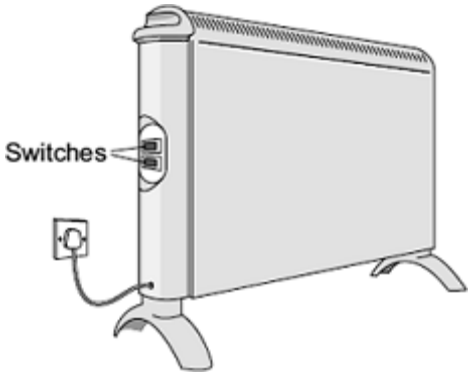
1. Complete revision for each topic
2. Put away your notes/resources and try to answer the questions in the best way possible.
3. Look at the mark scheme at the back of the booklet and compare it to your answer – add anything you have missed off in green pen.
4. Go back to the revision guide/your resources to go over anything you are unsure of.

Contents

P1 Energy

Q1.

(a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.



Setting	Power in watts
Low	700
Medium	1400
High	

(i) When both switches are on, the heater works at the high power setting.

What is the power of the heater, in kilowatts, when it is switched to the **high** power setting?

_____

Power = _____ kilowatts

(1)

(ii) The heater is used on the **high** power setting. It is switched on for 1½ hours.

Calculate the energy transferred from the mains to the heater in 1½ hours.

Show clearly how you work out your answer and give the unit.

_____

_____

_____

Energy transferred = _____

(3)

(iii) This type of heater is a very efficient device.

What is meant by a device being very efficient?

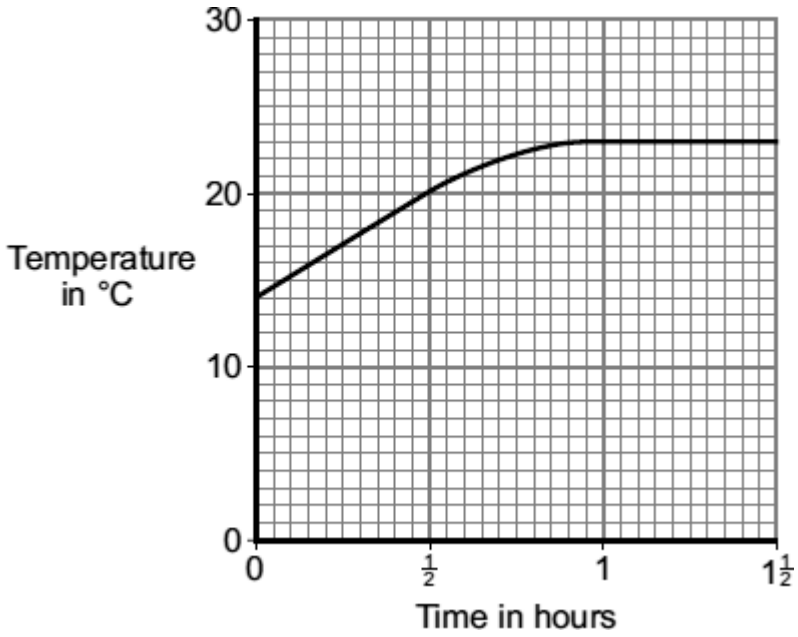
_____

_____

(1)

(b) The graph shows how the temperature of a room changes during the 1½ hours that

the heater is used.



After 1 hour, the temperature of the room has become constant, even though the heater is still switched on.

Explain why.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q2.

The figure below shows a large wind farm off the coast of the UK.

The mean power output of the wind farm is 696 MW, which is enough power for 580 000 homes.

(a) Calculate the mean power needed for 1 home.

Give your answer in watts.

_____

_____

_____

Mean power needed for 1 home = _____W

(2)

(b) On one day the demand for electricity in the UK was 34 000 MW.

Suggest **two** reasons why wind power was not able to meet this demand.

1. _____

_____

_____

2. _____

_____

_____

(2)

(c) Some of the energy from the wind used to rotate a wind turbine is wasted.

An engineer oils the mechanical parts of a wind turbine.

Explain how oiling would affect the efficiency of the wind turbine.

_____

_____

_____

_____

(3)

(d) In most homes in the UK there are many different electrical devices.

Explain why people should be encouraged to use energy efficient electrical devices.

_____

_____

_____

_____

(2)

Q3.

The photograph below shows a theme park ride called AquaShute.

Riders of the AquaShute sit on a sled and move down a slide.

(a) A light gate and data logger can be used to determine the speed of each rider and sled.

What two measurements are needed to determine the speed of a rider and sled?

Tick (✓) **two** boxes.

Gravitational field strength ☐

Length of sled ☐

Mass of rider and sled ☐

Temperature of surroundings ☐

Time for sled to pass light gate ☐

(2)

(b) The decrease in gravitational potential energy of one rider on the slide was 8.33 kJ.

The rider moved through a vertical height of 17.0 m.

gravitational field strength = 9.8 N/kg

Calculate the mass of the rider.

_____

_____

_____

_____

Mass of rider = _____ kg

(4)

(c) At the bottom of the slide, all riders and their sleds have approximately the same speed.

Explain why.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q4.

A girl is doing an experiment to determine her power output by running to the top of some stairs.

(a) The mass of the girl was 60.0 kg.

The height of the stairs was 175 cm.

The girl ran to the top of the stairs in 1.40 s.

gravitational field strength = 9.8 N/kg

Calculate the power output of the girl.

Use the Physics Equations Sheet.

_____

_____

_____

Power = _____ W

(5)

(b) The **total** power output of the girl was greater than the answer to part (a).

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(c) A boy took more than 1.40 s to run up the same stairs.

The power output of the boy was the same as the power output of the girl.

What conclusion can be made about the boy's mass?

Tick (✓) **one** box.

The boy's mass was greater than the girl's mass. ☐

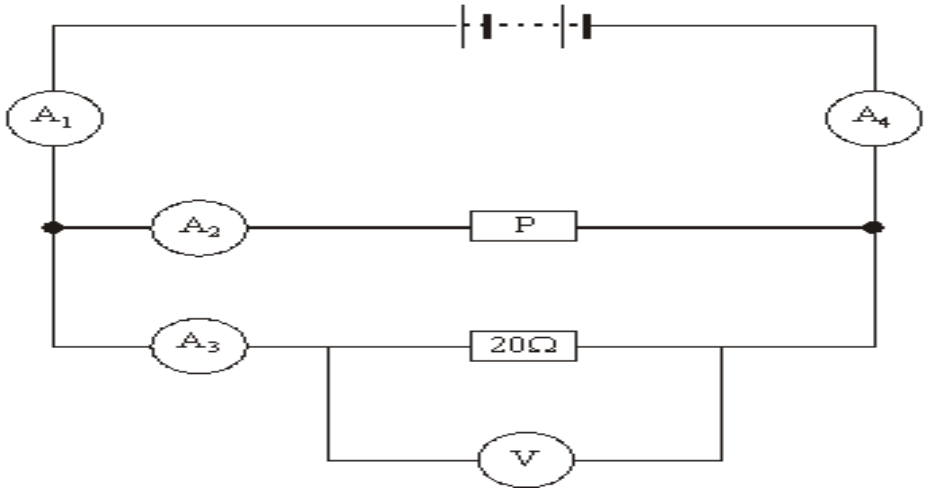
The boy's mass was lower than the girl's mass. ☐

The boy's mass was the same as the girl's mass. ☐

P2 Electricity

Q5.

The circuit shown has four identical ammeters.



(a) The table gives the current through two of the ammeters.

(i) Complete the table to show the current through the other two ammeters.

Ammeter	Reading on ammeter in amps
A_1	
A_2	0.2
A_3	0.3
A_4	

(2)

(ii) Which **one** of the following statements is correct. Tick (✓) the box next to your choice.

The resistance of **P** is more than 20 Ω. ☐

The resistance of **P** is equal to 20 Ω. ☐

The resistance of **P** is less than 20 Ω. ☐

Give a reason for your choice.

_____

_____

(2)

(b) (i) Write down the equation that links current, potential difference and resistance.

_____

(1)

(ii) Calculate the reading on the voltmeter. Show clearly how you work out your answer.

_____

_____

Voltmeter reading = _____ volts.

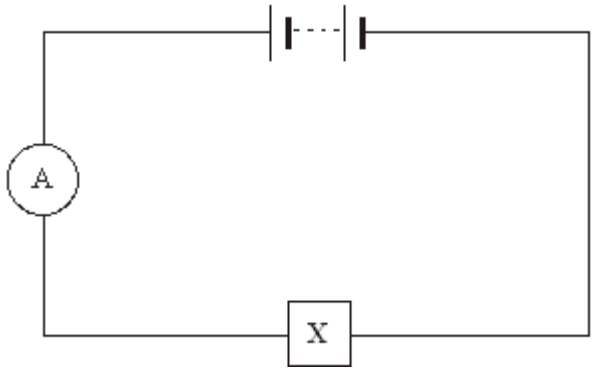
(2)

(iii) State the potential difference of the power supply.

_____

(1)

(c) A second circuit contains an unknown component labelled **X**.



As component **X** is heated, the reading on the ammeter goes up.

What is component **X**?

_____

Give a reason for your answer.

_____

_____

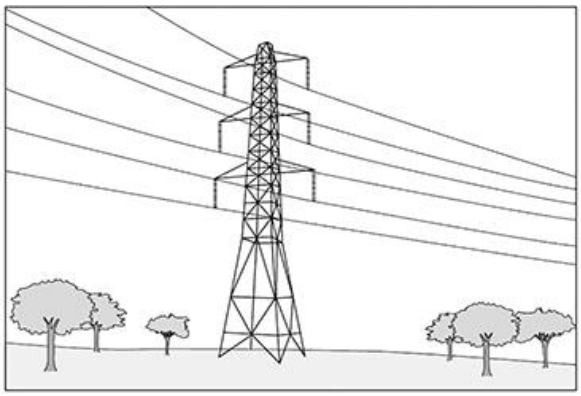
(2)

(Total 10 marks)

Q6.

Figure 1 shows some overhead power cables in the National Grid.

Figure 1



(a) Explain the advantage of transmitting electricity at a very high potential difference.

(3)

(b) It is dangerous for a person to fly a kite near an overhead power cable.

A person is flying a kite.

The person could receive a fatal electric shock if the kite was very close to, but not touching the power cable.

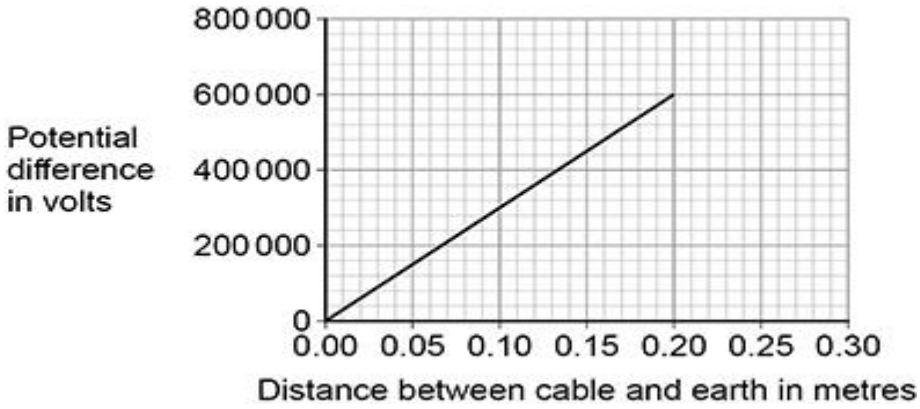
Explain why.

(3)

A scientist investigated how the potential difference needed for air to conduct charge varies with the distance between a cable and earth.

Figure 3 shows the results.

Figure 3



(c) The data in **Figure 3** gives the relationship between potential difference and distance when the air is dry.

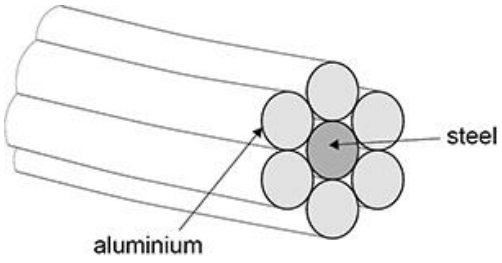
When the humidity of air increases the air becomes a better conductor of electricity.

Draw a line on **Figure 3** to show how the potential difference changes with distance if the humidity of the air increases.

(2)

(d) **Figure 4** shows a cross-section through a power cable.

Figure 4



A 1 metre length of a single aluminium wire is a better conductor than a 1 metre length of the steel wire.

The individual wires behave as if they are resistors connected in parallel.

Explain why the current in the steel wire is different to the current in a single aluminium wire.

_____

_____

_____

_____

_____

Q7.

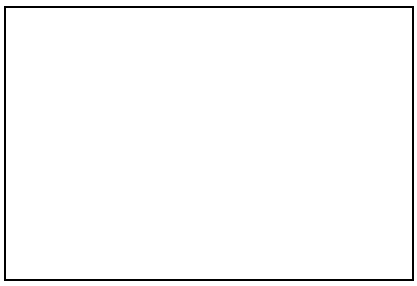
Figure 1 shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 1

(a) When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.



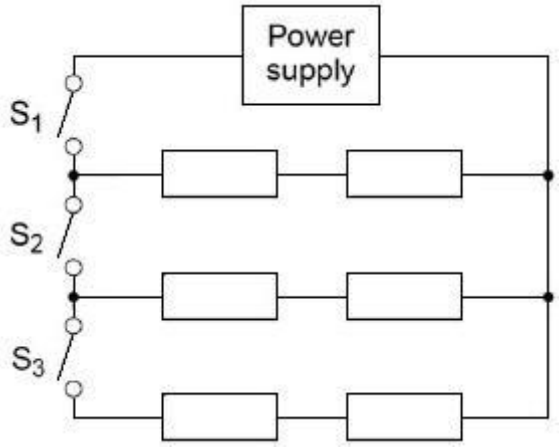
(1)

Figure 2 shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 2



(b) Why do the hair straighteners **not** turn on when only switch S_2 is closed?

_____

_____

(1)

(c) The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

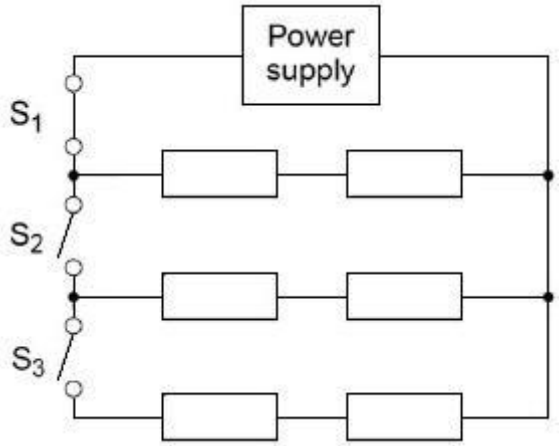
Use the Physics Equations Sheet.

Time = _____ seconds

(4)

(d) **Figure 3** shows the hair straighteners circuit with switch S_1 closed.

Figure 3



Switch S_2 and switch S_3 are then closed at the same time.

Explain what happens to the power output of the power supply.

_____

_____

(3)

Q8.

Figure 1 shows a student walking on a carpet.

Figure 1

(a) The student becomes negatively charged because of the friction between her socks and the carpet.

Explain why the friction causes the student to become charged.

_____

_____

_____

_____

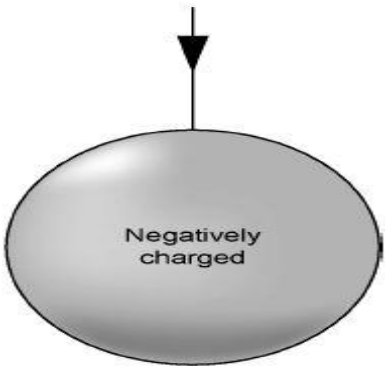
(2)

(b) The student's head is represented by the sphere in **Figure 2**.

The student is negatively charged. The arrow shows part of the electric field around the student's head.

Draw **three** more arrows on **Figure 2** to complete the electric field pattern.

Figure 2



(1)

(c) The negatively charged student touches a metal tap and receives an electric shock.

Explain why.

(3)

(d) Some carpets have thin copper wires running through them. The student is less likely to receive an electric shock after walking on this type of carpet.

Suggest why.

(2)

(Total 8 marks)

Q9.

The diagram below shows a hydroelectric power station.

Electricity is generated when water from the reservoir flows through the turbines.

(a) Write down the equation which links density (ρ), mass (m) and volume (V).

(1)

(b) The reservoir stores 6 500 000 m^3 of water.

The density of the water is 998 kg/m^3.

Calculate the mass of water in the reservoir.

Give your answer in standard form.

Mass (in standard form) = _____ kg

(4)

(c) Write down the equation which links energy transferred (E), power (P) and time (t).

(1)

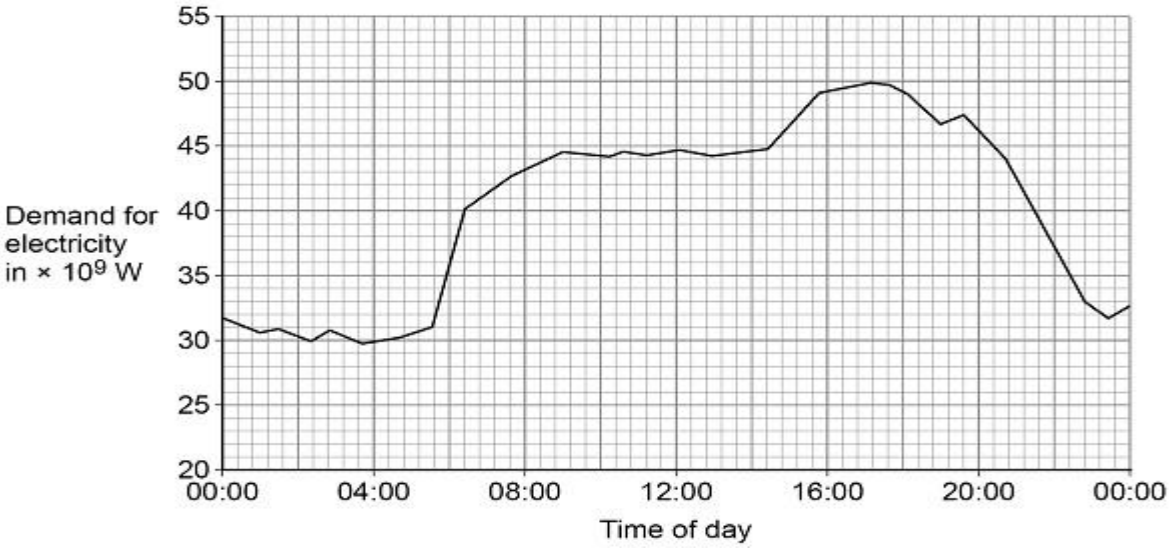
(d) The electrical generators can provide 1.5×10^9 W of power for a maximum of 5 hours.

Calculate the maximum energy that can be transferred by the electrical generators.

Energy transferred = _____ J

(3)

(e) The graph below shows how the UK demand for electricity increases and decreases during one day.



The hydroelectric power station in the above diagram can provide 1.5×10^9 W of power for a maximum of 5 hours.

Give **two** reasons why this hydroelectric power station is not able to meet the increase in demand shown between 04:00 and 16:00 in above graph.

1 _____

_____

_____

2 _____

_____

_____

(2)

P3 Particle Model of Matter

Q10.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The information in the box is about the properties of solids and gases.

Solids: • have a fixed shape • are difficult to compress (to squash). Gases: • will spread and fill the entire container • are easy to compress (to squash).

Use your knowledge of kinetic theory to explain the information given in the box.

You should consider:
- the spacing between the particles
- the movement of individual particles
- the forces between the particles.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

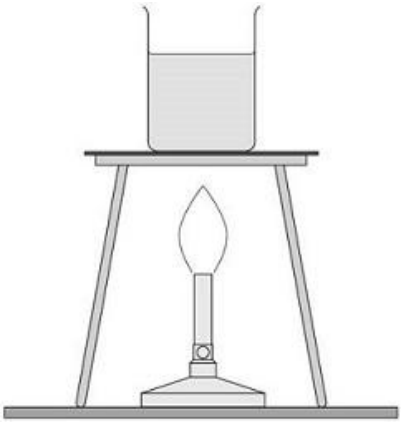
_____

_____

(Total 6 marks)

Q11.

The figure below shows a Bunsen burner heating some water in a beaker.
Eventually the water changes into steam.



(a) Explain how the internal energy of the water changes as it is heated from 20 °C to 25 °C

_____

_____

(2)

(b) How is the particle model used to explain the difference in density between a liquid and a gas?

Tick (✓) **one** box.

Particles in a gas have less kinetic energy than particles in a liquid. ☐

Particles in a gas have more potential energy than particles in a liquid. ☐

Particles in a liquid are further apart than particles in a gas. ☐

Particles in a liquid are larger than particles in a gas. ☐

(1)

(c) A student measured the mass of boiling water that was turned into steam in five minutes.

Explain how the student could use this information to estimate the power output of the Bunsen burner in watts.

(4)

(Total 7 marks)

Q12.

The table gives information about some methods of conserving energy in a house.

Conservation method	Installation cost in £	Annual saving on energy bills in £
Cavity wall insulation	500	60
Hot water tank jacket	10	15
Loft insulation	110	60
Thermostatic radiator valves	75	20

(a) Explain which of the methods in the table is the most cost effective way of saving energy over a 10 year period. To obtain full marks you must support your answer with calculations.

(3)

(b) Describe what happens to the energy which is 'wasted' in a house.

(2)

(Total 5 marks)

Q13.

According to kinetic theory, all matter is made up of small particles. The particles are constantly moving.

Diagram 1 shows how the particles may be arranged in a solid.

Diagram 1

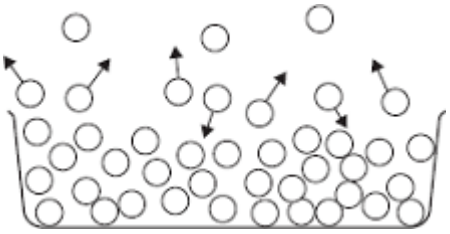
(a) One kilogram of a gas has a much larger volume than one kilogram of a solid.

Use kinetic theory to explain why.

(4)

(b) **Diagram 2** shows the particles in a liquid. The liquid is evaporating.

Diagram 2



(i) How can you tell from **Diagram 2** that the liquid is evaporating?

_____

(1)

(ii) The temperature of the liquid in the container decreases as the liquid evaporates.

Use kinetic theory to explain why.

_____

_____

_____

_____

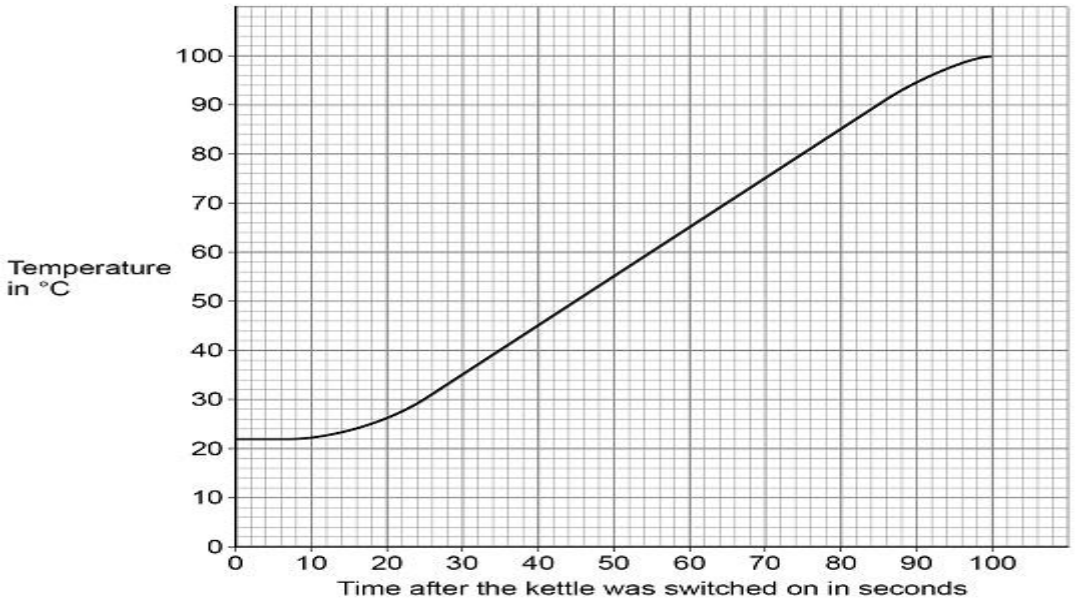
_____

_____

(3)

Q14.

An electric kettle was switched on. The graph below shows how the temperature of the water inside the kettle changed.



(a) When the kettle was switched on the temperature of the water did **not** immediately start to increase.

Suggest **one** reason why.

_____

_____

_____

(1)

(b) The energy transferred to the water in 100 seconds was 155 000 J.

specific heat capacity of water = 4200 J/kg °C

Determine the mass of water in the kettle.

Use the graph above.

Give your answer to 2 significant figures.

_____

_____

_____

_____

_____

_____

_____

Mass of water (2 significant figures) = _____ kg

(5)

(c) The straight section of the line in above graph can be used to calculate the useful power output of the kettle.

Explain how.

_____

_____

_____

_____

_____

_____

(3)

P4 Atomic Structure

Q15.

The table gives information about the three types of particle that make up an atom.

Particle	Relative mass	Relative charge
Proton		+1
Neutron	1	
Electron	very small	–1

(a) Complete the table by adding the **two** missing values.

(b) Use the information in the table to explain why an atom has no overall electrical charge.

_____

_____

_____

_____

(2)

(c) Uranium has two natural isotopes, uranium-235 and uranium-238.
Uranium-235 is used as a fuel inside a nuclear reactor.
Inside the reactor, atoms of uranium-235 are split and energy is released.

(i) How is the structure of an atom of uranium-235 different from the structure of an atom of uranium-238?

_____

_____

(1)

(ii) The nucleus of a uranium-235 atom must absorb a particle before the atom is able to split.

What type of particle is absorbed?

_____

(1)

(iii) The nucleus of an atom splits into smaller parts in a reactor.

What name is given to this process?

_____

(1)

(Total 7 marks)

Q16.

Radioactive waste from nuclear power stations is a man-made source of background radiation.

(a) Give **one** other man-made source of background radiation.

_____

(1)

Nuclear power stations use the energy released by nuclear fission to generate electricity.

(b) Give the name of **one** nuclear fuel.

_____

(1)

(c) Nuclear fission releases energy.

Describe the process of nuclear fission inside a nuclear reactor.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) A new type of power station is being developed that will generate electricity using nuclear fusion.

Explain how the process of nuclear fusion leads to the release of energy.

_____

_____

_____

_____

(2)

(e) Nuclear fusion power stations will produce radioactive waste. This waste will have a much shorter half-life than the radioactive waste from a nuclear fission power station.

Explain the advantage of the radioactive waste having a shorter half-life.

_____

(2)
(Total 10 marks)

Q17.

Nuclear fission and nuclear fusion are two processes that release energy.

(a) The following nuclear equation represents the fission of uranium-235 (U-235).

$$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{236}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n + \text{energy}$$

Chemical symbols:

- Ba = barium
- Kr = krypton
- $^{1}_{0}n$ = neutron

Describe the process of nuclear fission.

Use the information in the equation.

(4)

(b) Explain what happens in the process of nuclear fusion.

(3)

(c) Fission reactors are used in nuclear power stations.

Engineers are developing fusion reactors for use in power stations.

Fusion uses isotopes of hydrogen called deuterium and tritium.

- Deuterium is naturally occurring and can be easily extracted from seawater.
- Tritium can be produced from lithium. Lithium is also found in seawater.

The table shows the energy released from 1 kg of fusion fuel and from 1 kg of fission fuel.

Type of fuel	**Energy released from 1 kg of fuel in joules**
Fusion	3.4×10^{14}
Fission	8.8×10^{13}

Suggest **two** advantages of the fuel used in a fusion reactor compared with the fuel used in a fission reactor.

1. _____

_____

_____

2. _____

_____

_____

(2)

Q18.

Different radioactive isotopes have different values of half-life.

(a) What is meant by the ‘half-life’ of a radioactive isotope?

_____

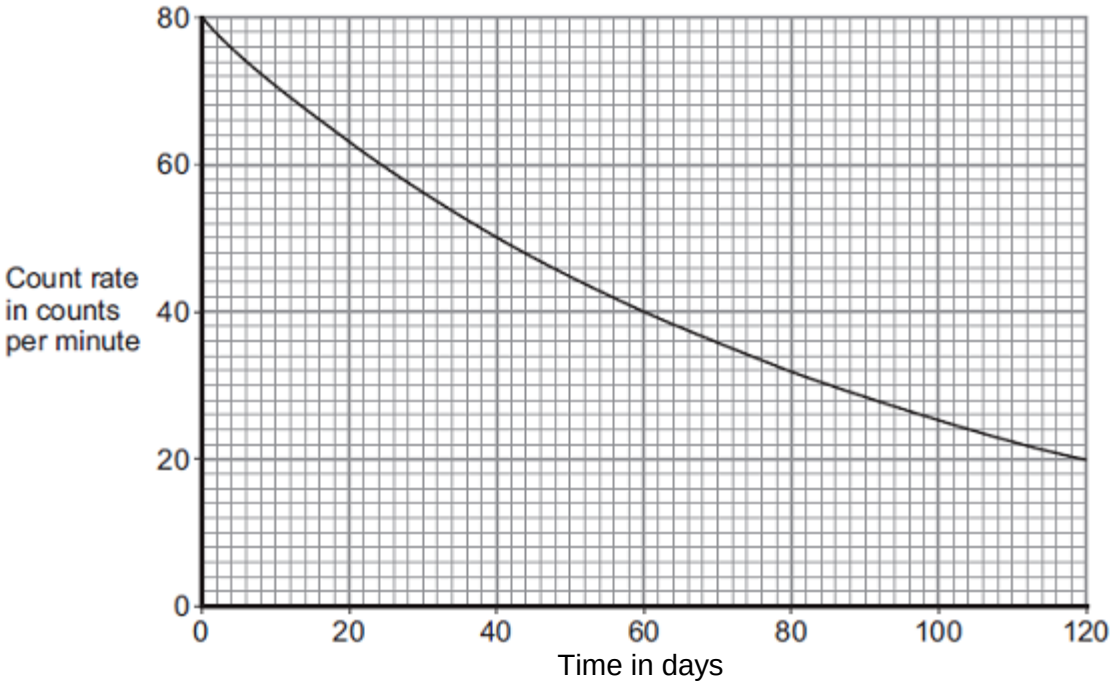
_____

_____

(1)

(b) **Figure 1** shows how the count rate from a sample of a radioactive isotope varies with time.

Figure 1



Use information from **Figure 1** to calculate the half-life of the radioactive isotope.

Show clearly on **Figure 1** how you obtain your answer.

Half-life = _____ days

(2)

(c) The table below shows data for some radioactive isotopes that are used in schools.

Radioactive isotope	**Type of radiation emitted**	**Half-life in years**
Americium-241	Alpha and gamma	460
Cobalt-60	Gamma	5
Radium-226	Alpha, beta and gamma	1600
Strontium-90	Beta	28
Thorium-232	Alpha and beta	1.4×10^{10}

(i) State which radioactive isotope in the table above emits only radiation that is **not** deflected by a magnetic field.

Give a reason for your choice.

_____

_____

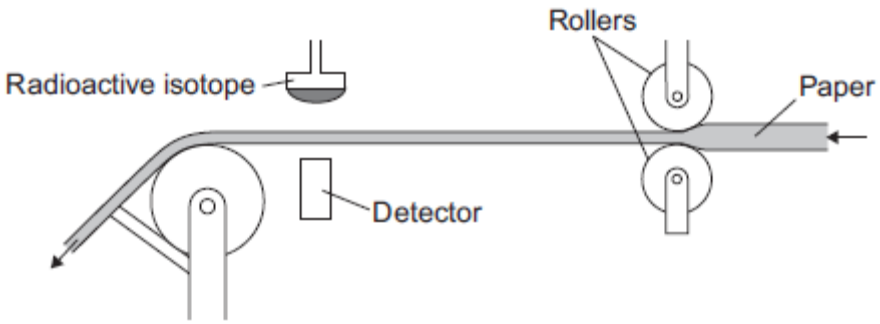
_____

_____

(2)

(ii) **Figure 2** shows a radioactive isotope being used to monitor the thickness of paper during production.

Figure 2



State which radioactive isotope in the table should be used to monitor the thickness of the paper.

Explain your choice.

_____

_____

_____

_____

_____

(3)

All the radioactive isotopes in the table have practical uses.

State which source in the table would need replacing most often.

Explain your choice.

_____

_____

_____

_____

_____

(3)

(iii) When the radioactive isotopes are not in use, they are stored in lead-lined wooden boxes.

The boxes reduce the level of radiation that reaches the surroundings.

Figure 3 shows two of these boxes.

State **one** source from the table which emits radiation that could penetrate the box.

Explain your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 14 marks)

Mark schemes

Q1.

(a) (i) 2.1

correct answer only

1

(ii) 3.15

or

their (a)(i) × 1.5 correctly calculated

*allow **1** mark for correct substitution*

ie 2.1 × 1.5

or

their (a)(i) × 1.5

2

kilowatt-hour

accept kWh

or

*a substitution 2100 × 5400 scores **1** mark*

*2100 × 5400 incorrectly calculated with answer in joules scores **2** marks*

*an answer of 11 340 000 scores **2** marks*

*an answer of 11 340 000 J scores **3** marks*

1

(iii) most (input) energy is usefully transformed

accept does not waste a lot of energy

accept most of the output / energy is useful

*do **not** accept it does not waste energy*

1

(b) the room is losing energy / heat

1

at the same rate as the heater supplies it

this mark only scores if the first is scored

*do **not** accept heater reaches same temperature as room / surroundings*

rate of heat gain = rate of heat loss scores both marks

1

[7]

Q2.

(a) P = 696 000 000 (W)

1

P = 1200 (W)

allow an answer consistent with their incorrectly / not converted value of P

1

(b) wind is unreliable

1

wind turbines don't turn when the wind is too strong/weak

allow there are not enough wind turbines in the UK

1

(c) the efficiency would increase

1

because the percentage / proportion of energy usefully transferred would increase
or
because the percentage/ proportion of energy wasted would decrease

allow amount for percentage/ proportion

1

(because) less work is done against friction

1

(d) more efficient devices need a lower energy input (for the same energy output)

1

which would minimise the electricity demand
or
less electricity needs to be generated
or
which would minimise the environmental impact from electricity generation

1

[9]

Q3.

(a) Length of sled

1

Time for sled to pass light gate

1

(b) $E_p = 8330$ (J)

1

$8330 = m \times 9.8 \times 17.0$

allow a correct substitution using an incorrectly/not converted value of E_p

1

$m = \frac{8330}{9.8 \times 17.0}$

allow a correct rearrangement using an incorrectly/not converted value of E_p

1

m = 50.0 (kg)

allow a correct calculation using an incorrectly/not converted

value of E_p

1

(c) $\frac{1}{2} mv^2 = mgh$
or
decrease in E_p = increase in E_k

1

masses cancel on both sides of the equation
or
$v^2 = 2gh$

1

(final) speed only depends on vertical height (and gravitational field strength)

1

variations will be due to air resistance/friction
or
different initial speed

1

[10]

Q4.

(a) h = 1.75 m

1

$E_p = 60 \times 9.8 \times 1.75$

this mark may be awarded if h is incorrectly/not converted

1

E_p = 1029 (J)

allow an answer consistent with their value for h

1

$$P = \frac{1029}{1.40}$$

allow their calculated value of $E_p \div 1.40$

1

P = 735 (W)

allow an answer consistent with their value for E_p

1

(b) girl increases her kinetic energy as well as increasing her gravitational potential energy

1

some energy is wasted in her muscles
or
some energy transferred as thermal energy (to surroundings)

1

(c) the boy's mass was greater than the girl's mass

1

[8]

Q5.

(a) (i) $A_1 = 0.5$

ignore any units

1

$A_4 = 0.5$

*allow **1** mark for $A_1 = A_4 \neq 0.5$*

1

(ii) the resistance of **P** is more than 20 Ω

1

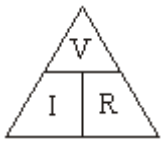
a smaller current goes through P / A_2 (than 20 Ω)

dependent on getting 1st mark correct
accept converse

1

(b) (i) potential difference = current × resistance

accept pd / voltage for potential difference
accept V = I × R, correct symbols and correct case only
accept volts = amps × ohms
accept



provided subsequent method is correct
allow combination of
physical quantities and named units
allow voltage = I × R

1

(ii) 6

*allow **1** mark for correct substitution*

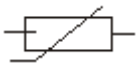
2

(iii) 6

accept their (b)(ii)

1

(c) thermistor or



accept correct circuit symbol
allow phonetic spelling

1

resistance goes down (as temperature of thermistor goes up)

*do **not** accept changes for goes down*
*do **not** accept an answer in terms of current only*
answers in terms of other components are incorrect

1

[10]

Q6.

(a) (very high p.d. means) very low currents

1

which means less (thermal) energy is transferred to surroundings

allow less power loss in cables

1

which increases the efficiency of power transmission

1

(b) electric field strength is very high

1

causing the air to become ionised

allow the air breaks down

allow the air becomes a conductor

allow the air conducts charge

1

(the kite / string) conducts charge to the person / earth

ignore answers referring to the kite touching the power cables

1

(c) straight line passing through the origin

1

line drawn below existing line for all values

1

(d) the potential difference across the wires/cable is the same

1

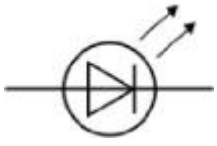
(but) the resistance of the steel wire is greater (and so less current in the steel)

1

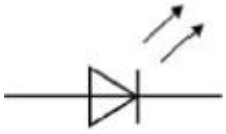
[10]

Q7.

(a)



allow:



1

(b) there is a gap in the circuit

or

S_1 needs to be closed to complete the circuit

or

S_1 needs to be closed to turn the hair straighteners on

1

(c) E = 3600 (J)

1

3600 = 120 × t

this mark may score if E is incorrectly / not converted

1

$t = \frac{3600}{120}$

this mark may score if E is incorrectly / not converted

1

t = 30 (s)

allow an answer consistent with their value of E

1

(d) the total resistance of the circuit decreases

1

so the current increases

1

which increases the power output

1

[9]

Q8.

(a) transfer of <u>electrons</u>

mention of positive charge moving negates both marks

1

from the carpet to the student

1

(b) three arrows perpendicular to sphere's surface with all arrows directed inwards and distributed evenly around sphere

1

(c) there is a potential difference between the student and the tap

*do **not** accept the tap / sink is charged*

1

which causes electrons / charges to transfer from the student
or
which causes electrons / charges to transfer to the tap

1

which earths the charge

allow the tap is earthed

1

(d) carpet / copper has a low resistance

allow carpet is a conductor
or
copper is a conductor

1

lower / no build-up of charge (on the student)
or
(so there is a) smaller / no potential difference between student and tap / earth

1

[8]

Q9.

(a) density = $\frac{\text{mass}}{\text{volume}}$
or
$\rho = \frac{m}{V}$

1

(b) $998 = \frac{\text{m}}{6\ 500\ 000}$

1

$m = 998 \times 6\ 500\ 000$

1

$m = 6\ 487\ 000\ 000$

1

$m = 6.487 \times 10^9$ (kg)
allow a correct conversion of their calculated value of mass into standard form

1

(c) energy transferred = power × time
or
$E = Pt$

1

(d) $t = 18\ 000$ (s)
or
$t = 5 \times 60 \times 60$

1

$E = 1.5 \times 10^9 \times 18\ 000$
allow a correct substitution using an incorrectly/not converted value of t

1

$E = 2.7 \times 10^{13}$ (J)
allow a correct calculation using an incorrectly/not converted value of t

1

(e) the variation in demand is (much) greater than 1.5×10^9 W
allow the increase in demand is greater than the (power) output of the (hydroelectric) power station

1

demand remains high for longer than 5 hours

allow 04:00 to 16:00 is 12 hours

allow 04:00 to 16:00 is greater than 5 hours

1

[11]

Q10.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1–2 marks)
Considers either solid or gas and describes at least one aspect of the particles.

or

Considers both solids and gases and describes an aspect of each.

Level 2 (3–4 marks)
Considers both solids and gases and describes aspects of the particles.

or

Considers one state and describes aspects of the particles and explains at least one of the properties.

or

Considers both states and describes an aspect of the particles for both and explains a property for solids or gases.

Level 3 (5–6 marks)
Considers both states of matter and describes the spacing and movement / forces between the particles. Explains a property of both solids and gases.

examples of the points made in the response

extra information

Solids

- (particles) close together
- (so) no room for particles to move closer (so hard to compress)
- vibrate about fixed point
- strong forces of attraction (at a distance)
- the forces become repulsive if the particles get closer
- particles strongly held together / not free to move around (shape is fixed)

any explanation of a property must match with the given aspect(s) of the particles.

Gases

- (particles) far apart
- space between particles (so easy to compress)
- move randomly

- negligible / no forces of attraction
- spread out in all directions (to fill the container)

[6]

Q11.

(a) the (mean) kinetic energy of the particles increases

allow the (mean) speed of the particles increases

'kinetic energy increases' is insufficient by itself

*do **not** accept particles vibrating*

1

which increases the (internal) energy of the water

ignore description of evaporation

1

(b) Particles in a gas have more potential energy than particles in a liquid.

1

(c) Energy given to water E = mL with quantities defined

1

$$\text{power output (of Bunsen burner)} = \frac{\text{energy transferred (to water)}}{\text{time}}$$

allow $P = \frac{E}{t}$ *with quantities defined*

1

$$\text{power output} = \frac{\text{change in mass} \times \text{specific latent heat}}{\text{time}}$$

allow E = Pt equated with E = mL or stated in words

or

$P = \frac{mL}{t}$ *with quantities defined*

1

time should be converted to seconds

or

use a time of 300 seconds

1

[7]

Q12.

(a) loft insulation

1

energy saved in 10 years £600

1

net saving (600 – 110) £490

1

OR

hot water jacket

1

energy saved in 10 years £140

1

This is the highest percentage saving on cost

1

(b) transferred to environment / surroundings

1

as heat / thermal energy

1

[5]

Q13.

(a) there are strong forces (of attraction) between the particles in a solid

accept molecules / atoms for particles throughout
accept bonds for forces

1

(holding) the particles close together

particles in a solid are less spread out is insufficient

1

or

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible

accept very small / zero for negligible
accept bonds for forces

1

so the particles spread out (to fill their container)

accept particles are not close together
gas particles are not in a fixed position is insufficient

1

(b) (i) particles are (shown) leaving (the liquid / container)

accept molecules / atoms for particles throughout
accept particles are escaping
particles are getting further apart is insufficient

1

(ii) *accept molecules / atoms for particles throughout*
accept speed / velocity for energy throughout

particles with most energy leave the (surface of the) liquid

accept fastest particles leave the liquid

1

so the <u>mean / average</u> energy of the remaining particles goes down

1

and the lower the average energy (of the particles) the lower the temperature (of the liquid)

1

[8]

Q14.

(a) the heating element of the kettle takes time to heat up

allow the kettle takes time to heat up

1

(b) $\Delta\Theta = 78$ (°C)

1

$155\,000 = m \times 4200 \times 78$

allow a correct substitution using an incorrect value of ΔΘ

1

$m = \frac{155\,000}{4200 \times 78}$

allow a correct rearrangement using an incorrect value of ΔΘ

1

$m = 0.4731$ (kg)

allow a correct calculation of mass using an incorrect value of ΔΘ

1

$m = 0.47$ (kg)

1

(c) Gradient = $\frac{\Delta\theta}{t}$

allow gradient = rate of temperature increase
allow calculation of gradient

1

$Pt = mc\Delta\Theta$

1

$P = \text{gradient} \times mc$

1

[9]

Q15.

(a)

Particle	Relative Mass	Relative charge
Proton	1	
Neutron		0

accept one, accept +1
*do **not** accept –1*

1

accept zero

*do **not** accept no charge/ nothing/neutral unless given with 0*

1

(b) equal numbers/amounts of protons and electrons

1

protons and electrons have equal but opposite charge

accept protons charge +1 and electron charge –1

accept (charge) on proton cancels/balances (charge) on electron

accept positive (charges) cancel out the negative(charges)

neutrons have no charge is neutral

*do **not** accept total charge of protons, electrons (and neutrons) is 0 unless qualified*

1

(c) (i) (3) fewer neutrons

accept lower/ smaller mass number

*do **not** accept different numbers of neutrons*

any mention of fewer/more protons/electrons negates mark

accept answers in terms of U-238 providing U-238 is specifically stated i.e. U-238 has (3) more neutrons

1

(ii) neutron

1

(iii) (nuclear) fission

accept fision

*do **not** accept any spelling that may be taken as fusion*

1

[7]

Q16.

(a) Any **one** from:

- (medical) x-rays

  allow CT scans
- radiotherapy
- nuclear weapons (testing)

  allow nuclear fallout
- named nuclear disaster e.g. Chernobyl / Fukushima / Three Mile Island.

  ignore radioactive / nuclear waste

1

(b) uranium / plutonium

ignore any number given

allow thorium

1

(c) neutron absorbed by a uranium nucleus

1

nucleus splits into two parts

allow an atom splits into two parts if 1st marking point doesn't score

1

and (2/3) neutrons (are released)

1

and gamma rays (are emitted)

1

(d) lighter nuclei join to form heavier nuclei

allow specific examples

1

some of the mass (of the nuclei) is converted to energy (of radiation)

1

(e) activity decreases quickly

allow nuclei / waste will decay at a greater rate
ignore waste is radioactive for less time

1

risk of harm decreases quickly

allow burial site doesn't need to be monitored for as long
or
doesn't need to be buried underground for as long
or
may not need to be buried underground

1

[10]

Q17.

(a) a uranium nucleus

1

absorbs a neutron

1

(uranium-236 nucleus) splits into two smaller nuclei
or
Kr and Ba nuclei
or
krypton and barium nuclei

1

and releases 3 neutrons and energy

1

(b) light nuclei

1

join to form a heavier nucleus

allow hydrogen nuclei for light nuclei
allow helium nucleus for heavier nucleus

1

(some of the) mass of the nuclei is converted to energy

allow particles for nuclei

1

(c) any **two** from:

- easy to obtain / extract

- available in (very) large amounts
- releases more energy (per kg)

*do **not** accept figures **only***

naturally occurring is insufficient

seawater is renewable is insufficient

less cost is insufficient

allow produces little / no radioactive waste

Q18.

(a) (average) time taken for the amount / number of nuclei / atoms (of the isotope in a sample) to halve
or
time taken for the count rate (from a sample containing the isotope) to fall to half

accept (radio)activity for count rate

(b) *60 ±3* (days)

indication on graph how value was obtained

(c) (i) cobalt(-60)

gamma not deflected by a magnetic field
or
gamma have no charge

dependent on first marking point

accept (only) emits gamma

gamma has no mass is insufficient

*do **not** accept any reference to half-life*

(ii) strontium(-90)

any **two** from:

- *only* has beta
- alpha would be absorbed
- gamma unaffected
- *beta penetration / absorption depends on thickness of paper*

*if thorium(-232) or radium(-226) given, max **2** marks can be awarded*

(iii) cobalt(-60)

shortest half-life

accept half-life is 5 years

dependent on first marking point

so activity / count rate will decrease quickest

(iv) *americium(-241) / cobalt(-60) / radium(-226)*

gamma emitter

(only gamma) can penetrate lead *(of this box)*

do not allow lead fully absorbs gamma