AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.3.2.1 INTERNAL ENERGY (PACK 1)

SCORE	PERCENTAGE
/253	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Mark schemes

Q1.

(a) chemical

1

kinetic

1

in this order only

(b) $E_k = 0.5 \times 80 \times 12^2$

1

$E_k = 5760$ (J)

1

*an answer of 5760 (J) scores **2** marks*

(c) $E = 0.040 \times 480 \times 50$

1

$E = 960$ (J)

1

*an answer of 960 (J) scores **2** marks*

(d) increased

1

[7]

Q2.

(a) range of speeds

1

moving in different directions

accept random motion

1

(b) internal energy

1

(c) density = mass / volume

1

(d) 0.00254 / 0.0141

1

0.18

1

*accept 0.18 with no working shown for the **2** calculation marks*

kg / m^3

1

[7]

Q3.

STEMUP.CO.UK

(a) decreased

correct order only

1

decreased

1

increased

1

(b) (i) A

reason only scores if A chosen

1

uses least / less energy (in 1 year)

a comparison is required

accept uses least power

accept uses least kWh

1

(ii) greater the volume the greater the energy it uses (in 1 year)

1

(iii) a very small number sampled

accept only tested 3

accept insufficient evidence / data

*allow not all fridges have the same efficiency **or** a correct description implying different efficiencies*

only tested each fridge once is insufficient

there are lots of different makes is insufficient

1

[7]

Q4.

(a) (i) any **two** from:

- mass (of block)

  accept weight for mass
- starting temperature
- final / increase in temperature

  temperature is insufficient
- voltage / p.d.

  same power supply insufficient
- power (supplied to each block)
- type / thickness of insulation

  same insulation insufficient

2

(ii) one of variables is categoric

or

(type of) material is categoric

accept the data is categoric

accept a description of categoric

*do **not** accept temp rise is categoric*

STEMUP.CO.UK

1

(iii) concrete

reason only scores if concrete chosen

1

(heater on for) longest / longer time

a long time or quoting a time is insufficient

*do **not** accept it is the highest bar*

1

(iv) 4500 (J)

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

2 × 450 × 5 provided no subsequent step shown

2

(b) (i) point at 10 minutes identified

1

(ii) line through all points except anomalous

line must go from at least first to last point

1

(iii) 20 (°C)

if 20°C is given, award the mark.

If an answer other than 20°C is given, look at the graph. If the graph shows a correct extrapolation of the candidate's best-fit line and the intercept value has been correctly stated, allow 1 mark.

1

(iv) 2 (minutes)

1

[11]

Q5.

(a) infrared / IR

correct answer only

1

(b) any **two** from:

- increase the power / watts

  allow increase the temperature of the oven or make the oven hotter
- decrease the speed

  allow leave the biscuits in for longer
- put biscuits through again

  increase radiation is insufficient

  ignore changes to the design of the oven

2

(c) (inside) surface is a (good) reflector or poor absorber (of IR)

Ignore bounce for reflect

STEMUP.CO.UK

surface is a (good) reflector of light does not score

surface is a (good) reflector of light and infrared / heat does score

1

(and) <u>outside</u> surface is poor emitter (of IR)

1

(so) increases the energy reaching the biscuits

allow reduces energy loss or makes oven more efficient

*do **not** accept no energy losses*

keeps oven hotter is insufficient

1

[6]

Q6.

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)

STEMUP.CO.UK

- 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]

Q7.

(a) air near freezer compartment is cooled or loses energy

accept air at the top is cold

1

cool air is (more) dense or particles close(r) together (than warmer air)

*do **not** allow the particles get smaller / condense*

1

so (cooler) air falls

1

air (at bottom) is displaced / moves upwards / rises

*do **not** allow heat rises*

accept warm air (at the bottom) rises

1

(b) if volume is doubled, energy use is not doubled
or
volume ÷ energy not a constant ratio

1

correct reference to data, eg 500 is 2×250 but 630 not 2×300

1

(c) accept suitable examples, eg

advantage:

- reduces emissions into atmosphere
- lower input power or uses less energy or wastes less energy
- costs less to run

cost of buying or installing new fridge is insufficient

ignore reference to size of fridge

1

disadvantage:

- land fill
- energy waste in production
- cost or difficulty of disposal
- transport costs

STEMUP.CO.UK

1

[8]

Q8.

(a) conduction

1

(b) 35 000

1

(c) 500

*their (b) = 2 x c x 35 correctly calculated scores **2** marks*
*allow **1** mark for correct substitution,*
ie 35000 = 2 x c x 35
or
their (b) = 2 x c x 35

2

J / kg°C

1

(d) energy lost to surroundings
or
energy needed to warm heater

accept there is no insulation (on the copper block)
*do **not** accept answers in terms of human error or poor results or defective equipment*

1

[6]

Q9.

(a) (i) 70

accept ± half a square
(69.8 to 70.2)

1

(ii) 15

*accept 14.6 to 15.4 for **2** marks*
*allow for **1** mark 70 − 55*
ecf from (b)(i) ± half a square

2

(iii) C

1

biggest drop in temperature during a given time
accept it has the steepest gradient this is a dependent

1

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

1

(v) because 20 °C is room temperature

STEMUP.CO.UK

accept same temperature as surroundings

1

(b) (i) 6720

*correct answer with or without working gains **3** marks*
*6 720 000 gains **2** marks*
*correct substitution of E = 0.2 × 4200 × 8 gains **2** marks*
*correct substitution of E = 200 × 4200 × 8 gains **1** mark*

3

(ii) the fastest particles have enough energy

accept molecules for particles

1

to escape from the surface of the water

1

therefore the mean energy of the remaining particles decreases

accept speed for energy

1

the lower the mean energy of particles the lower the temperature (of the water)

accept speed for energy

1

[14]

Q10.

(a) (i) temperature (increase) and time switched on are <u>directly</u> <u>proportional</u>

accept the idea of equal increases in time giving equal increases in temperature
answers such as:

- *as time increases, temperature increases*
- *positive correlation*
- *linear relationship*
- *temperature and time are proportional*

*score **1** mark*

2

(ii) any **one** from:

"it" refers to the metal block

- energy transfer (from the block) to the surroundings

accept lost for transfer
accept air for surroundings

- (some) energy used to warm the heater / thermometer (itself)

accept takes time for heater to warm up

- (metal) block is not insulated

1

(iii) 15 000

STEMUP.CO.UK

*allow **1** mark for correct substitution, ie 50 × 300 provided no subsequent step shown*

2

(b) lead

reason only scores if lead is chosen

1

needs least energy to raise temperature by 1°C

accept needs less energy to heat it (by the same amount)
lowest specific heat capacity is insufficient

1

[7]

Q11.

(a) any **two** from:

- water evaporates

  accept steam / water vapour for water molecules
  accept water turns to steam

- water molecules / particles go into the air

- mirror (surface) is cooler than (damp) air

  accept the mirror / surface / glass is cold

- water molecules / particles that hit the mirror lose energy

  accept water molecules / particles that hit the mirror cool down

- cooler air cannot hold as many water molecules / particles

2

(causes) condensation (on the mirror)

accept steam changes back to water (on the mirror)

or
particles move closer together

1

(b) mirror (surface) is warm

mirror is heated is insufficient

1

(rate of) condensation reduced

accept no condensation (happens)

1

[5]

Q12.

(a) 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 refer to the information in the Marking guidance.

STEMUP.CO.UK

0 marks
No relevant content.

Level 1(1-2 marks)
There is a basic explanation of **one** feature
or
a simple statement relating reduction in energy transfer to **one** feature.

Level 2(3-4 marks)
There is a clear explanation of **one** feature
or
a simple statement relating reduction in energy transfer to **two** features.

Level 3(5-6 marks)
There is a detailed explanation of at least **two** features
or
a simple statement relating reduction in energy transfer to all **four** features.

Examples of the points made in response

extra information

accept throughout:
heat for energy
loss for transfer

plastic cap:

- plastic is a poor conductor
  accept insulator for poor conductor
- stops convection currents forming at the top of the flask so stopping energy transfer by convection
- molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation
- plastic cap reduces / stops energy transfer by conduction / convection / evaporation

glass container:

- glass is a poor conductor so reducing energy transfer by conduction
- glass reduces / stops energy transfer by conduction

vacuum:

- both conduction and convection require a medium / particles
- so stops energy transfer between the two walls by conduction and convection
- vacuum stops energy transfer by conduction / convection

silvered surfaces:

- silvered surfaces reflect infrared radiation
  accept heat for infrared

STEMUP.CO.UK

- silvered surfaces are poor emitters of infrared radiation
- infrared radiation (partly) reflected back (towards hot liquid)
- silvered surfaces reduce / stop energy transfer by radiation

6

(b) (the ears have a) small surface area

ears are small is insufficient

1

so reducing energy radiated / transferred (from the fox)

accept heat lost for energy radiated

*do **not** accept stops heat loss*

1

[8]

Q13.

(a) conduction

1

(b) (i) there is a bigger temperature difference between the water and the surrounding air

accept the water is hottest / hotter

1

so the transfer of energy (from hot water) is faster

accept heat for energy

ignore temperature falls the fastest

1

(ii) 120

*allow **1** mark for converting kJ to J correctly, ie 4 032 000*

or

correctly calculating temperature fall as 8°C

or

allow **2** marks for correct substitution, ie 4 032 000 = m × 4200 × 8

answers of 0.12, 19.2 **or** 16.6 gain **2** marks

answers of 0.019 **or** 0.017 gain **1** mark

3

(iii) water stays hot for longer

1

so heater is on for less time

accept so less energy needed to heat water

1

so cost of the jacket is soon recovered from) lower energy costs / bills

accept short payback time

STEMUP.CO.UK

1

[9]

Q14.

(a) (i) Z

1

(ii) X

1

(b) (i) moving randomly

1

(ii) stronger than

1

(c) (i) evaporation

1

(ii) any **one** from:

- becomes windy
- temperature increases

accept (becomes) sunny
"the sun" alone is insufficient

- less humid

1

[6]

Q15.

(a) (i) 5(.0)

1

(ii) 35 **or** their (a)(i) × 7 correctly calculated

*allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown*

2

(iii) 525(p)
or
(£) 5.25
or
their (a)(ii) × 15 correctly calculated

if unit p or £ given they must be consistent with the numerical answer

1

(iv) decreases

1

temperature difference (between inside and outside) decreases

accept gradient (of line) decreases
*do **not** accept temperature (inside) decreases*
*do **not** accept graph goes down*

STEMUP.CO.UK

1

(b) air (bubbles are) trapped (in the foam)

*do **not** accept air traps heat*
foam has air pockets is insufficient

1

(and so the) air cannot circulate / move / form convection current

air is a good insulator is insufficient
no convection current is insufficient
answers in terms of warm air from the room being trapped are incorrect and score no marks

1

[8]

Q16.

(a) to reflect (the infrared)

accept (shiny surfaces) are good reflectors
ignore reference to incorrect type of wave

1

(b) black

1

best absorber (of infrared)

answer should be comparative
black absorbs (infrared) is insufficient
accept good absorber (of infrared)
ignore reference to emitter
ignore attracts heat
ignore reference to conduction

1

(c) to reduce energy loss

accept to stop energy loss
accept heat for energy
accept to stop / reduce convection

or

so temperature of water increases faster

accept to heat water faster
accept cooks food faster

or

reduces loss of water (by evaporation)

1

(d) 672 000

*allow **1** mark for correct substitution, ie 2 × 4200 × 80 provided no subsequent step shown*

2

[6]

Q17.

STEMUP.CO.UK

(a) (matt) black is a good emitter of infrared / radiation

accept heat for infrared / radiation
ignore reference to good absorber
attracts heat negates this marking point

1

to give maximum (rate of) energy transfer (to surroundings)

accept temperature (of coolant) falls fast(er)

*accept black emits more radiation for **1** mark*

*black emits most radiation / black is the best emitter of radiation for **2** marks*

1

(b) the fins increase the surface area

accept heat for energy

1

so increasing the (rate of) energy transfer
or
so more fins greater (rate of) energy transfer

1

(c) 114 000

*allow **1** mark for correct temperature change, ie 15 (°C)*

or

*allow **2** marks for correct substitution, ie 2 × 3 800 × 15*

*answers of 851 200 **or** 737 200 gain **2** marks*

or

*substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark*

*an answer of 114 kJ gains **3** marks*

3

(d) increases the efficiency

1

less (input) energy is wasted

accept some of the energy that would have been wasted is (usefully) used

or

more (input) energy is usefully used

accept heat for energy

1

[9]

Q18.

(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

STEMUP.CO.UK

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 mean / average 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]

Q19.

(a) conduction

1

(b) (i) any **one** from:

- starting temperature (of cold water)
  temperature is insufficient
- pipe length
  accept size of pipe
- pipe diameter
- pipe (wall) thickness
- volume of cold water
  accept amount for volume

STEMUP.CO.UK

- temperature of hot water (in)
- time

1

(ii) copper

1

greatest temperature change

only scores if copper chosen
accept heat for temperature
accept heated water the fastest
accept it was hottest (after 10 minutes)
accept it is the best / a good conductor

1

(c) the pipe has a larger (surface) area

accept pipe is longer

1

(so) hot / dirty water (inside pipe) is in contact with cold / clean water (outside pipe) for longer

1

[6]

Q20.

(a) (i) random distribution of circles in the box with at least 50 % of circles touching

1

random distribution of circles occupies more than 50 % of the space

judged by eye

1

(ii) (large) gaps between particles

accept particles do not touch
accept particles are spread out

1

(so) easy to push particles closer (together)
or
forces between particles are negligible / none

an answer in terms of number of particles is insufficient

1

(b) (i) (both are) random

accept a correct description of random eg unpredictable or move around freely or in all directions
they take up all the space is insufficient
they are spread out is insufficient
they move in straight lines is insufficient

1

(ii) (speed also) increases

1

[6]

STEMUP.CO.UK

Q21.

(a) **B**

*no mark for **B** - marks are for the explanation*
*first two mark points can score even if **A** is chosen*

draught increases (the rate of) evaporation

accept more evaporation happens
accept draught removes (evaporated) particles faster
*do **not** accept answers in terms of particles gaining energy from the fan / draught*

1

evaporation has a cooling effect

accept (average) <u>kinetic</u> energy of (remaining) particles decreases

1

so temperature will fall faster / further

1

(b) larger surface area

1

increasing the (rate of) evaporation

accept more / faster evaporation
accept easier for particles to evaporate

or

for water to evaporate from

accept more particles can evaporate
accept water / particles which have evaporated are trapped (in the bag)
answers in terms of exposure to the Sun are insufficient

1

[5]

Q22.

(a) $E = P \times t$

91 (p)

an answer £0.91 gains 3 marks
an answer 0.91 gains 2 marks
*allow **2** marks for energy transferred = 18.2 (kWh)*
or
substitution into 2 equations combined, ie 2.6 × 7 × 5
*allow **1** mark for correct substitution into E = P × t, ie E = 2.6 × 7*
or
*allow **1** mark for multiplying and correctly calculating an incorrect energy transfer value by 5*

3

STEMUP.CO.UK

(b) answers should be in terms of supply exceeding demand

accept there is a surplus / excess of electricity (at night)

1

(c) reduce (rate of) energy transfer (from ceramic bricks)

accept heat for energy

*do **not** accept no energy / heat escapes*

*do **not** accept answers in terms of lost / losing heat if this implies heat is wasted energy*

1

so keeping the (ceramic) bricks hot for longer

accept increase time that energy is transferred to the room

accept keep room warm for longer

or

to stop the casing getting too hot

accept so you do not get burnt (on the casing)

1

(d) $E = m \times c \times \theta$

120

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

ie 9 000 000 = m × 750 × 100

2

[8]

Q23.

(a) (i) conduction

1

(ii) atoms gain (kinetic) energy

accept particles / molecules for atoms

*do **not** accept electrons for atoms*

or

atoms vibrate with a bigger amplitude

accept vibrate faster / more

*do **not** accept start to vibrate*

or

atoms collide with neighbouring atoms

1

transferring energy to (neighbouring / other) atoms

*do **not** accept heat for energy*

or

making these other atoms vibrate with a bigger amplitude

accept faster / more for bigger amplitude

mention of (free) electrons moving and passing on energy negates this mark

1

(b) (i) 5 (°C) to 25 (°C)

STEMUP.CO.UK

either order

1

(ii) a correct example of doubling temperature difference doubling heat transfer

eg going from 5 to 10 (°C) difference doubles heat transfer from 30 to 60 (J/s)

accept for heat transfer number of joules / it

*allow **1** mark for correctly reading 1 set of data eg at 5 °C the heat transfer is 30*

or

for every 5°C increase in temperature difference heat transfer increases by 30 (J/s)

no credit for stating they are directly proportional

2

(iii) 1800

*allow **1** mark for obtaining heat transfer value = 120*

2

(c) payback time calculated as 33 years

calculations must be correct to score the first mark point

explanations must relate to it not being cost effective

1

this is greater than lifetime of windows
or
total savings (over 30 years) = £4800 (1)

this is less than cost of windows (1)
or
$\frac{5280}{30}$ = 176 (1)

this is more than the yearly savings (1)

1

[10]

Q24.

(a) any **two** from:

- black is a good emitter of (infrared radiation)

  accept heat for radiation

  ignore reference to absorbing radiation

- large surface (area)

- matt surfaces are better emitters (than shiny surfaces)

  accept matt surfaces are good emitters

  ignore reference to good conductor

2

(b) 90% or 0.9(0)

STEMUP.CO.UK

$$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

allow 1 mark for correct substitution, ie $\frac{13.5}{15}$
provided no subsequent step shown
*an answer of 90 scores **1** mark*
*an answer of 90 / 0.90 with a unit scores **1** mark*

2

(c) (producing) light

allow (producing) sound

1

(d) any **two** from:

- wood is renewable
  accept wood grows again / quickly
  accept wood can be replanted
- (using wood) conserves fossil fuels
  accept doesn't use fossil fuels
- wood is carbon neutral
  accept a description
  cheaper / saves money is insufficient

2

(e) $E = m \times c \times \theta$

2 550 000

*allow **1** mark for correct substitution*
ie 100 × 510 × 50
provided no subsequent step shown
*answers of 1 020 000, 3 570 000 gain **1** mark*

2

joules /J

accept kJ / MJ
*do **not** accept j*
for full credit the unit and numerical answer must be consistent

1

[10]

Q25.

accept atoms / particles for ions throughout

(a metal has) free <u>electrons</u>

accept mobile for free

1

(kinetic) energy of (free) electrons increases

STEMUP.CO.UK

accept energy of ions increases
accept ions vibrate with a bigger amplitude
accept ions vibrate more
*do **not** accept electrons vibrate more*

1

(free) <u>electrons</u> move faster

1

or

electrons move through metal
accept electrons collide with other electrons / ions

(so) electrons transfer energy to other electrons / ions
accept ions transfer energy to neighbouring ions

1

[4]

Q26.

(a) any **two** from:

- (air) particles / molecules / atoms gain energy
- (air) particles / molecules / atoms move faster
  *do **not** accept move more*
  *do **not** accept move with a bigger amplitude / vibrate more*
- (air) particles / molecules / atoms move apart
- air expands
  ignore particles expand
- air becomes less dense
  ignore particles become less dense
- warm / hot air / gases / particles rise
  *do **not** accept heat rises*
  answers in terms of heat particles negates any of the mark points that includes particles

2

(b) (i) any **two** from

- free / mobile electrons gain (kinetic) energy
  accept free / mobile electrons move faster
  accept vibrate faster for gain energy
- free electrons collide with other (free) electrons / ions / atoms / particles
- atoms / ions / particles collide with other atoms / ions / particles
  answers in terms of heat particles negates this mark point

2

(ii) (faster) energy / heat transfer to room(s) / house

STEMUP.CO.UK

accept room(s) / house gets warm(er)
accept lounge / bedroom / loft for rooms

1

[5]

Q27.

(a) (i) radiation

1

(ii) traps (small pockets of) air
*do **not** accept it's an insulator*
*do **not** accept reduces conduction and / or convection*
*do **not** allow it doesn't allow heat to escape*

1

(b) (i) bigger temperature difference (between the water and surroundings) at the start (than at the end)
*do **not** accept water is hotter*

1

(ii) starting temperature (of the water)
accept thickness of fleece
*do **not** accept same amount of fleece*
*do **not** accept thermometer / can*
*do **not** accept time is the same*

1

(iii) 18 (°C)
correct answer only

1

(iv) **M**

1

smallest temperature drop (after 20 mins)
*cannot score if **M** is not chosen*
accept it's the best insulator
accept smallest loss in heat
accept keeps heat / warmth in for longer

1

[7]

Q28.

(a) conduction

1

(b) (i) any **one** from:

- starting temperature (of cold water)
  temperature is insufficient
- pipe length
  accept size of pipe

STEMUP.CO.UK

- pipe diameter
- pipe (wall) thickness
- volume of cold water
  accept amount for volume
- temperature of hot water (in)
- time

1

(ii) (type of) material is categoric

accept one variable is categoric
accept variable(s) are categoric
accept it is categoric
accept variable(s) are not continuous
descriptions of variables ie names and numbers is insufficient

1

(iii) copper

1

greatest temperature change

only scores if copper chosen
accept heat for temperature
accept heated water the fastest
accept it was hottest (after 10 minutes)
accept it is the best / a good conductor

1

(c) larger (surface) area

accept the pipe is longer
accept hot (dirty) water (inside pipe) is in contact with the cold water (outside pipe) for a longer time
he pipe is a spiral is insufficient

1

[6]

Q29.

(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

STEMUP.CO.UK

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]

Q30.

(a) (i) silvered surfaces

more than the correct number of ticks in a row negates the mark

radiation

2

plastic cap

conduction, convection (both required)

	conduction	convection	radiation	
vacuum	✓	✓		
silvered surfaces			✓	(1)
plastic cap	✓	✓		(1)

(ii)

any mention of air or any other substance in a vacuum scores zero

because there are no particles in a vacuum

STEMUP.CO.UK

accept atoms / molecules for particles
accept vacuum is empty space
accept there is nothing in a vacuum
accept there is no air / gas in the vacuum

conduction **and** convection need particles / medium
*need reference to both conduction **and** convection*
accept correct descriptions

2

(b) (i) less heat lost (to air above the heater)
*do **not** accept **no** heat lost*

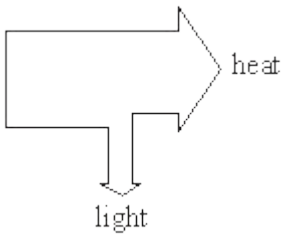
light shiny surfaces are poor emitters (of radiation)
accept radiators for emitters
references to reflection are neutral

or dull, matt surfaces are good emitters (of radiation)
*do **not** credit answers which infer reflection from the underside of the hood*
ignore correct reference to absorption

2

(ii) correct diagram drawn with one output arrow narrower than the other
ignore input

arrows correctly labelled with energy form
eg



flow charts score zero

2

(iii) energy cannot be destroyed
accept (principle of) conservation of energy
*do **not** accept because energy cannot be lost without clarification*

1

[9]

Q31.

(a) the bigger the surface area, the faster the water cools down / temperature falls
answers must imply rate
accept heat for temperature provided rate is implied
*do **not** accept cools down more unless qualified*

1

STEMUP.CO.UK

(b) any **two** from:

the ears:

- have large surface / area
  not just has large ears
- radiate heat
  accept loses heat, but does not score if the reason given for heat loss is wrong
- keep blood cooler

2

(c) (i) radiation

1

(ii) conduction

1

[5]

Q32.

(a) conduction
*do **not** accept conductor*

1

(b) the freezer
both parts needed

greater <u>temperature</u> difference (between freezer and room)
*do **not** accept because it is the coldest*

1

(c) any **two** from:

- poor absorber of heat / radiation
  accept does not absorb heat poor emitter of heat / radiation is neutral
- reflects heat / radiation (from room away from fridge-freezer)
- reduces heat transfer <u>into</u> the fridge-freezer
- reduces power consumption of fridge-freezer
  *do **not** accept it is a bad conductor / good insulator*

2

[4]

Q33.

(a) (i) makes it warmer / raises the temperature
accept produces convection (current)
accept makes it less dense

1

STEMUP.CO.UK

(ii) reduced **or** slows down

1

(b) (i) electrical energy (to run the pump) must be paid for

accept electricity for electrical energy
accept electricity is needed for the pump
accept it uses electricity
accept because of the pump

1

(ii) more useful (heat) energy is transferred into the house than the energy used to operate the pump

or reduced cost of heating the house is greater than the cost of running the (electrical) pump

or costs little to run compared to the savings made

*accept for **1** mark*
reduces energy bills
***or** reduced fuel costs / heating costs owtte*
*do **not** accept it's cheap*

2

[5]

Q34.

(a) (i) 7pm

accept 19.00 / 1900

1

(ii) 8pm

accept 20.00 / 2000

1

temperature drops more slowly

accept heat for temperature accept line is less steep

1

(b) insulator

1

conduction *

1

convection *

* *answers can be either way around*

1

(c) (i) 4 (years)

1

(ii) it is the cheapest / cheaper / cheap

*do **not** accept answers in terms of heat rising or DIY*

1

has the shortest / shorter payback time

STEMUP.CO.UK

*do **not** accept short payback time*

1

[9]

Q35.

(a) (i) as a source of thermal <u>radiation</u>

accept heat for thermal radiation
accept to act as the Sun
*do **not** accept sunlight alone*

1

(ii) any **one** from:

- volume of water
  accept amount for volume
- distance between lamp and boiling tube
- initial / starting temperature of water
- same room temperature
  *do **not** accept time or same insulation material*

1

(iii) any **one** from:

- greater sensitivity / precision
  *do **not** accept more reliable (negates mark)*
- could link to a computer for (automatic) data analysis
- could take more frequent readings
- reduces instrument reading error
  accept more accurate
  *do **not** accept easier to use on its own*

1

(b) (i) acts as a control

accept to be able to make a comparison
accept to see the difference
*do **not** accept 'to make it a fair test' OWTTE on its own*

1

(ii) (plastic) <u>foam</u> and aluminium foil

1

(iii) (aluminium) <u>foil</u> is a <u>poor</u> absorber of thermal radiation
accept heat / infra red for thermal radiation

1

or (aluminium) <u>foil</u> is a (good) reflector of thermal radiation
*do **not** accept 'reflects sunlight' on its own*

(plastic) <u>foam</u> traps air which is a (good) insulator

STEMUP.CO.UK

accept (plastic) foam is a poor conductor / (good) insulator

*do **not** accept 'the material' is a good insulator / poor conductor*

1

(c) particles vibrate with a bigger / stronger amplitude / faster / with more (kinetic) energy

accept particles vibrate more

*do **not** accept <u>start</u> to vibrate only*

1

energy transferred by <u>collisions</u> with other particles

*do **not** accept answers in terms of free/mobile electrons*

1

[9]

STEMUP.CO.UK