AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.1.1.3 ENERGY CHANGES IN SYSTEMS (PACK 2)

SCORE	PERCENTAGE
/127	%

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Q1.

(a) apparatus diagram to show:

- aluminium block (surrounded by insulation)

1

- thermometer and immersion heater inside (or in contact with) aluminium

1

- joulemeter connected to immersion heater
  or
  ammeter and voltmeter connected correctly around immersion heater

  full credit can be given for a correct alternative method

  ignore position or absence of stopclock

  ignore position or absence of electric balance

1

(b)

Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5-6
Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3-4
Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2
No relevant content	0
Indicative content **measurements:** • energy (transferred) using joulemeter **or** ammeter, voltmeter and stopclock • mass using electric balance • temperature change using thermometer **SHC calculation:** E = mcθ **or** $c = \frac{E}{m\theta}$ **valid results:** • repeat practical and calculate a mean • plot a graph of temperature against time and use linear section of graph for temperature change • small (eg 10 °C) temperature change (so cylinder isn't significantly hotter than surroundings)	

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safety: immersion heater gets very hot so avoid touching (heating element) with bare hand	

6

(c) some thermal energy
transferred to the surroundings
(not to the metal block)

allow not all of the energy (as measured by the joulemeter) is transferred to the block

1

(so) temperature increase not as high as it should be for the total energy transferred

allow justification using the equation: $C = \frac{E}{m\theta}$

1

[11]

Q2.

(a) 0.1 (°C)

1

(b) power = energy transferred / time

allow P = E / t

1

allow E = P × t

(c) 1050 / 300

1

3.5 (W)

1

*accept 3.5 (W) with no working shown for **2** marks*

(d) 1050 = m × 4200 × 0.6

1

m = 1050 / (4200 × 0.6)

1

m = 0.417 (kg)

1

*accept 0.417 (kg) with no working shown for **3** marks*

(e) any **one** from:

- energy used to heat metal pan (as well as the water)
- energy transfer to the surroundings (through the insulation)
- angle of solar radiation will have changed during investigation
- intensity of solar radiation may have varied during investigation

1

[8]

Q3.

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(a) it would decrease the time

1

(b) 720 (J)

*allow **1** mark for correct substitution ie 12 × 60 provided no subsequent step*

2

(c) decreases

1

decreases

1

decreases

1

more than one tick in any row negates the mark

[6]

Q4.

(a) energy required to raise the temperature of a substance by 1 °C

accept heat for energy

1

unit mass / 1 kg

1

(b) (i) 7 140 000 (J)

allow 2 marks for a correct substitution, ie

E = 20 × 420 × 850

provided no subsequent step

*850 gains **1** mark if no other mark awarded*

3

(ii) particles in the air have more (kinetic) energy than the particles in the steel

allow particles in the air have a greater speed.

1

steel

particles vibrate (about fixed positions)

1

air

particles move freely

1

(ii) the most energetic particles

accept molecules for particles throughout

accept the fastest particles

1

have enough energy to escape from (the surface of) the water

1

therefore the mean energy of the remaining particles decreases

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accept speed for energy

1

as energy decreased, temperature has decreased

1

[12]

Q5.

(a) any **two** from:

- wood falls off ropes
- child falls off
- wood hits child standing at side.

accept any reasonable suggestion

2

(b) (i) 7.77

1

0.78

*0.777 or 0.77 gain **1** mark*

*their mean value / 10 gains **1** mark*

2

(ii) use longer lengths (so longer times)
or
do both with the same lengths (so comparison can be made)

timing more than 10 cycles is insufficient

1

(iii) **1** value of k from **table 4**
k values 3.969…
4.056…
4.05

$k = T^2 / l$

allow full credit for an equivalent correct method
eg. allow inverse of
$k = l / T^2 = 0.25$

1

1 value of k from **table 5**
k values 4
4.03…
4.046

allow if average time for 10 cycles used

1

conclusion that matches student's results

1

(c) 720 N

*180 = F × 0.25 gains **2** marks*

*work done = maximum kinetic energy gains **1** mark*

3

[12]

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Q6.

(a) 20 790 (J)

*an answer of 21 000 (J) (2 s.f.) gains **2** marks*

*allow **1** mark for correct substitution:*
ie E = 0.33 × 4200 × 15 provided no subsequent step shown

2

(b) temperature

1

(c) (top pan) balance

accept scales

*do **not** accept a scale*
*do **not** accept weighing scales*
*do **not** accept newtonmeter*
*do **not** accept spring balance*

1

(d) dark / black / (dark) grey

1

convection

correct order only

1

(e) (i) created

accept made

1

(ii) increases

1

[8]

Q7.

(a) 4200

*allow **2** marks for correct substitution*
ie 6930 = 0.330 × c × 5.0

*answers of 1050 **or** 840*

or

correctly calculated answer from correct substitution of incorrect temperature change

or

identification of temperature change ie 5 °C
*gain **1** mark*

3

J / kg°C

accept J / kg K

1

(b) (in a metal) free electrons

to gain full credit the answer must be in terms of free electrons

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1

gain kinetic energy

accept move faster

1

(free electrons) transfer energy to other electrons / ions / atoms

*do **not** accept particles*

1

by collision

*allow a maximum of **2** marks for answers in terms of atoms / ions / particles*

- *gaining kinetic energy or vibrating faster / more*
- *transferring energy by collisions*

1

(c) (air) particles spread out

1

(which causes the) air to become less dense / expand

*do **not** accept particles become less dense*

1

(so the) warm air rises

*do **not** accept heat rises*
particles rise is insufficient

1

(d) large surface area

ignore references to type of metal or external conditions

1

black / dark (colour)

1

[13]

Q8.

(a) dark matt

1

light shiny

1

(b) B A C

1

biggest temperature difference (80 °C)

dependent on first mark

1

(c) (i) (the can that is) dark matt

1

best absorber (of infrared radiation)

1

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(ii) any **three** from:

- same area / shape of can
- surrounding temperature is the same for all cans
- same surface underneath cans
- same position in the room

3

(d) fox A

smaller ears

1

thicker fur

1

these minimise energy transfer

dependent on first 2 marks

1

[12]

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

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

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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) 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.

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

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- 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
- 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]

Q11.

(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*

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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

1

[9]

Q12.

(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

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(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*

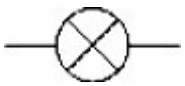
rate of heat gain = rate of heat loss scores both marks

1

[7]

Q13.

(a)



accept 'the humpback bridge' symbol

accept circle with cross but no lines

if more than one symbol drawn, no mark unless lamp is labelled

1

(b) (i) 24

*allow **1** mark for correct substitution ie* $\frac{2800}{120}$

*allow **1** mark for an answer 1440*

ignore any unit

2

(ii) watt

1

(c) larger than

accept correct indication inside the box

accept an answer meaning larger than ie greater than

1

[5]

Q14.

newton **or** N

metre **or** m

joules **or** J

all three correct 2 marks
two or one correct 1 mark

[2]

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