Energy Changes in Systems

Mark Scheme

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.1 Energy
Sub-Topic	Energy Changes in Systems
Difficulty Level	Silver Level
Booklet	Mark Scheme

Time Allowed: **60 minutes**

Score: **/58**

Percentage: **/100**

Grade Boundaries:

M1.(a) the store of chemical energy (in the battery) decreases

1

the internal energy of the surrounding air increases.

1

*accept description of energy becoming less usefully stored for **2** marks*

(b) kinetic energy = ½ mass × velocity^2

1

(c) $E_K = ½ \times 0.8 \times 12^2$

1

$E_K = 57.6$ (J)

1

*allow 57.6 (J) without working shown for **2** marks*

(d) lower proportion of wasted energy

accept less energy is wasted

1

higher proportion of energy is converted into kinetic energy

accept more kinetic energy

1

(e) **Level 2 (3–4 marks):**
A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.

Level 1 (1–2 marks):
Simple comparisons are made which demonstrate a basic ability to numerically analyse

the information presented. The conclusion, if present, may not be consistent with the calculations.

0 marks:
No relevant content

Indicative content
- The electric car costs £12 000 more to buy
- Running cost of electric car = £3 000
- Running cost of petrol engine car = £24 000
- Total cost of electric car = £30 000
- Total cost of petrol engine car = £39 000
- The electric car cost £1 750 less to run each year
- The electric car will save £9 000
- Additional cost is covered in 6.9 years
- So the electric car will be cheaper over the 12 year lifetime

or

Electric
27000 / 12 = 2250
Annual cost = 2250 + 250 = 2500

Petrol
15000 / 12 = 1250
Annual cost = 1250 + 2000 = 3250

So electric is £750 cheaper per year

4

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M2.(a) **Level 3 (5–6 marks):**
A full, detailed and coherent plan covering all the major steps is provided, which outlines what needs to be measured to calculate specific heat capacity. The steps are set out
in a logical manner that could be followed by another person to calculate the specific heat capacity.

Level 2 (3–4 marks):
The substantive content of a plan is present but may be missing some steps. The plan
may not be in a completely logical sequence but leads towards the calculation of the specific heat capacity.

Level 1 (1–2 marks):
Simple statements relating to relevant apparatus or steps are made but they may not be
in a logical order. The plan would not allow another person to calculate specific heat capacity.

0 marks:
No relevant content.

Indicative content
- measure the mass of metal
- correct use of balance
- description of how work is done or energy transferred to metal
  eg electrical work, mechanical work (eg dropping lead shot)
- how energy transfer or work done is measured
  eg electrical using joulemeter, mechanical decrease in potential energy store of falling lead shot
- equate work done / energy transferred = increase in thermal energy store of the metal
- calculate specific heat capacity

6

(b) 4 600 = 1 × 657 × temperature change

1

temperature change = 4 600 / 657

1

= 7 (°C)

*allow 7 with no working shown for **3** marks*

1

(c) Type of material

1

(d) heat loss

1

then any **one** from:

- turned off the power supply too early
- incorrectly measured mass of material
- incorrectly measured temperature
- incorrectly read the change in thermal energy

1

(e) would give a more accurate value **or** the calculated specific heat capacity will be smaller

1

because the bubble wrap insulates the material **or** prevents heat loss

1

[14]

M3.(a) conduction

must be in correct order

1

convection

1

(b) (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

(c) (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

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M4.(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
- 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]

M5. *(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]

M6. *newton **or** N*

*metre **or** m*

*joules **or** J*

all three correct 2 marks
two or one correct 1 mark

[2]