AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.1.1.2 CHANGES IN ENERGY (PACK 1)

SCORE	PERCENTAGE
/92	%

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.

Q1.

(a) $E_p = 50 \times 9.8 \times 4.0$

1

$E_p = 1960$ (J)

allow an answer rounded to 2000 (J)

1

*allow a maximum of **1** mark if g = 10 N/kg is used*
*an answer of 1960 scores **2** marks*

(b) $E_k = 0.5 \times 50 \times 7^2$

1

$E_k = 1225$ (J)

allow 1200 or 1230 (J)

1

*an answer of 1225 scores **2** marks*

(c) some energy is wasted

1

the g.p.e of the girl is not zero

1

(d) reduces the amount of friction

*do **not** accept reference to friction between the wheels and the ramp*

1

so more energy is usefully transferred

*allow less energy is wasted **or** less heating*

1

greater kinetic energy

1

[9]

Q2.

(a) the wall has two / three layers

allow the wall is thick

1

cavity wall insulation / brick / block has a low thermal conductivity

1

so less energy is transferred by conduction

allow rate of energy transfer is lower
ignore any reference to convection and / or radiation

1

(b)

STEMUP.CO.UK

$$T = 17.4 + \left(\frac{(20.8 - 17.4)}{2}\right)$$

or

$$T = 20.8 + \left(\frac{(20.8 - 17.4)}{2}\right)$$

1

T = 19.1 (°C)

1

an answer in the range 18.5−19.1 scores **2** marks

(c) chemical energy store of the fuel decreases

1

thermal energy store of the water increases

allow kinetic energy store of the water particles increases

1

thermal energy store of the air / atmosphere increases

allow kinetic energy store of the air particles increases

1

(d) E = 15 000 000 (J)

1

t = 600 (s)

1

$$p = \frac{15\,000\,000}{600}$$

allow a correct substitution of incorrectly / not converted values of E and / or t

1

P = 25 000 (W)

allow a correct calculation using incorrectly / not converted values of E and / or t

1

[12]

Q3.

(a) 870 000 × 36

1

31 320 000 (J)
or
3.1×10^7 (J)

allow 31 000 000 (J)
***or** 31 300 000(J))*

1

*an answer 31 320 000 (J) scores **2** marks*

STEMUP.CO.UK

(b) some energy was wasted / dissipated

allow efficiency is always less than 100%

1

(and) transferred to thermal energy

1

(c) 27 (%)

1

(d) **similarity**

any **one** from:

- contain same amount of aluminium
- contain (very) similar amounts of silicon

*ignore same amount of silicon unless their answer to part **(c)** was 28%*

- oxygen makes up the highest percentage

allow both contain aluminium, iron, oxygen and silicon

1

difference

any **one** from:

- Moon rock contains more iron (than Earth rock)
- Moon rock contains less oxygen (than Earth rock)
- Moon rock contains less silicon (than Earth rock)

*allow ecf from part **(c)***

1

*do **not** allow 2 marks for silicon as both similarity and difference*

(e) scientists discover new evidence which the existing theory cannot explain

1

(f) gravitational potential energy = mass × gravitational field strength × height

allow $E_p = mgh$

1

(g) 86 000 000 = 2150 × 1.6 × h

1

$$(h =) \frac{86\,000\,000}{2150 \times 1.6}$$

1

(h =) 25 000 (m)

1

*an answer 25 000 (m) scores **3** marks*

[12]

Q4.

(a) E = 15 000 × 36

1

E = 540 000

STEMUP.CO.UK

1

E = 540 (kJ)

*an answer of 540 (kJ) scores **3** marks*

1

(b) (the motor in) scooter **B** has a higher power

1

therefore

(because both motors have the same efficiency) scooter **B** will have a greater kinetic energy

1

(c) the battery in scooter **B** has a greater store of chemical energy

1

(d) energy transferred = power × time

allow $E = P \times t$

1

(e) 20 × 60

1

E = 1 200 × 700

1

E = 840 000 (J)

*an answer of 840 000 (J) scores **3** marks*

1

[10]

Q5.

(a) thermometer

1

stopclock / stopwatch

accept measuring cylinder

accept top pan balance

1

(b) independent: type of oil

1

dependent: temperature rise in °C

1

(c) wear safety goggles

1

oil not heated directly

accept any reasonable comment about not handling hot apparatus.

1

(d) repeat the experiment

1

STEMUP.CO.UK

and calculate the mean temperature rise

OR

heat the oil for a longer period of time (1)

to get a wider range of temperatures (1)

1

(e) (17 + 17 + 18) / 3 (= 17.33)

1

temperature rise = 17 (°C)

1

*accept 17 (°C) with no working shown for **2** marks*
*allow 17.33 with no working shown for **1** mark*

(f) E = 0.025 × 1800 × 20 (J)

1

E = 900 (J)

1

*allow 900 without working shown for the **2** calculation marks*

Joule

1

[13]

Q6.

(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 <u>kinetic</u> energy
accept more kinetic energy

1

(e) **Level 2 (3–4 marks):**
A relevant and coherent argument which demonstrates processing and numerical

STEMUP.CO.UK

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

[11]

Q15.

(a) (i) electrical
answers must be in the correct order

1

kinetic

1

(ii) any **one** from:
- thermal (energy)
- sound (energy).
allow "heat" (energy)

1

(iii) The wasted energy is transferred to the surroundings

1

(b) *advantage of A*:
answers must be comparative

1

STEMUP.CO.UK

any **one** from:
- bigger wash load
- uses less energy
  allow uses less electricity
- uses less water.

disadvantage of A:
higher cost (to buy)

1

[6]

Q16.

(a) (i) infrared radiation

1

(ii) absorbed

1

(b) France has more hours of sunlight (all year round)
or
France has more hours of sunlight in every month of the year
accept the converse
allow France is sunnier

1

(so) there will be more energy to heat the water
or
(so) more energy can be absorbed / transferred
allow (so) more water can be heated
allow 'heat' for energy

1

(c) 42 000 000
allow 4.2×10^7
*allow for **1** mark correct substitution*
200 × 4200 × 50 provided no subsequent step shown
or
42 000

2

joules
*42 000 kJ = **3** marks*

1

[7]

Q17.

(a) black (paint) is a good absorber of (infrared) radiation
allow 'heat' for radiation
ignore light / sunlight / energy
allow black (paint) is a good emitter of (infrared) radiation to the water

1

STEMUP.CO.UK

copper pipes are
good conductors (of energy)

1

the pipes have a large surface area to absorb (a lot of) energy

allow 'heat' for energy

ignore light / sunlight for energy

1

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

- energy is available 24 hours a day
- constant supply of energy all year around
- works at night.

ignore no visual pollution

1

(ii) *Student A*:

***max** 3 marks if conclusions for student A and Student B are written in the wrong places.*

nothing can be more than 100% efficient

1

(because the law of conservation of energy states that) energy cannot be created (or destroyed)
or
(because) some energy is always wasted to the surroundings

1

Student B:
the output heat energy is 3 to 4 times greater than the (electrical) energy input

1

so the efficiency is 3 or 4 which is 300 − 400 %
or
because additional energy is provided by the warm water from the ground

allow a correct calculation of efficiency using either 3 or 4 joules for useful energy output

1

(iii) 94 (kg)

*allow **3** marks for an answer with more than 2 significant figures that rounds to 94 kg*

*allow **2** marks for*
19 000 000 = m × 4200 × 48
or
m = 19 000 000 / (4200 × 48)
or
m = 19 000 000 / 201 600
or
correctly calculated mass using an incorrect temperature change.

*allow **1** mark for a temperature rise of 48 °C*

*allow **1** mark for a correct substitution using an incorrect temperature change provided some evidence of working out the temperature change is shown*

STEMUP.CO.UK

*allow **1** mark for an incorrect answer correctly rounded to two significant figures, provided some evidence of working is shown*

4

[12]

STEMUP.CO.UK

Q1.

(a) A straightforward calculation with a given equation. Students needed to use the height from the diagram and some did not do this and so only managed to calculate the weight but 83% of students scored both marks.

(b) A slightly more difficult calculation but with a given equation, this question caused a few more problems with the squaring of the speed tripping up a few students but 76% were able to score both marks. A significant number made no attempt.

(c) This multiple choice question about energy transfer proved difficult. A third of students gained both marks and just over a half scored one mark.

(d) This question required an explanation in terms of the forces and the energy transferred. 57% of students scored zero and only a tenth scored more than 1 mark. The concept of energy was not well understood. There were frequent references to generating more energy or increasing gravitational potential energy. Even when the students recognised that the lubrication would reduce friction, they failed to understand what effect this would have.

Q2.

(a) Very few students gained more than one mark on this question. This is a new specification point this year but the answer to the question is straight recall from the specification. Most students wrote vague answers about heat being contained inside and the cold not being allowed to enter. The starting point about the thickness of the wall was rarely mentioned and nor was the low thermal conductivity of the material.

(b) 72% of students calculated this correctly, either using the method in the mark scheme, or by calculating the midpoint using (20.8 + 17.4) /2. Of the incorrect responses, some students attempted to adjust the result to take into account the decreasing rate at which the temperature decreased, but were not always successful. Some students calculated the differences between the given temperatures, then the differences between the differences in order to determine the trend and then estimated the temperature at 30 minutes. Some students attempted to find an average temperature over a range of time, using various ranges.

(c) 49% of students scored no marks. Only 17% of students scored more than one mark and fewer than 2% scored three marks. Many students appeared confused by the reference to energy stores, rather than being asked to simply identify a chain of energy changes. Most commonly, one mark was scored for referring to thermal energy being added to the water. There were very few who considered the thermal store of the air.

A fairly common misconception was that, despite clearly shown exiting the boiler as hot water, the water would be heated enough to boil and leave the boiler as steam − the implication being that the hot exhaust gas was formed in this way.

(d) 75% of students gained at least one mark. Just over a tenth of students correctly carried out both conversions and achieved four marks. The most common mistake was in the conversion of 15 MJ into J but most students knew the equation and could substitute their sometimes incorrect conversions into the equation and calculate it correctly. A very simple answer saw 15 / 10 = 1.5 often written down and this gave the student two marks. Unfortunately a few students calculated energy ×

STEMUP.CO.UK

time and could only obtain the conversion marks if done correctly.

Q3.

(a) Around three quarters of students gained the two marks for this calculation.

10% did not attempt it, and a small number of students divided the two given numbers.

Some students worked out the correct answer, then divided by 1000, possibly because the answer of 31 320 000 J looked very large.

(b) Around one quarter of students did not attempt this question. Few realised that this was a question about useful and wasted energy and only 6% gained both marks. Those who scored one mark tended to get it for the mention of thermal / heat energy.

A common incorrect response was to refer to the energy being 'lost' rather than 'wasted'. Many seemed to think that the Moon's gravity affected how the energy from the batteries was transferred to kinetic energy.

(c) Around 6% of students did not attempt this question. Around one third gave the correct value of 27%.

A fairly common incorrect answer was 73%, where the given values had been added, but not subtracted from 100.

There were a large number of answers in the region of 27, indicating that students knew what to do but either added the values together incorrectly or subtracted from 100 incorrectly. In some cases, working was shown which confirmed this.

(d) 12% of students did not attempt this question. Around one third of students were able to correctly identify both a similarity and a difference from the table, the majority choosing the aluminium and iron percentages respectively.

Despite the instruction to use the table of data, many students stated similarities and differences in texture, hardness, gravity, colour, density, etc. Such answers gained no marks.

Some students, although using the table, did not score marks because they did not 'add value' to the data. This was relevant for the 'difference' mark, where a qualitative description of the difference was required. For instance, an answer or 'iron' or 'iron is different' did not gain a mark, whereas 'Moon rock contains a higher percentage of iron' did.

(e) Around 85% of student responses were correct. Responses for the incorrect options were fairly evenly spread, with 'scientists change their theories to make the theories more popular' being chosen more than the other two.

(f) This was the first occasion in this paper where an equation had to be recalled. Nearly one third of students left this blank.

Of those who wrote something, some wrote an equation which was totally unconnected to the quantities listed. Some wrote expressions which were not equations, i.e. did not have an equals sign. Some wrote equations in the form of chemical equations, e.g. gravitational potential energy + mass ⟶ gravitational field strength + height.

STEMUP.CO.UK

Of those who wrote a mathematical equation connecting the given quantities, less than 20% gave a correct form of the equation to gain the mark.

(g) More than one quarter of students left this blank, which tied in with the fact that many had left the previous question blank because they did not know the gravitational potential energy equation.

Of the students who attempted this calculation, many had difficulty manipulating an equation linking four quantities. Many combinations of the given values were seen, the most popular being to multiply the energy value by one of the other two quantities and then divide by the third. Some students took all three numbers, or just two of them and multiplied them together.

Q15.

(a) (i) Some students gave the correct answers, but in the wrong order. Chemical energy was sometimes given for the starting energy and sound for the useful energy.

(ii) Sound was the most common correct answer given for the energy wasted by the washing machine. Thermal energy was rarely mentioned. Quite a lot of students thought that electrical energy was wasted.

(iii) Three quarters of students identified that the wasted energy is transferred to the surroundings.

(b) Comparative statements were needed, so simply quoting figures did not gain a mark. Some students misunderstood the energy transferred per cycle and thought it was either energy wasted, or that using less energy meant that the machine was not as good.

Q16.

(a) (i) Less than half the students correctly said that the solar panel is black to increase energy transfer to the water by infrared radiation. Almost as many thought it was to reduce energy transfer by conduction.

(ii) The majority of students correctly said that the solar panels have a large surface area to absorb more energy.

(b) Most students gained the first marking point for saying that there are more hours of sunlight in France. This was phrased in a variety of ways. Few students gained the second marking point due to poor use of language. Some reference to more energy being absorbed was required. ‘More sun’ or ‘more light’ were ignored.

(c) Most students gained at least 1 mark for either substituting correctly into the equation, or for selecting the correct unit. There were quite a lot who did not attempt the question, and did not select a unit, which might have been worth a guess. Those who gained two marks were able to correctly calculate the energy needed but then gave an incorrect unit, or they gave the correct unit and substituted into the equation correctly, but then made a mistake in the calculation. This was often by omitting a 0 from a correctly calculated value on the answer line.

Q17.

(a) Students had to make clear that black paint is a good absorber of radiation, not just say ‘it absorbs radiation’. Similarly, they had to say that the copper is a good

STEMUP.CO.UK

conductor of energy or heat, not just that it is a conductor. Few students gained the last marking point as they needed to link the large surface area to absorbing a lot of energy or 'heat'. Many just said that the water would be in the pipe for a longer time. Credit could not be gained from using poor terminology such as black paint 'attracts' or 'collects' heat. The word 'absorb' was required. It was possible to gain a mark for saying 'black paint is a good emitter of radiation', but only if students made clear where the radiation was being emitted to, i.e. to the water in the pipe.

(b) (i) Most correct responses included reference to the ground source heat pump being more reliable than solar panels or working all day and night. There were quite a lot of references to the cost of solar panels or them being an eyesore, both of which were ignored. Some said that the ground source heat pump recycled water, which was also ignored.

(ii) A lot of confused responses were seen. Students did not appear to understand that the water would be warmed by energy underground. Some students gained a mark for saying that efficiency could not be greater than 100% or that energy cannot be created, but they were not usually linked together.

(iii) Many students do not understand the difference between significant figures and decimal places, so could not gain full marks. Some students attempted to give a reorganised equation without first showing the substitution into the equation. This often meant that errors were made and only 1 mark could be awarded for a temperature rise of 48 °C. Students should be encouraged to write down the initial substitution which would have gained an extra mark.

STEMUP.CO.UK