AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.1.2.2 EFFICIENCY (PACK 1)

SCORE	PERCENTAGE
/75	%

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Q1.

(a) (in circular motion) the direction is (constantly) changing

1

(so) velocity is (constantly) changing

1

(and) acceleration is rate of change of velocity

allow

$$acceleration = \frac{change\ in\ velocity}{time}$$

1

(b) $$s = \frac{2.6^2 - 1.4^2}{2 \times 0.31}$$

1

(c) $$0.72 = \frac{190}{P_{input}}$$

allow $\frac{72}{100} = \frac{190}{P_{input}}$

1

$$P_{input} = \frac{190}{0.72}$$

1

P_{input} = 264 (W)

allow an answer that rounds to 264 (W)

1

264 = 36 × I

allow their calculated
P_{input} = 36 × I

1

I = 7.33 (A)

1

I = 29 (A)

allow an answer that rounds to 29 (A)
allow their value for I × 4 correctly calculated

1

*an answer of 29 (A) scores **6** marks*

(d) old theory suggests Moon rocks would be different from Earth rocks

1

(but) new evidence shows they are similar

this mark is dependent on scoring the first mark

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1

*allow **1** mark for new evidence (from studying Moon rocks) could not be explained by the old theory*

[12]

Q2.

(a) 80 °C

1

ΔE = 0.5 × 3400 × 80

1

ΔE = 136 000 (J)

*an answer of 136 000 (J) scores **3** marks*

1

(b) energy is dissipated into the surroundings

allow any correct description of wasted energy

1

(c) put a lid on the pan

allow any sensible practical suggestion
eg add salt to the water

1

(d) efficiency = 300/500

1

efficiency = 0.6

*an answer of 0.6 or 60% scores **2** marks*
allow efficiency = 60%
*an answer of 0.6 with a unit scores **1** mark*
*an answer of 60 without a unit scores **1** mark*

1

(e) lower rate of energy transfer

1

(so) potato soup will remain at a higher temperature

1

[9]

Q3.

(a) kinetic energy = 0.5 × mass × (speed)^2

allow $E = \frac{1}{2}mv^2$

1

(b) 0.5 × 9000 × 30^2

1

4 050 000

1

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4050 (kJ)

*an answer of 4050 (kJ) scores **3** marks*

*an answer of 4 050 000 scores **2** marks*

1

(c) efficiency =

$$\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

1

(d) $$0.80 = \frac{\text{useful output energy transfer}}{4050}$$

allow ecf from (b)

1

(useful output energy transfer =) 0.80 × 4 050

1

= 3240 (kJ)

*an answer of 3240 (kJ) scores **3** marks*

1

(e)

Level 2: Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	3-4
Level 1: Relevant features are identified and differences noted.	1-2
No relevant content	0
Indicative content **advantages of both methods:** • both renewable sources of energy • both have no fuel (cost) • no carbon dioxide produced **advantages of wind** • higher average power output **advantages of hydroelectric** • constant / reliable power (output) • lower (installation) cost **disadvantages of wind** • higher (installation) cost • variable / unreliable power output	

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disadvantages of hydroelectric • lower power output **disadvantages of both methods** • (may be) noisy • visual pollution	

4

[12]

Q4.

(a) 600 kg = 5880 N

1

power = $\frac{5880 \times 35}{45}$

1

= 4573.3 (W)

*this step without the previous steps stated gains **3** marks*

1

% Eff. = $\frac{4573.3}{8000} \times 100$

1

= 57.17 (%)

*allow 57.17 with no working shown for **5** marks*

1

(b) gpe = 600 × 9.8 × 35

1

= 205 800

1

gpe = KE = ½ m v^2

1

$v = \sqrt{\frac{2 \times kE}{m}}$

1

$= \sqrt{\frac{411\,600}{600}}$

1

= 26.2 (m / s)

*allow 26.2 with no working shown for **6** marks*

1

[11]

Q19.

(a) A greater proportion of the energy is wasted

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1

(b) (i) 6(J)

1

(ii) 60 % **or** 0.6

*allow ecf from (c)(i) for **2** marks*

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

i.e. $\frac{6}{10}$ *(× 100)*

*allow for **1** mark:*

$\frac{ecf(c)(i)}{10}$ *(× 100)*

*allow for **1** mark an answer of 60 or 0.6 with unit*

2

(iii) heats them / increases the temperature

1

[5]

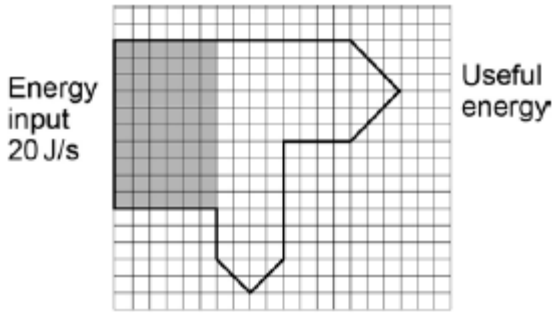
Q20.

(a) A greater proportion of the energy is wasted

1

(b) arrow 4 squares wide labelled 'wasted (energy)'and arrow 6 squares wide labelled 'useful (energy)'

i.e.



*allow for **1** mark:*

correct width arrows with no labels

or

correct width arrows with numerical labels only

or

arrows plotted correctly but wasted energy arrow in incorrect position

or

a correctly labelled diagram showing useful energy is greater than wasted energy

2

[3]

Q21.

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(a) energy efficient means a small proportion of wasted energy

1

(b) plasma (TV)

1

(c) 1.8

allow 1 mark for correct substitution eg 0.3 x 6

2

kWh

box takes precedent

1

[5]

Q22.

(a) highest <u>proportion / percentage</u> of (input) energy wasted

NB this answer gains 2 marks

allow higher / greater

allow ratio

*accept for **1** mark lots of energy wasted*

or

*allow for **1** mark wastes most energy*

2

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

10 % (or 0.1 if % sign crossed out)

*allow **1** mark for the correct substitution into the correct equation*

eg (5/50) × 100

***or** (1/10) × 100*

*allow **1** mark if 0.1 is given as the answer, but % sign is still present*

2

(c) heats it (the surroundings)

allow given off as heat

or

increases the temperature

ignore global warming

1

(d) low<u>est</u> energy input / needed / used

allow input only 2 J

1

(e) (i) filament (bulb)

*allow **1** mark for filament bulb being chosen provided a reason is given (reason may be incorrect, but sensible eg*

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cheapest)

1

lifespan is longest for the purchase cost

accept cost per hour is least / hours per £ is most

accept relevant calculation

1

(ii) longest lifespan

allow lasts 25 000 hours

*do **not** accept most cost-effective*

1

[9]

Q23.

(a) chemical

1

electrical

1

kinetic

1

must be in correct order

(b) (i) 70(%)

allow 0.7

allow $\frac{7}{10}$ ***or*** $\frac{70}{100}$

ignore units

1

(ii) increase

1

[5]

Q24.

(a) energy used to refine oil... = 20J

energy 'wasted' = 60J

energy used to make car move = 20J

*all three correct = **2** marks*

*two correct = **1** mark*

*one / none correct = **0** marks*

2

(b) 25% / 0.25

for correct answer

allow error carried forward correctly from part (a)

if answer is incorrect accept evidence of $\frac{\text{useful energy out}}{\text{total energy in}}$

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or *20% / 0.2 for* ***1*** *mark*

2

[4]

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Q1.

(a) Over 11% of students made no attempt to answer this question and more than three quarters scored no marks.

Few students realised that this question was linked to the vector nature of velocity and acceleration. Indeed, several students stated that the question was incorrect because the moon could not be accelerating because it was moving at constant speed.

Students who attempted an incorrect explanation attributed the acceleration to a variety of causes − global warming, astronauts landing on the moon and the earth's changing magnetic field were fairly common answers.

Students who scored marks for this question usually cited the constant change in direction of the moon, linking this to a change in velocity, but omitting the link between velocity and acceleration.

(b) Around half of students chose the correct response to the calculation. The next most popular choice was the final box, which was similar to the correct one, but with '2' as a multiplier. The other two responses were equally chosen.

(c) Around 3% of students performed this complex calculation correctly to gain all six marks. Some students attempted calculations, but it was often difficult to follow the line of reasoning. Strings of figures, apparently randomly multiplied or divided, were often seen, with no attempt to explain what was being worked out. It would benefit students to explain, just with a word or two, what they think they are working out. Some students attempted to deal with all stages of this multi-stage calculation in one equation − such answers seldom scored any marks.

Of those whose working was clear enough to follow, the most frequent mistake was working out the input power as 72% of the output power, ending up with a smaller value for the input power than the output. However, such answers could go on to gain up to three of the marks by using the P = IV equation and/or multiplying by four.

(d) In order to gain marks, students needed to refer to the old theory and what it would suggest about the composition of Moon rocks compared to Earth rocks. Very few answers made reference to the old theory, so very few students gained marks.

Many answers stated that if the Moon rocks had a similar composition to Earth rocks, it was likely that they originated from the same place − this is what was stated in the question so there was no credit for repeating it.

There was evidence that a number of students had mis-read or failed to understand the question, as they referred to the Giant Impact Hypothesis as being incorrect because the Earth would have been destroyed in a collision.

Q19.

(a) Decreased efficiency was understood by most students.

(b) (i) Just over half of the students were able to interpret the Sankey diagram to give the correct useful energy output.

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(ii) Most students calculated the percentage efficiency, but many forgot to give the % symbol, so only gained 1 mark for an answer of 60. A few students made an error in part (i), but if they used this value to calculate the efficiency they could still gain 2 marks, although very few did this. Students should be reminded to always show their working, as this may gain them a mark even if their final answer is incorrect.

(iii) Just under half of the students could describe the effect of the wasted energy on the surroundings. Others had not read the question carefully and gave a description of wasted energy. Global warming, noise and pollution were all ignored.

Q20.

(a) The majority of students knew that decreased efficiency means a greater proportion of the energy is wasted. The most common distractor was that the energy input is decreased.

(b) A wide range of styles of Sankey diagrams were drawn. Most students managed to plot the width of the bars correctly, but often the wasted energy was drawn incorrectly and shown to come off the useful energy arrow. Often the labels were incomplete or not attempted. Useful energy was sometimes labelled as used or transferred energy, which was insufficient, or the arrows were just labelled with the figures. The question confused some students who had not seen a Sankey diagram before.

Q21.

(a) Most students knew that energy efficient means a small proportion of energy is wasted.

(b) Around 80 per cent of the students correctly identified from the Sankey diagrams that the plasma TV wastes the largest proportion of input energy.

(c) Students could generally substitute correctly into the equation, but then often carried out an incorrect calculation, obtaining 0.18 or 18 instead of 1.8. A common mistake was to change hours into minutes. An incorrect unit was often given.

Q22.

(a) There was widespread confusion about what efficiency is, exemplified by statements such as ‘appliance that’s the least useful’. The lowest level of acceptable response ‘the bulb with lots of energy wasted’ gained one mark. To gain two marks, students should have made it clear that efficiency is about proportion or percentage, rather than simple comparative statements about the amount of energy lost. Many students stated that it was ‘the bulb that loses the most energy’, which is incorrect because out of the three bulbs, the halogen bulb wastes the most energy as it has the highest energy input. Some students said it was not good for the environment or it caused pollution.

(b) A quarter of students were able to gain at least one mark and it was clear that many students are unfamiliar with the use of Sankey diagrams to calculate efficiency and used incorrect values in their calculations. Many answers were more than 100% because they had not used the equation from the sheet correctly. Students would benefit from being taught how to organise calculations logically.

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(c) Few students read the question properly and did not answer in terms of the effect on the surroundings. Only a third of students gained credit for this question.

(d) Most incorrect answers focussed on the efficiency of the LED bulb rather than the fact that the energy input was only 2 J compared with 40 J and 50 J for the other two bulbs. As three bulbs were being compared an absolute comparator was needed - lowest energy input, rather than less or low.

(e) (i) Many students ignored the instruction, 'Use ***only*** *the information in the table to answer the following questions', leading to the incorrect answer of LED, or a statement about efficiency. Only a few students followed the instruction and gained one mark for filament bulb, but the correct reason was rarely given. Once again an absolute comparator was needed to compare three bulbs.*

(ii) Again, many students ignored the instruction, leading to the use of the Sankey diagrams to answer the question. Many incorrectly stated that, 'the LED bulbs last a long time', which makes no comparison with the other two bulbs. The filament bulb lasting 1000 hours may also be considered a long time, but an absolute comparator was needed for the mark to be awarded.

Q23.

(a) Almost two-thirds of students gained three marks. Of the incorrect responses, many students named electrical energy in the batteries, rather than chemical, and chemical energy in the wires instead of electrical.

(b) (i) Many students carried out a calculation to work out the efficiency of the fan, even though this was not necessary given the figures on the diagram. Quite a few added all three numbers up to give an answer of 200, or described the efficiency as being 'good' rather than giving a figure. Some quoted that 30% of the energy was wasted, which did not answer the question.

(ii) By far the most common answer was that the energy transferred from the fan decreases the temperature of the surroundings. Less than a third of students selected 'increase'.

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