1.14 Energy sources and storage

AQA 8552 · Calculator allowed · about 40 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions.

1 A remote footpath marker needs light after dusk. Option A uses a small solar panel to generate electricity during daylight and a rechargeable cell to store it. Option B uses replaceable cells only. Identify which part of Option A is the energy source and which is the energy store. (2 marks)

(Total for Question 1 is 2 marks)

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2 A fictional bicycle safety light is used on short journeys. The design requirements are low purchase cost, simple replacement when its supply is depleted, and no need for recharging equipment. Compare rechargeable and replaceable supplies and recommend one approach. The fictional cost data are: rechargeable unit, £18; replaceable-cell unit, £7; replacement cell pair, £2 per pair. Do not assume how many journeys either supply lasts.

(Total for Question 2 is 3 marks)

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3 A fictional outdoor notice board uses energy stored earlier in a rechargeable pack. Explain why storing energy does not create a new energy source, and describe one design reason for choosing storage alongside a variable renewable source.

(Total for Question 3 is 2 marks)

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4 Two fictional backup packs are being considered for a mobile repair bench. The bench needs 0.36 kWh for one task. Pack P stores 0.50 kWh and costs £42; Pack Q stores 0.40 kWh and costs £31. Assume the full stated stored energy is usable and ignore any other losses. Calculate the remaining energy after one task for each pack, then recommend the cheaper pack that can complete the task. Give remaining energy in kWh.

(Total for Question 4 is 3 marks)

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5 A community hall has a small wind generator. Its output rises when the wind is strong and falls when the wind is weak. Explain why a storage system could help the hall use this generation more reliably.

(Total for Question 5 is 3 marks)

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6 A fictional battery pack stores 1.8 kWh of usable energy. A display uses energy at a steady rate of 0.30 kW. Assume all the stated usable energy can be supplied and the rate stays constant. Calculate the running time. Use time = energy / power. Give your answer in hours.

(Total for Question 6 is 2 marks)

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7 A fictional emergency radio is intended for a locked storage cabinet that may be unused for months. Design requirements are: it must be ready for occasional use and the owner cannot recharge it in the cabinet. Compare replaceable primary cells with rechargeable cells for this use, giving one advantage of each and a justified recommendation.

(Total for Question 7 is 3 marks)

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8 A school workshop has a hand-cranked generator and a rechargeable energy store for a demonstration lamp. Explain the different roles of the generator and the store, and why one cannot be described as the other.

(Total for Question 8 is 2 marks)

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9 A fictional portable work light takes 24 Wh of energy for one full operating period. Its rechargeable pack is 80% efficient, meaning 80% of input energy is delivered as usable energy. Calculate the input energy needed for one operating period. Use efficiency = useful output energy / input energy and give your answer in Wh.

(Total for Question 9 is 2 marks)

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10 A fictional pop-up information stand must operate for one day in a sunny open park. It has a modest energy demand during daylight, and the design brief prioritises avoiding routine cell replacement. Compare a solar source paired with rechargeable storage against replaceable cells alone. Recommend one option and identify a relevant limitation.

(Total for Question 10 is 3 marks)

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11 A small wind generator at a fictional visitor shelter sometimes produces more energy than the shelter uses and sometimes less. Explain why the generator alone does not guarantee a steady supply, and how a store could reduce this mismatch.

(Total for Question 11 is 3 marks)

12 A fictional campsite lantern uses 12 W while lit. It is used for 5 hours. Assume its power remains constant. Calculate the energy used in Wh. Use energy = power x time.

(Total for Question 12 is 2 marks)

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Mark scheme · 1.14 Energy sources and storage

Question 1

solar panel is the energy source because it converts incoming sunlight into electrical energy **B1**

rechargeable cell is the energy store because it holds energy for later use **B1**

Answer: The solar panel is the source; the rechargeable cell is the store.

Question 2

replaceable-cell unit has lower stated initial cost: £7 compared with £18 **B1**

replaceable cells can be swapped without charging equipment; alternatively, rechargeable supply can be recharged and reused if charging becomes available **B1**

recommends replaceable cells for the stated low initial cost and no-charger requirements, or gives a different defensible choice that explicitly addresses both requirements and the supplied cost data **B1**

Answer: The replaceable-cell unit costs less initially and can be swapped without charging equipment, so it fits the stated requirements. Rechargeable cells can be reused where charging is available.

Question 3

a store holds energy supplied by a source and does not generate that energy itself **B1**

storage can make energy available when the renewable source output is low or unavailable **B1**

Answer: The pack holds energy provided by a source rather than creating it. It can supply energy when variable generation is low.

Question 4

P remaining = 0.50 - 0.36 = 0.14 kWh **M1**

Q remaining = 0.40 - 0.36 = 0.04 kWh **A1**

Q is the cheaper pack and has enough energy for the task because 0.40 kWh exceeds 0.36 kWh **B1**

Answer: Pack P has 0.14 kWh remaining and Pack Q has 0.04 kWh. Choose Q because it costs less and has enough stored energy.

Question 5

wind generation is intermittent or varies with wind conditions **B1**

a store can retain some surplus energy generated when output is high **B1**

stored energy can be released when generation is low, helping meet demand then **B1**

Answer: Wind output varies. A store can keep surplus generated during windy periods and release it when output falls.

Question 6

time = energy / power = 1.8 / 0.30 **M1**

6 hours **A1**

Answer: 6 hours

Question 7

replaceable primary cells can be fitted when depleted without needing a charging point **B1**

rechargeable cells can be used again after recharging, reducing repeated cell replacement when charging is available **B1**

recommends replaceable cells for this cabinet because recharging there is unavailable, with a relevant reason such as readiness after storage **B1**

Answer: Replaceable cells need no charging point, while rechargeable cells can be reused if they can be recharged. Replaceable cells suit this cabinet because no charging is available.

Question 8

the hand-cranked generator is a source that converts movement into electrical energy **B1**

the rechargeable store retains energy for later, rather than generating it from the hand movement itself **B1**

Answer: The generator converts cranking movement into electrical energy; the store retains energy so it can be used later.

Question 9

input energy = useful output energy / efficiency = 24 / 0.80 **M1**

30 Wh **A1**

Answer: 30 Wh

Question 10

solar generation can supply energy during daylight and may recharge the store **B1**

solar plus storage can reduce routine replacement of cells, matching the stated priority **B1**

identifies a relevant limitation, such as variable sunlight or needing stored energy when generation is unavailable **B1**

Answer: Solar generation with rechargeable storage fits the aim of avoiding routine cell replacement; sunlight varies, so the store must cover periods without generation.

Question 11

wind speed and generator output vary over time **B1**

when generation exceeds use, a store can take in surplus energy **B1**

when generation is below use, the store can supply some energy to reduce the shortfall **B1**

Answer: The wind and output vary. A store can take surplus when output exceeds use and supply energy when output falls below use.

Question 12

energy = power x time = 12 x 5 **M1**

60 Wh **A1**

Answer: 60 Wh

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