3.1 Energy: 1-hour Pack

AQA 8463 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A lamp has a power of 30 W. power = energy transferred / time

(a) Calculate the energy the lamp transfers when it is switched on for 1 hour. Give your answer in kilojoules (kJ). **(3)**

.....

(Total for Question 1 is 3 marks)

---

2 A ball of mass 0.5 kg is thrown vertically upwards. It leaves the thrower's hand at a speed of 8 m/s. Assume air resistance is negligible and take g = 9.8 N/kg. At the highest point, all of the ball's kinetic energy has been transferred to its gravitational potential energy store.

(a) Calculate the maximum height the ball reaches above the point where it left the hand. **(4)**

.....

(Total for Question 2 is 4 marks)

© Revision Library | revisionlibrary.co.uk

3 Energy is conserved when it is transferred.

(a) State the principle of conservation of energy. **(1)**

(b) A ball is dropped from a height and falls towards the ground. Describe the main energy transfer that happens as the ball falls, before it hits the ground. **(2)**

(Total for Question 3 is 3 marks)

---

4 A car of mass 1200 kg is moving at a speed of 15 m/s. kinetic energy = 0.5 x mass x $(\text{speed})^2$

(a) Calculate the kinetic energy of the car. **(3)**

(b) The car later travels at 30 m/s. State the factor by which the kinetic energy has increased compared with when it travelled at 15 m/s, and explain your answer. **(2)**

(Total for Question 4 is 5 marks)

---

5 A climber of mass 60 kg climbs up a cliff. gravitational potential energy = mass x gravitational field strength x height. Take g = 9.8 N/kg.

(a) The climber rises to a height of 25 m. Calculate the gain in gravitational potential energy. **(2)**

(b) The climber then descends all the way back to the starting point. State the change in the climber's gravitational potential energy store for the descent. **(1)**

(Total for Question 5 is 3 marks)

© Revision Library | revisionlibrary.co.uk

6 A spring has a spring constant of 200 N/m and is stretched by an extension of 0.10 m. elastic potential energy = 0.5 x spring constant x (extension)^2

(a) Calculate the elastic potential energy stored in the spring. Assume the limit of proportionality is not exceeded. **(3)**

.....

(Total for Question 6 is 3 marks)

---

7 A beaker contains 2 kg of water at 20°C. The water is heated to 100°C. specific heat capacity of water = 4200 J/kg °C. change in thermal energy = mass x specific heat capacity x temperature change.

(a) Calculate the change in thermal energy of the water. **(3)**

.....

(b) The water is heated by a 2800 W heater that transfers all of this energy to the water. Calculate the time taken. Use: power = energy transferred / time. **(3)**

.....

(Total for Question 7 is 6 marks)

© Revision Library | revisionlibrary.co.uk

8 Power is the rate of energy transfer. power = energy transferred / time

(a) A kettle transfers 672000 J of energy in 200 s. Calculate the power of the kettle. **(2)**

.....

(b) A heater has a power of 2000 W. Calculate the energy it transfers when switched on for 5 minutes. Give your answer in joules. **(3)**

.....

(Total for Question 8 is 5 marks)

---

9 In an experiment a pupil supplies 5000 J of energy to 0.50 kg of water and the temperature of the water rises by 2.0°C. Calculate the specific heat capacity of the water using c = E / (m x deltaT). Show your working and unit.

(a) Calculate c = E / (m x deltaT). **(3)**

.....

(Total for Question 9 is 3 marks)

---

10 A lift raises a load with a force of 200 N through a height of 4.0 m in 10 s. Calculate the power produced while lifting. Show your working.

(a) First calculate work done then power = work / time. **(2)**

.....

(Total for Question 10 is 2 marks)

© Revision Library | revisionlibrary.co.uk

11 An electric lamp takes in 60 J of electrical energy each second. Each second it gives out 12 J as light energy. Calculate the efficiency of the lamp as a percentage. Show your working.

(a) Use efficiency = (useful energy output / total energy input) x 100. **(3)**

(Total for Question 11 is 3 marks)

---

12 Extended response (6 marks).

A national grid must be able to supply electricity efficiently over long distances, from power stations to homes and businesses.

Explain how transformers are used in the National Grid to reduce energy losses, and why this reduces energy dissipated in the transmission cables.

(Total for Question 12 is 6 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 3.1 Energy: 1-hour Pack

Question 1

(a) time converted to seconds: 1 hour = 3600 s **M1**

(a) energy = 30 x 3600 (correct substitution) **M1**

(a) 108000 J = 108 kJ **A1**

(a) Answer: 108 kJ (108000 J)

Question 2

(a) sets kinetic energy equal to gravitational potential energy: $0.5 \times m \times v^2 = m \times g \times h$ **M1**

(a) cancels mass and rearranges: $h = v^2 / (2 \times g)$ **M1**

(a) $8^2 / (2 \times 9.8)$ (correct substitution) **M1**

(a) 3.3 m (awrt, from 3.265...) **A1**

(a) Answer: 3.3 m

Question 3

(a) energy cannot be created or destroyed, only transferred, stored or dissipated (oe) **B1**

(a) Answer: Energy cannot be created or destroyed, only transferred between stores

(b) energy is transferred from the gravitational potential store **B1**

(b) to the kinetic store (of the ball) **B1**

(b) Answer: Gravitational potential store to kinetic store

Question 4

(a) $0.5 \times 1200 \times 15^2$ (correct substitution) **M1**

(a) $15^2 = 225$ used (oe evaluation step) **M1**

(a) 135000 J (135 kJ) **A1**

(a) Answer: 135000 J (135 kJ)

(b) increased by a factor of 4 **B1**

(b) because kinetic energy is proportional to $(\text{speed})^2$, and the speed has doubled ($2^2 = 4$) **B1**

(b) Answer: Factor of 4, because KE is proportional to speed squared and the speed doubled

Question 5

(a) 60 x 9.8 x 25 (correct substitution) **M1**

(a) 14700 J **A1**

(a) Answer: 14700 J

(b) decreases by 14700 J (returns to its original value) ft from (a) **B1**

(b) Answer: Decreases by 14700 J

Question 6

(a) $0.5 \times 200 \times 0.10^2$ (correct substitution) **M1**

(a) $0.10^2 = 0.01$ used **M1**

(a) 1 J **A1**

(a) Answer: 1 J

Question 7

(a) temperature change = 100 - 20 = 80 (°C) **M1**

(a) 2 x 4200 x 80 (correct substitution) **M1**

(a) 672000 J (672 kJ) **A1**

(a) Answer: 672000 J (672 kJ)

(b) rearranges: time = energy / power = 672000 / 2800 **M1**

(b) correct substitution of their energy from (a) **M1**

(b) 240 s **A1**

(b) Answer: 240 s

Question 8

(a) 672000 / 200 (correct substitution) **M1**

(a) 3360 W **A1**

(a) Answer: 3360 W

(b) time converted to seconds: 5 x 60 = 300 s **M1**

(b) energy = 2000 x 300 (correct substitution) **M1**

(b) 600000 J (600 kJ) **A1**

(b) Answer: 600000 J (600 kJ)

Question 9

(a) substitutes values: c = 5000 / (0.50 x 2.0) **M1**

(a) evaluates denominator 0.50 x 2.0 = 1.0 and divides 5000 / 1.0 **M1**

(a) 5000 J/kg °C cao **A1**

(a) Answer: 5000 J/kg °C

Question 10

(a) calculates work done: W = 200 x 4.0 = 800 J and substitutes into P = W / t **M1**

(a) 80 W cao **A1**

(a) Answer: 80 W

Question 11

(a) substitutes values into efficiency formula: efficiency = (12 / 60) x 100 **M1**

(a) 20 % cao **A1**

(a) correct working or statement showing 12/60 = 0.20 and 0.20 x 100 = 20 % **B1**

(a) Answer: 20 %

© Revision Library | revisionlibrary.co.uk

Question 12

Level 3 A complete, correctly sequenced explanation using step-up and step-down transformers, correctly linking higher voltage to lower current, and lower current to reduced heating (I^2R) losses in the cables, with accurate scientific terminology throughout.	**5-6**
Level 2 A mostly correct explanation covering the role of transformers in changing voltage and current, but with an incomplete or partially correct link to why this reduces energy loss.	**3-4**
Level 1 Basic statements, e.g. 'transformers make transmission more efficient', with little explanation of voltage, current or heating losses.	**1-2**

Indicative content:

- Step-up transformers at the power station increase the voltage of the electricity supply to a very high value before it is sent along the transmission cables.
- Because power transferred = current x voltage (P = IV), for a fixed amount of power, increasing the voltage means the current in the cables is correspondingly reduced.
- The energy dissipated as heat in a cable due to its resistance depends on the current squared (P = I^2 x R), so even a moderate reduction in current causes a much larger reduction in the energy wasted as heat in the cables.
- This means transmitting electricity at high voltage and low current wastes much less energy (as heat) in the cables than transmitting the same power at a lower voltage and higher current would.
- Step-down transformers are then used near homes and businesses to reduce the very high transmission voltage back down to a safer, usable voltage (e.g. 230 V in the UK) before it reaches consumers.
- Overall this system (step-up, high-voltage transmission, step-down) allows the National Grid to transmit electrical power efficiently across the country with minimal energy loss.

© Revision Library | revisionlibrary.co.uk