3.16 Energy Stores, Transfers and Calculations: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A crane lifts a load of mass 500 kg through a height of 12 m at a constant speed. Take g = 9.8 N/kg. gravitational potential energy = mass * g * height. power = energy transferred / time

(a) Calculate the gravitational potential energy gained by the load. **(2)**

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(b) The crane takes 40 s to lift the load through this height. Calculate the power needed to lift the load at this constant speed, assuming all the energy supplied is transferred to the load's gravitational potential energy store. **(2)**

.....

(Total for Question 1 is 4 marks)

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2 An immersion heater with a power output of 1200 W is used to heat 2.5 kg of water from 18°C to 45°C. The specific heat capacity of water is 4200 J/kg °C. change in thermal energy = mass * specific heat capacity * temperature change. power = energy transferred / time

(a) Calculate the energy needed to raise the temperature of the water by this amount. **(3)**

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(b) Calculate the minimum time needed for the heater to supply this energy, assuming no energy is lost to the surroundings. **(3)**

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(Total for Question 2 is 6 marks)

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3 A bungee jumper of mass 65 kg jumps from a platform 40 m above a river. At the lowest point of the jump, the jumper is 5 m above the river surface and is momentarily at rest. Take g = 9.8 N/kg. gravitational potential energy = mass * g * height

(a) Calculate the loss in the jumper's gravitational potential energy between the platform and the lowest point of the jump. **(2)**

.....

(b) State the energy store that this lost gravitational potential energy has mostly been transferred to by the time the jumper reaches the lowest point. **(1)**

(c) Assuming no energy is dissipated to the surroundings, calculate the elastic potential energy stored in the bungee cord at the lowest point of the jump. **(1)**

.....

(Total for Question 3 is 4 marks)

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4 A pendulum bob of mass 0.40 kg is pulled to one side so that it is raised 0.12 m above its lowest point, then released from rest. Assume no energy is dissipated to the surroundings. Take g = 9.8 N/kg. gravitational potential energy = mass * g * height. kinetic energy = 0.5 * mass * $(\text{speed})^2$

(a) Calculate the gravitational potential energy gained when the bob is raised. **(2)**

.....

(b) Calculate the speed of the bob as it passes through its lowest point. **(3)**

.....

(Total for Question 4 is 5 marks)

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5 A ball of mass 0.058 kg is thrown vertically upward with an initial kinetic energy of 4.5 J. Assume all this kinetic energy is transferred to the gravitational potential energy store as the ball rises, with no energy dissipated to the surroundings. Take g = 9.8 N/kg. gravitational potential energy = mass * g * height

(a) Calculate the maximum height reached by the ball above the point where it was thrown. **(3)**

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(Total for Question 5 is 3 marks)

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6 A trolley of mass 2.5 kg is released from rest at the top of a track and rolls down to the bottom, a drop in height of 3.2 m. Assume the track is smooth (no energy is dissipated to the surroundings). Take g = 9.8 N/kg. gravitational potential energy = mass * g * height. kinetic energy = 0.5 * mass * $(\text{speed})^2$

(a) Calculate the gravitational potential energy lost by the trolley as it descends. **(2)**

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(b) Using the principle of conservation of energy, calculate the speed of the trolley when it reaches the bottom of the track. **(3)**

.....

(Total for Question 6 is 5 marks)

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Mark scheme · 3.16 Energy Stores, Transfers and Calculations: 30-minute Pack

Question 1

(a) 500 * 9.8 * 12 (correct substitution) **M1**

(a) 58800 J cao **A1**

(a) Answer: 58800 J

(b) 58800 / 40 (correct substitution, ft their value from (a)) **M1**

(b) 1470 W cao **A1**

(b) Answer: 1470 W

Question 2

(a) temperature change = 45 - 18 = 27 (°C) **M1**

(a) 2.5 * 4200 * 27 (correct substitution) **M1**

(a) 283500 J cao **A1**

(a) Answer: 283500 J

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

(b) 283500 / 1200 (correct substitution, ft their value from (a)) **M1**

(b) 236.25 s (awrt 236 s) cao **A1**

(b) Answer: 236.25 s (awrt 236 s)

Question 3

(a) height fallen = 40 - 5 = 35 (m); 65 * 9.8 * 35 (correct substitution) **M1**

(a) 22295 J cao **A1**

(a) Answer: 22295 J

(b) elastic potential (energy store of the stretched bungee cord) **B1**

(b) Answer: Elastic potential energy store (of the stretched cord)

(c) 22295 J, ft their value from (a) (by conservation of energy, equal to the gravitational potential energy lost) **B1**

(c) Answer: 22295 J (same as the gravitational potential energy lost in (a), by conservation of energy)

Question 4

(a) 0.40 * 9.8 * 0.12 (correct substitution) **M1**

(a) 0.4704 J (awrt 0.47 J) cao **A1**

(a) Answer: 0.4704 J (awrt 0.47 J)

(b) sets kinetic energy = gravitational potential energy, using their value from (a) (ft) **M1**

(b) rearranges to: speed = $\sqrt{2 * \text{kinetic energy} / \text{mass}}$ **dM1**

(b) 1.53 m/s (awrt 1.5 m/s) ft from (a) **A1**

(b) Answer: 1.53 m/s (awrt 1.5 m/s)

Question 5

(a) sets gravitational potential energy = kinetic energy: mass * g * height = 4.5 **M1**

(a) rearranges to: height = 4.5 / (mass * g) **dM1**

(a) 7.92 m (awrt 7.9 m) cao **A1**

(a) Answer: 7.92 m (awrt 7.9 m)

Question 6

(a) 2.5 * 9.8 * 3.2 (correct substitution) **M1**

(a) 78.4 J cao **A1**

(a) Answer: 78.4 J

(b) sets kinetic energy = gravitational potential energy lost, using their value from (a) (ft) **M1**

(b) rearranges to: speed = $\sqrt{2 * \text{kinetic energy} / \text{mass}}$ **dM1**

(b) 7.92 m/s (awrt 7.9 m/s) ft from (a) **A1**

(b) Answer: 7.92 m/s (awrt 7.9 m/s)

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