Work & Power

Question Paper

Level	GCSE
Subject	Physics
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1P)
Topic	Energy Resources & Energy Transfer
Sub-Topic	Work & Power
Booklet	Question Paper

Time Allowed: **115 minutes**

Score: **/96**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

1. A shopping centre has escalators to move people between floors.

(a) A man of mass 78 kg steps on to an escalator.

The escalator lifts him a height of 5.0 m.

(i) State the equation linking gravitational potential energy, mass, *g* and height.

(1)

(ii) Show that the gravitational potential energy gained by the man is about 4000 J.

(2)

(iii) State the work done on the man and give the unit.

(2)

Work done = ... Unit .....

(b) The escalator is powered by a 7.5 kW electric motor.

(i) State the equation linking efficiency, useful energy output and total energy input.

(1)

(ii) The escalator lifts 30 people each minute.

Each person has a mass of 78 kg.

Calculate the efficiency of the escalator.

(3)

Efficiency = ...

(c) Another escalator has an efficiency of 20%.

Its input power is 15 kW.

Draw a Sankey diagram for this escalator.

(3)

(Total for Question 1 = 12 marks)

2. The photograph shows equipment used for generating electricity from renewable sources.

(a) Complete the sentences using words from the box.

chemical	**heat**	**kinetic**	**light**	**sound**

(i) The panel of solar cells transforms ..... energy into electrical energy.

(1)

(ii) The wind turbine transforms ..... energy into electrical energy.

(1)

(b) On a windy day, the wind turbine transfers 78 W of power.

(i) State the equation linking power, energy transferred and time.

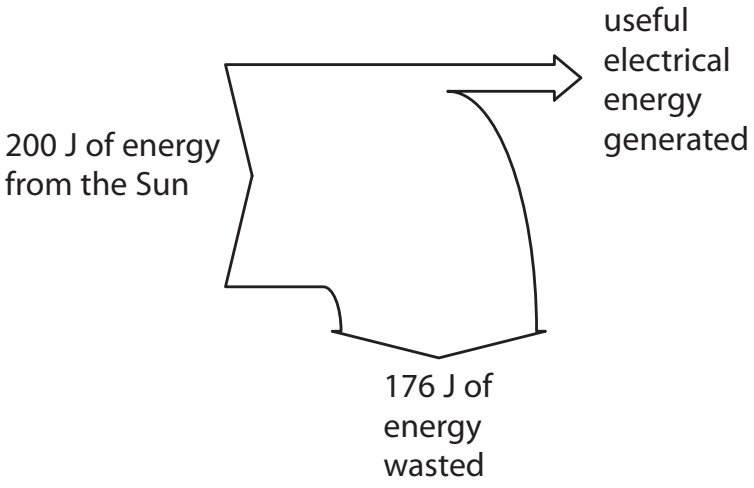
(1)

(ii) Calculate the amount of energy the turbine transfers in 10 s.

(3)

Energy transferred = ... J

(c) The Sankey diagram shows the energy transferred by the panel of solar cells.



Show that the efficiency of the panel of solar cells is 12%.

(2)

(Total for Question 2 = 8 marks)

3. The photograph shows a small aeroplane, of mass 600 kg.

This aeroplane has an electric motor powered by fuel cells.

Fuel cells use hydrogen gas and provide an electric current.

(a) When the aeroplane is working, the energy changes are

(1)

☒ **A** chemical → electrical → kinetic

☒ **B** electrical → chemical → kinetic

☒ **C** electrical → kinetic → chemical

☒ **D** kinetic → chemical → electrical

(b) The velocity of the aeroplane is 28 m/s.

(i) State the equation linking kinetic energy, mass and velocity.

(1)

(ii) Calculate the kinetic energy of the aeroplane.

(2)

Kinetic energy = ... J

(c) The aeroplane takes off and climbs to a height of 1000 m.

(i) State the equation linking gravitational potential energy (GPE), mass, *g* and height.

(1)

(ii) Calculate the gravitational potential energy gained by the aeroplane.

(2)

GPE of the aeroplane = ... J

(iii) The fuel cells provide a maximum total power of 24 kW. The aeroplane also carries a large rechargeable battery.

Show, by calculation, that the aeroplane needs this extra source of power to climb to 1000 m in 3 minutes.

(2)

(iv) The aeroplane uses fuel cells connected together in series in a 'stack'.

The voltage of each fuel cell is 0.6 V. The maximum current in each fuel cell is 30 A.

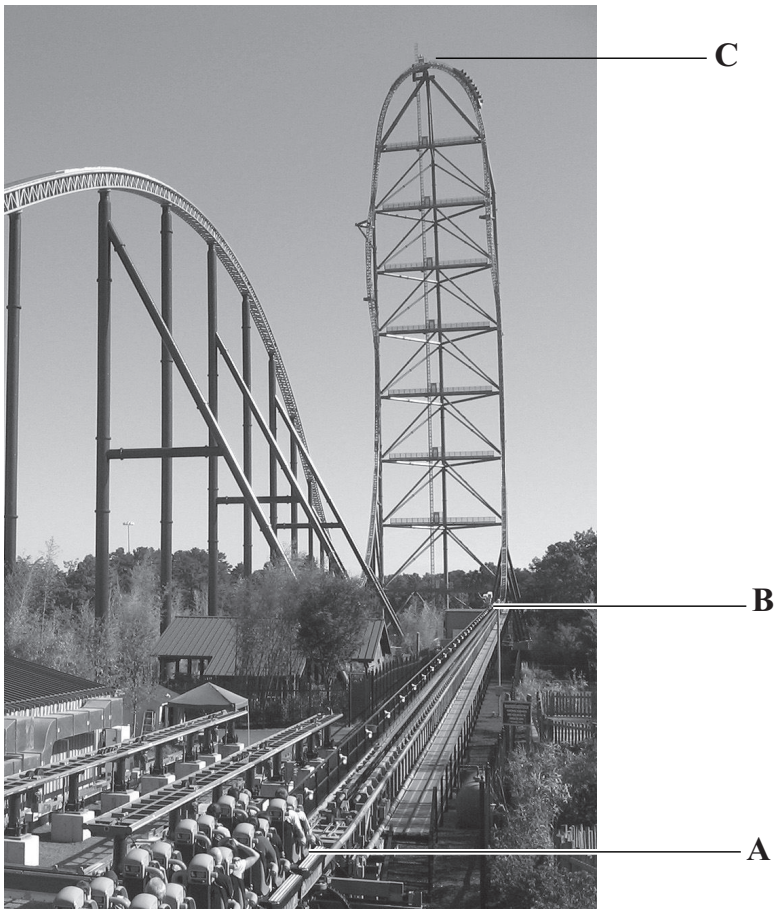
Show that there must be more than 1300 fuel cells in the stack.

(2)

(Total for Question 3 = 11 marks)

4. The photograph shows a type of rollercoaster.

The car is launched from point **A** in the photograph, accelerates to point **B** and then rises over point **C**.



(a) Each loaded car has a mass of 2000 kg.

C is 128 m above **B**.

(i) State the equation linking gravitational potential energy, mass, height and gravitational field strength.

(1)

(ii) Show that the gravitational potential energy gained by the car when it rises from **B** to **C** is about 2.6 MJ.

(2)

(b) The car gains kinetic energy when work is done on it by the launching system between **A** and **B**.

Assume there are no energy losses.

(i) State the minimum kinetic energy that the car must have at **B** for it to reach **C**.

(1)

.....

(ii) How is the kinetic energy gained related to the work done?

(1)

.....

(iii) Write down the equation linking work done, force and distance.

(1)

(iv) The launching system provides a force of 32 kN.

Calculate the minimum length of track needed between **A** and **B** for the car to reach **C**.

(2)

Length of track = ... m

(c) Sometimes the car does not reach **C**, but rolls backwards to the start.

This can happen when it becomes windy or the track becomes wet.

Explain why these conditions could cause the car to stop before it reaches **C**.

(2)

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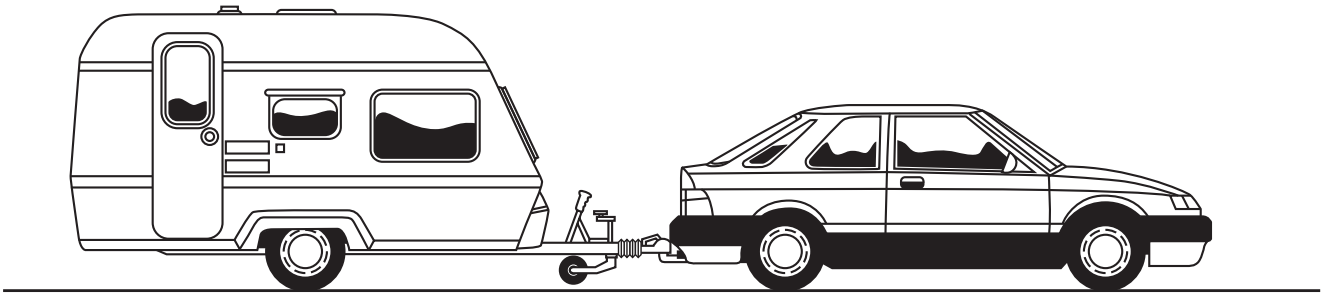
(Total for Question 4 = 10 marks)

5. A car pulls a caravan along a horizontal road.



(a) The car pulls the caravan with a resultant force of 170 N for a distance of 110 m.

(i) State the equation linking work done, force and distance.

(1)

(ii) Calculate the work done by the car on the caravan.

(2)

work done = ... J

(iii) State how much energy is transferred to the caravan.

(1)

energy transferred = ... J

(b) The mass of the car is 1650 kg.

The mass of the caravan is 950 kg.

(i) State the equation linking kinetic energy, mass and velocity.

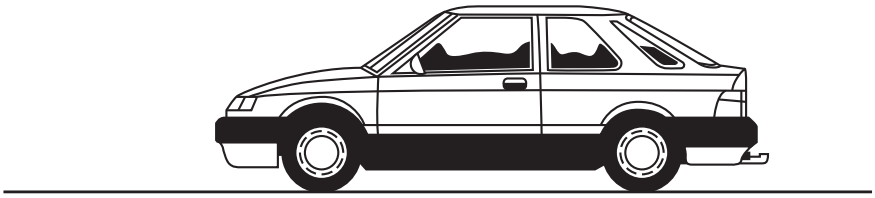
(1)

(ii) Calculate the total kinetic energy when the car and caravan travel together at a constant speed of 23 m/s.

(3)

total kinetic energy = ... J

(c) The caravan is removed and the car makes the return journey without it.



Without the caravan, the car has greater acceleration and uses less fuel.

Explain these changes.

(3)

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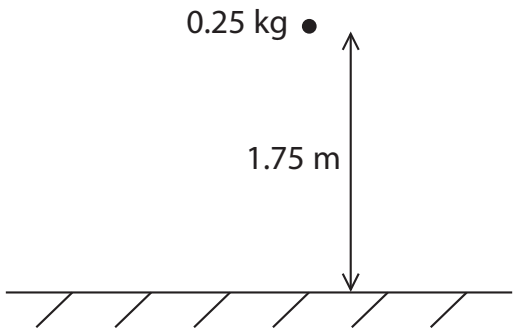
(Total for Question 5 = 11 marks)

6. A ball has a mass of 0.25 kg.

A student holds the ball 1.75 m above the ground.



(a) (i) State the equation linking gravitational potential energy (GPE), mass, *g* and height.

(1)

(ii) Calculate the gravitational potential energy of the ball.

(2)

GPE = ... J

(b) The student lets the ball fall.

State the value of the kinetic energy (KE) of the ball just before it hits the ground.

Assume that there is no air resistance.

(1)

KE = ... J

(c) Another ball with the same mass has a kinetic energy of 3.1 J.

(i) State the equation linking kinetic energy, mass and speed.

(1)

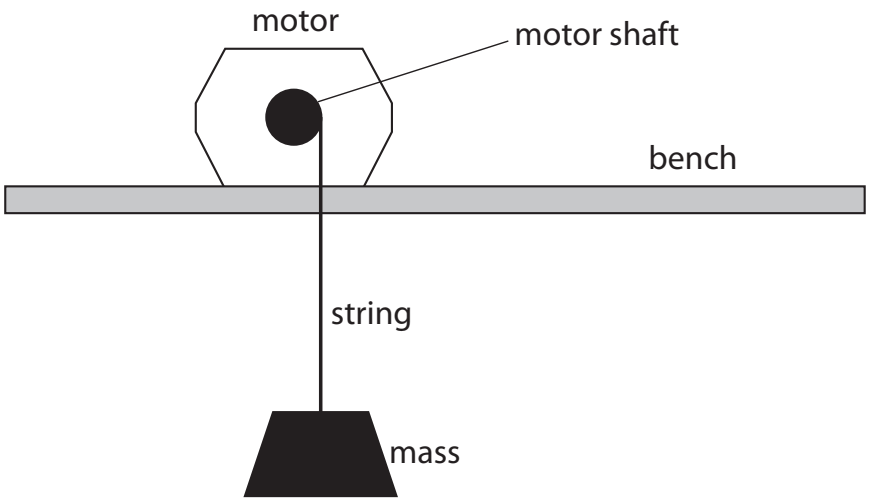
(ii) Calculate the speed of the ball.

(3)

speed = ... m/s

(Total for Question 6 = 8 marks)

7. A student investigates the efficiency of an electric motor.



She uses the motor to lift a mass.

The table shows her measurements.

Current in motor	1.3 A
Voltage across motor	10.3 V
Time taken to lift mass	4.7 s
Force needed to lift mass	20 N
Distance the mass was lifted	0.85 m

(a) Calculate the electrical energy supplied to the motor during this time.

(2)

energy supplied = ... J

(b) (i) State the equation linking work done, force and distance moved.

(1)

(ii) Calculate the work done on the mass.

(2)

work done = ... J

(iii) State the useful energy transferred to the mass.

(1)

.....

(c) (i) State the equation linking efficiency, useful energy output and total energy input.

(1)

(ii) Calculate the efficiency of the motor.

(2)

efficiency = ...

(Total for Question 7 = 9 marks)

8. The Moon orbits the Earth.

(a) State a difference between the orbit of a moon and the orbit of a planet.

(2)

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(b) The radius of the Moon's orbit is 385 000 km.

It takes 27 days for the Moon to complete one orbit.

Calculate the orbital speed of the Moon.

Give a suitable unit.

(3)

orbital speed = ... unit .....

(c) In 1971, astronaut Alan Shepard hit a golf ball on the surface of the Moon.

The golf ball had a mass of 50 g and he transferred 56 J of energy to it.

(i) State the equation linking kinetic energy, mass and velocity.

(1)

(ii) Calculate the initial velocity of the ball.

(3)

initial velocity = ... m/s

(d) At its highest point the ball had gained 12 J of gravitational potential energy.

(i) State the kinetic energy of the ball at its highest point.

(1)

kinetic energy = ... J

(ii) State the equation linking gravitational potential energy, mass, *g* and height.

(1)

(iii) Calculate the maximum height that the ball reached.
(gravitational field strength on the Moon, *g* = 1.6 N/kg)

(2)

maximum height = ... m

(e) Suggest why the ball travelled further on the Moon than it would have done on Earth.

(2)

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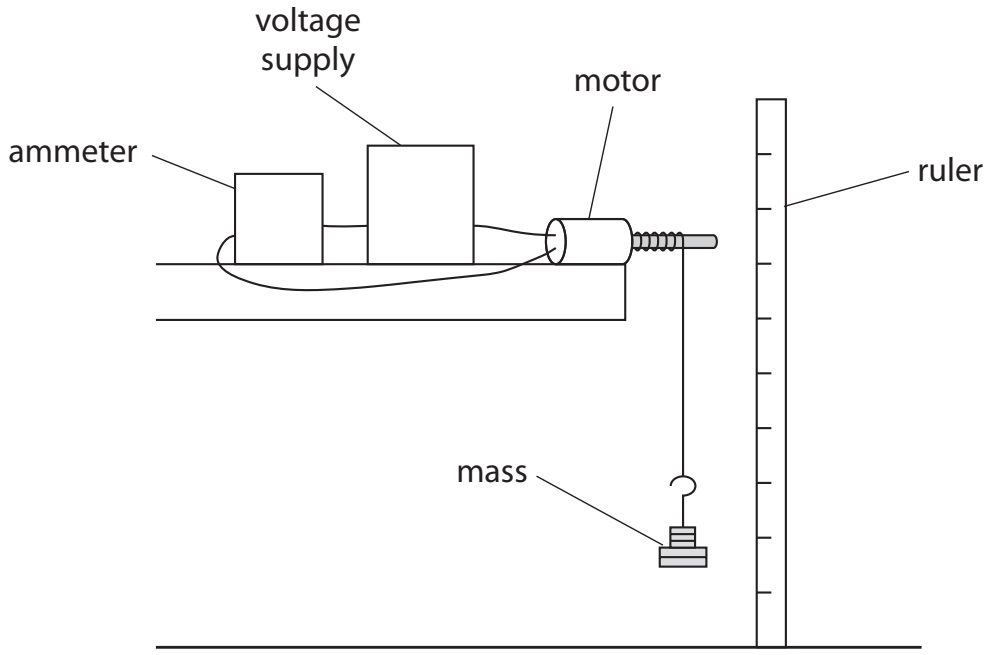
(Total for Question 8 = 15 marks)

9 (a) The diagram shows a motor lifting a 130 g mass.



The current in the motor is 2.1 A and the voltage across it is 12 V.

The motor takes 1.5 s to lift the mass.

(i) Calculate the electrical energy transferred to the motor as it lifts the mass.

Give your answer to two significant figures.

(3)

energy = ... J

(ii) State the equation linking gravitational potential energy, mass, *g* and height.

(1)

(iii) The motor lifts a 130 g mass to a height of 63 cm.

Calculate the gravitational potential energy (GPE) gained by the 130 g mass.

(2)

GPE = ... J

(iv) Why is the amount of GPE gained by the mass less than the amount of electrical energy transferred to the motor?

(2)

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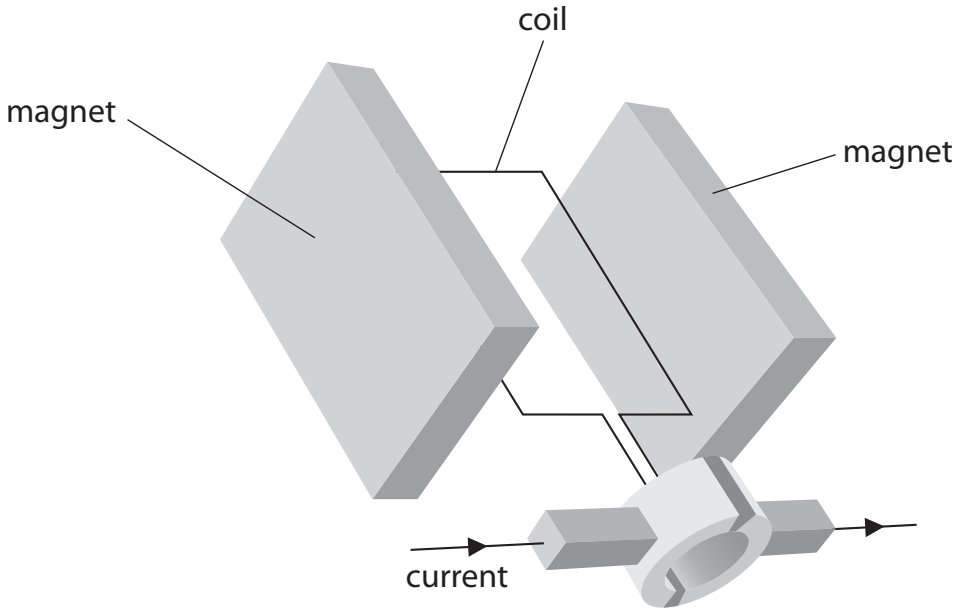
(b) The diagram shows an electric motor and the direction of current.



Explain how the current produces movement of the coil.

(4)

(Total for Question 9 = 12 marks)