# Work, Energy & Power

## Question paper 3

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|---|---|
| **Level** | International A Level |
| **Subject** | Physics |
| **Exam Board** | CIE |
| **Topic** | Work, Energy & Power |
| **Sub Topic** | |
| **Paper Type** | Theory |
| **Booklet** | Question paper 3 |

**Time Allowed:** **56 minutes**

**Score:** **/46**

**Percentage:** **/100**

| A* | A | B | C | D | E | U |
|---|---|---|---|---|---|---|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

**1** **(a)** Distinguish between *gravitational potential energy* and *electric potential energy*.

.....

.....

..... [2]

**(b)** A body of mass *m* moves vertically through a distance *h* near the Earth's surface. Use the defining equation for work done to derive an expression for the gravitational potential energy change of the body.

[2]

**(c)** Water flows down a stream from a reservoir and then causes a water wheel to rotate, as shown in Fig. 4.1.

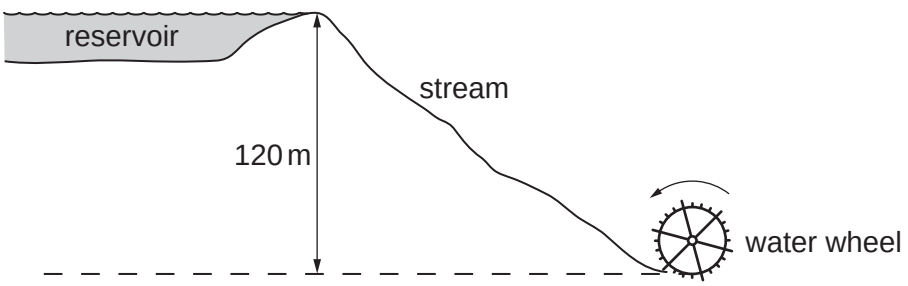


**Fig. 4.1**

As the water falls through a vertical height of 120 m, gravitational potential energy is converted to different forms of energy, including kinetic energy of the water. At the water wheel, the kinetic energy of the water is only 10% of its gravitational potential energy at the reservoir.

**(i)** Show that the speed of the water as it reaches the wheel is 15 m $s^{-1}$.

[2]

**(ii)** The rotating water wheel is used to produce 110 kW of electrical power. Calculate the mass of water flowing per second through the wheel, assuming that the production of electric energy from the kinetic energy of the water is 25% efficient.

mass of water per second = ..... $kg\,s^{-1}$ [3]

**2** **(a)** Define

**(i)** *force*,

.....

.....[1]

**(ii)** *work done*.

.....

.....[1]

**(b)** A force *F* acts on a mass *m* along a straight line for a distance *s*. The acceleration of the mass is *a* and the speed changes from an initial speed *u* to a final speed *v*.

**(i)** State the work *W* done by *F*.

[1]

**(ii)** Use your answer in **(i)** and an equation of motion to show that kinetic energy of a mass can be given by the expression

$$\text{kinetic energy} = \tfrac{1}{2} \times \text{mass} \times (\text{speed})^2.$$

[3]

**(c)** A resultant force of 3800 N causes a car of mass of 1500 kg to accelerate from an initial speed of 15 m s$^{-1}$ to a final speed of 30 m s$^{-1}$.

**(i)** Calculate the distance moved by the car during this acceleration.

distance = ..... m [2]

**(ii)** The same force is used to change the speed of the car from 30 m s$^{-1}$ to 45 m s$^{-1}$. Explain why the distance moved is not the same as that calculated in **(i)**.

.....

.....

.....[1]

**3** **(a)** Explain what is meant by *work done*.

.....

..... [1]

**(b)** A car is travelling along a road that has a uniform downhill gradient, as shown in Fig. 2.1.

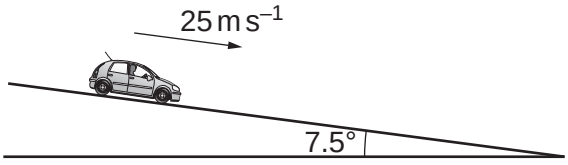


**Fig. 2.1**

The car has a total mass of 850 kg. The angle of the road to the horizontal is 7.5°.

Calculate the component of the weight of the car down the slope.

component of weight = ..... N [2]

**(c)** The car in **(b)** is travelling at a constant speed of 25 m s$^{-1}$. The driver then applies the brakes to stop the car. The constant force resisting the motion of the car is 4600 N.

**(i)** Show that the deceleration of the car with the brakes applied is 4.1 m s$^{-2}$.

[2]

**(ii)** Calculate the distance the car travels from when the brakes are applied until the car comes to rest.

distance = ..... m [2]

**(iii)** Calculate

**1.** the loss of kinetic energy of the car,

loss of kinetic energy = ..... J [2]

**2.** the work done by the resisting force of 4600 N.

work done = ..... J [1]

**(iv)** The quantities in **(iii) part 1** and in **(iii) part 2** are not equal. Explain why these two quantities are not equal.

.....

..... [1]

**4** **(a)** **(i)** Explain what is meant by *work done*.

.....

..... [1]

**(ii)** Define *power*.

.....

..... [1]

**(b)** Fig. 3.1 shows part of a fairground ride with a carriage on rails.

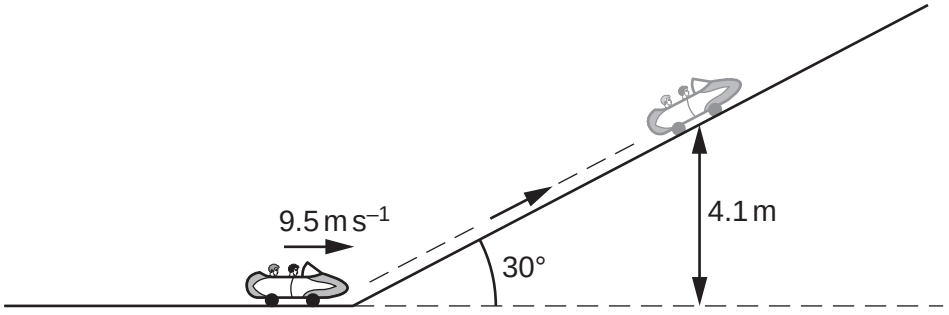


**Fig. 3.1**

The carriage and passengers have a total mass of 600 kg. The carriage is travelling at a speed of 9.5 m s$^{-1}$ towards a slope inclined at 30° to the horizontal. The carriage comes to rest after travelling up the slope to a vertical height of 4.1 m.

**(i)** Calculate the kinetic energy, in kJ, of the carriage and passengers as they travel towards the slope.

kinetic energy = ..... kJ [3]

**(ii)** Show that the gain in potential energy of the carriage and passengers is 24 kJ.

[2]

**(iii)** Calculate the work done against the resistive force as the carriage moves up the slope.

work done = ..... kJ [1]

**(iv)** Use your answer in **(iii)** to calculate the resistive force acting against the carriage as it moves up the slope.

resistive force = ..... N [2]

**5** **(a)** **(i)** Define potential energy.

.....

..... [1]

**(ii)** Distinguish between *gravitational* potential energy and *elastic* potential energy.

gravitational potential energy .....

.....

elastic potential energy .....

..... [2]

**(b)** A small sphere of mass 51 g is suspended by a light inextensible string from a fixed point P.
The centre of the sphere is 61 cm vertically below point P, as shown in Fig. 3.1.

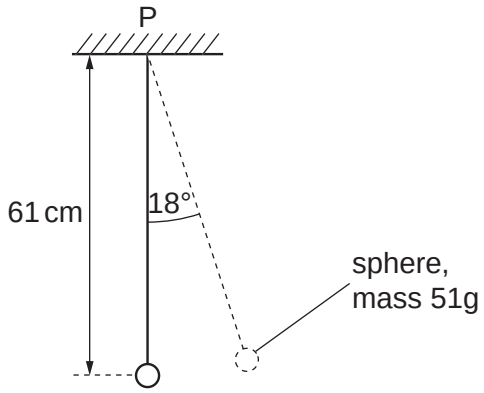


**Fig. 3.1**

The sphere is moved to one side, keeping the string taut, so that the string makes an angle of 18° with the vertical. Calculate

**(i)** the gain in gravitational potential energy of the sphere,

gain = …….. J [2]

**(ii)** the moment of the weight of the sphere about point P.

moment = ..... N m [2]