1 **(a)** Define *work done* by a force.

.....

..... **[1]**

(b) Fig. 6.1 shows a water slide.

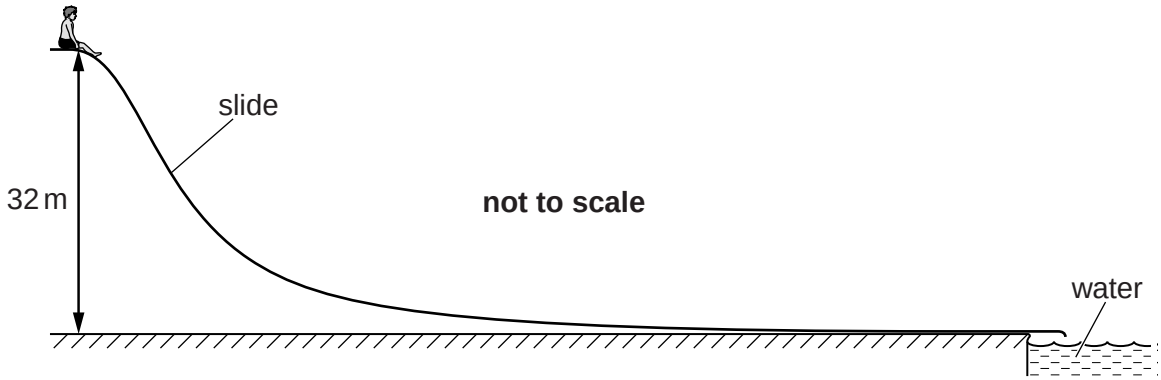

Fig. 6.1

The top of the slide is 32 m above the bottom of the slide. The total distance along the slide is 120 m. A person of weight 700 N, initially at rest at the top, slides down. His speed at the end of the slide is 15 m s^{-1}.

(i) Calculate his kinetic energy at the end of the slide.

kinetic energy = ... J **[2]**

(ii) Calculate the average resistive force acting on him as he travels down to the end of the slide.

average resistive force = ... N **[3]**

[Total: 6]

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

.....

..... **[1]**

(b) Define *work done* by a force and state its unit.

definition .....

.....

.....

unit ..... **[3]**

(c) Fig. 2.1 shows a crater on the surface of the Earth.

Fig. 2.1

The crater was formed by a meteor impact about 50,000 years ago. The meteor was estimated to have a mass of 3.0×10^8 kg with an initial kinetic energy of 8.4×10^{16} J just before impact.

(i) State one major energy transformation that took place during the impact of the meteor with the Earth.

.....

..... **[1]**

(ii) Show that the initial impact speed of the meteor was about $2.0 \times 10^4\,\text{m}\,\text{s}^{-1}$.

[2]

(iii) The crater is about 200 m deep. Estimate the average force acting on the meteor during the impact.

force = ... N **[3]**

[Total: 10]

3 **(a)** Define *work done* by a force.

.....

..... **[1]**

(b) Fig. 3.1 shows a car travelling up a slope at a constant speed.

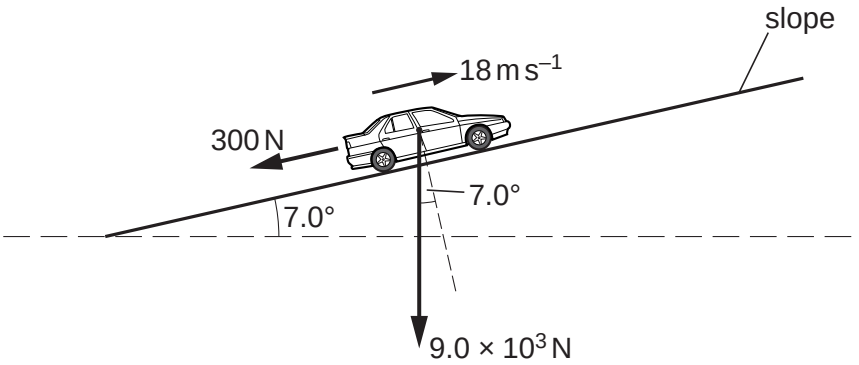

Fig. 3.1

The angle between the slope and the horizontal is 7.0°. The weight of the car is 9.0×10^3 N. The car travels up the slope at a constant speed of 18 m s^{-1}. A resistive force of 300 N acts on the car down the slope.

(i) What is the net force acting on the car? Explain your answer.

.....

.....

..... **[2]**

(ii) Calculate the component of the weight of the car acting down the slope.

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

(iii) Calculate the work done per second against the resistive force.

work done per second = ... Js^{-1} **[1]**

(iv) Calculate the power developed by the car as it travels up the slope.

power = ... W **[3]**

[Total: 9]

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

.....

..... **[1]**

(b) Describe one example where elastic potential energy is stored.

..... **[1]**

(c) Fig. 5.1 shows a simple pendulum with a metal ball attached to the end of a string.

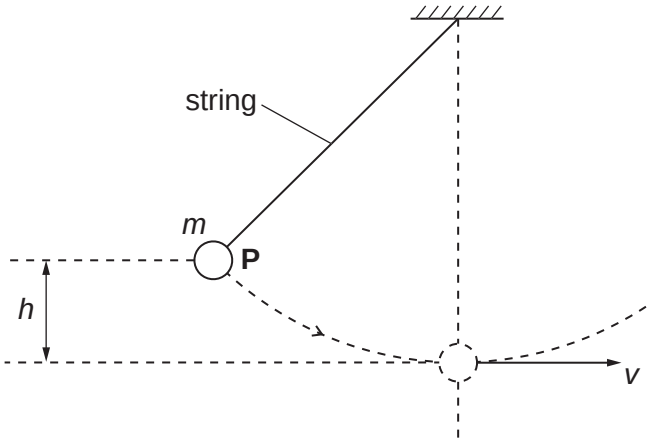

Fig. 5.1

When the ball is released from **P**, it describes a circular path. The ball has a maximum speed v at the bottom of its swing. The vertical distance between **P** and bottom of the swing is h. The mass of the ball is m.

(i) Write the equations for the change in gravitational potential energy, E_p, of the ball as it drops through the height h and for the kinetic energy, E_k, of the ball at the bottom of its swing when travelling at speed v.

$E_p =$

$E_k =$ **[1]**

(ii) Use the principle of conservation of energy to derive an equation for the speed v. Assume that there are no energy losses due to air resistance.

(d) Some countries in the world have frequent thunderstorms. A group of scientists plan to use the energy from the falling rain to generate electricity. A typical thunderstorm deposits rain to a depth of 1.2×10^{-2} m over a surface area of 2.0×10^{7} m^2 during a time of 900 s. The rain falls from an average height of 2.5×10^{3} m. The density of rainwater is 1.0×10^{3} kg m^{-3}. About 30% of the gravitational potential energy of the rain can be converted into electrical energy at the ground.

(i) Show that the total mass of water deposited in 900 s is 2.4×10^{8} kg.

[2]

(ii) Hence show that the average electrical power available from this thunderstorm is about 2 GW.

[3]

(iii) Suggest one problem with this scheme of energy production.

.....

..... **[1]**

[Total: 11]

5 **(a)** *Energy* and *work done* are scalar quantities and have the same unit as each other.

State **two** other scalar quantities in physics that have the same unit as each other.

.....

..... **[1]**

(b) Two forces **A** and **B** act through the same point in an object. These two forces are shown in Fig. 2.1. No other forces act on the object.

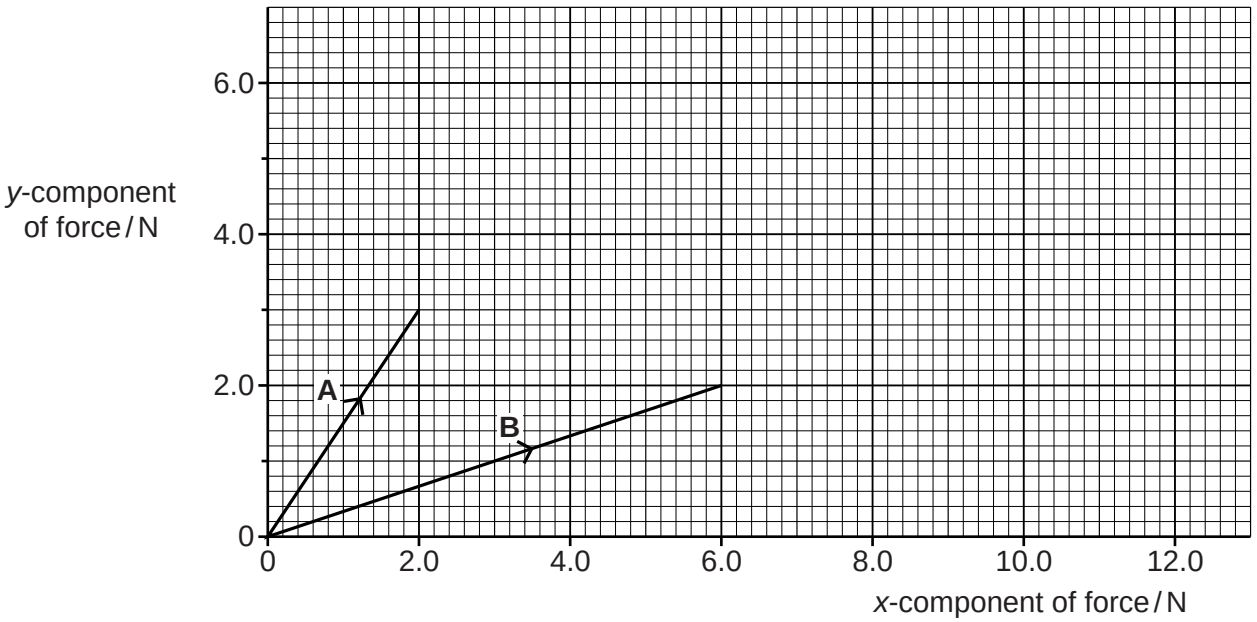

Fig. 2.1

(i) Use Fig. 2.1 to determine the *x*- and *y*- components of the force **B**.

x-component = ... N

y-component = ... N
[1]

(ii) Use Fig. 2.1 to determine the magnitude of the resultant of the two forces **A** and **B**.

resultant force = ... N **[3]**

(c) Fig. 2.2 shows a jet of water from the end of a hosepipe.

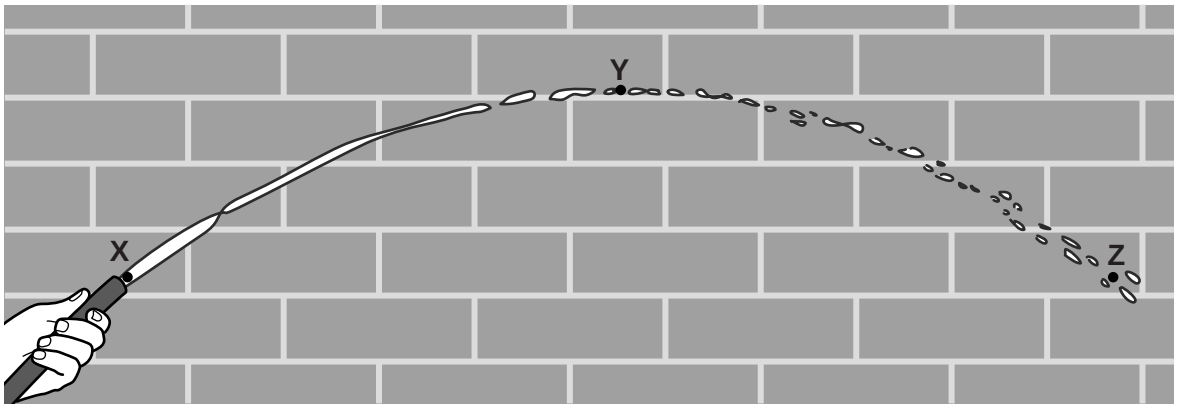

Fig. 2.2

Air resistance has negligible effect on the motion of the water jet. The water jet reaches maximum height at point **Y**.

(i) State the direction of the force acting on the water at **Y**.

..... **[1]**

(ii) Describe and explain how the horizontal component of the velocity of the water varies from point **X** to point **Y**.

.....

.....

.....

.....

..... **[2]**

(iii) Describe how the vertical component of the velocity of the water varies from point **X** to point **Z**.

.....

.....

.....

.....

.....

..... **[2]**

6 A student wants to carry out an experiment to determine the input power to a small electric motor without using electrical meters. The motor is used to lift light loads. The efficiency of the motor is 15%. Describe how this student can determine the input power to the motor. Your description should include:

- the measurements taken
- the instruments used to take the measurements
- how the measurements are used to determine the input power to the motor.

In your answer, you should use appropriate technical terms, spelled correctly.

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.....

.....

..... **[4]**