

1 (a) (i) Define *power*.

.....[1]

(ii) In the following list, tick the **two** boxes next to the two quantities needed to calculate the work done on an object.

mass of the object

force acting on the object

speed of the object

acceleration of the object

distance moved by the object

[1]

(b) A lift (elevator) in a high building transports 12 passengers, each of mass 65 kg, through a vertical height of 150 m in a time of 64 s.

(i) Calculate the power needed to transport the passengers through this height.

power = .....[4]

(ii) The lift (elevator) is driven by an electric motor.

State a reason, other than friction, why the power supplied by the motor is greater than the power needed to transport the passengers.

.....

.....[1]

[Total: 7]

2 A soft rubber ball of mass 0.15 kg is dropped, in a vacuum, from a height of 2.0 m on to a hard surface. The ball then bounces.

(a) State the main energy changes taking place when

(i) the ball is falling,

.....

(ii) the ball hits the surface and is changing shape,

.....

(iii) the ball is regaining its shape and is rising from the surface.

.....

[3]

(b) Calculate the speed with which the ball hits the surface.

speed = ..... [4]

(c) After rebounding from the surface, the ball rises to a height of 1.9 m.

Suggest why the height to which the ball rises is less than the height from which the ball falls.

.....

..... [1]

[Total: 8]

3 A scientist finds that the temperature of the water at the bottom of waterfalls is greater than the temperature of the water at the tops of those waterfalls.

(a) (i) State the type of energy that falling water has because of its motion.

..... [1]

(ii) In one waterfall, the water falls 300 m.

Calculate the decrease in the gravitational potential energy (g.p.e.) of 1.0 kg of water as it falls through this distance.

decrease in g.p.e. = ..... [2]

(iii) Assume that the increase in internal energy of the 1.0 kg of water is equal to its decrease in g.p.e.

Calculate the rise in temperature of the water. The specific heat capacity of water is  $4200 \text{ J}/(\text{kg } ^\circ\text{C})$ .

rise in temperature = ..... [2]

(iv) Suggest a reason why the actual increase in temperature of the water is less than the value calculated in (a)(iii).

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

(b) State why the thermometer used to measure the temperature of the water in the scientist's experiment required a high sensitivity.

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

[Total: 7]

- 4 (a) On a day with no wind, a fountain in Switzerland propels 30 000 kg of water per minute to a height of 140 m.

Calculate the power used in raising the water.

power = ..... [4]

- (b) The efficiency of the pump which operates the fountain is 70%.

Calculate the power supplied to the pump.

power = ..... [3]

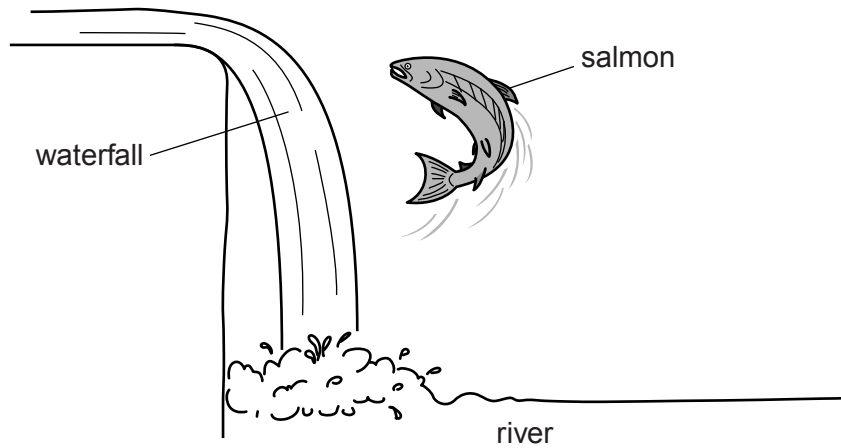
- (c) On another day, a horizontal wind is blowing. The water does not rise vertically.

Explain why the water still rises to a height of 140 m.

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

[Total: 8]

- 5 When a salmon swims up a river to breed, it often has to jump up waterfalls. Fig. 3.1 shows a salmon jumping above the surface of the water. On this occasion the salmon falls back down into the river.



**Fig. 3.1**

The salmon has a mass of 2.0 kg.

- (a) The salmon leaves the water vertically with a kinetic energy of 16.2 J.
- (i) Calculate the speed of the salmon as it leaves the water.

speed = ..... [2]

- (ii) Calculate the maximum height gained by the salmon. Ignore air resistance.

gain in height = ..... [3]



(iii) After the salmon has re-entered the river, it has lost nearly all its original kinetic energy.

State what has happened to the lost energy.

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

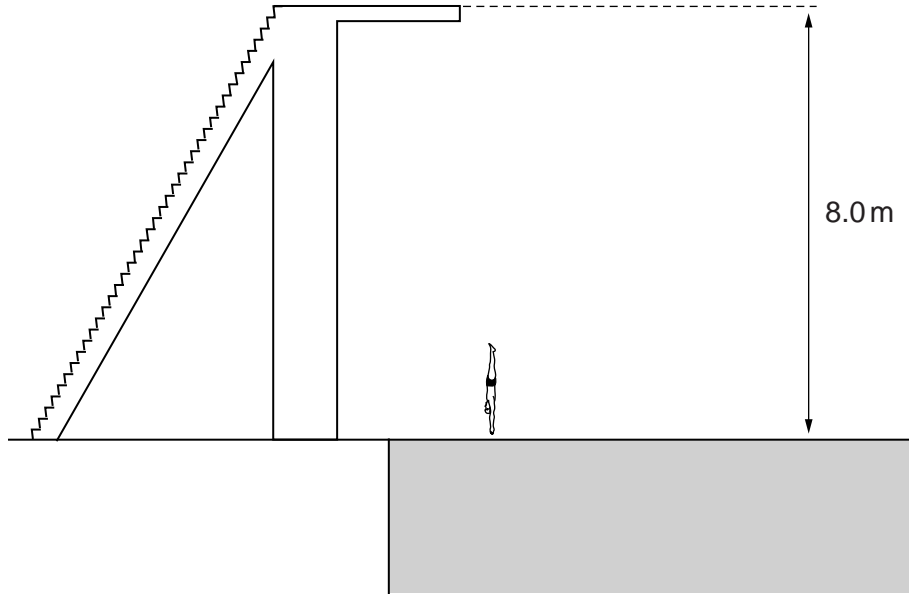
(b) Another salmon, of much greater mass, leaves the water vertically with the same speed.

State and explain how the height of this salmon's jump compares to the height reached by the first salmon.

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

[Total: 9]

- 6 A diver climbs some steps on to a fixed platform above the surface of the water in a swimming-pool. He dives into the pool. Fig. 2.1 shows the diver about to enter the water.



**Fig. 2.1**

The mass of the diver is 65 kg. The platform is 8.0 m above the surface of the water.

**(a)** Calculate

- (i)** the increase in the gravitational potential energy of the diver when he climbs up to the platform.

increase in gravitational potential energy = .....[1]

- (ii)** the speed with which the diver hits the surface of the water. Ignore any effects of air resistance.

speed = .....[4]



- (b) In another dive from the same platform, the diver performs a somersault during the descent. He straightens, and again enters the water as shown in Fig. 2.1.

Discuss whether the speed of entry into the water is greater than, less than or equal to the speed calculated in (a)(ii). Ignore any effects of air resistance.

.....  
.....  
.....  
.....[3]

[Total: 8]