2 A spring is placed on a flat surface and different weights are placed on it, as shown in Fig. 2.1.

For Examiner's Use

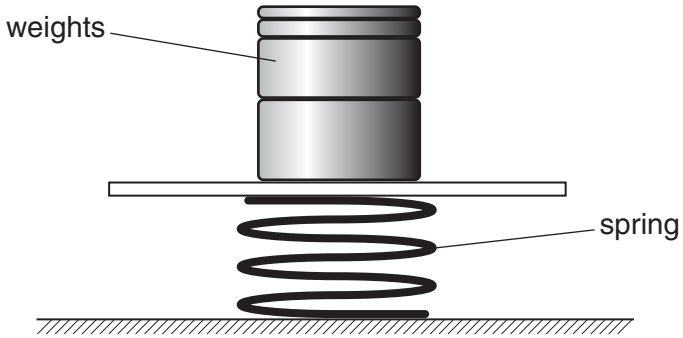

Fig. 2.1

The variation with weight of the compression of the spring is shown in Fig. 2.2.

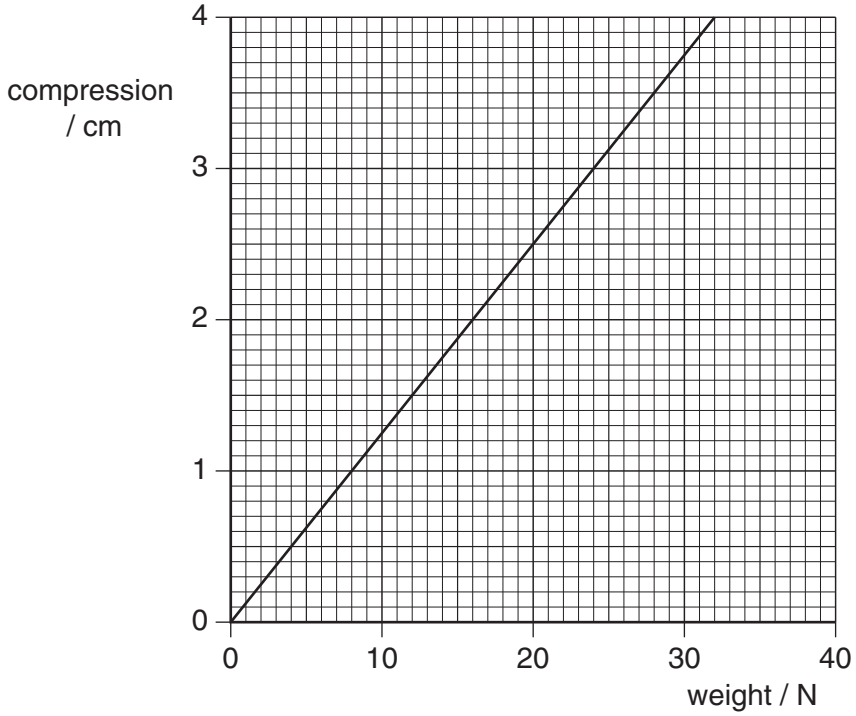

Fig. 2.2

The elastic limit of the spring has not been exceeded.

(a) (i) Determine the spring constant k of the spring.

k = ... $N\,m^{-1}$ [2]

(ii) Deduce that the strain energy stored in the spring is 0.49 J for a compression of 3.5 cm.

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[2]

(b) Two trolleys, of masses 800 g and 2400 g, are free to move on a horizontal table. The spring in **(a)** is placed between the trolleys and the trolleys are tied together using thread so that the compression of the spring is 3.5 cm, as shown in Fig. 2.3.

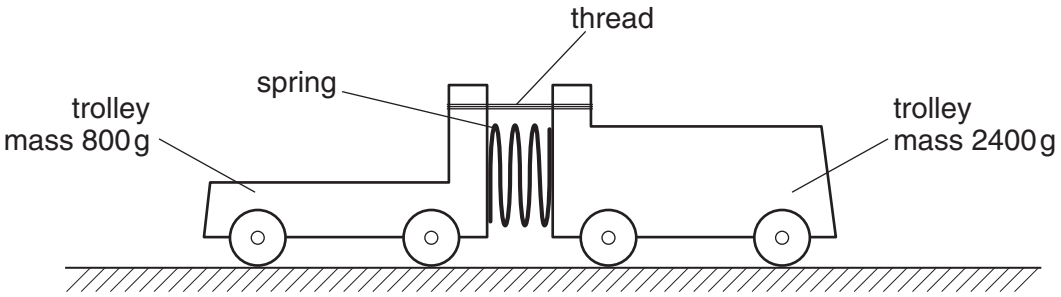

Fig. 2.3

Initially, the trolleys are not moving.
The thread is then cut and the trolleys move apart.

(i) Deduce that the ratio

$$\frac{\text{speed of trolley of mass 800 g}}{\text{speed of trolley of mass 2400 g}}$$

is equal to 3.0.

[2]

(ii) Use the answers in **(a)(ii)** and **(b)(i)** to calculate the speed of the trolley of mass 800 g.

For Examiner's Use

speed = ... $m\,s^{-1}$ [3]

Answer **all** the questions in the spaces provided.

For Examiner's Use

1 **(a)** Define what is meant by

(i) *work done*,

.....

.....

..... [2]

(ii) *power*.

.....

..... [1]

(b) A force F is acting on a body that is moving with velocity v in the direction of the force.

Derive an expression relating the power P dissipated by the force to F and v.

[2]

(c) A car of mass 1900 kg accelerates from rest to a speed of 27 m s^{-1} in 8.1 s.

(i) Calculate the average rate at which kinetic energy is supplied to the car during the acceleration.

rate = ... W [2]

(ii) The car engine provides power at a constant rate. Suggest and explain why the acceleration of the car is **not** constant.

For Examiner's Use

.....

.....

..... [2]

8 **(a)** Explain the concept of *work*.

For Examiner's Use

.....

.....

..... [2]

(b) A table tennis ball falls vertically through air. Fig. 8.1 shows the variation of the kinetic energy E_K of the ball with distance h fallen. The ball reaches the ground after falling through a distance h_0.

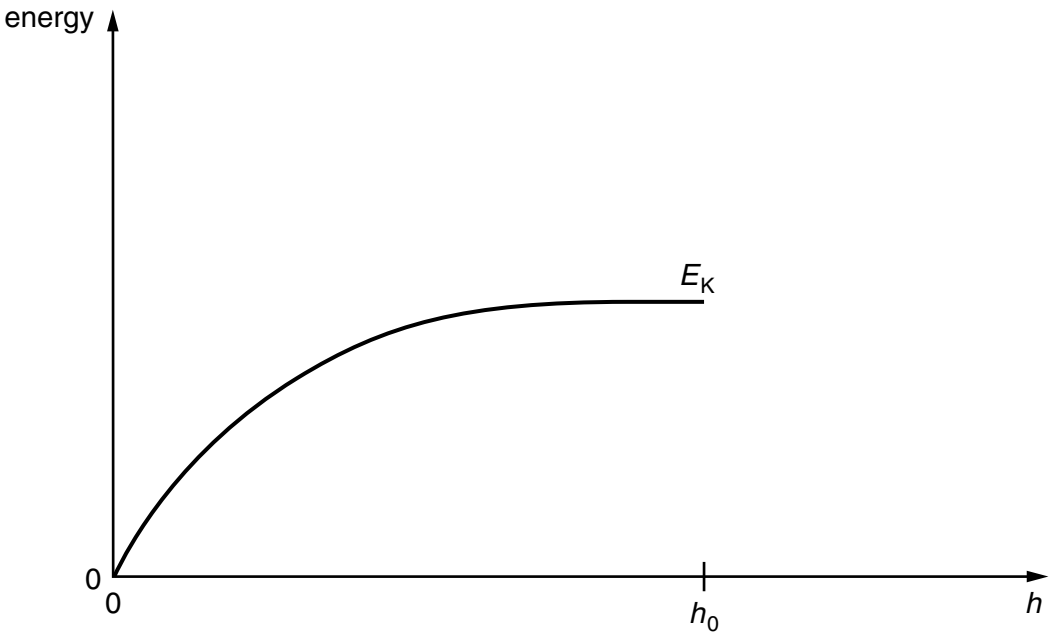

Fig. 8.1

(i) Describe the motion of the ball.

.....

.....

.....

.....

..... [3]

(ii) On Fig. 8.1, draw a line to show the variation with h of the gravitational potential energy E_P of the ball. At $h = h_0$, the potential energy is zero. [3]