2 **(a)** The variation with extension x of the tension F in a spring is shown in Fig. 2.1.

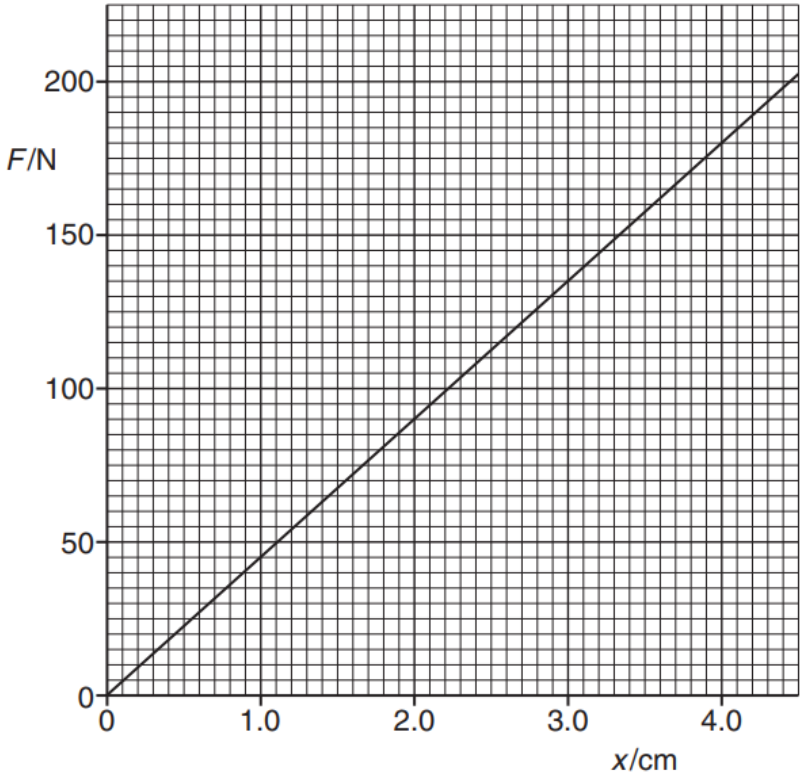

Fig. 2.1

Calculate the energy stored in the spring for an extension of 4.0 cm. Explain your working.

energy = ... J [3]

(b) The spring in **(a)** is used to join two frictionless trolleys A and B, of mass M_1 and M_2 respectively, as shown in Fig. 2.2.

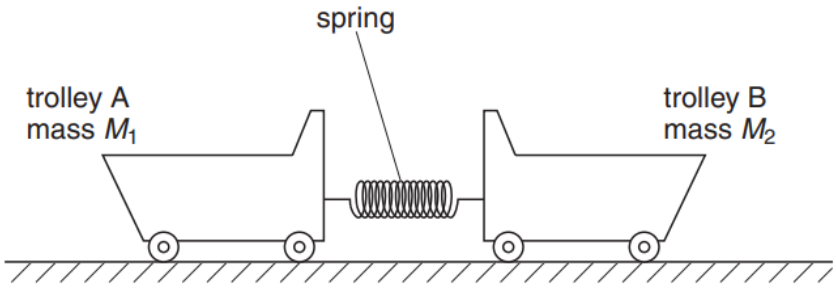

Fig. 2.2

The trolleys rest on a horizontal surface and are held apart so that the spring is extended. The trolleys are then released at the same time.

(i) Explain why, as the extension of the spring is reduced, the momentum of trolley A is equal in magnitude but opposite in direction to the momentum of trolley B.

…….

…….

…….

……. [2]

(ii) At the instant when the extension of the spring is zero, trolley A has speed V_1 and trolley B has speed V_2.

Write down

1. an equation, based on momentum, to relate V_1 and V_2,

……..... [1]

2. an equation to relate the initial energy E stored in the spring to the final energies of the trolleys.

……..... [1]

(iii) **1.** Show that the kinetic energy E_K of an object of mass m is related to its momentum p by the expression

$$E_K = \frac{p^2}{2m}.$$

[1]

2. Trolley A has a bigger mass than trolley B.
Use the expression in **(iii)1.** to deduce which trolley, A or B, has the larger kinetic energy at the instant when the extension of the spring is zero.

.....

..... [1]

[Total: 9]