2 Two blocks, P and Q, of masses 0.50 kg and 1.00 kg respectively, are connected by a string that passes over a pulley as shown in Fig. 2.1. The spring constant is 200 N m^{-1}.

The pulley is frictionless and the string is inelastic. The system is released from rest.

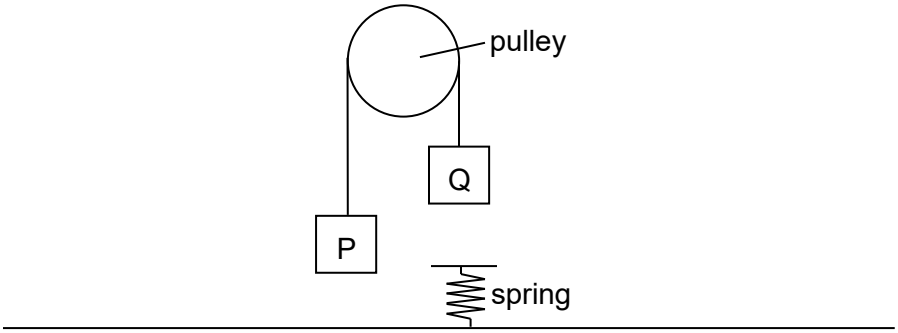

Fig. 2.1

(a) (i) Block Q falls vertically before it strikes a spring that is firmly attached to the floor.

Determine the magnitude of acceleration of block Q just before it strikes the spring.

acceleration of block Q = …….…….. m s^{-2} [2]

(ii) Hence, determine the tension in the string just before block Q strikes the spring.

tension in the string = …….…….. N [2]

(iii) The acceleration of Block Q decreases after it touches the spring. Block Q comes to a permanent stop after some time and the spring is observed to be compressed.

Calculate the compression of the spring, x.

compression of spring, x = ……..……. m [2]

(iv) In an ideal system where there is no energy loss, explain how is it that collision between Block Q and the spring is elastic even though the kinetic energy of Block Q and the spring was momentarily zero.

……....

……....

…….. [1]

(b) A bullet of mass 5.0 g is fired from a gun into a block of mass 0.500 kg, which is suspended by thin threads from fixed points. The bullet remains in the block, which swings upwards as to a maximum height of h as shown in Fig. 2.2.

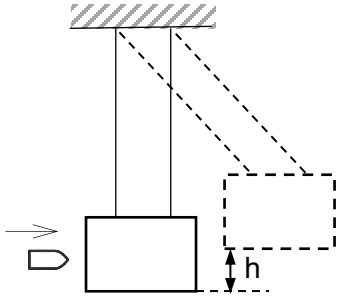

Fig. 2.2

(i) If the velocity of the bullet just before it strikes the block is 100 m s^{-1}, determine the maximum height h.

maximum height = ……..……. m [2]

(ii) State the type of collision between the bullet and the block.

…….. [1]