3 Fig. 3.1 shows a trolley of mass 0.50 kg resting on a smooth horizontal surface. The trolley is attached to two identical springs, both of which are initially at their natural lengths.

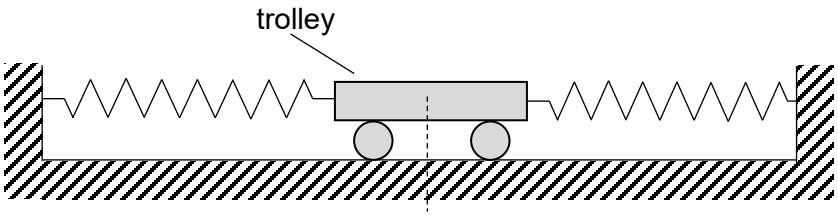

Fig. 3.1

(a) The trolley is displaced to the right along the axis of the springs and then released. The trolley undergoes simple harmonic motion.

Fig. 3.2 shows the variation with time t of velocity v of the trolley.

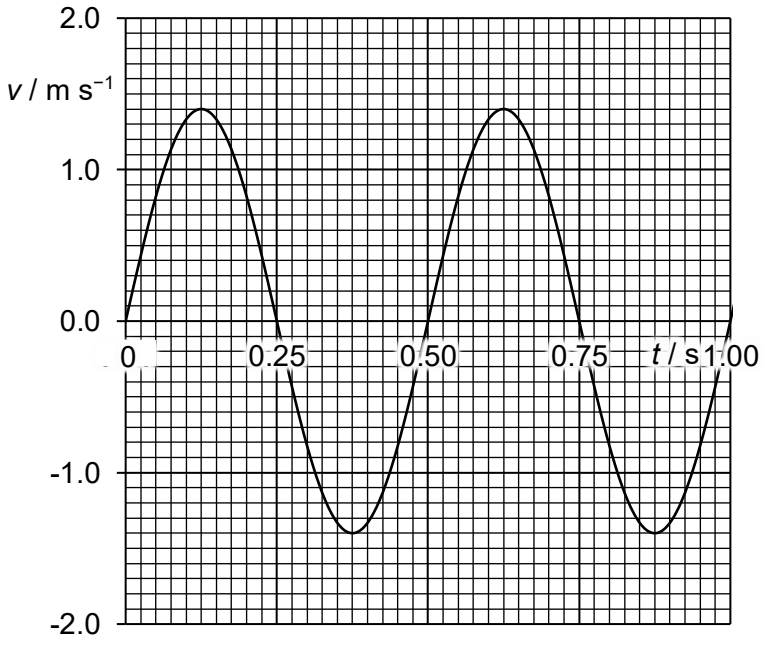

Fig. 3.2

(i) Determine the kinetic energy of the oscillating trolley when it is at the equilibrium position.

kinetic energy = …… J [2]

(ii) Determine the amplitude of the oscillation.

amplitude = …… m [2]

(b) A wooden board is attached vertically to the top of the trolley as shown in Fig. 3.3. The modified trolley is displaced to the right and then released.

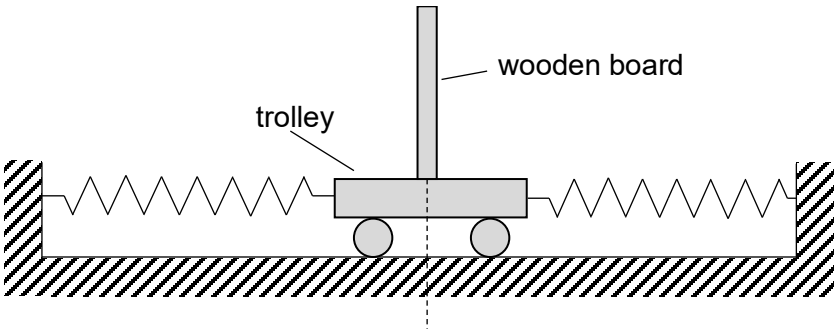

Fig. 3.3

Fig. 3.4 shows the variation with time t of velocity v of the modified trolley.

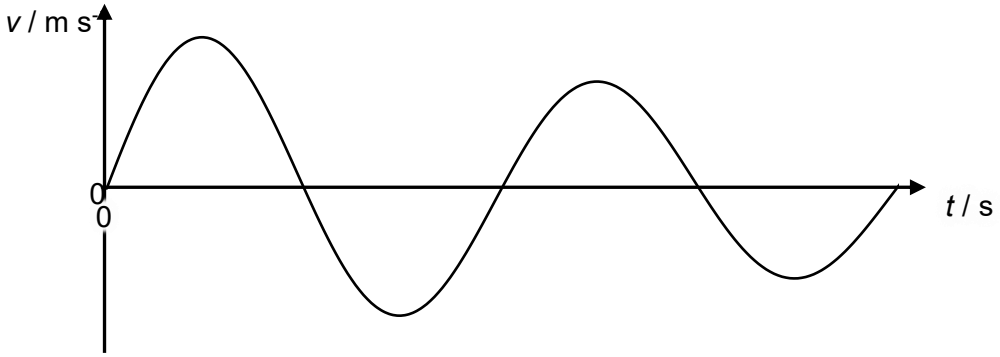

Fig. 3.4

State the type of oscillation illustrated in Fig. 3.4. Suggest what caused it.

……

…… [2]

(c) An air jet is placed as shown in Fig. 3.5. It emits periodic pulses of air at a frequency f as the modified trolley oscillates.

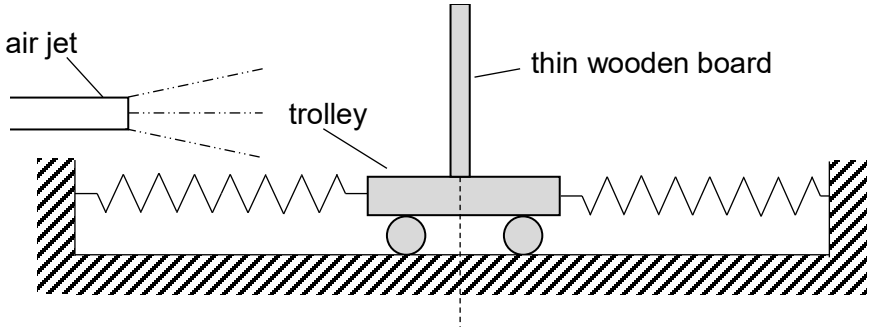

Fig. 3.5

Fig. 3.6 shows the variation with time t of the displacement x of the modified trolley when pulses of air is emitted at 2.0 Hz for some time.

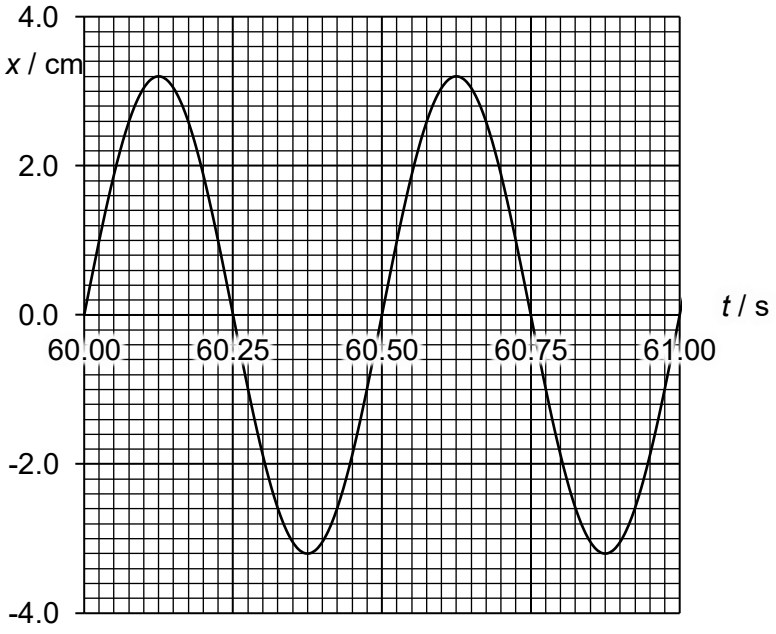

Fig. 3.6

The variation with frequency f of the pulses of air of the amplitude A of the oscillation of the trolley is shown in Fig. 3.7.

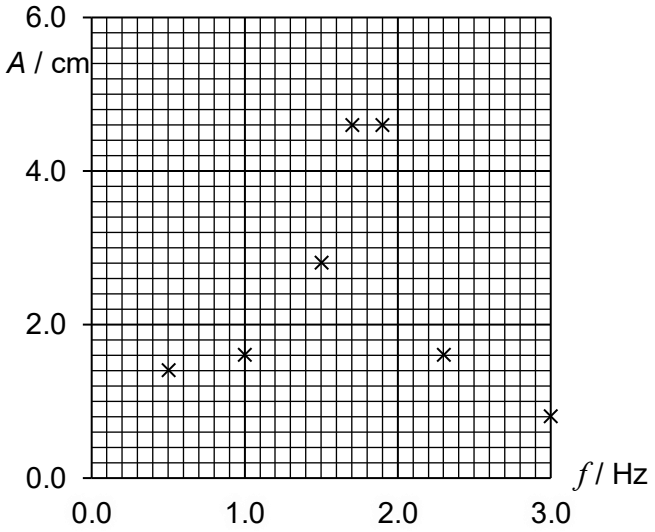

Fig. 3.7

(i) Plot the point in Fig. 3.7 for when f = 2.0 Hz. [1]

(ii) Complete Fig. 3.7 by drawing the curve of best fit. [1]

(iii) Estimate the resonant frequency.

resonant frequency = …… Hz [1]