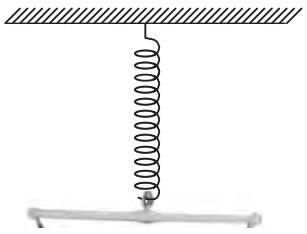
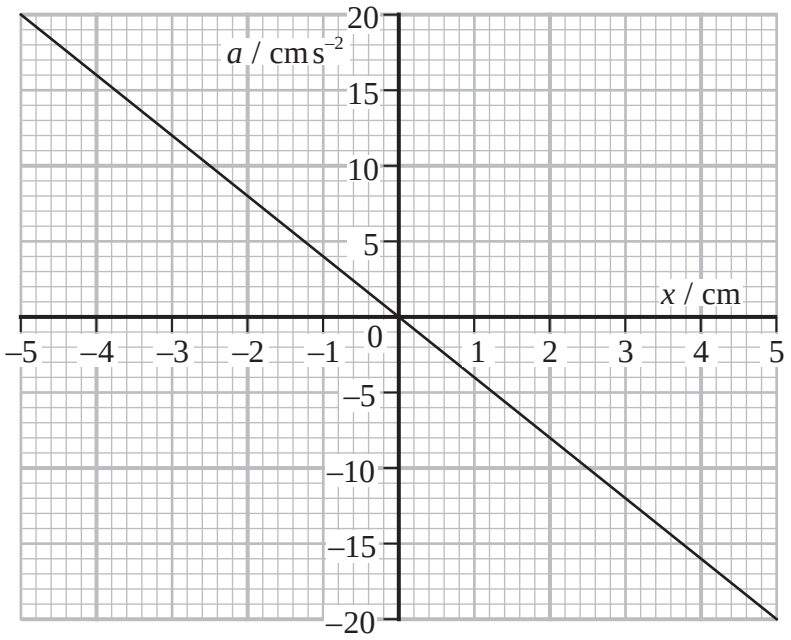
10 A ‘jumperoo’ is a harness, suspended by a vertical spring, into which a baby can be placed, as shown.



The jumperoo is adjusted so that the baby’s feet are a few centimetres above the floor. If the baby is then displaced downwards and released, he oscillates vertically.

(a) The graph shows how the acceleration a of the baby depends upon the displacement x of the baby from its equilibrium position.



For safety reasons, it is suggested that the maximum velocity of the baby should not exceed $0.5\,m\,s^{-1}$.

Assess whether it is safe for the baby to oscillate in the jumperoo with an amplitude of 22 cm.

(3)

(b) The amplitude of the oscillations quickly decreases, so the baby has to push down on the floor to maintain the oscillations.

When the baby pushes at a particular frequency, the amplitude of oscillation increases to a maximum.

A baby of greater mass is placed in the jumperoo.

This baby pushes on the floor at a frequency that produces a maximum amplitude of oscillation.

Explain how this frequency compares with the frequency of pushing of the original baby.

A calculation is not necessary.

(3)

(Total for Question 10 = 6 marks)