4 A piston moves vertically up and down in a cylinder, as illustrated in Fig. 4.1.

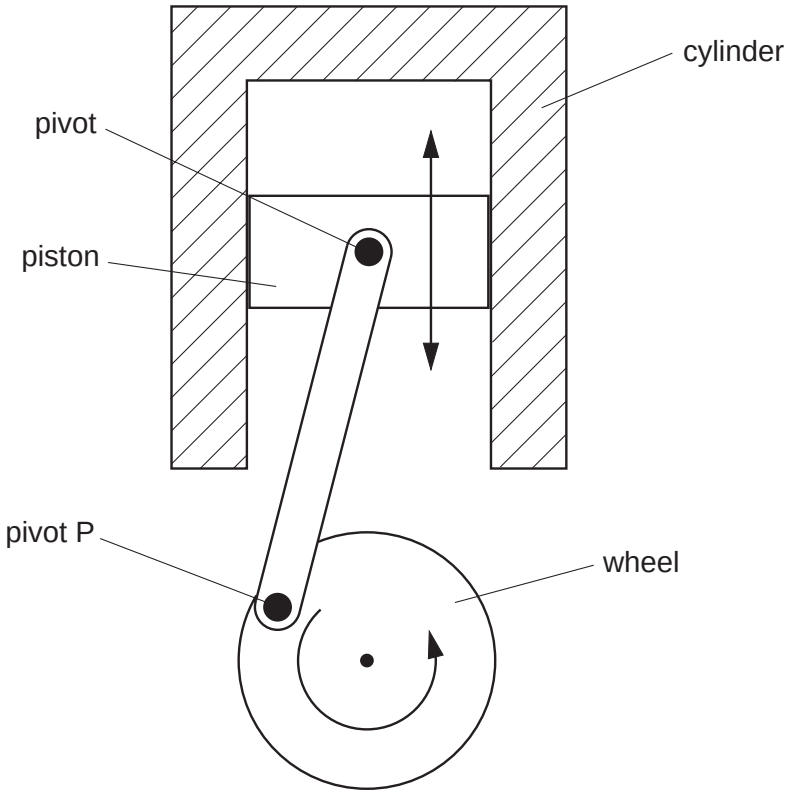

Fig. 4.1

The piston is connected to a wheel by means of a rod that is pivoted at the piston and at the wheel. As the piston moves up and down, the wheel is made to rotate.

(a) (i) State the number of oscillations made by the piston during one complete rotation of the wheel.

number = ... [1]

(ii) The wheel makes 2400 revolutions per minute. Determine the frequency of oscillation of the piston.

frequency = ... Hz [1]

(b) The amplitude of the oscillations of the piston is 42 mm.

Assuming that these oscillations are simple harmonic, calculate the maximum values for the piston of

(i) the linear speed,

speed = ... $m\,s^{-1}$ [2]

(ii) the acceleration.

acceleration = ... $m\,s^{-2}$ [2]

(c) On Fig. 4.1, mark a position of the pivot P for the piston to have

(i) maximum speed (mark this position S), [1]

(ii) maximum acceleration (mark this position A). [1]