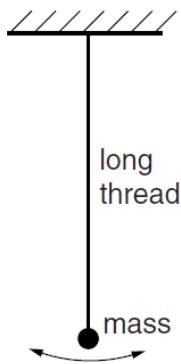


**4** Galileo used a simple pendulum to take the time for objects to roll down an inclined plane.

Fig. 4.1 shows a simple pendulum.



**Fig. 4.1** (not to scale)

A simple pendulum oscillates with simple harmonic motion.

(a) State what is meant by *simple harmonic motion*.

.....

.....

.....

.....

.....

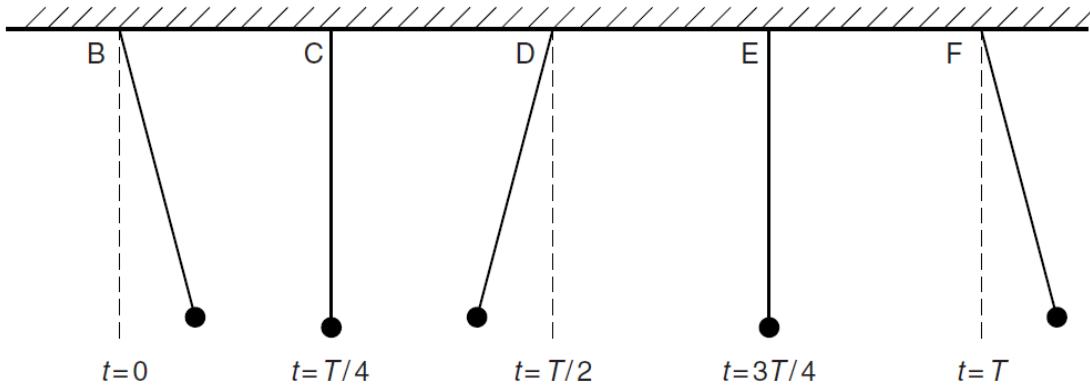
.....

.....

.....

..... [2]

- (b) The pendulum is displaced to one side and then released at time  $t = 0$ . Fig. 4.2 shows the positions of the mass at various times during a single oscillation.



**Fig. 4.2** (not to scale)

Complete the table below to describe the directions of the displacement, velocity and acceleration of the mass at times B to F using the symbols +, 0 and -.

Apply the convention that displacements, velocities and accelerations to the right are positive.

	B	C	D	E	F
displacement					
velocity					
acceleration					

[3]

(c) State the phase difference, for the pendulum in (b), between

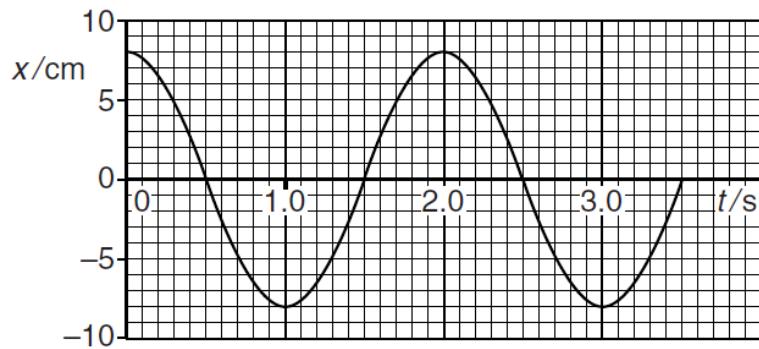
(i) the displacement and the velocity,

.....  
..[1]

(ii) the displacement and the acceleration.

.....  
..[1]

(d) Fig. 4.3 shows the variation of displacement  $x$  with time  $t$  for a particular pendulum.



**Fig. 4.3**

(i) Use information from Fig. 4.3 to determine

a. amplitude,

amplitude = ..... cm [1]

- b. the frequency of oscillation.

frequency = ..... Hz [1]

(ii) The mass  $m$  of the pendulum is 20 g.

- a. Calculate the maximum force exerted on the mass.

maximum force = ..... N [1]

- b. On Fig. 4.4, sketch a graph to show how, for the time period given in Fig. 4.3,

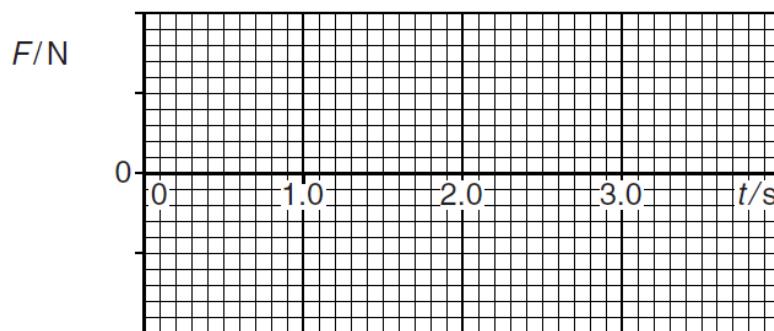


Fig. 4.4

[1]

[Total: 11]