1. A particle P is moving along the x-axis.
At time t seconds the displacement of P from the origin O is x metres, where
$x = 0.6\cos\left(kt + \frac{\pi}{4}\right)$ and k is a positive constant.

(a) Prove that P is moving with simple harmonic motion by showing that

$$\ddot{x} = -k^2 x$$

(3)

(b) State the amplitude of the motion of P

(1)

(c) Find, in terms of k, the maximum speed of P

(1)

The period of the motion is 4 seconds.

(d) Find k in terms of π

(2)

The points A and B lie on the x-axis, on opposite sides of O, with $OA = OB = 0.2\,\text{m}$

(e) Find the time taken by P to move directly from A to B

(4)

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Question 1 continued

(Total for Question 1 is 11 marks)