1) A piston has position given by

$$x(t) = A\cos(\omega t + \phi)$$

where

$A = 9\ m$

$\omega = 0.2\ rad/s$

$\phi = 0.7\ rad$

a) At time $t = 5$, what is position x?

$$x(5) = 9\,m\cos\left(\frac{0.2\ rad}{s} * 5\,s + 0.7\ rad\right)$$
$$= 9\,m\cos(1.7\ rad)$$
$$= -1.16\ m$$

b) The maximum speed of the piston is given by the max value of

$$v(t) = \frac{dx}{dt} = -\omega A \underbrace{\sin(\omega t + \phi)}_{\text{max of } \sin = 1}$$

So.

$$\max v(t) = \omega A = \left(0.2\ \tfrac{rad}{s}\right)(9\,m) = 1.8\ m/s$$

c) How can we express position in the alternate form

$$x(t) = B\cos(\omega t) + C\sin(\omega t) \quad ?$$

Look at $x(t)$ and $v(t)$ at special time $t = 0$

$$x(0) = A\cos(\phi) = B\cos(0) + C\sin(0)$$

$$\rightarrow B = A\cos(\phi) = 6.88\ m$$

$$v(0) = -\omega A\sin(\phi) = -\omega B\sin(\phi) + \omega C\cos(0)$$

$$\rightarrow C = A\sin(\phi) = -5.80\ m$$