D.1
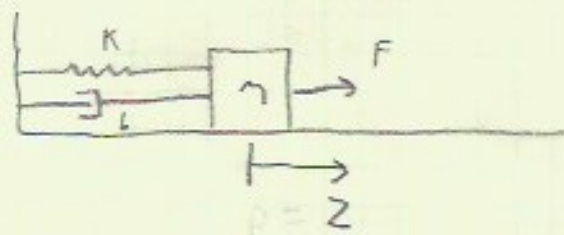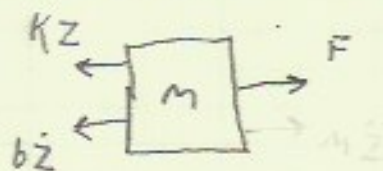
Find KE

Known

$$KE = \frac{1}{2} m v^2$$

sub given

$$KE = \frac{1}{2} m \dot{Z}^2$$

$p = Z$

FBD

D.3

(A) $PE = \frac{1}{2} K Z^2$

(B) $q = [Z]$

(C) $F = [F]$

$b = \begin{bmatrix} b \end{bmatrix}$

(D) $L = \frac{1}{2} m \dot{Z}^2 - \frac{1}{2} K Z^2$

Known

$$\frac{d}{dt}\left(\frac{\partial}{\partial \dot{q}} L\right) - \frac{\partial}{\partial q} L = \gamma - B \dot{q}$$

$$\frac{d}{dt}\left(\frac{\partial}{\partial \dot{Z}}\left(\frac{1}{2} m \dot{Z}^2 - \frac{1}{2} K Z^2\right)\right) - \frac{\partial}{\partial Z}\left(\frac{1}{2} m \dot{Z}^2 - \frac{1}{2} K Z^2\right)$$
$$= F - (\cdot b)\dot{Z}$$

$$\frac{d}{dt}\left(m \dot{Z}\right) - (\cdot K Z) = F - b\dot{Z}$$

$$m \ddot{Z} + K Z = F - b\dot{Z}$$

$$m \ddot{Z} + b \dot{Z} + K Z = F \quad \longleftarrow$$

check work from FBD

$$\sum F = m a$$

$$m \ddot{Z} = F - b\dot{Z} - K Z \rightarrow m \ddot{Z} + b \dot{Z} + K Z = F \checkmark$$