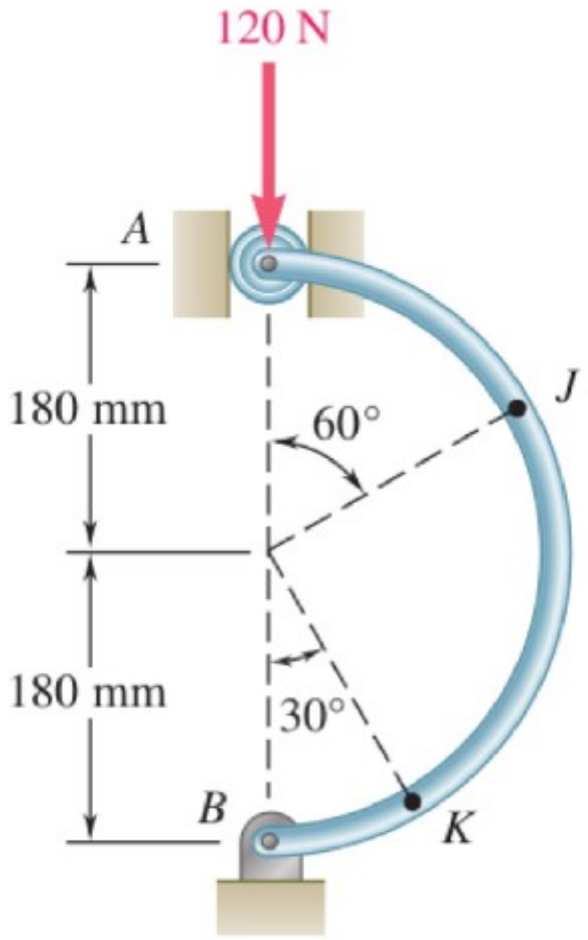
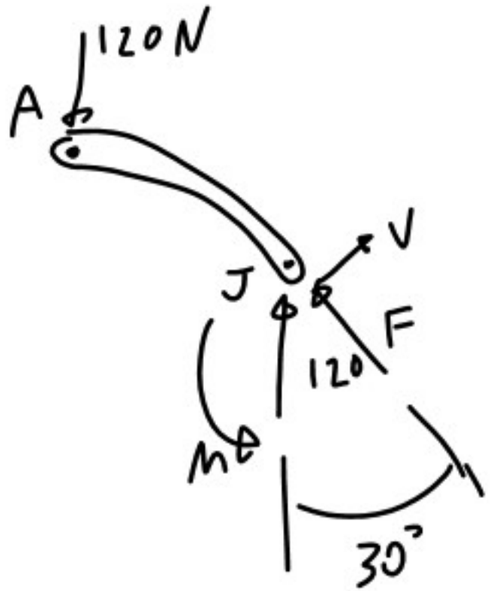
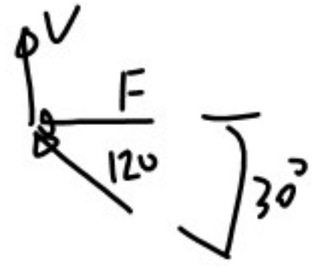
7.9 A semicircular rod is loaded as shown. Determine the internal forces at point J.

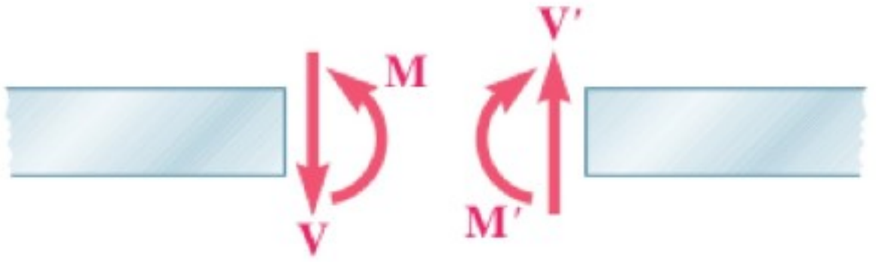




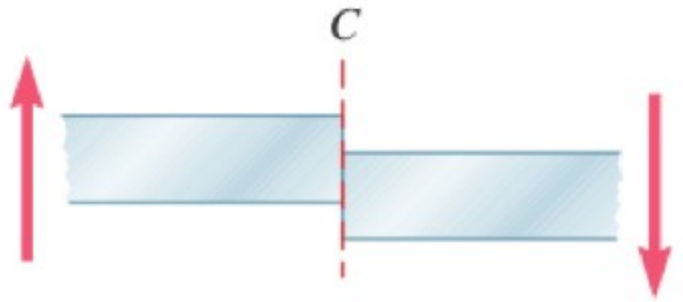


$F = 120 \cos 30$

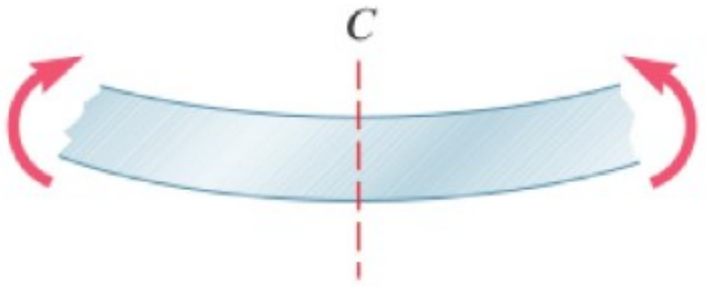
$V = 120 \sin 30$



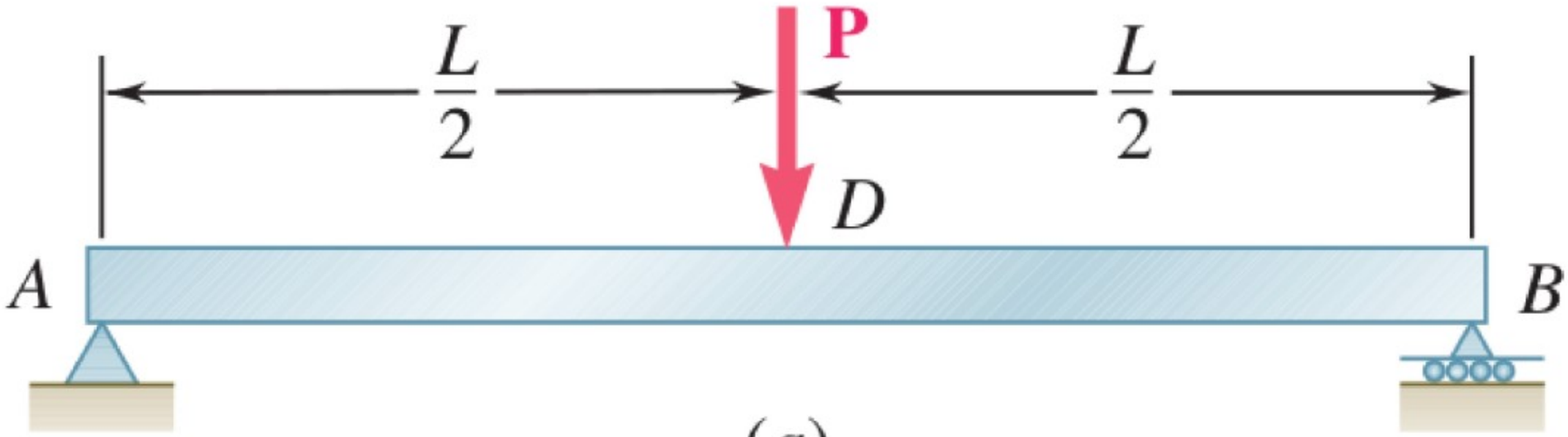
(*a*) Internal forces at section
(positive shear and positive bending moment)



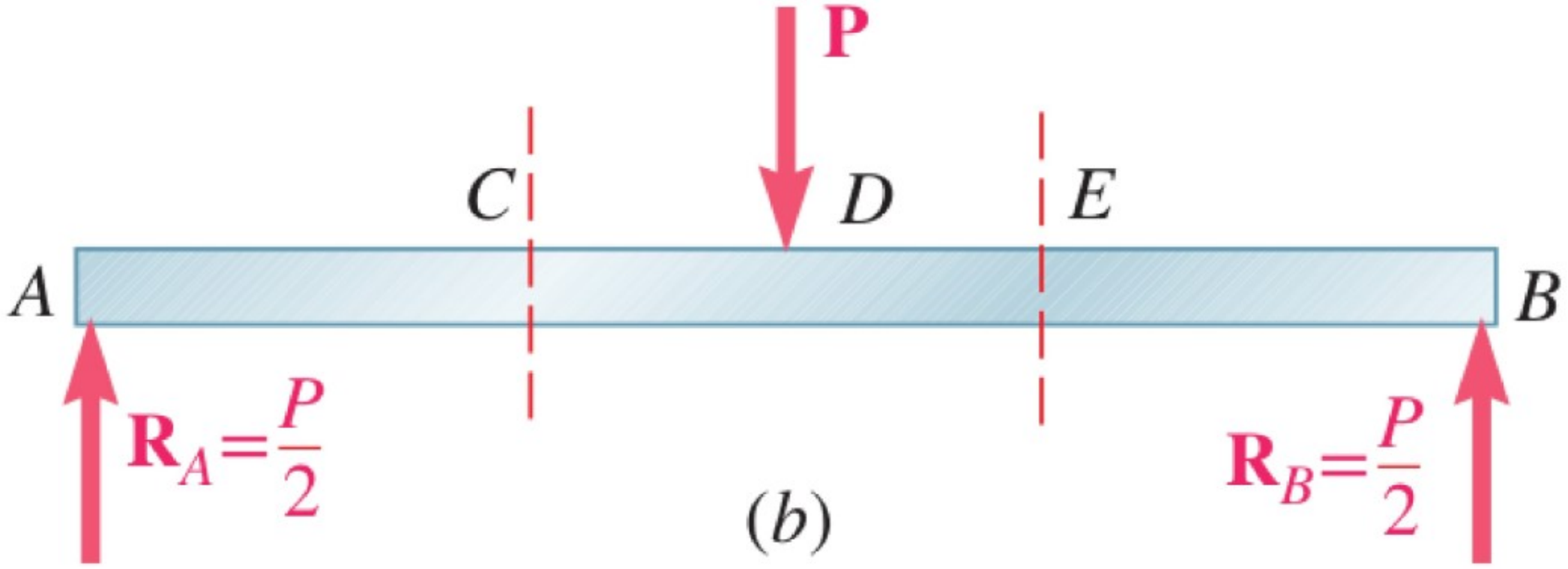
(*b*) Effect of external forces
(positive shear)

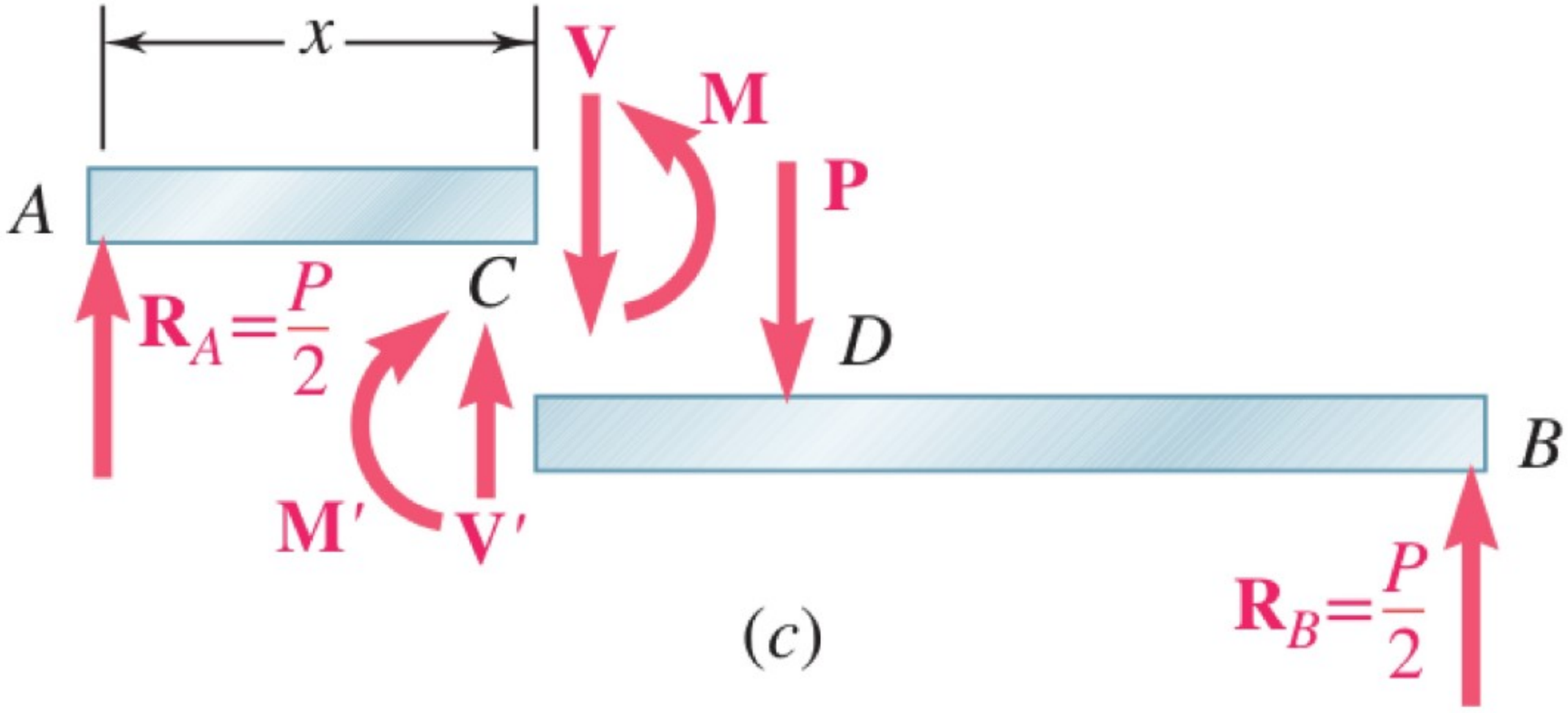


(*c*) Effect of external forces
(positive bending moment)

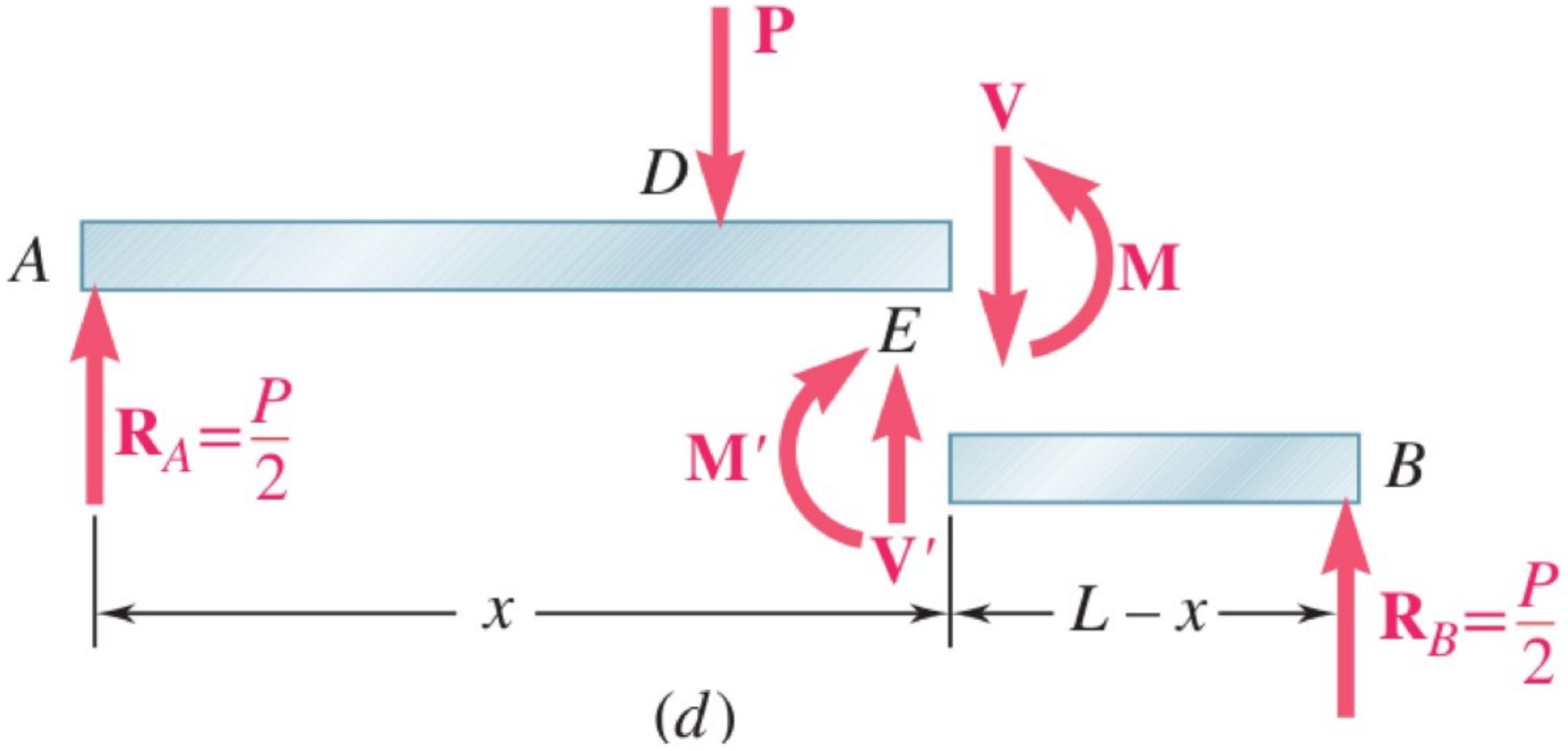


(a)

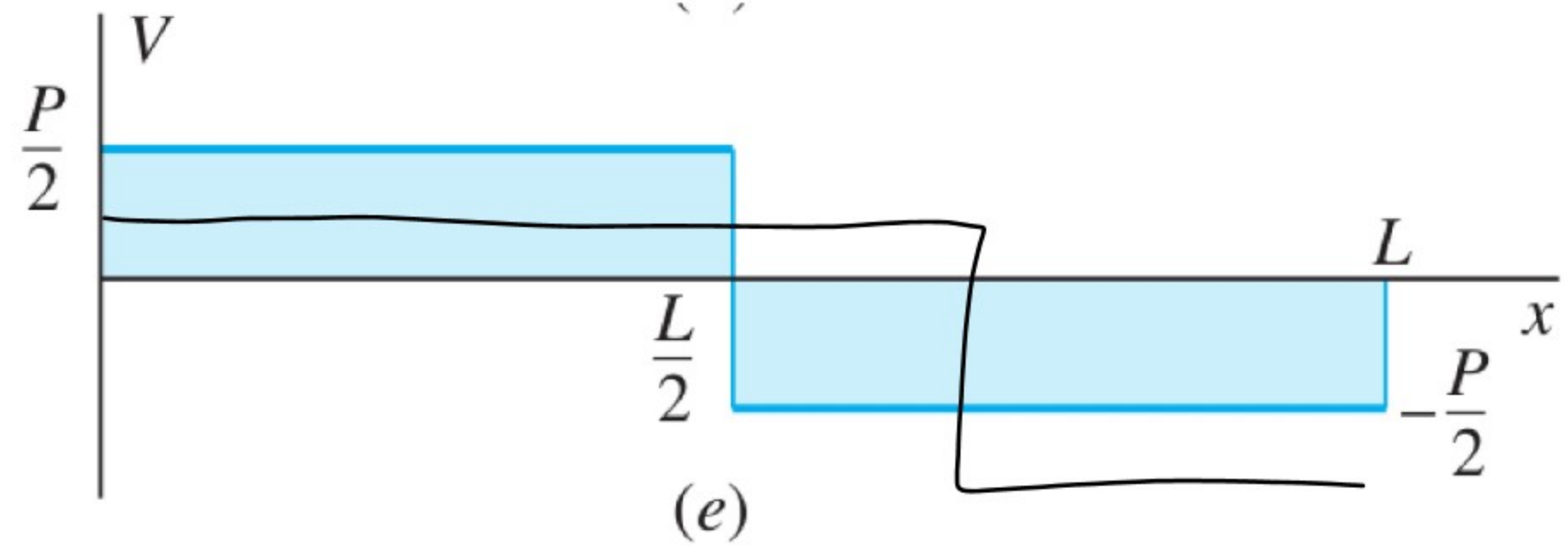

P
C
D
E
A
B
$\mathbf{R}_A = \frac{P}{2}$
$\mathbf{R}_B = \frac{P}{2}$
(b)



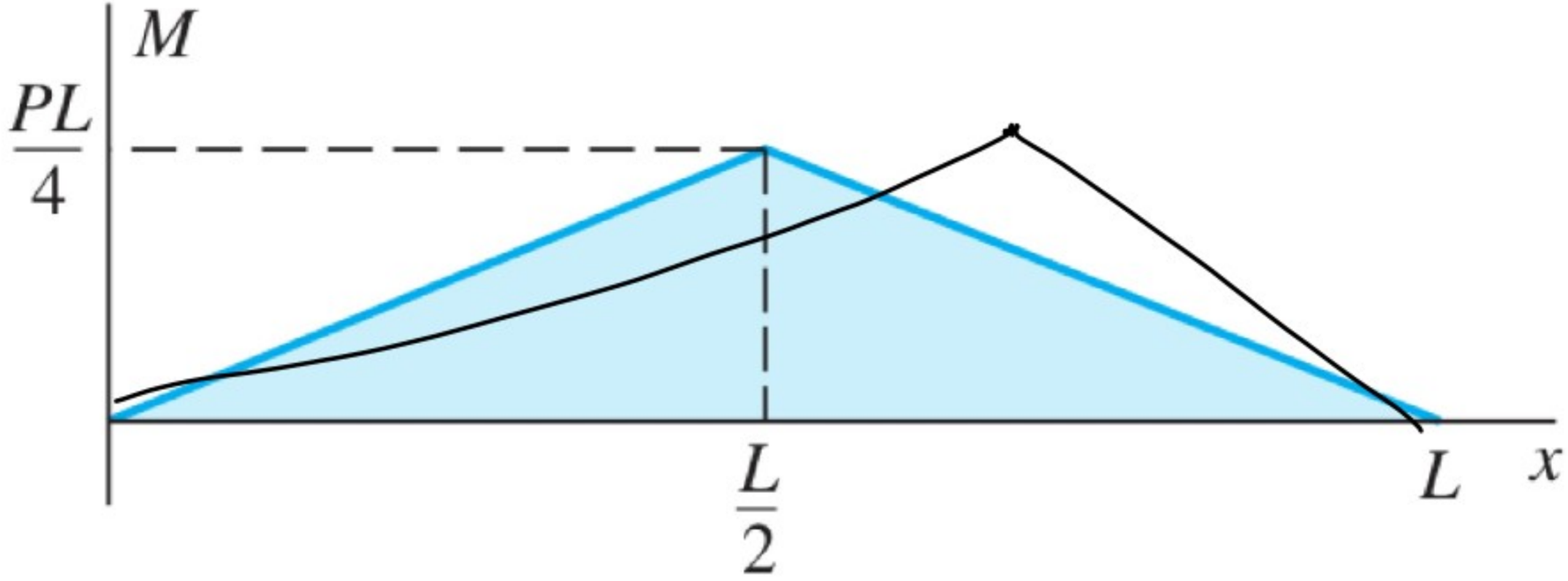
(c)

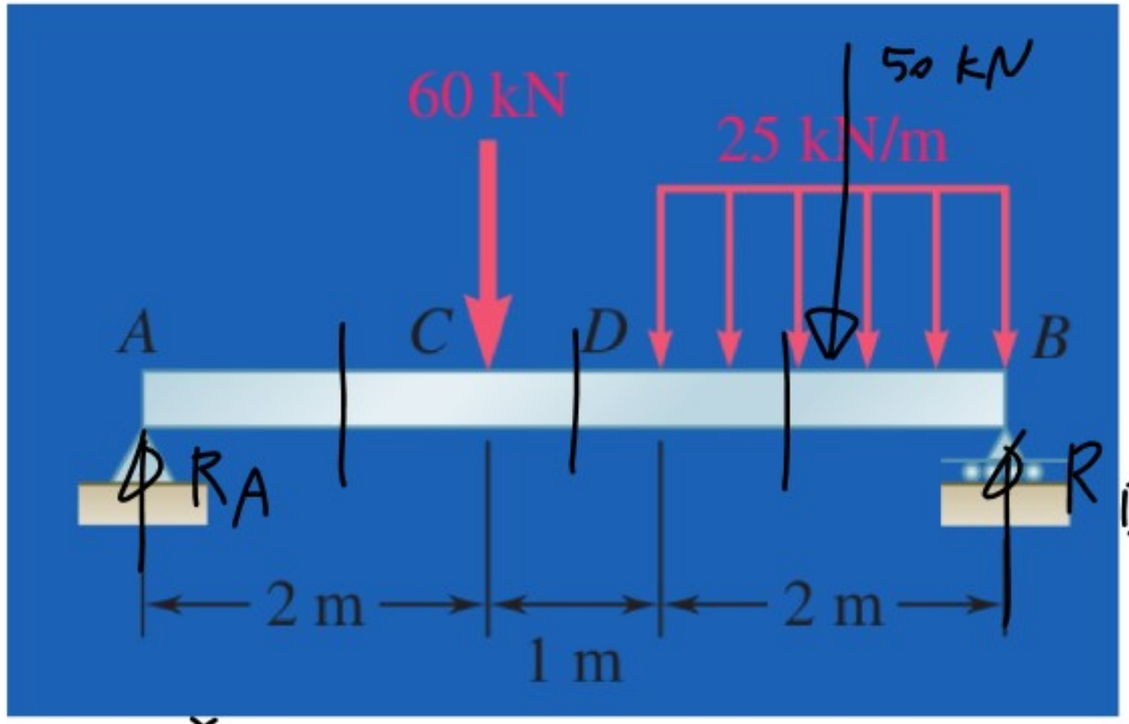


(d)



(e)





$25\ kN/m \cdot 2m = 50\ kN$

$\Sigma M_A = 0$

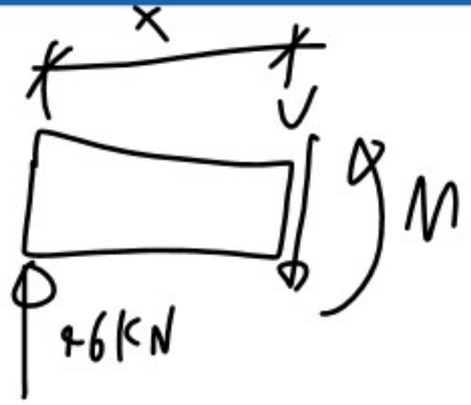
$-2 \cdot 60 - 4 \cdot 50 + 5R_B = 0$

$R_B = \frac{2 \cdot 60 + 4 \cdot 50}{5} = 64\ kN$

$\Sigma F_y = 0$

$R_A + 64 - 60 - 50 = 0$

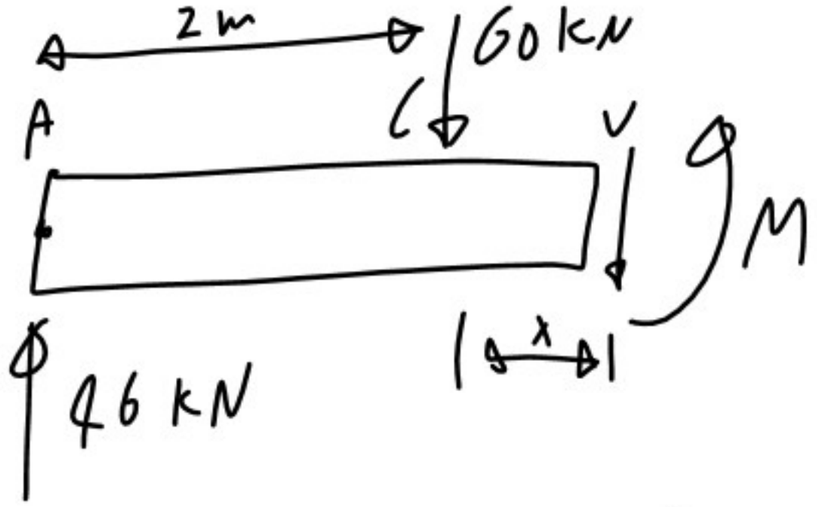
$R_A = 60 + 50 - 64 = 46\ kN$

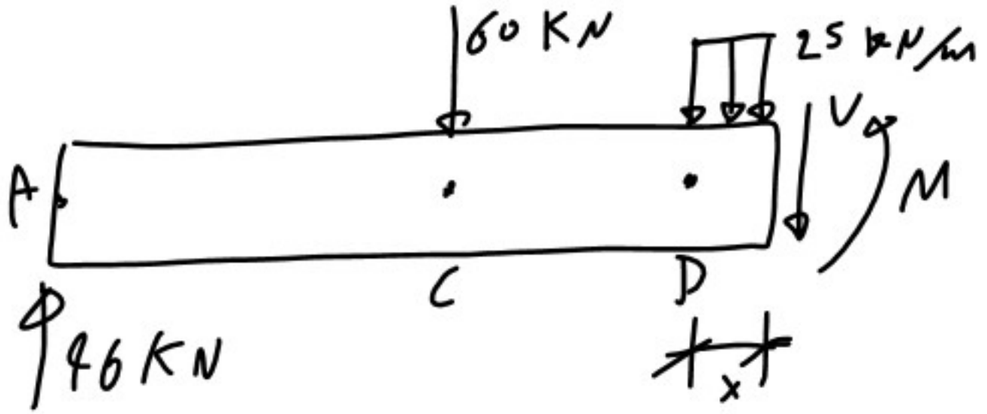


$V = 46\ kN$

$M - x46 = 0$

$M = 46x$





$\sum F_y = 0$

$46 - 60 - V = 0$

$46 - 60 = V$

$V = -14\ kN$

$\sum M = 0$

$M + 60x - (x+2)46 = 0$

$M = (x+2)46 - 60x$

$= 46x + 92 - 60x$

$= 92 - 14x$

$\sum F_y = 0$

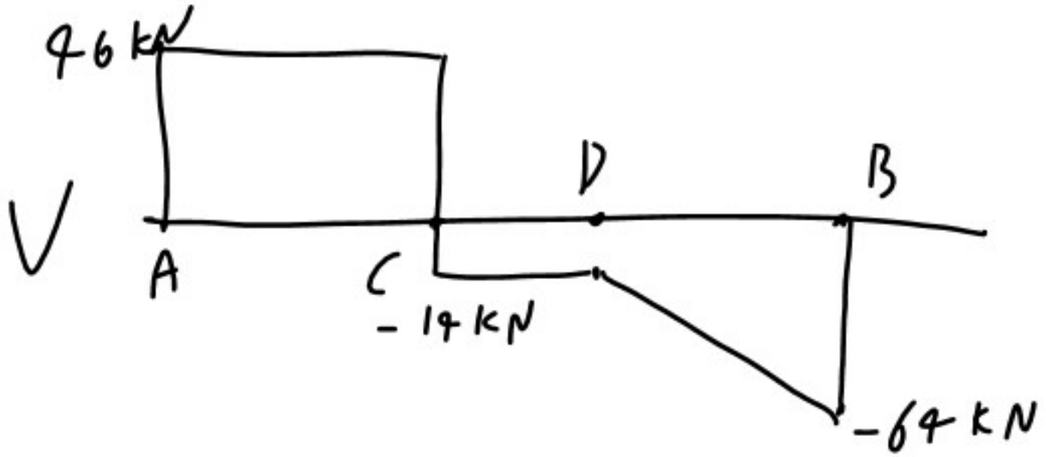
$46 - 60 - 25x - V = 0$

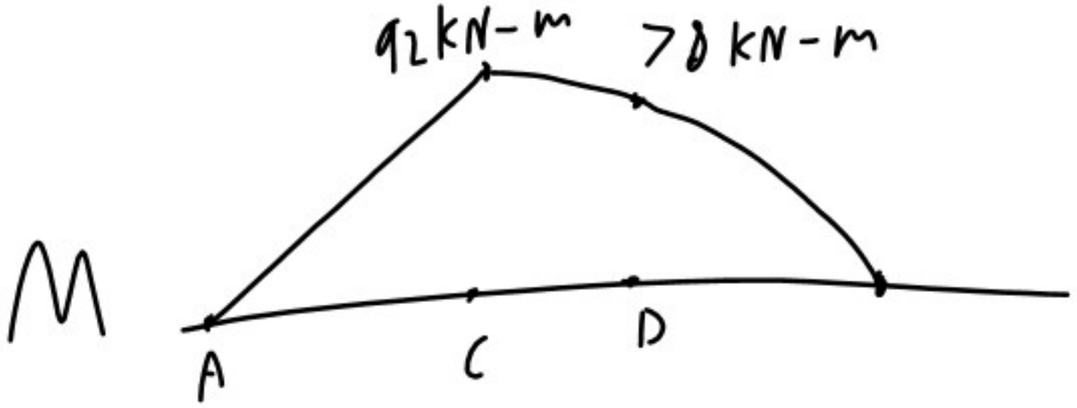
$V = 46 - 60 - 25x$

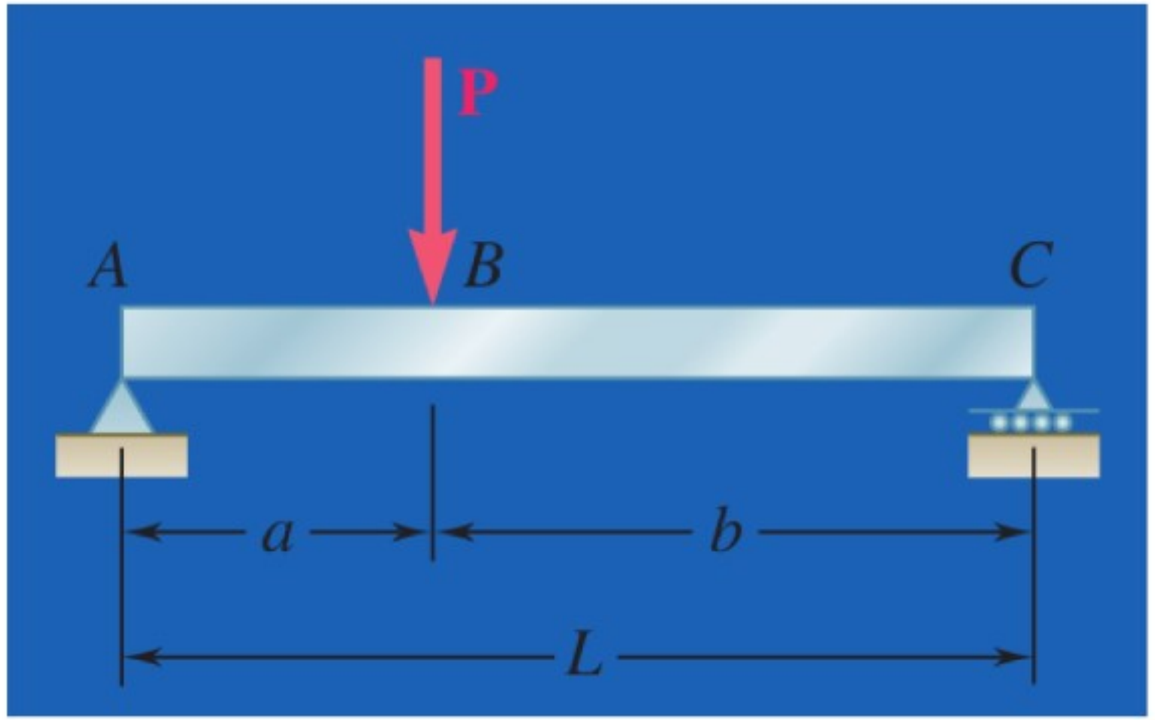
$= -14 - 25x$

$\sum M = 0$

$-46(x+1+2) + 60(x+1) + 25x\frac{x}{2} + M = 0$


96 kN
V
A
C
D
B
- 14 kN
- 64 kN


92 kN-m
78 kN-m
M
A
C
D


P
A
B
C
a
b
L