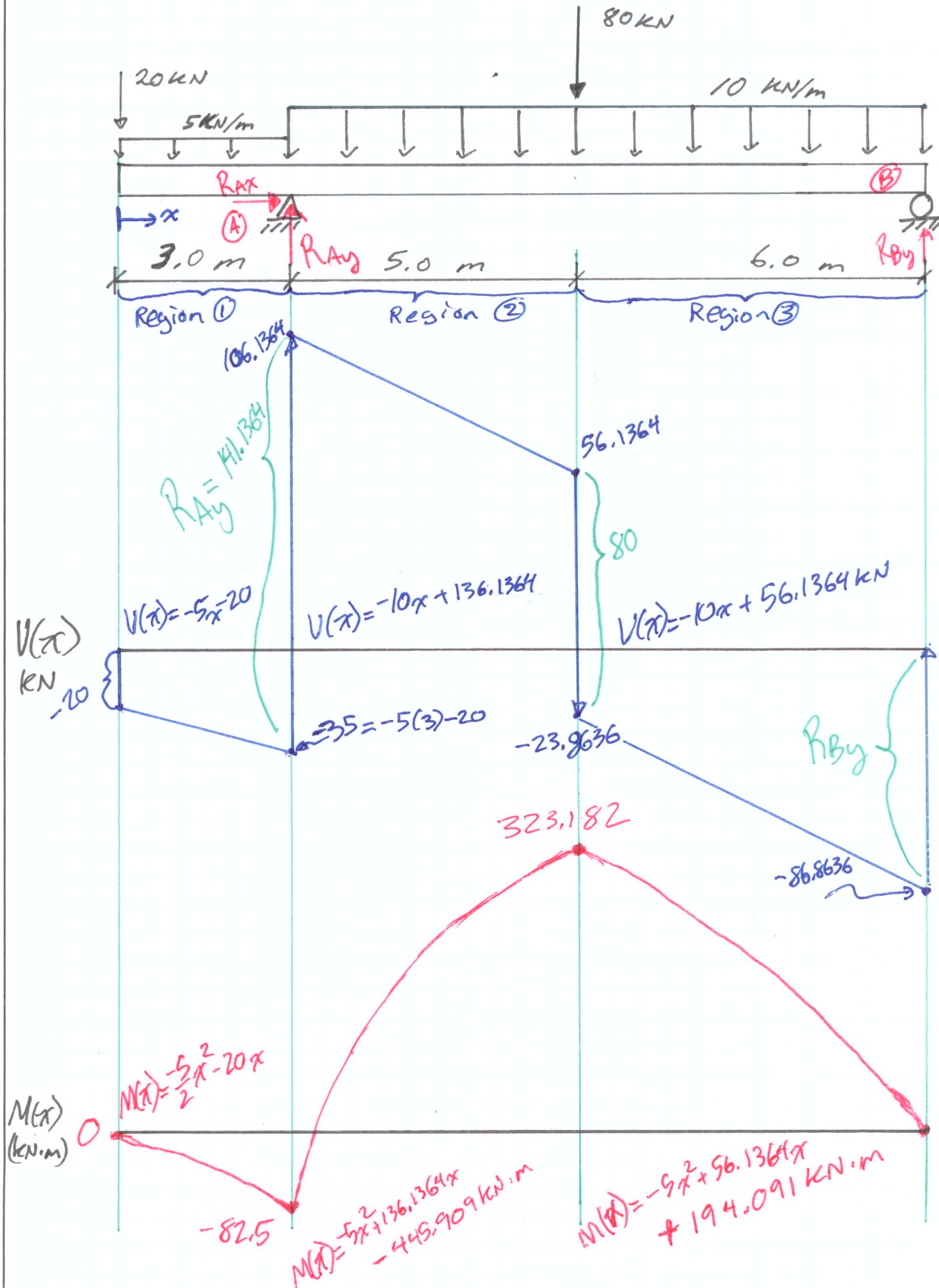


Find  $w(x)$ ,  $V(x)$ ,  $m(x)$  with direct integration and plot.



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Reactions  $\Sigma F_x = 0$ ,  $\Sigma F_y = 0$ ,  $\Sigma M_z = 0$

$$\Sigma M_A = 0$$

$$(20 \text{ kN})(3 \text{ m}) + \underbrace{(5 \text{ kN/m})(3 \text{ m})}_{FR} \underbrace{\left(\frac{3 \text{ m}}{2}\right)}_{\bar{x}} - (80 \text{ kN})(5 \text{ m}) - 10 \text{ kN/m} \left(\frac{11 \text{ m}}{2}\right) (11 \text{ m}) + R_{By}(11 \text{ m}) = 0 \rightarrow R_{By} = 83.8636 \text{ kN} \uparrow$$

$$\Sigma F_y = 0$$

$$R_{Ay} + R_{By} - 20 - 80 - 5 \times 3 - 10 \times 11 = 0$$

$$R_{Ay} = 141.1364 \text{ kN} \uparrow$$

$$\Sigma F_x = 0 \rightarrow R_{Ax} = 0$$

Define Regions (Identify discontinuities)

Region ①	$0 \leq x < 3 \text{ m}$
Region ②	$3 \leq x < 8 \text{ m}$
Region ③	$8 \leq x \leq 11 \text{ m}$

Find Equations for Region ①

$$w(x) = 5 \text{ kN/m}$$

$$V(x) = -\int w(x) dx = -\int 5 dx = -5x + C_1$$

Apply B.C.  $\rightarrow$  at  $x=0$ ,  $V(0) = -20 \text{ kN}$

Solve for  $C_1$

$$V(0) = -20 = -5(0) + C_1 \quad C_1 = -20 \text{ kN}$$

$$V(x) = -5x - 20 \text{ kN}$$

$$M(x) = \int V(x) dx = \int (-5x - 20) dx = -\frac{5x^2}{2} - 20x + C_2$$

$$\text{at } x=0, M(0) = 0$$

$$M(0) = 0 = -\frac{5(0)^2}{2} - 20(0) + C_2 \quad C_2 = 0$$

$$M(x) = -\frac{5}{2}x^2 - 20x$$

$$\text{Find } M(3) \rightarrow M(3) = -\frac{5}{2}(3)^2 - 20(3) = \underline{M(3) = -82.5 \text{ kN}\cdot\text{m}}$$

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4Region 2

$$w(x) = 10 \text{ kN/m}$$

$$V(x) = -\int w(x) dx = -\int 10 dx = -10x + C_3$$

$$\text{at } x = 3 \text{ m, } V(3) = +106.1364 \text{ kN}$$

$$H(t) \quad V(3) = 106.1364 = -10(3) + C_3$$

$$C_3 = 136.1364 \text{ kN}$$

$$V(x) = -10x + 136.1364 \text{ kN}$$

$$\text{Find } V(8) = \cancel{106.1364} -10(8) + 136.1364 \rightarrow V(8) = 56.1364 \text{ kN}$$

$$M(x) = \int V(x) dx = \int (-10x + 136.1364) dx = -5x^2 + 136.1364x + C_4$$

$$\text{@ } x = 3 \text{ m, } M(3) = -82.5 \text{ kN}\cdot\text{m}$$

$$M(3) = -82.5 = -5(3)^2 + 136.1364(3) + C_4 \rightarrow C_4 = -445.909 \text{ kN}\cdot\text{m}$$

$$M(x) = -5x^2 + 136.1364x - 445.909 \text{ kN}\cdot\text{m}$$

$$M(8) = -5(8)^2 + 136.1364(8) - 445.909 = M(8) = +323.182 \text{ kN}\cdot\text{m}$$

Region 3

$$w(x) = 10 \text{ kN/m}$$

$$V(x) = -\int w(x) dx = -\int 10 dx = -10x + C_5$$

$$\text{at } x = 8, V(8) = -23.8636 \text{ kN}$$

$$V(8) = -23.8636 = -10(8) + C_5 \rightarrow$$

$$C_5 = 56.1364 \text{ kN}$$

$$V(x) = -10x + 56.1364 \text{ kN}$$

check

$$V(14) = -R_{By} = -83.8636 \text{ kN}$$

$$-83.8636 = -10(14) + 56.1364$$

$$-83.8636 = -83.8636$$





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$$M(x) = \int V(x) dx = \int (-10x + 56.1364) dx = -5x^2 + 56.1364x + C_6$$

$$\text{at } x = 8\text{m}, M = +323.182 \text{ kNm}$$

$$M(8) = 323.182 = -5(8)^2 + 56.1364(8) + C_6$$

$$C_6 = +194.091 \text{ kNm}$$

$$M(x) = -5x^2 + 56.1364x + 194.091 \text{ kNm}$$

check @  $x = 14$ ,  $M = 0$

~~$$M(0) = 0 = -5$$~~

~~$$M(14) = 0 = -5(0)^2 + 56.1364(0) +$$~~

$$M(14) = 0 = -5(14)^2 + 56.1364(14) + 194.091$$

$$0 = -980 + 785.876 + 194.091$$

$$0 = -0.033 \quad \checkmark \quad (\text{rounding error})$$

