Q1
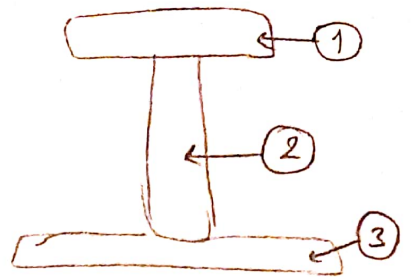
$$A = A_1 + A_2 + A_3$$

$$= \left[(24)(6) + (8)(48) + (48)(6)\right] mm^2$$

$$= (144 + 384 + 288)\, mm^2$$

$$= 816\, mm^2$$

$$I_x = (I_x)_1 + (I_x)_2 + (I_x)_3$$

$$(I_x)_1 = \frac{1}{12}(24\,mm)(6\,mm)^3 + (144\,mm^2)(27\,mm)^2$$

$$= (432 + 104,976)\, mm^4$$

$$= 105,408\, mm^4$$

$$(I_x)_2 = \frac{1}{12}(8\,mm)(48\,mm)^3 = 73,728\, mm^4$$

$$(I_x)_3 = \frac{1}{12}(48\,mm)(6\,mm)^3 + (288\,mm^2)(27\,mm)^2$$

$$= (864 + 209,952)\,mm^4 = 210,816\, mm^4$$

$$I_x = (I_x)_1 + (I_x)_2 + (I_x)_3 = 389,952\, mm^4$$

$$k^2_x = \frac{I_x}{A} = \frac{389,952\,mm^4}{816\,mm^2} \qquad k_x = 21.9\, mm$$

Q2

	A, mm²	$\bar{x}$, mm	$\bar{x}\bar{A}$, mm³
1	$108 \times 60 = 6480$	54	349,920
2	$-\frac{1}{2} \times 72 \times 36 = -1296$	46	-59,616
			290,304
Σ	5184		

$\bar{X}\Sigma A = \Sigma \bar{x}A:$ $\bar{X}(5184\,mm^2) = 290,304\,mm^3$

$\bar{X} = 56.0\,mm$

$\bar{I}_x = (I_x)_1 - (I_x)_2$

$(I_x)_1 = \frac{1}{12}(108\,mm)(60\,mm)^3 = 1.944 \times 10^6\,mm^4$

$(I_x)_2 = 2\left[\frac{1}{36}(72\,mm)(18\,mm)^3 + \left(\frac{1}{2} \times 72\,mm \times 18\,mm\right)(6\,mm)^2\right]$

$= 2(11,664 + 23,328)\,mm^4 = 69.984 \times 10^3\,mm^4$

$[(I_x)_2$ is obtained from diving A_2 into $\triangleright]$

$\bar{I}_x = (1,944 - 0.069984) \times 10^6\,mm^4$

$\bar{I}_y = (I_y)_1 - (I_y)_2$

$(I_y)_1 = \frac{1}{12}(60\,mm)(108\,mm)^3 + (6480\,mm^2)[(56.54)\,mm]^2$

$= (6,298,560 + 25,920)\,mm^4 = 6.324 \times 10^6\,mm^4$

$(I_y)_2 = \frac{1}{36}(36\,mm)(72\,mm)^3 + (1296\,mm^2)[(56-46)\,mm]^2$

$= (373,248 + 129,600)\,mm^4 = 0.502 \times 10^6\,mm^4$

$\bar{I}_y = (6.324 - 0.502)10^6\,mm^4$

$= 5.82 \times 10^6\,mm^4$