Problem 3 - 27 points

The distributed load shown below acts on a solid beam and has an equivalent resultant force. Find:

a) The magnitude of the equivalent resultant force
b) The line of action of the equivalent resultant force

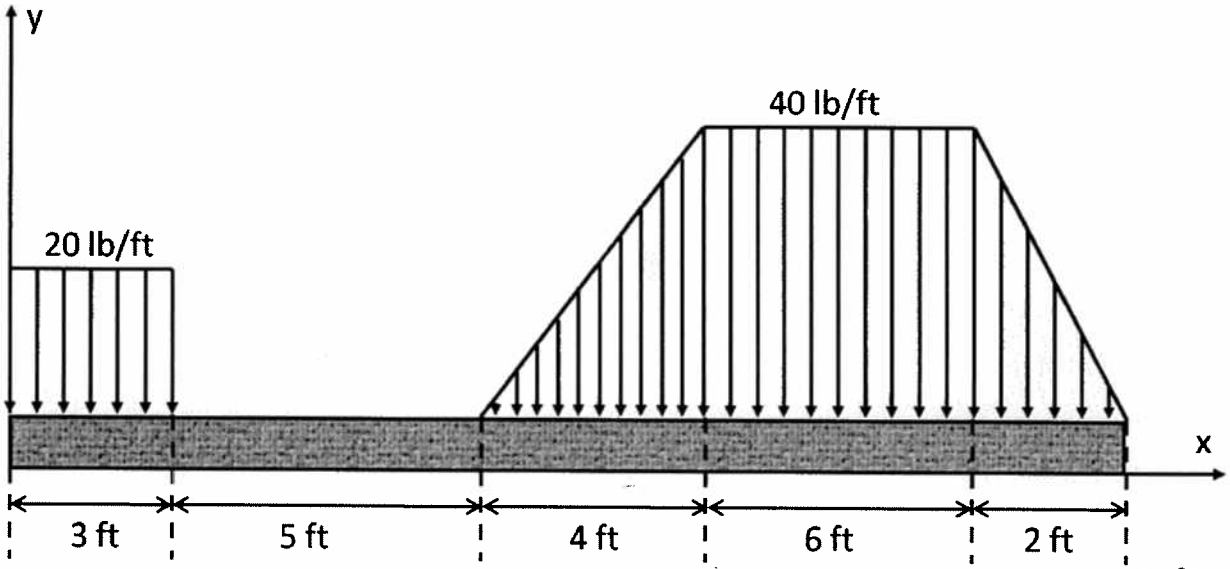
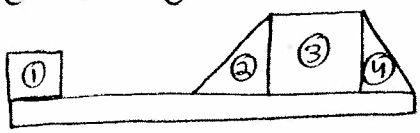


Table Method



	A [lb]	x_c [ft]	$x_c A$ [ft lb]
①	$(20)(3) = 60$	$\frac{1}{2}(3) = 1.5$	90
②	$\frac{1}{2}(40)(4) = 80$	$8 + \frac{2}{3}(4) = 10\frac{2}{3}$	$853\frac{1}{3}$
③	$(40)(6) = 240$	$12 + \frac{1}{2}(6) = 15$	3600
④	$\frac{1}{2}(40)(2) = 40$	$18 + \frac{1}{3}(2) = 18\frac{2}{3}$	$746\frac{2}{3}$
Σ	420		5290

Scoring: +2 each entry in A column (10 total)
+2 each entry in x_c column (8 total)
+1 each entry in $x_c A$ column (5 total)
+1 for $R = 420$ lb
+3 for $x_c = 12.6$ ft
total = 27

a) $R = 420$ lb

b) $x_c = \frac{5290 \text{ ft lb}}{420 \text{ lb}} = 12.6$ ft from left edge of solid beam

Equation Method

a) $R = \Sigma F = (20)(3) + \frac{1}{2}(40)(4) + (40)(6) + \frac{1}{2}(40)(2)$ lb
$= 60 + 80 + 240 + 40$ lb
$R = 420$ lb

Scoring: a) +2 each term (8 total)
+2 $R = 420$ lb
+1 units
b) +2 each x_c term (8 total)
+1 each moment term (4 total)
+4 $x_c = 12.6$ ft
total = 27

b) $x_c R = \Sigma M = (60\text{lb})(1.5\text{ ft}) + (80\text{lb})(10\frac{2}{3}\text{ ft}) + (240\text{ lb})(15\text{ ft}) + (40\text{lb})(18\frac{2}{3}\text{ ft})$
$x_c R = 90 + 853\frac{1}{3} + 3600 + 746\frac{2}{3}$ ft lb
$x_c (420\text{lb}) = 5290$ ft lb
$\therefore x_c = \frac{5290 \text{ ft lb}}{420 \text{ lb}} = 12.6$ ft