

Problem Set 3

Problem 3.1 Center of Gravity for a Bent Rod

Determine the distance x_C and y_C to the center of gravity of the bent rod.

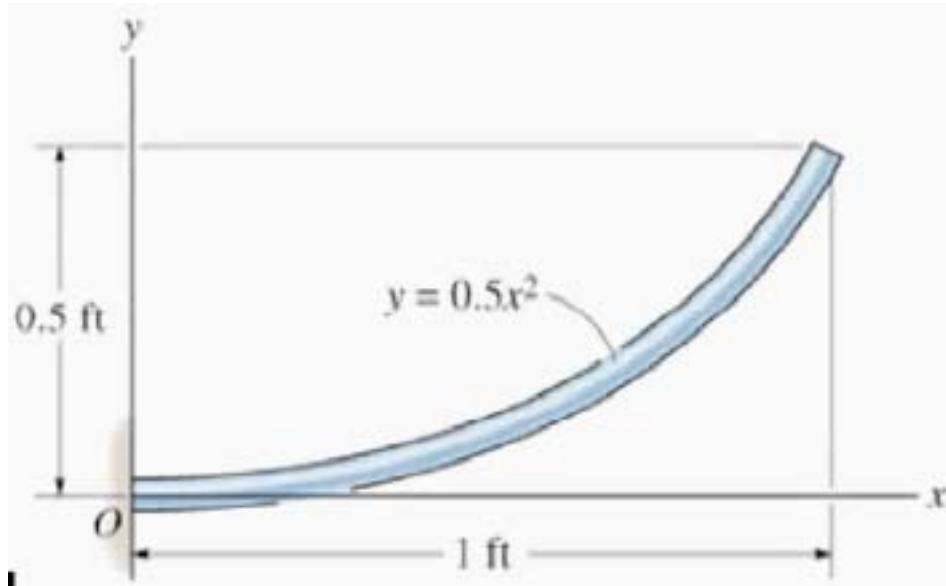


Figure P9.1: Problem 9.1

Problem 3.2 Centroid of a Composite Section

Determine the location y_C of the centroid of the beam's cross sectional area. Neglect the size of the corner welds at A and B for the calculation.

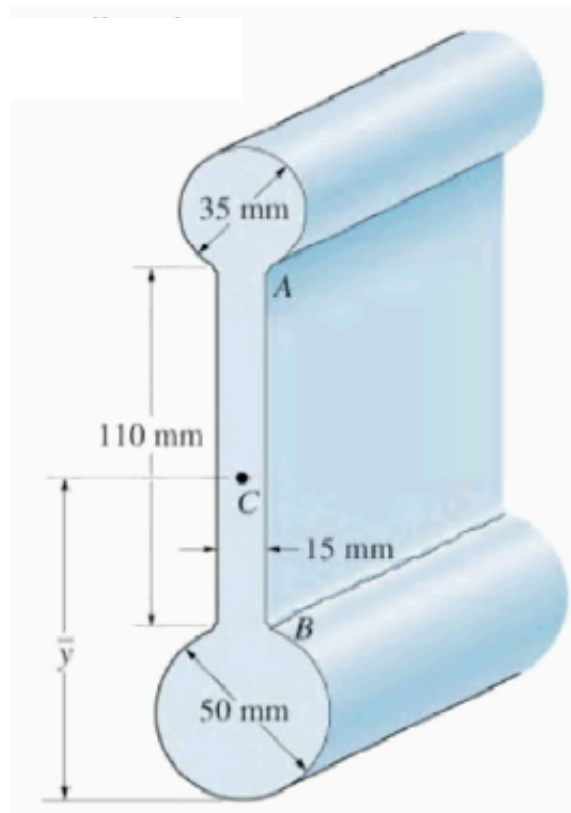


Figure P9.2: Problem 9.2

Problem 3.3 Centroid of a Tapered Cross Section

Locate the centroid y_C of the concrete beam with the tapered cross section shown.

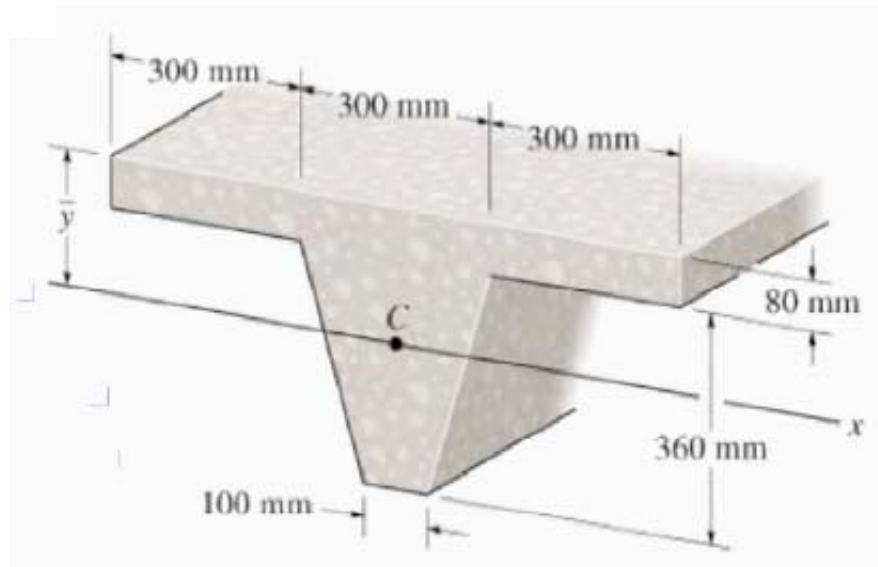


Figure P9.3: Problem 9.3

Problem 3.4

Find the x -coordinate of the centroid of the indicated region where $A = 2$ m and $k = \pi/8$ m⁻¹.

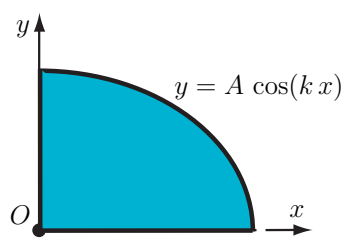
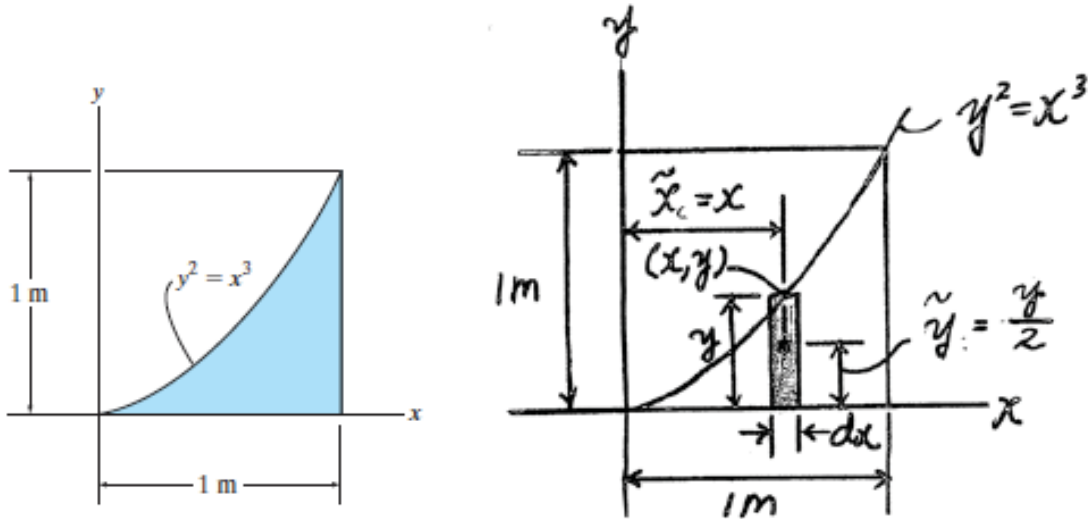


Figure 3.1: Problem 3.1

Problem 3.5

Determine the area and the centroid of the area.



Solution

```

% y(x) = x^(3/2)
% where 0 < x < a and 0 < y < a
a = 1; % m

% differential element
% dA = y dx = x^(3/2) dx
% centroid of the differential element is at
% x and y/2 = (1/2) x^(3/2)

% A = int(dA) where 0 < x < a
A = int( x^(3/2), x, 0, a);
% A = 0.400 (m^2)

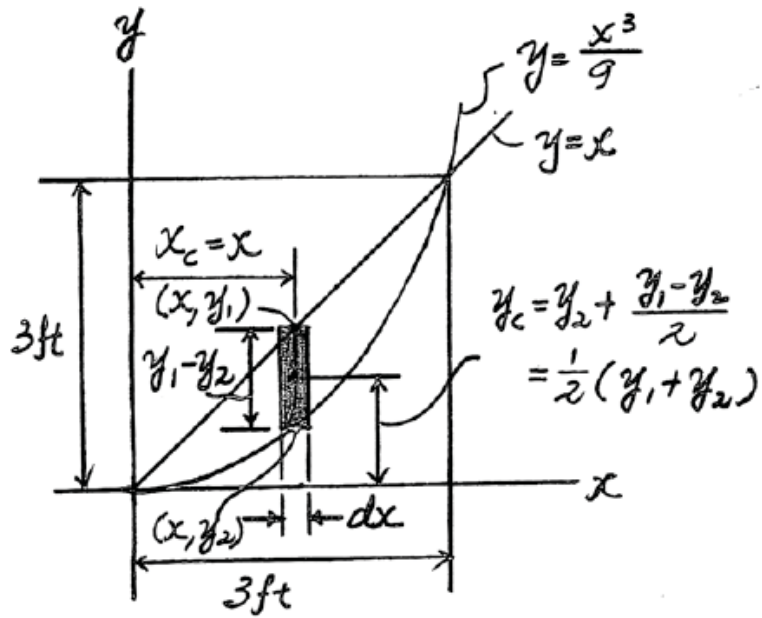
% My = int(x dA) where 0 < x < a
My = int(x*x^(3/2), x, 0, a);
xC = My/A;
% xC = 0.714 (m)

```

```
% Mx = int(y/2 dA) where 0<x<a
Mx = int((1/2)*x^(3/2)*x^(3/2),x,0,a);
yC = Mx/A;
% yC = 0.312 (m)
```

Problem 3.6

Determine the area and the centroid of the area.



Problem 3.7

Determine the location of the centroid C of the area where $a = 6$ in, $b = 6$ in, $c = 3$ in, and $d = 6$ in.

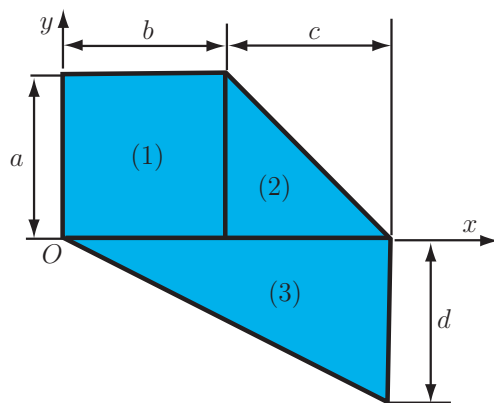
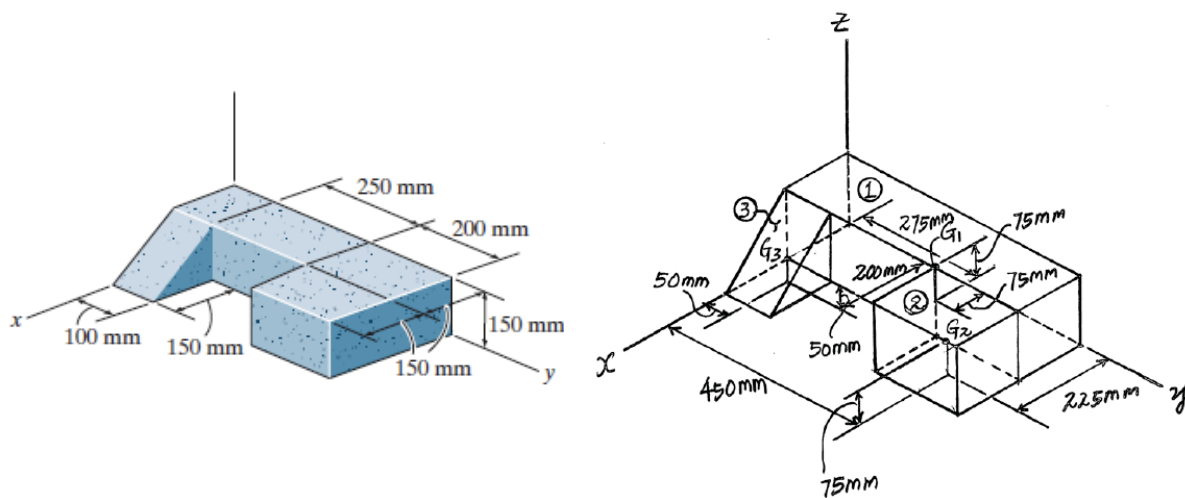


Figure 3.7: Problem 3.7

Problem 3.8

Locate the center of mass of the homogeneous block assembly



Solution

```

% rectangular prism 1
V1 = 150*150*550; % mm^3
x1 = 75;          % mm
y1 = 275;        % mm
z1 = 75;         % mm

% rectangular prism 2
V2 = 150*150*200; % mm^3
x2 = 225;        % mm
y2 = 450;        % mm
z2 = 75;         % mm

% triangular prism 3
V3 = 150*150*100/2; % mm^3
x3 = 200;        % mm
y3 = 50;         % mm
z3 = 50;         % mm

% total area

```

$$V = V1 + V2 + V3;$$

$$xC = (x1*V1+x2*V2+x3*V3)/V;$$

$$yC = (y1*V1+y2*V2+y3*V3)/V;$$

$$zC = (z1*V1+z2*V2+z3*V3)/V;$$

$$\% V = 1.8e+07 \text{ (mm}^3\text{)}$$

$$\% xC = 120.312 \text{ (mm)}$$

$$\% yC = 304.688 \text{ (mm)}$$

$$\% zC = 73.438 \text{ (mm)}$$

Problem 3.9

Locate the centroid of the paraboloid defined by the equation $x/a = (y/b)^2$ where $a = b = 4$ m. The material is homogeneous.

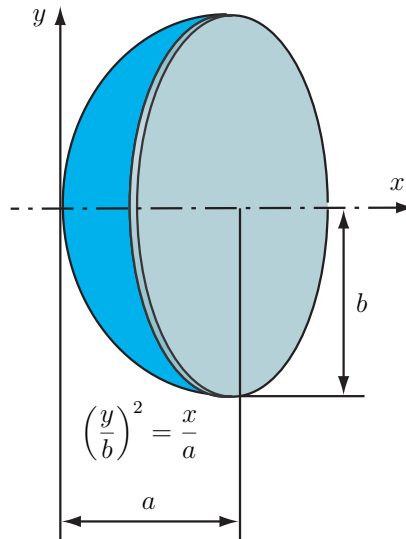


Figure 3.6: Problem 3.6

Solution

```
a = 4; % m
```

```
b = 4; % m
```

```
y = b*sqrt(x/a);
```

```
% dV = pi*y^2 dy
```

```
V = int(pi*y^2, x, 0, a);
```

```
% V = 32 pi (m^3)
```

```
% xC = (1/V) int(x dV)
```

```
xC = int(x*pi*y^2, x, 0, a)/V;
```

```
% xC = 2.667 (m)
```

Problem 3.10

A circular V-belt has an inner radius $r = 600$ mm and a cross-sectional area with the dimensions $a = 25$ mm, $b = 50$ mm, and $c = 75$ mm. Determine the volume of material required to make the belt.

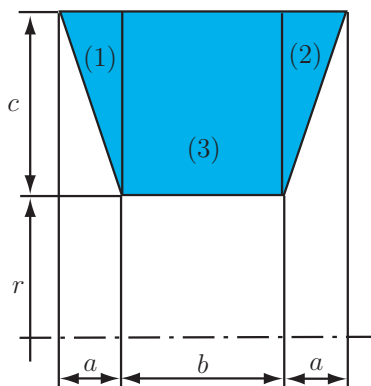


Figure 3.10: Problem 3.10