Question 1. *(1 mark each)* Integrate the following indefinite integrals:

a.

$$\int \frac{1}{x^{1/3}}\,dx = \int x^{-1/3}\,dx = \frac{x^{-\frac{1}{3}+1}}{-\frac{1}{3}+1}+C = \frac{x^{2/3}}{2/3}+C = \frac{3}{2}x^{2/3}+C$$

b.

$$\int \sec x\,dx = \ln|\sec x + \tan x| + C$$

c.

$$\int \cot x\,dx = \ln|\sin x| + C$$

d.

$$\int \frac{1}{x\sqrt{x^2-11}}\,dx = \int \frac{1}{x\sqrt{x^2-(\sqrt{11})^2}}\,dx = \frac{1}{\sqrt{11}}\operatorname{arcsec}\frac{x}{\sqrt{11}} + C$$

e.

$$\int \frac{1}{x}\,dx = \ln|x| + C$$

f.

$$\int \sin x\,dx = -\cos x + C$$

Question 2. *(4 marks)* Find f.

$$f''(\theta) = 3\sin\theta + 2\cos\theta \quad f(0) = 0,\ f(\pi) = 0$$

$f'(\theta) = \int f''(\theta)d\theta = \int 3\sin\theta + 2\cos\theta\, d\theta = -3\cos\theta + 2\sin\theta + C$

$f(\theta) = \int f'(\theta)d\theta = \int -3\cos\theta + 2\sin\theta + C\, d\theta = -3\cos\theta - 2\sin\theta + C\theta + D$

$0 = f(0)$

$0 = -3\cos(0) - 2\sin(0) + C(0) + D$

$D = 3$

$0 = f(\pi)$

$0 = -3\cos(\pi) - 2\sin(\pi) + C(\pi) + 3$

$0 = -3(-1) - 2(0) + C\pi + 3$

$C = \frac{6}{\pi}$

$\overset{0}{\underset{0}{\circ}}\, f(\theta) = -3\cos\theta - 2\sin\theta + \frac{6\theta}{\pi} + 3$