

1) (16 points) Let  $g(x) = \int_0^x f(t) dt$  where  $f$  is the function whose graph  $y = f(t)$  is shown below.

- At what values of  $x$  do the local maximum and minimum of  $g(x)$  occur?
- At what value of  $x$  does  $g(x)$  attain its absolute maximum value?
- On what intervals is  $g(x)$  concave downward ?
- Sketch a graph of  $g(x)$  that reflects your answers to the above questions.

2) (16 points) Use the  $u$ -substitution rule for **definite** integrals and the formula

$$\int \frac{u^2 du}{\sqrt{a^2 - u^2}} = -\frac{u}{2} \sqrt{a^2 - u^2} + \frac{a^2}{2} \sin^{-1}\left(\frac{u}{a}\right) + C$$

to find the value of

$$\int_0^{\sqrt{2}} \frac{x^5}{\sqrt{4 - x^4}} dx$$

3) , 4), 5) (16 points each ) Find the following indefinite integrals. Indicate clearly which techniques of integration you use.

3)

$$\int x e^{x/2} dx$$

4)

$$\int \frac{\cos^2(1/x)}{x^2} dx$$

5)

$$\int_1^2 \frac{2x^2 + 6x - 6}{x(x+2)(x-3)} dx$$

Use properties of the natural logarithm to simplify your answer to be form  $\ln c$  for the appropriate value  $c$ .

6) (16 points) Is the following integral improper or not? Explain.

$$\int_{-2}^0 \frac{1}{\sqrt{x+2}} dx$$

Determine the value of this integral (if finite). Write any necessary limits needed to determine your answer.