MCS 121
Antiderivatives

1. Find an antiderivative for each of the following functions.
   (a) $g(z) = 2z^2 + 3z^3 + 4z^4$

   (b) $f(t) = 2^t + t^2$

   (c) $r(t) = e^t + 5e^{5t}$

   (d) $f(x) = \dfrac{x^2 + 3x + 1}{x}$

   (e) $f(x) = \dfrac{1}{\sqrt{x}}$

2. Find an antiderivative $F(x)$ with $F'(x) = f(x)$ and $F(0) = 1$.
   (a) $f(x) = 3$

   (b) $f(x) = -7x$

   (c) $f(x) = \sqrt{x}$

   (d) $f(x) = 2^x$

3. Find the following indefinite integrals.

(a) $\int 3x \; dx$

(b) $\int \cos\theta \; d\theta$

(c) $\int \cos(x+1) \; dx$

(d) $\int \frac{1}{e^z} \; dz$

4. Using the Fundamental Theorem, evaluate the following definite integrals exactly.

(a) $\int_1^2 (5x^2 - 4x + 3)dx$

(b) $\int_0^{\pi/4} (\sin t + \sec^2 t)dt$

(c) $\int_0^1 2e^x dx$

(d) $\int_{-1}^1 2^x \; dx$

Answers

1. (a) $G(z) = \frac{2z^3}{3} + \frac{3z^4}{4} + \frac{4z^5}{5}$
   (b) $F(t) = \frac{2^t}{\ln 2} + \frac{t^3}{3}$
   (c) $R(t) = e^t + e^{5t}$
   (d) $F(x) = \frac{x^2}{2} + 3x + \ln|x|$
   (e) $F(x) = \frac{x^{1/2}}{1/2} = 2\sqrt{x}$
2. (a) $F(x) = 3x + 1$
   (b) $F(x) = \frac{-7x}{2} + 1$
   (c) $F(x) = \frac{2}{3}x^{3/2} + 1$
   (d) $F(x) = \frac{1}{\ln 2}2^x + 1 - \frac{1}{\ln 2}$
3. (a) $\frac{3x^2}{2} + C$
   (b) $\sin\theta + C$
   (c) $\sin(x+1) + C$
   (d) $-e^{-z} + C$
4. (a) $F(x) = \frac{5x^3}{3} - 2x^2 + 3x,\ F(2) - F(1) = 26/3$
   (b) $F(t) = -\cos t + \tan t,\ F(\pi/4) - F(0) =$
   (c) $F(x) = 2e^x,\ F(1) - F(0) = 2e - 2$
   (d) $F(x) = \frac{1}{\ln 2}2^x,\ F(1) - F(-1) =$