1. Find the open interval where $f(x) = \dfrac{1}{2}x^4 + 2x^3$ is concave downward.

   A. $(-2, 0)$
   B. $(-\infty, -3)$
   C. $(-2, \infty)$
   D. $(-3, 0)$
   E. $(-3, -2)$

2. Find the inflection point of $y = x^3 + 3x^2$.

   A. $(-2, 4)$
   B. $(-2, 0)$
   C. $(0, 0)$
   D. $(-1, 0)$
   E. $(-1, 2)$

3. $\lim\limits_{x\to\infty} f(x) = \infty$ is true for which of the following functions?

    A. $f(x) = \dfrac{2x^3 + x^2 - 2}{-3x^3 + 7}$

    B. $f(x) = \dfrac{2}{x} + 3$

    C. $f(x) = \dfrac{x + 9}{x^2 + x + 6}$

    D. $f(x) = \dfrac{x - x^2}{-x + 5}$

    E. $f(x) = \dfrac{x^3 + x^2 - 2}{-x + 5}$

4. Choose the correct statement regarding the asymptotes of $f(x)$.

$$f(x) = \frac{x^2 - 2x + 6}{x + 1}$$

    A. Horizontal Asymptote: $y = -1$; Vertical Asymptote: $x = 1$; Slant Asymptote: None

    B. Horizontal Asymptote: $y = 0$; Vertical Asymptote: $x = -1$; Slant Asymptote: None

    C. Horizontal Asymptote: None; Vertical Asymptote: $x = -1$; Slant Asymptote: None

    D. Horizontal Asymptote: $y = -1$; Vertical Asymptote: $x = 1$;
       Slant Asymptote: $y = x - 3$

    E. Horizontal Asymptote: None; Vertical Asymptote: $x = -1$;
       Slant Asymptote: $y = x - 3$

5. A manufacturer has determined that the total cost C of operating a factory is

$$C(x) = 1.5x^2 + 45x + 15000$$

where x is the number of units produced. Which of the following statements is true regarding the **average cost**?

   A. The minimum average cost is 195

   B. The maximum average cost is 195

   C. The minimum average cost is 345

   D. The maximum average cost is 345

   E. The minimum average cost is 300

6. $f(x)$ is a polynomial and

$$f'(2) = 0, \qquad\qquad f'(5) = 0$$

$$f''(3) = 0, \qquad f''(x) < 0 \quad \text{on} \quad (-\infty, 3) \quad \text{and} \quad f''(x) > 0 \quad \text{on} \quad (3, \infty)$$

Which of the following statements are true?

I. $(2, f(2))$ is an inflection point of $f(x)$.
II. $(3, f(3))$ is an inflection point of $f(x)$.
III. $f(x)$ has a relative maximum at $x = 2$.
IV. $f(x)$ has a relative minimum at $x = 5$.

   A. Only I and III are true.

   B. Only I and IV are true.

   C. Only II and III are true.

   D. Only I, II and IV are true.

   E. Only II, III and IV are true.

7. $\int \dfrac{\sin x - 2\cos x}{4}\,\mathrm{d}x =$

    A. $\dfrac{2\sin x + \cos x}{4} + C$

    B. $\dfrac{2\sin x - \cos x}{4} + C$

    C. $\dfrac{-\sin x + 2\cos x}{4} + C$

    D. $\dfrac{-2\sin x - \cos x}{4} + C$

    E. $\dfrac{-2\sin x + 2\cos x}{4} + C$

8. An evergreen nursery usually sells a certain shrub after 5 years of growth and shaping. The growth rate during those 5 years is approximated by

$$\frac{\mathrm{d}h}{\mathrm{d}t} = 1.4t + 8,$$

where t is the time in years and h is the height in centimeters. The seedlings are 14 centimeters tall when planted. How tall are the shrubs when they are sold?

    A. 29 cm

    B. 36 cm

    C. 57.5 cm

    D. 71.5 cm

    E. 92.5 cm

9. A company's marketing department has determined that if their product is sold at the price of p dollars per unit, they can sell $q = 2800 - 200p$ units. Each unit costs \$ 10 to make. What is the **maximum profit** that the company can make?

    A. 600 dollars

    B. 800 dollars

    C. 980 dollars

    D. 1000 dollars

    E. 1200 dollars

10. A particle is moving on a straight line with an initial velocity of 10 ft/sec and an acceleration of
$$a(t) = \sqrt{t} + 2,$$
where t is time in seconds and $a(t)$ is in ft/sec^2. What is its velocity after 9 seconds?

    A. 90 ft/sec

    B. 140 ft/sec

    C. 46 ft/sec

    D. 135 ft/sec

    E. 24 ft/sec

11. A rectangular plot of farmland will be bounded on one side by a river and on the other three sides by a single-strand electric fence. With 160 m of wire at your disposal, what is the **largest area** you can enclose?

    A. 1600 m^2

    B. 3200 m^2

    C. 6400 m^2

    D. 4800 m^2

    E. 4000 m^2

12. A rectangular box with square base and top is to be constructed using sturdy metal. The volume is to be 16 m^3. The material used for the sides costs $4 per square meter, and the material used for the top and bottom costs $1 per square meter. What is the **least amount of money** that can be spent to construct the box?

    A. $30

    B. $55

    C. $96

    D. $136

    E. $160