1. Find the critical numbers of $f(x) = 3x^3 + 17x^2 - 8x$.

   a) $x = 0$ and -8

   b) $x = -4$ and $\frac{2}{9}$

   c) $x = \frac{4}{9}$ and 3

   d) $x = -\frac{32}{9}$ and 17

   e) $x = \frac{2}{9}$ and -8

2. The graph of the second derivative f'' of a function f is shown. Find the x-coordinates of the inflection points.

   a) 6 and 9

   b) 5 and 8

   c) 3 and 6

   d) 4 and 8

   e) 3 and 9

3. Find the open interval in $(0, 2\pi)$ on which $f(x) = 3x + 10\cos x$ is concave upward.

   a) $\left(0, \frac{\pi}{2}\right)$

   b) $(\pi, 2\pi)$

   c) $\left(\frac{3\pi}{2}, 2\pi\right)$

   d) $\left(\frac{5\pi}{4}, \frac{7\pi}{4}\right)$

   e) $\left(\frac{\pi}{2}, \frac{3\pi}{2}\right)$

4. Find $\lim_{x\to\infty}(\sqrt{x^2 + 7x} - \sqrt{x^2 + 11x})$.

   a) 9

   b) -4

   c) -2

   d) 18

   e) $\sqrt{7} - \sqrt{11}$

5. Which one of the following statements is correct?

   a) The graph of $y = 8x^2 - x^4$ is decreasing on $(-2, 0)$.

   b) The graph of $y = 8x^2 - x^4$ is increasing on $(-\infty, \infty)$.

   c) The graph of $y = 8x^2 - x^4$ is increasing on $(-\infty, 0)$.

   d) The graph of $y = 8x^2 - x^4$ is decreasing on $(-2, 2)$.

   e) The graph of $y = 8x^2 - x^4$ is decreasing on $(0, 2)$.

6. Find the sum of two positive numbers such that the product of the two numbers is 225 and the sum is a minimum.

   a) 78

   b) 50

   c) 34

   d) 30

   e) 25

7. Find the absolute maximum value of $y = \sqrt{49 - x^2}$ on the interval $[-7, 7]$.

   a) 7

   b) 8

   c) 0

   d) 6

   e) 14

8. Find the exact value(s) of the numbers c that satisfy the conclusion of the Mean Value Theorem for the function $f(x) = x^3 - 5x$ for the interval $[-5, 5]$.

   a) $\pm\frac{\sqrt{3}}{5}$

   b) $\pm\frac{5\sqrt{3}}{3}$

   c) $\frac{\sqrt{3}}{3}$

   d) ± 3

   e) ± 5

9. How many real roots does the equation $x^5 - 6x + c = 0$ have in the interval $[-1, 1]$?

   a) no real roots

   b) three real roots

   c) at most one real root

   d) two real roots

   e) at least 5 real roots

10. Find $\lim_{x\to\infty} \frac{\sqrt{x^2+8x}}{8x+5}$.

a) 0

b) ∞

c) $\frac{5}{8}$

d) $\frac{1}{5}$

e) $\frac{1}{8}$

11. Find the slant asymptote of $f(x) = \frac{x^4+4}{x^3}$.

a) $y = x$

b) $y = x^2$

c) $y = 1$

d) $y = x + 4$

e) $y = 4$

12. Find the point in the line $y = 2x + 9$ that is closest to the origin.

a) $\left(-\frac{9}{2}, 0\right)$

b) $(-4, 1)$

c) $(2, 13)$

d) $\left(-\frac{18}{5}, 0\right)$

e) $\left(-\frac{18}{5}, \frac{9}{5}\right)$

13. Suppose oil spills from a ruptured tanker and spreads in a circular pattern. If the radius of the oil spill increases at a constant rate of 1 m/s, how fast is the area of the spill increasing when the radius is 48 m?

a) 202π m^2/s

b) 101π m^2/s

c) 192π m^2/s

d) 96π m^2/s

e) 288π m^2/s

14. A plane flying horizontally at an altitude of 1 mile and a speed of 450 mi/h passes directly over a radar station. Find the rate at which the distance from the plane to the station is increasing when it is 10 miles away from the station.

a) $50\sqrt{99}$ mi/h

b) $45\sqrt{99}$ mi/h

c) $50\sqrt{101}$ mi/h

d) 540 mi/h

e) 517 mi/h

15. Find the linear approximation of the function $g(x) = \sqrt[7]{1+x}$ at $a = 0$.

a) $\sqrt[7]{1+x} \approx \frac{1}{7}x + 1$

b) $\sqrt[7]{1+x} \approx 7x - 1$

c) $\sqrt[7]{1+x} \approx 7x + 1$

d) $\sqrt[7]{1+x} \approx x + 7$

e) $\sqrt[7]{1+x} \approx \frac{1}{7}x - 1$

16. Find the differential of the function $y = x^4 + 2x$.

a) $dy = (4x^4 + 2)dx$

b) $dy = (x^3 + 2)dx$

c) $dy = (4x^3 + 2)dx$

d) $dy = (4x - 2)dx$

e) $dy = (x^4 + 2x)dx$

17. (10 pts) The altitude of a triangle is increasing at a rate of 4 cm/min while the area of the triangle is incrasing at a rate of 5 cm^2 /min. At what rate is the base of the triangle changing when the altitude is 2 cm and the area is 92 cm^2?

18. (10 pts) Find the largest possible volume of the box with a square base and an open top whose total surface is 1200 cm^2.