1. Sketch a graph that satisfies all of the conditions:

   domain $f = (-\infty, \infty)$,
   $f(3) = -1, \quad f'(3) = 0$
   $f'(x) < 0$ when $x < 3, f'(x) > 0$ when $x > 3$,
   $f''(x) < 0$ when $x < 0, \quad f''(x) > 0$ when $x > 0$
   $\lim_{x\to-\infty} f(x) = 4$

2. Evaluate the following limits.

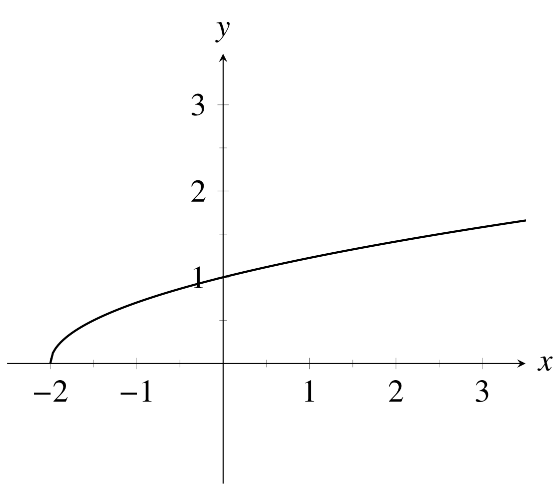
   (a) $\lim_{x\to 0} \frac{\sin(x^2)}{x^2}$
   (b) $\lim_{x\to 0^+} \sqrt{x}\ln(x)$
   (c) $\lim_{x\to 0^+} (1+\sin(x))^{\frac{1}{x}}$

3. A function and its first and second derivatives are given below.

$$f(x) = x^{5/3} - 5x^{2/3}, \qquad f'(x) = \frac{5x-10}{3x^{1/3}}, \qquad f''(x) = \frac{10x+10}{9x^{4/3}}$$

   (a) Identify any critical points of $f(x)$.
   (b) Find the intervals of increase and decrease, and identify any local maximum or minimum values. Your answer should have the form: "$f(x)$ has a maximum of ____ at ____" or "$f(x)$ has no maxima."
   (c) Find the intervals of concavity and any inflection points.

4. The graph of the function $f(x) = \sqrt{\frac{x}{2}+1}$ is shown.



   (a) Let $G(x)$ be the square of the distance from the origin to a point on the graph of $y = f(x)$. Write an expression for $G(x)$.
   (b) Use the expression for $G(x)$ to find the closest point on the graph $y = f(x)$ to the origin.

(c) Show your result by adding a point, with coordinates, to the graph.

5. A ship passes a lighthouse at 3:30pm, sailing to the east at 5 mph, while another ship sailing due south at 6 mph passes the same point half an hour later. How fast will the distance between the ships be increasing at 5:30pm?

6. Use differentials to estimate the amount of paint needed to apply a coat of paint 0.1 cm thick to a hemispherical dome with radius 10 m. Give your final answer with proper units. (Note the volume of a sphere is $V = \frac{4}{3}\pi r^3$.)

7. Find the linearization of $f(x) = e^x$ at $a = 0$ and use it to estimate $e^{0.1}$. Express your answer as simplified fraction or decimal.

8. Solve the initial value problem. If the velocity of an object is given by $v(t) = e^t + t$, find the position of the object assuming that the initial position of the object is 0. (That is, $s(0) = 0$.)

9. Evaluate the indefinite integral below. Give the most complete answer. $\int (5\sec^2(x) + \frac{1}{x^5})\, dx$.

10. Estimate the area under the curve $f(x) = x^3$ and above the x-axis on the interval $[0, 2]$ using 4 rectangles and right-hand endpoints. (i.e. Find R_4.) Draw a picture to illustrate your computation.

11. Determine the absolute maximum and absolute minimum of $f(t) = \frac{t}{2+2t^2}$ on the interval $[0, 2]$.