INSTRUCTIONS: Books, notes, and electronic devices are **not** permitted. Write (1) **your name**, (2) **1350/EXAM 2**, and (3) **SUMMER 2014** on the front of your bluebook. Also make a grading table with room for 5 problems and a total score. **Work all problems. Start each problem on a new page.** **Box** **your answers.** A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit. **SHOW ALL WORK**

---

1. (20 pts) Consider the function $f(x) = \sqrt{2-x}$.
   (a) Find the linear approximation for $f(x)$ at $x = -2$.
   (b) Use your approximation from part (a) to estimate the value of $\sqrt{4.1}$.
   (c) Compute $f''(x)$. Use f'' to explain whether your approximation from (b) is an overestimate or an underestimate.

---

2. (24 pts) A rocket is launched vertically and is tracked by a radar station located on the ground 4 miles from the launch pad. If the angle between the ground and the line of sight from the radar station to the rocket is increasing at a rate of 0.05 radians per second, what is the speed of the rocket when the angle is $\frac{\pi}{3}$ radians? Assume the ground is horizontal and flat. A complete answer should include a labeled diagram and the correct units.

---

3. (35 pts) Consider the function $f(x) = \dfrac{\sin x}{\cos x + 2}$, whose second derivative is $f''(x) = \dfrac{2\sin x(\cos x - 1)}{(\cos x + 2)^3}$. You must justify your answers for each part of this problem.
   (a) Show that $f'(x) = \dfrac{2\cos x + 1}{(\cos x + 2)^2}$.
   (b) What is the domain of f? Is $f(x)$ even, odd, or neither?
   (c) Find the x and y intercepts of $f(x)$.
   (d) Find the vertical and horizontal asymptotes of $f(x)$, if they exist.
   (e) Find the intervals of increase and decrease of $f(x)$ for $0 \le x \le 2\pi$. What are the coordinates of any local extrema of $f(x)$ in this interval?
   (f) Where is $f(x)$ concave up for $0 \le x \le 2\pi$? Where is $f(x)$ concave down?
   (g) Sketch $f(x)$ for $0 \le x \le 2\pi$.

---

4. (15 points) Let $y = x^5 + 2x^3 + 5x + 2$ on the interval $(-1, 1)$. Show that at least one tangent line to the curve is parallel to the line $y = 8x + 3$. If you use any theorems, you must state them and show that their conditions are satisfied.

---

5. (6 points) For this question, answer with the word **True** or **False**. Do not write T or F. You do not need to show any work for this problem.
   (a) If $f'(c) = 0$, then there is a local maximum or a local minimum at $x = c$.
   (b) If $f(x)$ and $g(x)$ are increasing on an interval I, then the product $f(x)g(x)$ is also increasing on I.
   (c) If $f'(x) = g'(x)$ for $-1 < x < 1$, then $f(x) = g(x)$ for $-1 < x < 1$.
