12 1. Find the derivatives of the following functions. <u>You do not need to simplify your answer</u>.

(a) $f(x) = \left[\sin^{-1}(x) - x^3\right]^2$

(b) $f(x) = \sin^2 x + \cos^2 x$

(c) $f(x) = 2^{(3x^2 - 5x + \pi)}$

Solution: `ww2.coastal.edu/rdahal/math160/ap2`

5 2. If $f(x) = \sec x$, find $f''(\pi/4)$.

Solution: #7. here: `http://ww2.coastal.edu/rdahal/math160/trig_derivative/`

8 3. Find $\dfrac{dy}{dx}$ by implicit differentiation. $(xy)^2 + 3x = y^2$

$$\begin{aligned} \text{Here, we have} \quad x^2y^2 + 3x &= y^2 \\ \text{(diff. w/r to } x\text{, we get,)} \quad 2xy^2 + 2x^2yy' + 3 &= 2yy' \\ 2xy^2 + 3 &= 2yy' - 2x^2yy' \\ 2xy^2 + 3 &= y'(2y - 2x^2y) \\ y' &= \frac{2xy^2 + 3}{2y - 2x^2y}. \end{aligned}$$

6 4. The Mean Value Theorem guarantees the existence of a special number c in the interval $(0, 4)$ for the function $f(x) = \sqrt{x}$. Find the number c.

Solution: #2 here: `http://ww2.coastal.edu/rdahal/math160/mvt/`

5. If a ball is thrown vertically upward with a certain velocity, its height after t seconds is

$$s(t) = 9t - 2t^2.$$

2 (a) What is the **velocity** of the ball after 2 sec?

Here $v(t) = s'(t) = 9 - 4t$. Then $v(2) = 9 - 8 = 1$ ft/sec.

4 (b) What is the **maximum height** reached by the ball?

Max. height $\implies v(t) = 0$. That is, $9 - 4t = 0 \implies t = 2.25$.

Then max. height $= s(2.25) = 9 * 2.25 - 2 * (2.25)^2 = 10.125$ feet.

4 (c) What is the **velocity** of the ball when it is 9 ft above the ground on its way down?

Set height equals 9 ft. That is, $9t - 2t^2 = 9 \implies 2t^2 - 9t + 9 = 0$. Factoring we get $(2t - 3)(t - 3) = 0$. Thus we have $t = 3/2, 3$. We take $t = 3$ (for on the way down), and thus $v(3) = 9 - 4 * 3 = -3$ ft/sec.

8 6. Use a linear approximation to approximate the value of $e^{0.2}$.

Solution: #3. here `http://ww2.coastal.edu/rdahal/math160/linearization/`

10 7. Determine the absolute maximum and minimum of f on the given interval.

$$f(x) = -x^2 + 3x - 2, \qquad [1,3]$$

Here $f'(x) = -2x + 3$. Set $f'(x) = 0 \implies -2x + 3 = 0 \implies x = 3/2$, a critical number in the domain. Now $f(3/2) = 0.25, \quad f(1) = 0, \quad f(3) = -2$. Thus abs. max. value is 0.25, and abs. min. value is -2.

10 8. Two cars start moving from the same point. One travels south at 60 mph and the other travels west at 25 mph. At what rate is the distance between the cars increasing two hours later?

Solution: #5. here: `http://ww2.coastal.edu/rdahal/math160/related_rates/`

8 9. Consider the function $f(x) = x\,e^{3x}$. Answer the following using **calculus**. Show your work to support your answer. (Answer produced from graphing calculator receives no credit.)

(a) Find the intervals on which f is increasing or decreasing.

(b) Find the $x-$values where f attains its local maximum and minimum values.

Solution: Find here: `https://ximera.osu.edu/andrewcalc/calcBook/calcBook/incDec/incDec`

8 10. Consider the function $f(x) = x + x^2 - x^3$. Answer the following using **calculus**. (Answer produced from graphing calculator receives no credit.)

(a) Find the intervals on which f is concave up or concave down.

(b) Find the x- coordinate(s) of inflection point(s) of f.

Solution: `ww2.coastal.edu/rdahal/math160/ap3`

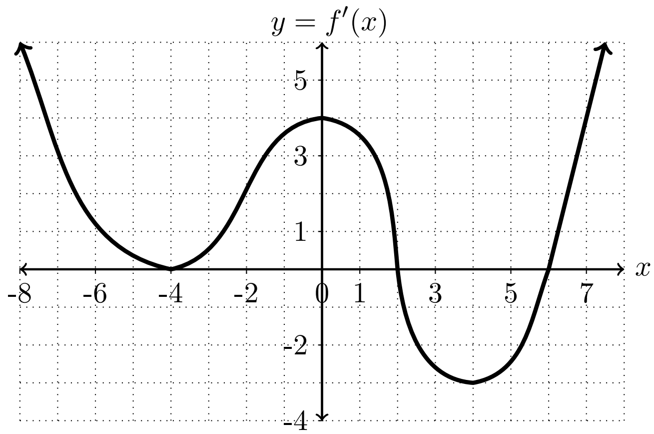
6 11. Find an equation of the tangent line to the curve $y = e^{\cos x}$ at $x = \dfrac{\pi}{2}$.

Solution: #15 here: `http://ww2.coastal.edu/rdahal/math160/chain_rule/`

Last question on the next page.

12. Use the graph of $y = f'(x)$ given below to **choose the correct answer** for each of the following questions about the function f. (No partial credit.)

Solution: #E here: `http://ww2.coastal.edu/rdahal/math160/shape_of_graph/`



3 (a) On what interval(s) is the graph of f decreasing?

(a) $(-8, 0)$ (b) $(-8, 4) \cup (0, 4)$ (c) $(-4, 2)$ **[(d) $(2, 6)$]**

3 (b) Find the x-value(s) at which f has a local maximum.

(a) -4 (b) 0 **[(c) 2]** (d) 4 (e) 6

3 (c) On which interval(s) is the graph of f concave up?

(a) $(-8, -2) \cup (1, \infty)$ **[(b) $(-4, 0) \cup (4, \infty)$]** (c) $(-8, -4) \cup (0, 4)$ (d) **[$(-2, 3)$]**