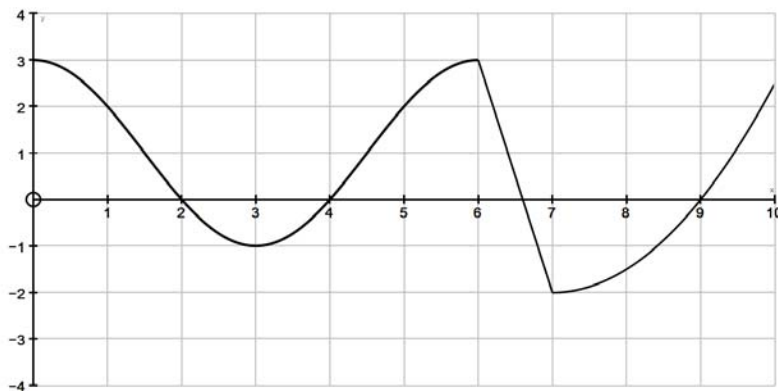# Worksheet – Additional Practice Understanding Concepts

1. Find the local maximum and minimum values of the function defined by:
$$f(x) = \begin{cases} x - 39 & ; & x \le -4 \\ x^3 + 3x^2 - 9x; & -4 < x < 3 \\ 30 - x & ; & x \ge 3 \end{cases}$$

2. The graph of the derivative of a function is shown below.

   a)   What is the x coordinate of the critical point(s)of *f(x)?*
   b)   On what intervals is *f* increasing?
   c)   For what value(s) of *x* does the function have a local maximum?
   d)   For what intervals is *f* concave up?

3. The graph of a function, *g(x)*, is shown below. $g(x) = \begin{cases} -x^3 + 5x^2 - 6x; 0 \le x \le 3 \\ x^2 - 8x + 15 & ; & x > 3 \end{cases}$
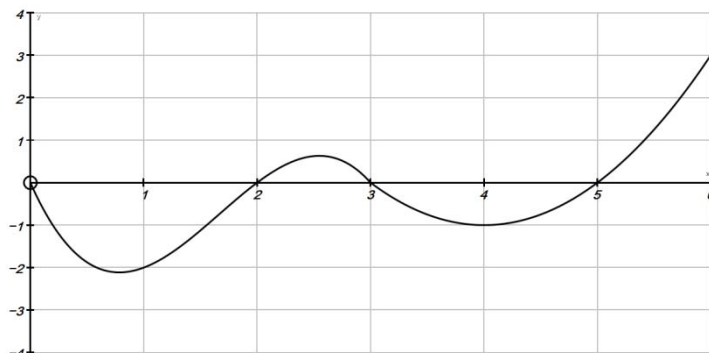
   a)   What is the *x* coordinate of the critical point(s) of *g(x)?*
   b)   On what intervals is *g* decreasing?
   c)   For what value(s) of *x* does the function have a local minimum?
   d)   For what intervals is *g* concave down?

4.   Use the first and second derivatives to describe the shape and direction of the curve $xy^2 + x = 1$ at the point (1/2, 1).
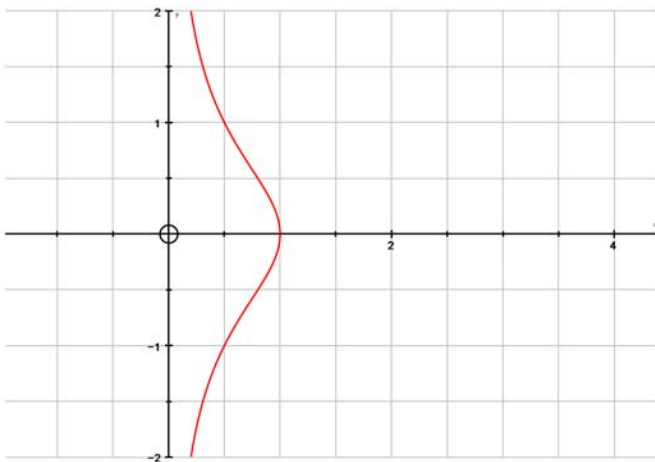
5.   A ladder 5 m long leans against a vertical wall. If the bottom of the ladder slides away from the base of the wall at a speed of 0.8m/s, how fast is the angle between the ladder and the wall changing when the bottom of the ladder is 3 m from the base of the wall?

6.   A lighthouse is on a small island 2 km away from the nearest point P on a straight shoreline and its light makes four revolutions per minute. How fast is the beam of light moving along the shoreline when it is 1 km from P?

7.   An observer watches a rocket launch from a distance of 2 km. The angle of elevation is increasing at 3degrees per second. At the instant when the angle of elevation is 45 degrees how fast is the rocket climbing?

8.   For the function: $m(x) = (2x)\sin(2x)$, determine the equation of the tangent line at $x = \dfrac{\pi}{8}$.

9.   An officer in a patrol car sitting 100m from the highway observes a train approaching. When the train is at x = 500m, the angle is observed to be changing at a rate of -0.04 radians per second. How fast is the train going? How many km/hour is this?

10.   What are the point(s) of inflection for the function $f(x) = \sin x + \cos x$ for the interval $[0, \pi]$?