

**Implicit Differentiation**

For problems 1 & 2 find  $y'$ .

1.  $y^3 e^{x^2} + x^4 = 1 - \sin(y)$

2.  $\ln(x^2 y^4) = y^2 + 1$

3. Find the equation of the tangent line to  $\cos(x - y^2) = 9 - xy$  at  $(4, 2)$ .

**Related Rates**

In order to receive any credit for problems 4 – 6 you MUST use Calculus techniques to find the answer. Any decimal work should include at least 4 decimal places.

4. A balloon is held 100 feet straight off the ground and not allowed to move. A person standing 50 feet away from the balloon has a string attached to the balloon starts to move away from the balloon.

(a) How fast is the length of the string increasing 30 seconds after the person starts moving if the person is moving away from the balloon at a constant rate of 1.5 ft/sec.

(b) If the person is moving in such a way that the length of the string is increasing at a constant rate of 1.5 ft/sec how fast is the person moving away from the balloon after 30 seconds of movement?

5. A water tank is 10 feet long and its ends are in the shape of isosceles triangles whose width is 3 feet and height is 6 feet and water is being pumped out of the tank at a rate of  $\frac{1}{2}$  ft<sup>3</sup>/min. At what rate is the height of the water changing when the water is at the point in the tank where the maximum width of the water is 18 inches across?

6. Two cars start out 1000 kilometers apart with car A directly to the west of car B. At the same time both cars start moving with car A traveling to the east at 100 km/hr while car B travels north at 65 km/hr. Determine if the distance between the cars is increasing, decreasing or not changing after,

(a) 3 hours

(b) 8 hours

(c) 12 hours

**Higher Order Derivatives**

For problems 7 – 10 compute the second derivative.

7.  $f(x) = 5x^{-4} - \sqrt{x^3} + \frac{1}{6x}$

8.  $y = \sin(1 + x^2) - \ln(1 + x^2)$

9.  $P(z) = \tan(1 + 4z)$

10. Compute  $g^{(3)}(x)$  for  $g(x) = \cos(4x) + \ln(2x^3) - e^{7x}$