Calc1: Related Rates & Optimizations

(Q1.) A particle is moving along a hyperbola $x^2 - y^2 = 5$. As it reaches the point (3, -2), the y-coordinate is **decreasing** at a rate of 0.9 cm/s. **How fast is the x-coordinate of the point changing** at that instant?

(A) increasing at a rate of 0.6 cm/s (B) increasing at a rate of 0.8 cm/s
(C) increasing at a rate of 1.5 cm/s (D) decreasing at a rate of 0.4 cm/s
(E) decreasing at a rate of 2.4 cm/s (F) decreasing at a rate of 1.4 cm/s

(Q2.) Water runs into a conical tank at the rate of 9 ft^3/min. The tank stands point down and has a height of 15 ft and a base radius of 5 ft. **How fast is the water level rising** when the water is 6 ft deep?

(A) 0.716 ft/min (B) 1.003 ft/min (C) 0.341 ft/min
(D) 1.225 ft/min (E) 0.381 ft/min (F) 0.295 ft/min

(Q3.) Car A is traveling east at 50 mph and car B is traveling north at 60 mph. Both are headed for the intersection of the two roads. At **what rate are the cars approaching each other** when car A is 0.3 mi and car B is 0.4 mi from the intersection?

(A) 86 mph (B) 80 mph (C) 78 mph
(D) 63 mph (E) 54 mph (F) 49 mph

(Q4.) A television camera is positioned 4000 ft from the base of a rocket launching pad. The angle of elevation of the camera has to change at the correct rate in order to keep the rocket in sight. If the rocket rises vertically and its speed is 600 ft/s when it has risen 3000 ft, **how fast is the camera's angle of elevation changing** at that moment?

(Q5.) If 300 cm^2 of material is available to make a box with a square base and an open top, find the **largest possible volume** of the box.

(A) 400 cm^3 (B) 500 cm^3 (C) 500 cm^3

(D) 750 cm^3 (E) 850 cm^3 (F) 900 cm^3

(Q6.) Find the equation of the line through the point (5, 2) that cuts off the **least area** from the first quadrant.

(A) $y = \frac{-2}{5}x + 4$ (B) $y = \frac{-4}{5}x + 2$ (C) $y = \frac{-4}{5}x + 4$

(D) $y = \frac{-2}{5}x + 2$ (E) $y = \frac{-5}{2}x + 2$ (F) $y = \frac{-5}{2}x + 4$

(Q7.) A rectangular swimming pool is to be built with an area of 2450 square feet. The owner wants 5-foot wide decks along either side and 10-foot wide decks at the two ends. What are **the dimensions** (whole lengths and widths, including the decks) **of the smallest piece** of property on which the pool can be built?

(A) 45 ft by 90 ft (B) 50 ft by 85 ft (C) 35 ft by 95 ft

(D) 55 ft by 85 ft (E) 60 ft by 90 ft (F) 40 ft by 105 ft

(Q8.) A piece of wire 10 meters long is cut into two pieces. One piece is bent into a square and the other is bent into an equilateral triangle. Explain how should the wire be cut so that the **total area from both the square and the equilateral triangle enclosed is a minimum**?