

GRADE 12 CALCULUS ASSIGNMENT  
RELATED RATES

[28 Marks]

Provide a sketch with each solution and exact answers where possible.

1. A spherical weather balloon is being filled with helium at the constant rate of 30 liters per minute. Determine the rate of change in the radius when the volume is 4000 liters.  
[5 marks]
2. A conveyor belt at a gravel pit is dropping gravel onto the top of a conical pile. The radius of the base of the pile is increasing at the rate of  $\frac{1\text{ m}}{20\text{ min}}$  and the height is always  $\frac{3}{5}$  of the radius. How fast is the volume of the pile changing, when the height of the pile is 6 meters? [6 marks]
3. A 5 metre ladder is set up against a wall. When the bottom is 1.5 metres from the wall, it is slipping away from the wall at 0.4 metres per second . Determine the vertical rate of change of the top of the ladder. [5 marks]
4. At noon a navy ship spots a stationary submarine 2000 metres away and increases speed to  $\frac{6300}{463}$  knots to intercept the sub. At the same time the submarine submerges and descends vertically at the rate of 4 metres per second . What is the rate of change of the distance between the ship and the submarine 120 seconds later? [6 marks...there are a couple unit conversions in this question.]
5. A plane flying at an altitude of 1009 metres passes directly over a radar installation 9 metres above the ground. When the angle of elevation to the plane is  $\frac{\pi}{4}$  radians, it is observed that this angle is decreasing at a rate of  $\frac{\pi}{6}$  radians per second . How fast is the plane traveling? [6 marks]