EXTRA RELATED RATES PROBLEMS

Question 1. A spherical snowball is melting in such a way that its volume is decreasing at a rate of $1cm^3/s$. At what rate is the diameter decreasing when the diameter is $10cm$?

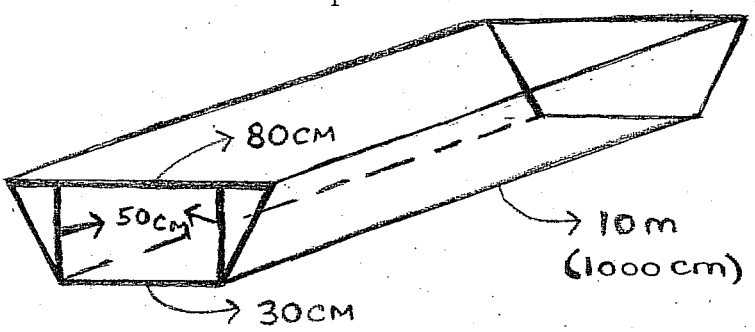
Question 2. A plane flying horizontally at an altitude of $1km$ and a speed of $500km/h$ is on a fligt path that will take it directly over a radar station. Find the rate at which the distance from the plane to the station is increasing when it is $2km$ away from the station.

Question 3. Two cars start moving from the same point. One travels south at $60km/h$ and the other travels west at $25km/h$. At what rate is the distance between the cars increasing two hours later?

Question 4. The height of a triangle is increasing at a rate of $1cm/min$ while the area of the triangle is increasing at a rate of $2cm^2/min$. At what rate is the base of the triangle changing when the height is $10cm$ and the area is $100cm^2$?

Question 5. Water is being pumped into a conical tank. The tank has height $6m$ and the diameter of the top is $4m$. If the water level is rising at a rate of $20cm/min$ when the height of the water is $2m$, find the rate at which water is being pumped into the tank.

Question 6. A water trough is $10m$ long and a cross-section of the trough has the shape of an isosceles trapezoid that is $30cm$ wide at the bottom, $80cm$ wide at the top and has height $50cm$. If the trough is being filled with water at the rate of $20cm^3/min$, how fast is the water level rising when the water is $30cm$ deep?



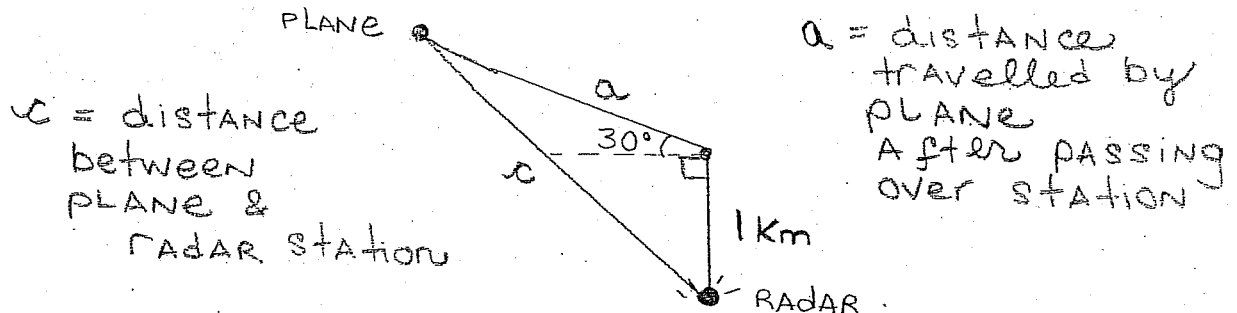
Question 7. Gravel is being dumped from a conveyor belt at a rate of $30ft^3/s$. The pile forms in the shape of a cone whose base diameter and height are always equal. How fast is the height of the pile increasing when the pile is $10ft$ high?

Question 8. A kite $100ft$ above the ground moves horizontally at a speed of $8ft/s$. At what rate is the angle between the string and the ground decreasing when $200ft$ of string have been let out?

Question 9. Two sides of a triangle are fixed at $4m$ and $5m$ in length but the angle between them is increasing at a rate of $0.06rad/s$. Find the rate at which the area of the triangle is increasing when the angle between the two sides of fixed length is $\pi/3$.

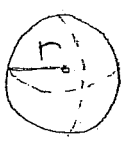
Question 10. A television camera is positioned $4000ft$ from the base of a rocket launching pad. A rocket rises vertically and its speed is $600ft/s$ when it has risen $3000ft$.
(a) How fast is the distance from the camera to the rocket changing at the moment it has risen $3000ft$?
(b) If the television camera is always kept focused on the rocket, how fast is the camera's angle of elevation changing at the moment the rocket is $3000ft$ in the air?

Question 11. A plane flying with a constant speed of $300km/h$ passes over a ground radar station at an altitude of $1km$ and then begins climbing at an angle of $30°$. At what rate is the distance from te plane to the radar station increasing $1min$ later?



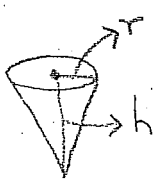
Question 12. A ladder $10ft$ long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a speed of $2ft/s$ how fast is the angle between the top of the ladder and the wall changing when the angle is $\frac{\pi}{4}rad$?

FORMULAS



SPHERE

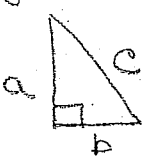
$$V = \frac{4}{3}\pi r^3$$



CONE

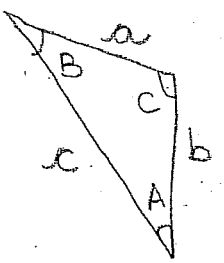
$$V = \frac{1}{3}\pi r^2 h$$

RIGHT ANGLE TRIANGLE



$$a^2 + b^2 = c^2$$

LAW of COSINES



$$c^2 = a^2 + b^2 - 2ab\cos C$$

SOLUTIONS

1. $\frac{1}{50\pi}$cm/min **2.** $250\sqrt{3}$km/hr **3.** 65km/hr **4.** -1.6cm/min **5.** $\frac{800000\pi}{9}$ cm^3/min **6.** $\frac{10}{3}$ cm/min **7.** $\frac{6}{5\pi}$ ft/s **8.** -0.02 rad/s **9.** 0.3 m^2/s **10.** (a) 360ft/s (b)0.096 rad/s **11.** $\frac{1650}{\sqrt{31}}$ km/hr or approx. 296 km/hr **12.** $\frac{\sqrt{2}}{5}$ rad/s