**COLLECTION OF RELATED RATE PROBLEMS.**

1. A

 A ladder AC, 10m long, is leaning against a vertical wall AB.

 *y* 10 m ladder

 B *x* C

The top of the ladder is sliding down the wall at 0.3m/s.

Find at what rate the bottom of the ladder is moving when *x* = 8 m

2. The volume of liquid in a container is given by *V = 2 π h3*

 *3*

where h is the depth in cm at time *t* seconds.

This container is being filled with a chemical at the rate of 8 cm3 per second.

Find the rate of increase of the depth of the liquid when the depth is 2 cm.

3. The volume, V of a spherical bubble is : V = 4 π r3

 3

If the Volume is increasing at a rate of 12 cm3/ sec find the rate of increase of the radius when r = 1 cm.

4. The volume of a spherical weather balloon, as it rises through the atmosphere, is increasing at a rate of 2000 cm3/min.

Find the rate of increase of the radius at the point when the radius r = 10 cm.

5.A plane is flying **horizontally** at 200 Km/h at a height of 3 Km.

 Find the rate at which the distance ***z***, from the plane P to an observer

 at O, is increasing when the horizontal distance ***x***, to the plane is 8 Km

 ✈ P

***z*** Km

 3 Km

 O ***x*** Km Q

6. A stuntman at S, is being filmed by a camera at C, as he slides down a

 vertical metal pole at a constant rate given by *dh = – 2 m/s*

 *dt*

S Find the rate at which the camera is

 rotating ( *dθ* ) when the stuntman

 h *dt*

 has descended to a height of 5 m

 θ above the ground.

 20 m C

7. A car C is travelling from A to B along this road at a constant velocity

 of 30 m/s

 A B

 C

 θ

P

The car is being filmed by a camera at P which is 40 metres from A.

Find the rate of rotation of the camera in rads/sec when θ = π/3

8. A TV camera is set up 20 metres from the side of a motorcycle racetrack

 as shown below.

 The camera rotates so as to keep pointing at the rider as he races.

 🏍 *x* A

 20m

 θ

 Camera

The speed of the rider on this straight section of the track is 45 m/s.

Find the rate at which the camera is rotating at the instant the rider is

50 metres from A.

9.

80m

 θ

 s

The elevation of the sun is increasing at a rate : *dθ* = π rads per hour

 *dt*  9

Find the rate at which the length of the building’s shadow, S, is changing when θ = π . The height of the building is 80 metres.

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10. A large spherical balloon is being pumped up so that its surface area is

 increasing at a constant rate of 0.5 m2  per minute.

 Calculate the rate at which the volume is increasing when the radius is 1.5 m.

i.e. find *dV* when *r* = 1.5 m

 *dt*

11. The cone starts off full of water.

 Water is leaking out through a small hole in the bottom

Find the RATE at which the circular top of the water is changing when the depth of water has reached 5cm.

Hints: Use simple proportion to find a relationship between r and h.

The surface area is S = πr2

The volume of a cone is V = πr2h

 3

You are given dV = 2

 dt

You need to find dS

 dt

 at a constant rate of 2 cm3/min.

 10cm

 r

 40cm

 h

12. A conical rain gauge with radius 90mm and depth 180mm is filled with water at a constant rate of 150 000mm cubed/s. At what rate is the depth of the water increasing when the depth is 100mm?