**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.

4

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?