

SCAN 1st

Mechanics test 1

Friday, 8th March 2019 – Duration: 1h30

Lecture Notes (booklet) authorised.

Exercise 1:

A car is travelling at a constant speed of 72 km/h and passes a stationary police car. The police car immediately gives chase, accelerating uniformly to reach a speed of 90 km/h in 10 s and continues at this speed until he overtakes the other car.

Using $v-t$ graphs, find:

- (a) the time taken by the police to catch up with the car,
- (b) the distance travelled by the police car when this happens.

Exercise 2:

A ball is rolled up an incline as shown in Figure 1. Friction and air resistance are neglected.

- 1 – Using Newton's 2nd law, determine the acceleration of the ball at any distance s in terms of the acceleration of gravity g and the incline angle θ .
- 2 – Knowing that the initial speed is v_0 , determine the distance s_{MAX} the ball moves up the incline before reversing its direction.
- 3 – Deduce the total time required for the ball to return to the girl's hand.

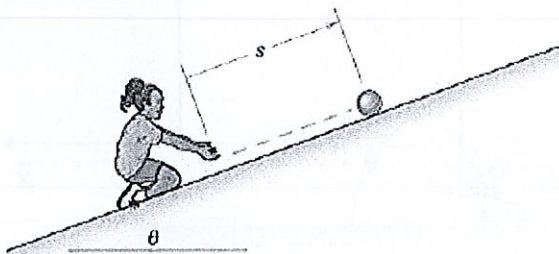


Figure 1.

Exercise 3:

A projectile is fired with a speed u at the entrance A to a horizontal tunnel of length L and height H (Figure 2). Determine the minimum value of u and the corresponding value of θ for which the projectile will reach B at the other end of the tunnel without touching the top of the tunnel.

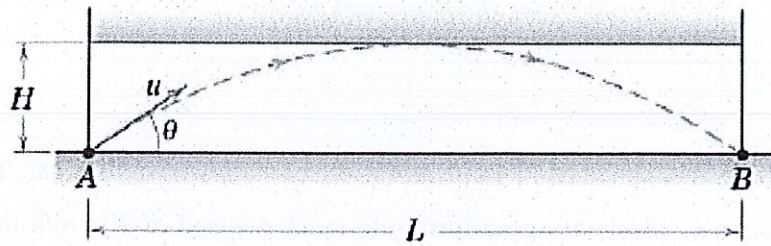


Figure 2.

Exercise 4:

A jet plane flying at a constant speed v at an altitude h (Figure 3) is being tracked by a radar located at O directly below the line of flight (so that the motion of the plane with respect to the radar is planar). The radar measures continuously variables r and θ along with their time-derivatives.

1 – Express the altitude h and speed v in terms of r , θ and their time-derivatives.

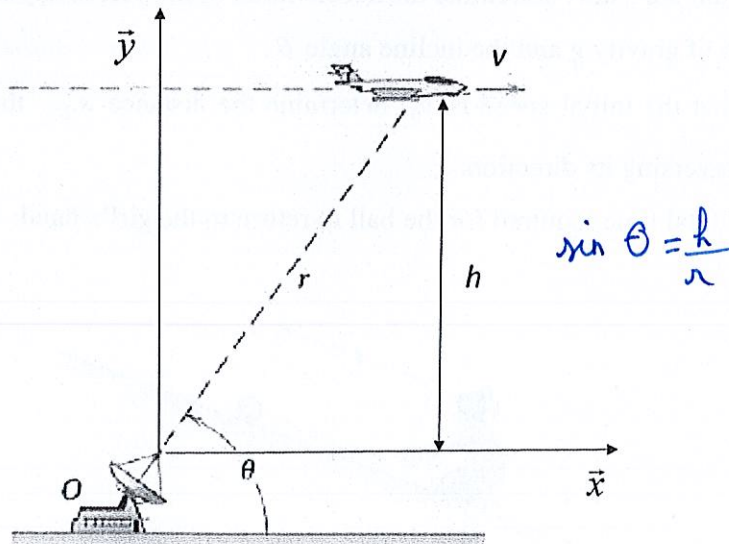


Figure 3.