4) The collar of weight 5 Ib is released from rest at *A* and travels along the smooth guide. Determine its speed when its center reaches point *C* and the normal force it exerts on the rod at this point. The spring has an un-stretched length 30 ft, and point *C* is located just before the end of the curved portion of the rod. The spring has stiffness 0.8 Ib/ft.

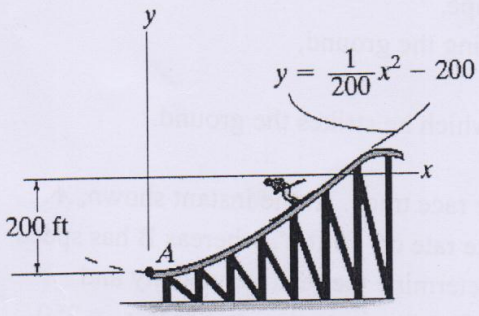


Fig.3

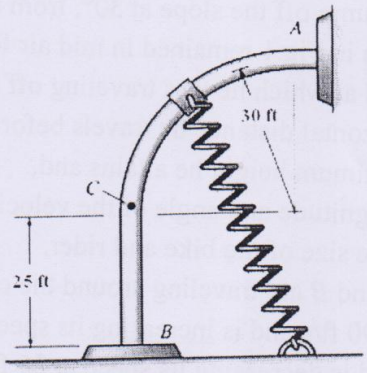


Fig.4

5) The bus *B* has weight 15000 Ib and is traveling to the right at speed v_B=5 ft/s. Meanwhile car *A* of weight 3000 Ib is traveling at speed v_A=4 ft/s to the left. If the vehicles crash head-on and become entangled, determine their common velocity just after the collision. Assume that the vehicles are free to roll during collision.

6) If at the instant represented, *B* has moved down a distance 1.6 m from rest with a constant acceleration of 0.2 m/s^2, determine the velocity of point *C* and the acceleration of the center *O* at this instant. Dimensions on Figure are in mm.

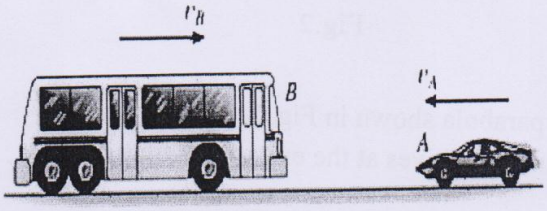


Fig.5

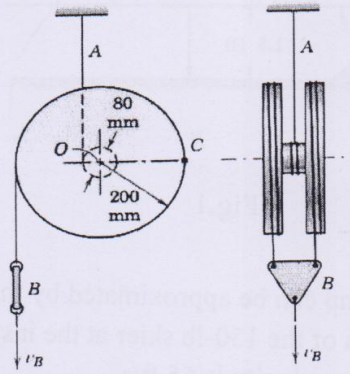


Fig.6

Best of luck, Dr. Ahmed Elsaid

Exam is in two pages.

Exam Guidelines

- This Exam contains **6** questions in **2** pages.
- Answer the following questions. Start every question in a new page.

1) Riders jump off the slope at 30°, from a height of 1.5 m. It was observed that the rider shown in Fig.1 remained in mid air for 2 seconds. Determine:

i) the speed at which he was traveling off the slope,

ii) the horizontal distance he travels before striking the ground,

iii) the maximum height he attains and,

iiii) the magnitude and angle of the velocity at which he strikes the ground.

Neglect the size of the bike and rider.

2) Cars *A* and *B* are traveling around the circular race track. At the instant shown, *A* has speed 90 ft/s and is increasing its speed at the rate of 15 ft/s^2, whereas B has speed 105 ft/s and is decreasing its speed at 25 ft/s^2. Determine the relative velocity and relative acceleration of car *A* with respect to car *B* at this instant. $r_A = 300$ ft, $r_B = 250$ ft, $\theta = 60^o$

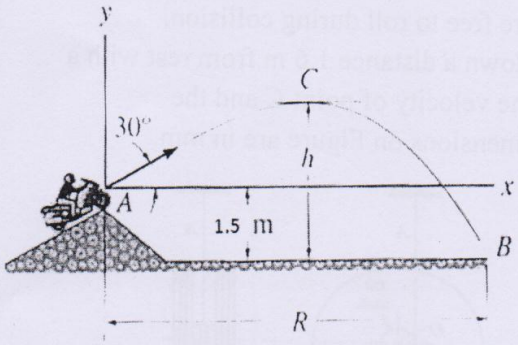


Fig.1

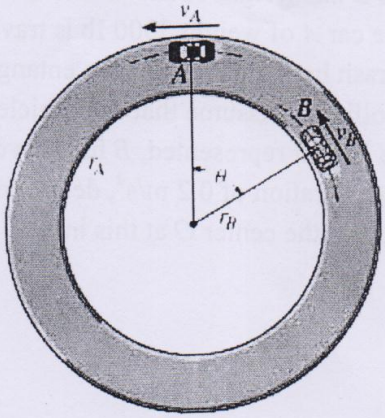
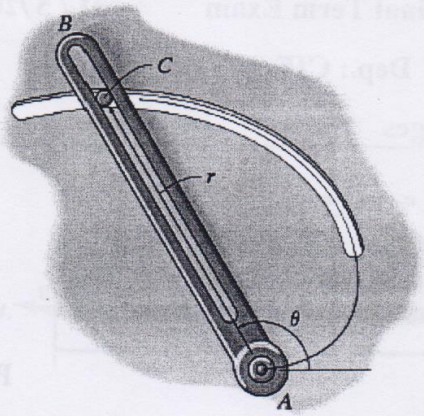


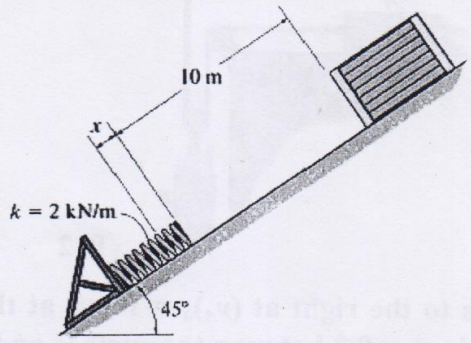
Fig.2

3) If the jump can be approximated by the parabola shown in Fig. 3, determine the acceleration of the 150-lb skier at the instant she arrives at the end of the jump, point *A*, where her velocity is 65 ft/s.



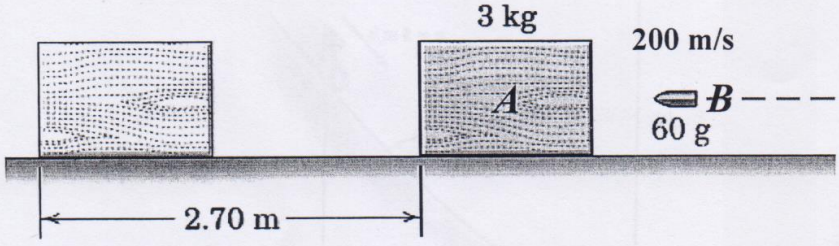
P. 4

4- The horizontal slotted arm *AB* drives pin *C* (m_C = 2 kg) through the spiral groove described by the equation $r = (1.5\,\theta)$ m, where θ is in radians. The angular velocity is $\dot{\theta}$ = 4 rad/s. When $\theta = 60°$ determine: (a) the radial and transverse components of velocity and acceleration of the pin *C*, (b) the force which the arm *AB* exerts on the pin *C*, and (C) the normal reaction between the pin *C* and the groove. (10 Marks)



P. 5

5- If the coefficient of kinetic friction between the l00-kg crate and the plane is μ_k = 0.20, determine the compression *x* of the spring required to bring the crate momentarily to rest. Initially the spring is unstretched and the crate is at rest. (8 Marks)



P. 6

6- A 60-g bullet *B* is fired horizontally with a velocity $(v_B)_1$ = 200 m/s into the 3-kg block *A* of soft wood initially at rest and becomes embedded in it. The block *A* is observed to slide a distance of 2.7 m before coming to rest. Determine: (a) $(v)_2$ the velocity of the block *A* just after the impulse, (b) the average impulsive force acting on the bullet if it takes 0.3 sec, and (c) the coefficient of kinetic friction μ_k between the block and the horizontal surface. (8 Marks)