

Program: B. Sc. in Mechanical Engineering  
Semester: 2nd

Date: 15 February, 2023  
Time: 02:00 pm – 03:30 pm

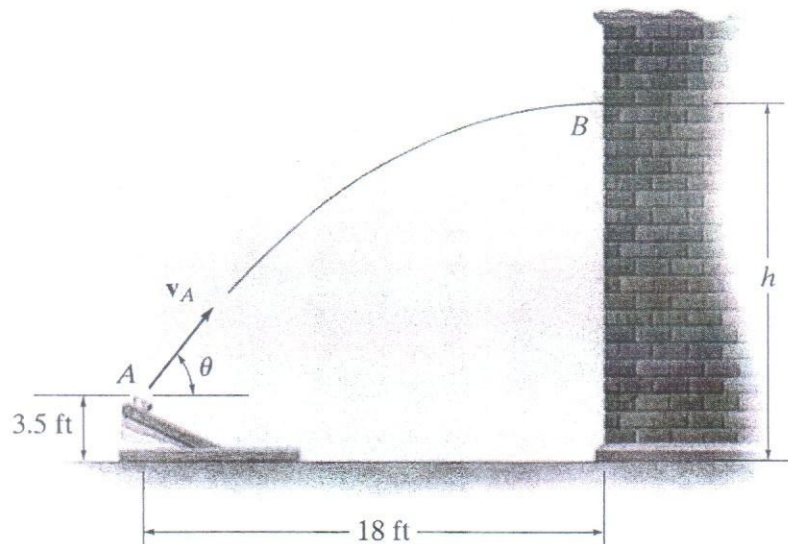
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Mid Semester Examination  
Course Number: ME 4203  
Course Title: Dynamics

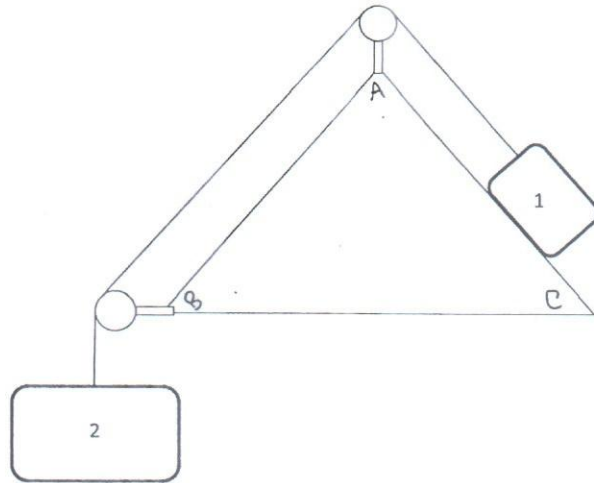
Summer Semester: 2021 - 2022  
Full Marks: 75  
Time: 1.5 Hours

There are **03 (three)** questions. Answer **all** questions. Marks in the Margin indicate full marks. Don't write on this question paper. Symbols carry their usual meanings. **Assume reasonable values for any missing data.** Programmable calculators are not allowed.

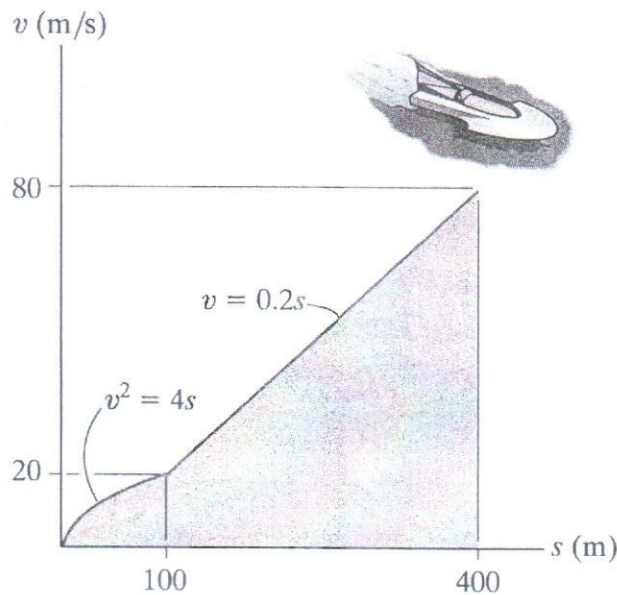
- 1 (a) The acceleration of a particle traveling along a straight line is  $a = \frac{s}{4} \text{ m/s}^2$ , where  $s$  is in meters. If at  $t = 0$ , the particle is at rest ( $v=0, s=0$ ), determine the particle's acceleration, velocity and required time at  $s = 2 \text{ m}$ . ( $v > 0$ ) (8)  
(CO1)  
(PO1/PO2)
- (b) The catapult is used to launch a ball such that it strikes the wall of the building at the maximum height of its trajectory. If it takes  $2 \text{ s}$  to travel from  $A$  to  $B$ , determine the velocity at which it was launched, the angle of release and the height. [ $g = 32 \text{ ft/s}^2$ ] (7)  
(CO1)  
(PO1/PO2)



- (c) A mass-pully arrangement is shown in the figure below has two masses, where  $m_1 = 5 \text{ kg}$  and  $m_2 = 20 \text{ kg}$ . In the given ramp,  $AB=BC=AC$ . Kinematic friction co-efficient of the surface is 0.3. (10)  
(CO1)  
(PO1/PO2)
- (i) Apply Newton's second law of motion on both  $m_1$  and  $m_2$  upon showing the freebody diagrams.
- (ii) Determine the velocity of mass 1 after 3 seconds.

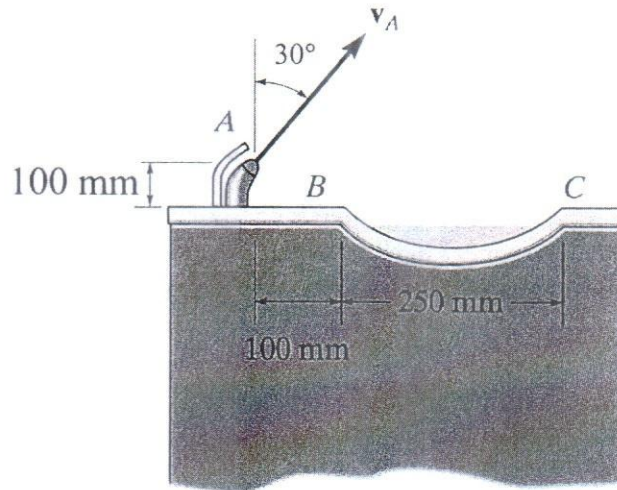


- 2 (a) The boat travels along a straight line with the speed described by the graph. (15)  
(CO1)  
(PO1/PO2)
- (i) Construct the  $s-t$  and  $a-s$  graphs. ( $s = 0$  when  $t = 0$ )
- (ii) Construct the  $v-t$  and  $a-t$  graphs. ( $s = 0, v=0$  when  $t = 0$ )
- (iii) Also, determine the velocity, acceleration and time required for the boat to travel a distance  $s = 350 \text{ m}$  if  $s = 0$  when  $t = 0$ .



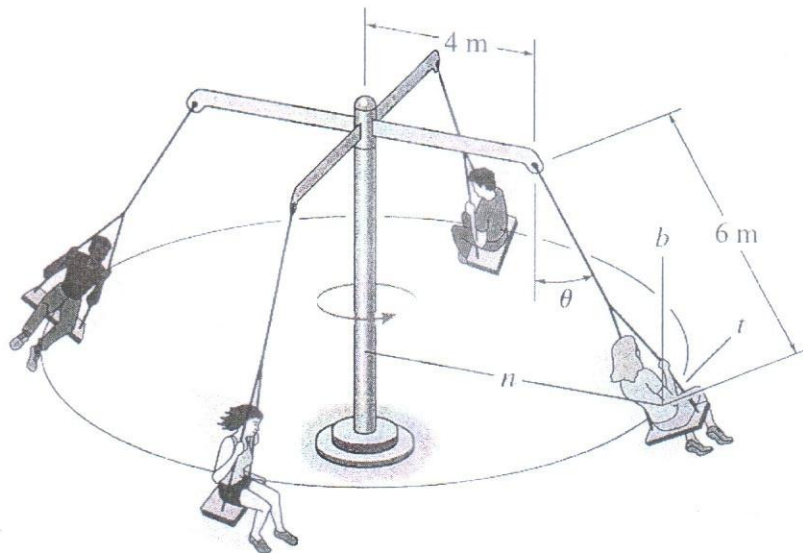
- (b) The drinking fountain is designed such that the nozzle is located from the edge of the basin as shown. Determine the maximum and minimum speed at which water can be ejected from the nozzle so that it does not splash over the sides of the basin at *B* and *C*. [ $g = 10 \text{ m/s}^2$ ]

(10)  
(CO1)  
(PO1/PO2)



- 3 (a) Determine the constant speed of the passengers on the amusement-park ride if it is observed that the supporting cables are directed at  $\theta = 30^\circ$  from the vertical. Each chair including its passenger has a mass of 80 kg. Also, what are the components of force in the *n*, *t*, and *b* directions which the chair exerts on a 50-kg passenger during the motion?

(10)  
(CO2)  
(PO1/PO2)



- (b) The 10-kg block A rests on the 50-kg plate B in the position shown. Neglecting the mass of the rope and pulley, and using the coefficients of kinetic friction indicated, determine the time needed for block A to slide 0.5 m on the plate when the system is released from rest. (15)  
(CO2)  
(PO1/PO2)

