NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

B-Eng. Hons Industrial and Manufacturing Engineering

Supplementary Examination

COURSE	**:**	**DYNAMICS 1**
CODE	**:**	**TIE 2106**
DATE	**:**	**JULY 2013**
DURATION	**:**	**3 HOURS**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer any FIVE questions out of SEVEN.
2. Each question carries 20 marks.
3. Show all working
4. There are five (3) printed pages.

REQUIREMENTS

1. Scientific calculator

Question 1

A particle hanging from a spring moves with an acceleration that is proportional to its position and has the opposite sign. Suppose that $a(x) = -4x\ m/s^2$ and that the velocity of the particle is 2m/s upward when it passes through the origin.

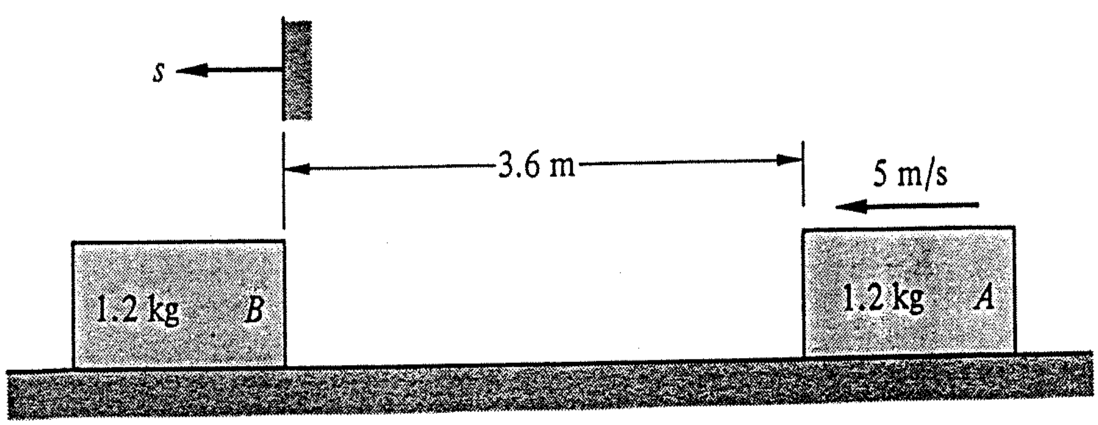
a. Determine the velocity of the particle as a function of its position. [10]
b. If the particle is at the origin at t =1s. Determine its position, velocity, and acceleration as a function of time. [10]

Question 2

The motion of box B moving along the spiral conveyor is defined by the position vector r = {0.5sin(2t)i+0.5cos(2t) j-0.2tk}m where t is given in seconds and then arguments for sine and cosine are given in radius (πrad=180^0).determine the location of the box when t=0.75s and the magnitude of its velocity and acceleration at this moment. [20]

Question 3

Block ***B*** in figure 3 is initially at rest, and the plane surface is assumed to be frictionless. Block ***A*** has an initial velocity of 5 m/s in the direction shown.
a) If the impact is assumed to be elastic, determine, the velocities of the blocks after impact and the distance between the two blocks 2 seconds after impact.
b) If a coefficient of restitution of 0.2 is assumed, determine, the velocities of the blocks after impact and the distance between the two blocks 2 seconds after impact.



[20]

Fig 3 Collision of elastic bodies.

Question 4

The total linear momentum of a system of three particle at time **t**=5s is given by $G_{2.2}=4i-6j+6k$ kg.m/s. At time t=8s, the linear momentum has changed to $G_{2.4}=3i-2j+4k$ kg.m/s. Calculate the magnitude of F of the time average of the resultant of the external forces acting on the system during the interval. [20]

Question 5

The bars shown in Fig Q5 are sliding freely on a horizontal rod. For the conditions specified in Table Q5 determine:

a. The final velocity of both beads. [8]
b. The percentage of the initial kinetic energy lost as a result of the collision of the two elastic bars. [8]
c. The average interaction force between the beads if the duration of impact is 0.001s. e is the coefficient of restitution. [4]

Table Q5

M_a	V_a	M_b	V_b	E
9kg	3m/s	2kg	0m/s	0.3

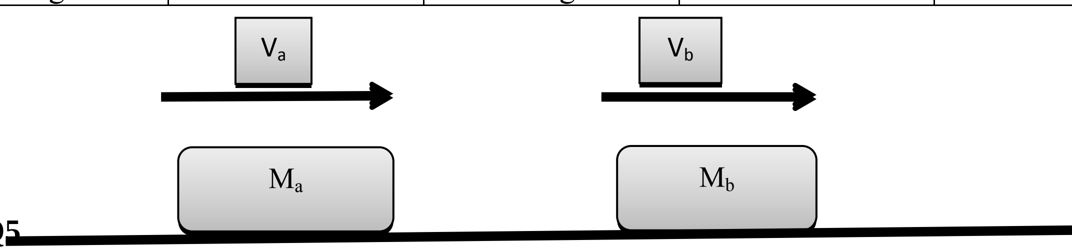


Fig Q5

Fig Q5 Impulse and momentum illustration.

Question 6

a. Determine the banking angle α of the circular track so that the wheels of a sports car will not have to depend on the friction to prevent the car from slipping either up or down the curve. The car has a negligible size and travels at a constant speed of 30m/s. The radius of the track is 180m. [5]
b. A 17.5 KN automobile is travelling down the 10^0 inclined rod at a speed of 6m/s. If the driver wishes to stop this car determine how far his tires skid on the road if he jams on the brakes causing the wheels to lock. The coefficient of friction between the wheels and the road is μ_k=0.5. [15]

Question 7

The 5kg block shown in Fig Q7 slides along a horizontal floor and strikes the bumper B. The coefficient of friction between the block and the floor is μ_k=0.25, and the mass of the bumper maybe neglected. if the speed of the block is 10m/s when it is 15m from the bumper, determine

a. The speed v_c of the block at the instant it strikes the bumper. [10]

b. The maximum deflection δ_{max} of the spring due to the motion of the block. [10]

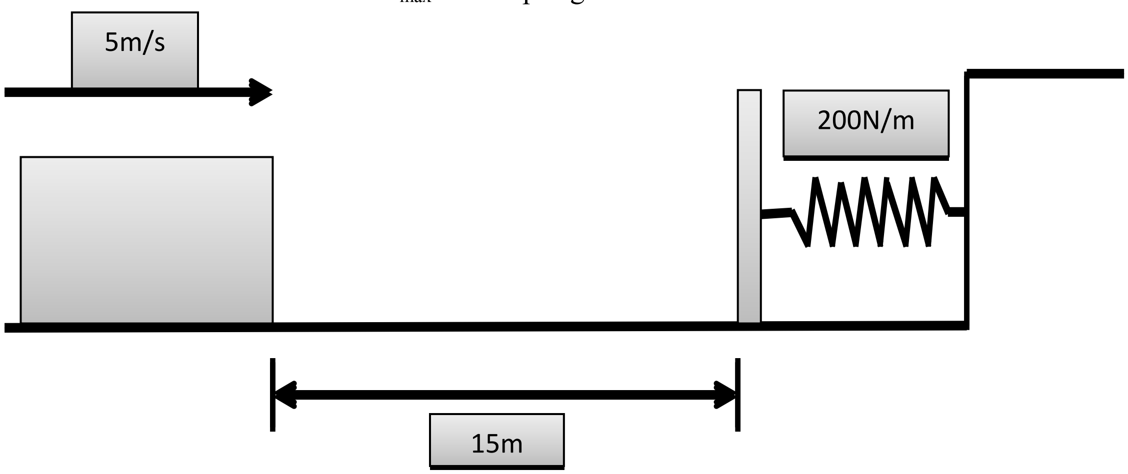


Fig Q7

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