

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

1st EXAMINATIONS APRIL 2009

DYNAMICS TIE 2106

ANSWER ANY FIVE (5) QUESTIONS

TIME ALLOWED: 3 HRS

Question 1

Rectilinear motion is a motion that occurs along a straight line. Derive the equations for position, displacement, velocity, and acceleration given:

- (a) Position $x(t)$ as a function of time (t) [2]
- (b) Velocity $v(t)$ as a function of time (t) [3]
- (c) Acceleration $a(t)$ as a function of time (t) [3]
- (d) Acceleration $a(x)$ as a function of position (x) [4]
- (e) Acceleration $a(v)$ as a function of velocity (v) [4]
- (f) Acceleration a as a constant ($a=c$) [4]

Question 2

The velocity of a particle moving along the x-axis is given as a function of time; the position is given at some instant as follows:

$$v(t) = 48 - 16 \frac{m}{s}$$

$$x(0) = 60m$$

- (a) Determine the position of the particle as a function of time [2]
- (b) Determine the acceleration of the particle as a function of time [2]

(c) Evaluate the:

- (i) position, [2]
- (ii) velocity, and [2]
- (iii) acceleration of the particle at $t = 8s$ [2]

(d) Determine the total distance traveled by the particle between $t = 5s$ and $t = 8s$ [4]

(e) Sketch $x(t)$, $v(t)$, and $a(t)$; $0 \leq t \leq 8s$ [6]

Question 3

For the Figure Q3 the 5kg block comes off the ramp with at a high velocity, a bumper B may be required to catch them. The kinetic coefficient of friction between the block and the floor is $\mu_k = 0.3$, and the spring's modulus is $k=1750N/m$. If the speed of the 5kg package is $v=8m/s$ when it is $l=3m$ from the bumper determine

(a) The maximum deflection of the spring [10]

(b) The final resting position of the package [10]

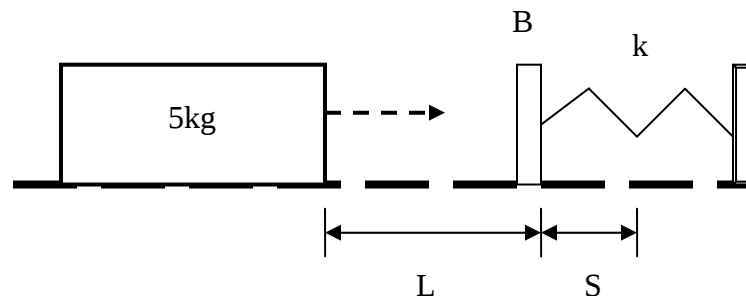


Figure Q3

Question 4

(a) Give a description of the collision of elastic bodies [8]

(b) A ball weighing 2N has an initial velocity $v_i = 8j + 6k$ m/s when a gust of wind exerts a force of $F = 0.8t i$ on the ball. Determine the magnitude and direction of the velocity of the ball after 0.6 seconds [12]

Question 5

A 50 N projectile is fired horizontally with an initial velocity of 500m/s from the top of a hill, which is 500m above the surrounding area.

- (a) Determine the range R of the projectile (horizontal distance traveled) [10]
- (b) The elapsed time before it strikes the ground. Air resistance is negligible [10]

Question 6

Two beads are sliding freely on a horizontal rod as shown in Figure Q6. For the conditions specified in table Q6, determine:

- (a) The final velocity of both beads [5]
- (b) The percentage of the initial kinetic energy lost as a result of the collision [7]
- (c) The average interaction force between the beads if the duration of impact is 0.001s. [8]

Table Q6

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

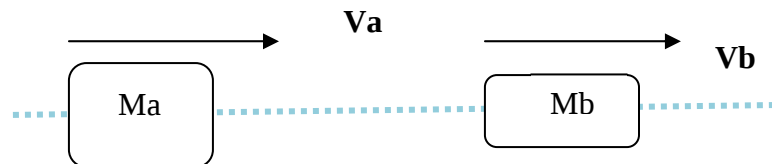


Figure Q6

End of Examination!!!