UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME   :   DYNAMICS

COURSE CODE   :   BNJ 20103

PROGRAMME   :   BNK/BNH/BNL

EXAMINATION DATE   :   DECEMBER 2013/JANUARY 2014

DURATION   :   3 HOURS

INSTRUCTION   :   ANSWER **FIVE (5)** QUESTIONS ONLY FROM **SIX (6)** QUESTIONS PROVIDED.

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1   Figure **Q1** shows an example of projectile motion with reference of X and Y axis, where package is dropped from the plane which is flying with a constant horizontal velocity, v_A = 50 m/s to the ground B. Given also h = 500m the distance from A to the ground.

   (a)   At the moment the package is release at A, where it has a horizontal velocity v_A.

   (i)   Determine the normal (a_n) and tangential (a_t) components of acceleration

   (2 marks)

   (ii)   Determine the radius of curvature of the path of motion, ρ_A

   (2 marks)

   (b)   Just before it strikes the ground at B

   (i)   Determine the time taken, t

   (4 marks)

   (ii)   Determine the velocity of x components, V_{Bx} and y components, V_{By}

   (3 marks)

   (iii)   Determine the velocity, V_B and the angle, θ

   (4 marks)

   (iv)   Determine the normal (a_n) and tangential (a_t) components of acceleration.

   (3 marks)

   (v)   Determine the radius of curvature of the path of motion, ρ_B

   (2 marks)

Q2 Figure **Q2** shows a system with a pulleys to move block A and B at an incline plane of angle, $\theta = 60°$. Block A has a weight of $W_A = 400$ N, and B has a weight of $W_B = 100$ N. Given also the coefficient friction is 0.2. Neglect the mass of the pulley and cord.

    (a) Simply sketch the kinematics of the pulleys and also write its equation referring to its motion and distance.

                                         (4 marks)

    (b) Sketch the free body diagram of block A and B that shows the movement and forces generated.

                                         (4 marks)

    (c) Determine the acceleration of block A and block B when the system is released from rest.

                                         (12 marks)

Q3 Fiqure **Q3(a)** shows, the collar B of mass $M_B = 5$ kg is at rest, and when it is in the position shown the spring is unstretched with measurement a=0.9 m and coefficient spring given, k=300 N/m. If another collar A of mass $M_A = 0.5$ kg, strikes it so that B slides a distance b=1.2m on the smooth rod before momentarily stopping, as shown in Figure **Q3(b)**

    (a) Using the conservation energy/work equation, calculate the velocity of B after impact.

                                         (6 marks)

    (b) Given coefficient of restitution is e = 0.5 and using the conservation momentum equation, determine the velocity of A just after impact.

                                         (8 marks)

    (c) Using the concept of momentum and impulse determine the average force exerted between A & B during the impact if the impact occurs in time $\Delta t = 0.002$ s.

                                         (6 marks)

Q4   (a)   Explain what is `rigid body` and `general plane motion`

(4 marks)

(b)   The slider system of block C is moving with speed V_c = 12 cm/s, up the incline as shown in Figure Q4. It has an arm AB 5cm long, arm BC 4 cm long, angle θ = 30 deg and ϕ = 45 deg.
Sketch free body diagram of the slider system in Figure **Q4**, that relates with the relative motion analysis and sketch the trigonometry triangle related to its measurement and velocity acted.

(4 marks)

(c)   From (b) , determine :

(i)   The angular velocity of arm BC, ω_{BC}

(6 marks)

(ii)   The angular velocity of arm AB, ω_{AB}

(2 marks)

(iii)   The velocity of point B, V_B

(4 marks)

Q5   Figure **Q5** shows a system that analyzed on planar kinetic of a rigid where the uniform slender rod has a mass M, 5 kg. Also given, the measurement of the rod, a = 200 mm and b = 600 mm.

If the cord at A is cut ;

(a)   Sketch the Free Body Diagram and determine the reaction at pin O, when the rod is still in the horizontal position.

(8 marks)

(b)   Sketch the Free Body Diagram and determine the reaction at pin O, when the rod is in the θ position. (0 < θ < 90 deg position).

(7 marks)

(c)   Compute the reaction at pin O, when the rod swings to the vertical.

(5 marks)

Q6   (a)   Explain what is pure translation and pure rotation in kinetic energy of a rigid body.

(4 marks)

(b)   Figure Q6 shows the spool has m_s = 50 kg, radius of gyration k_0 = 0.280 m and with pulley of block A, of mass m_A = 20 kg is released from rest, determine :-

(i)   The distance the block must fall in order for the spool to have angular velocity ω = 5 rad/s.

(8 marks)

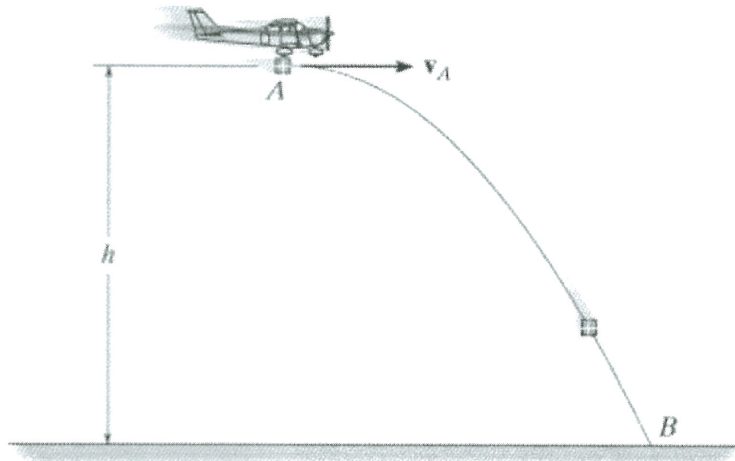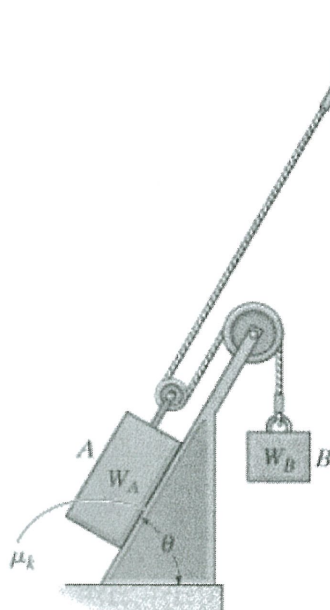(ii)   The tension in the cord while the block is in motion.

(8 marks)

-   **END OF QUESTION –**

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FIGURE Q1

FIGURE Q2

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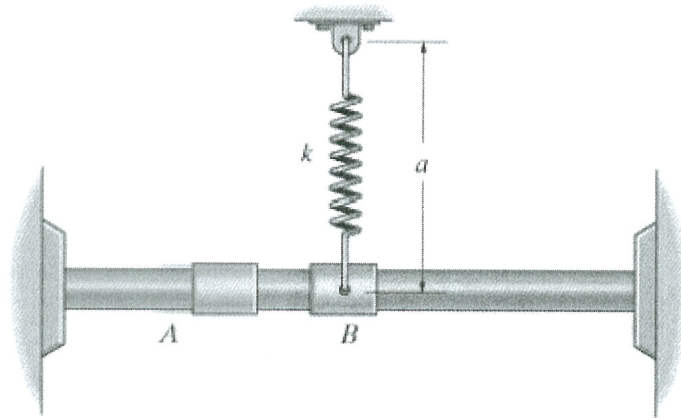
FIGURE Q3(a)
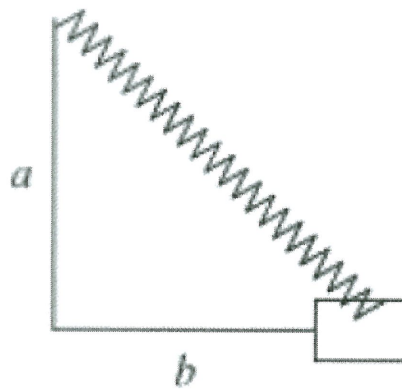
FIGURE Q3(b)

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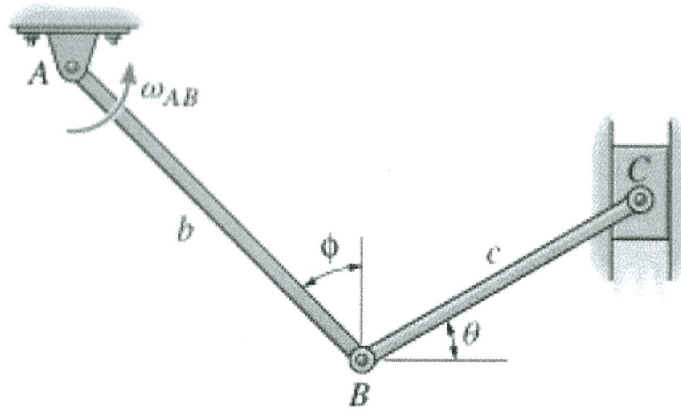
FIGURE Q4
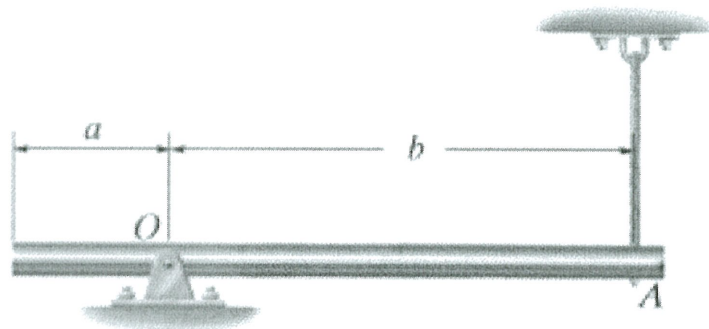
FIGURE Q5

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$r_0 = 0.3\ m$

$r_i = 0.2\ m$

FIGURE Q6