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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	NMB 21404
SUBJECT TITLE	:	ENGINEERING MECHANICS 2
LEVEL	:	BACHELOR
TIME / DURATION	:	3.5 HOURS
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answers should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.**
6. **Answer all questions in English.**
7. **Formula sheet is appended**

THERE ARE 4 PAGES OF QUESTIONS AND 1 PAGE OF APPENDIX, EXCLUDING THIS PAGE.

INSTRUCTION: Answer only FOUR questions.
Please use the answer booklet provided.

Question 1

(a) The acceleration of the particle in the straight line is given by $a = (3t - 4)\ m/s^2$, where t is time in seconds. If $s = 2\ m$ and $v = 3\ m/s$ when $t = 0$, determine the particle's velocity and position when $t = 3\ s$ and total distance travel by the particle during this period.

(10 marks)

(b) Referring the Figure 1 below, If the block A is moving upward with speed *4 m/s* and block *C* is also moving upwards at speed 7 m/s determine the speed of block *B* and at what time the length block *A* is equal with block *B* and block *C*. Initially, all the block is at rest when *t = 0 second*

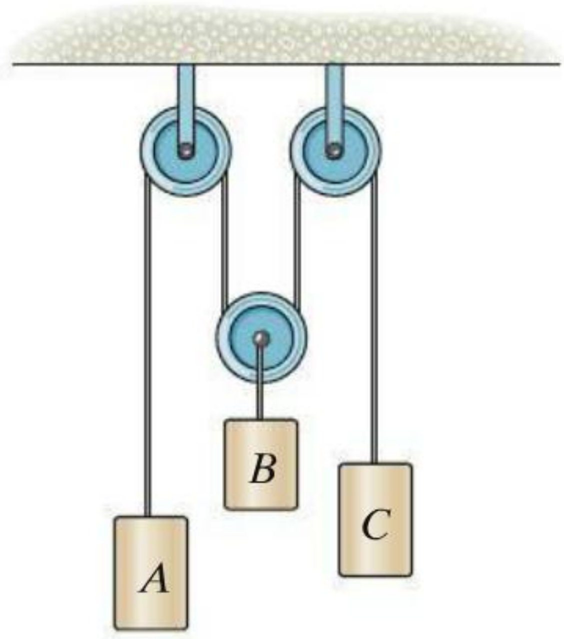

Figure 1: Pulley System with Block A, B and C

(Figure courtesy of Hibbeller, R.C. Yap. K.B., Mechanics for Engineers: Dynamics, 13th Ed, Pearson 2013. Pg 95)

(15 Marks)

Question 2

(a) A block M has a mass *3 kg* is being pulled by a force *200 N* in the inclined surface as shown in Figure 2 below. If the block initially at rest when $t = 0$, determine the time taken for the block to reach a distance of *2 m*. Assume the coefficient of friction for the block M with the surface, $\mu = 0.3$.

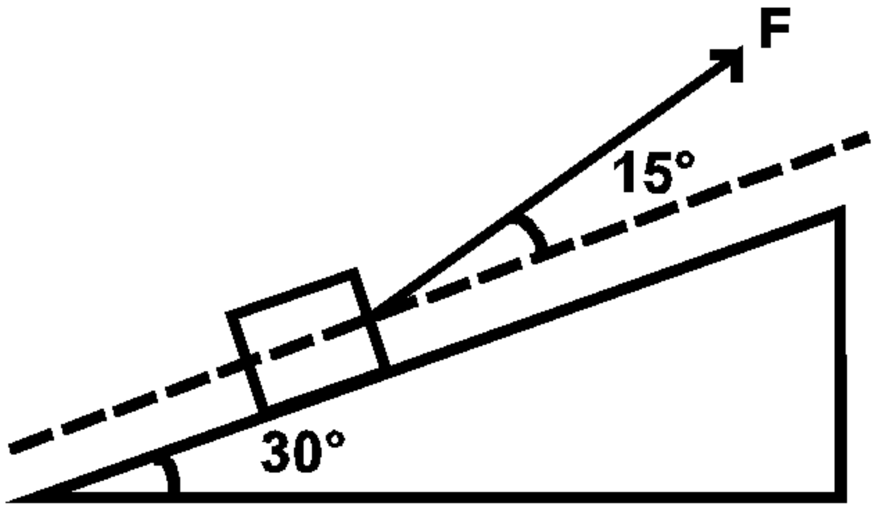

Figure 2: Block in the Inclined Plane

(12 Marks)

(b) The *300 tons* airplane as shown in Figure 3 is flying at constant speed of *400 km/hr* along a horizontal circular path. If the banking angle $\theta = 20°$, determine the uplift force N acting on the airplane and the radius R of the circular path.
(Hint: ignore the size of the airplane)

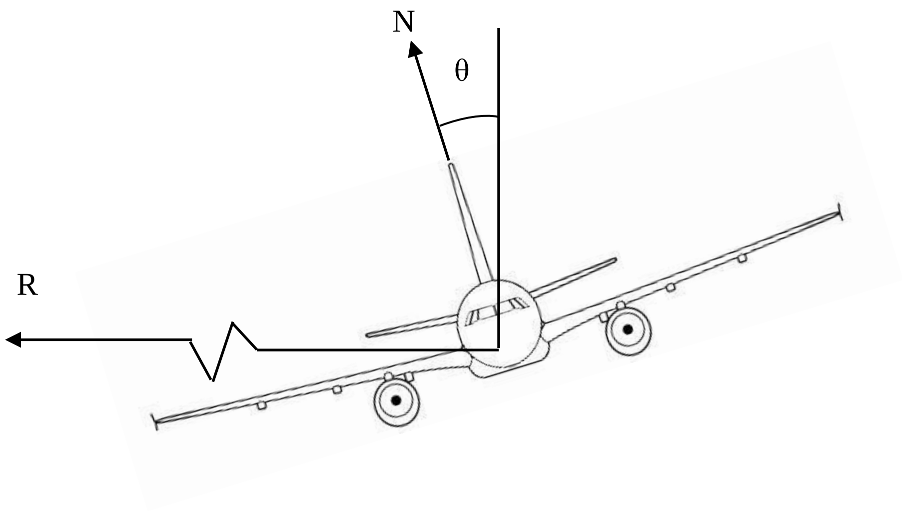

Figure 3: Aircraft in Circular Path

(13 marks)

Question 3

(a) Ball A and B have a mass of *3 kg* and *5 kg* respectively. If the ball is sliding on a smooth vertical plane with the velocity as shown in Figure Q4 below. Determine their speeds after impact. The coefficient of restitution is $e = 0.75$

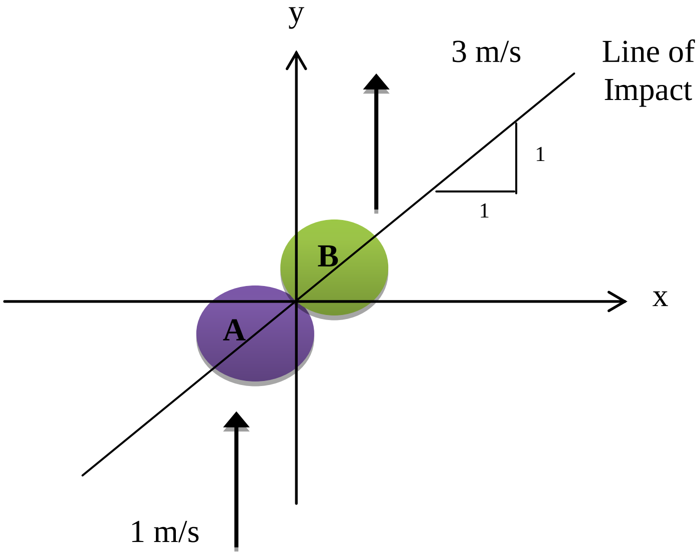

Figure 4: Collision of ball

(12 Marks)

(b) The flywheel shown in the Figure 5 is rotating with an angular velocity of $\omega_A = 12$ *rad/s*. Calculate the angular velocity of rod *BC* at the instant shown.

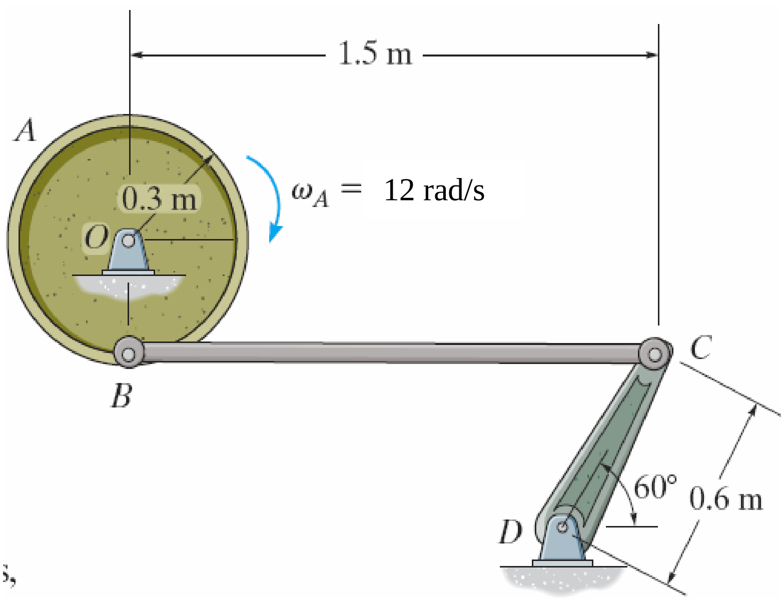

Figure 5: Flywheel

(Figure courtesy of Hibbeller, R.C. Yap. K.B., Mechanics for Engineers: Dynamics, 13th Ed, Pearson 2013. pg 345)

(13 marks)

Question 4

The pendulum consists of *3 kg* uniform slender rod and 8 kg sphere as shown in Figure 6 below. If the pendulum is subjected to a torque of *M = 30 N.m*, and has an angular velocity *2 rad/s* when *θ = 30°*, determine the magnitude of the reactive force pin O exerts on the pendulum at this torque

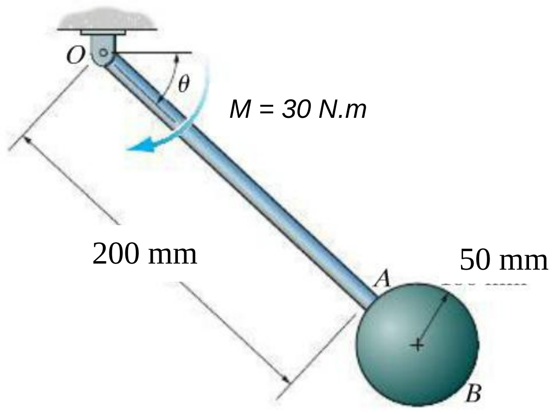

Figure 6: The Pendulum System

(Figure courtesy of Hibbeller, R.C. Yap. K.B., Mechanics for Engineers: Dynamics, 13th Ed, Pearson 2013. pg 435)

(25 marks)

Question 5

The pendulum consists a 2 kg of rod BA and 4 kg of disk as shown in Figure 7 below. The disk is stretched 0.05 m when the rod is in horizontal. If the pendulum is released from rest and rotates about point D, determine the angular velocity when the rod is in vertical position. The roller C allows the spring to remain vertical as the rod rotates.

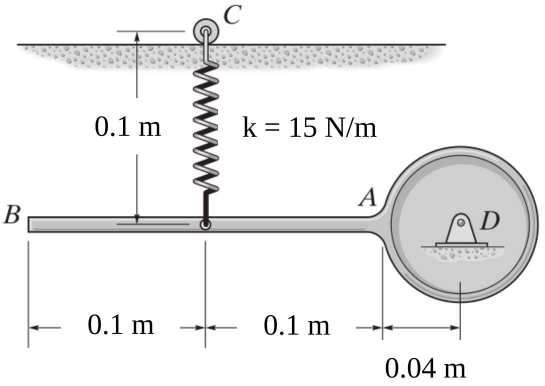

Figure 7: Spring Pendulum System

(Figure courtesy of Hibbeller, R.C. Yap. K.B., Mechanics for Engineers: Dynamics, 13th Ed, Pearson 2013. pg 487)

(25 marks)

END OF QUESTION

APPENDIX

$$v = v_o + at$$

$$v^2 = v_o^2 + 2a(s - s_o)$$

$$s = s_o + vt + ½ at^2$$

$$F_s = ks$$

$$T_1 + \Sigma U_{1\text{-}2} = T_2$$

$$U_{spring\ (1\text{-}2)} = -(½ ks_2^2 - ½ ks_1^2)$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$mv_1 + \int_{t1}^{t2} F\,dt = mv_2$$

$$(H_G)_1 + \sum \int M_G\,dt = (H_G)_2$$

$$e = \frac{(v_B)_2 - (v_A)_2}{(v_A)_1 - (v_B)_1}$$

$$I_G = mk_g^2$$

$$(I_G)_{rod} = ml^2/12$$

$$(I_G)_{sphere} = 2mr^2/5$$

$$(I_G)_{Disk} = mr^2/2$$

$$\Sigma M_o = I_o\alpha$$

$$I_o = I_a + md^2$$

$$T = ½ mv^2 = ½ I_G\,\omega$$

$$F = ma = ma_t = ma_n = m\omega^2 r$$