Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2010 SESSION

SUBJECT CODE	:	FMB 11102
SUBJECT TITLE	:	STATICS & DYNAMICS
LEVEL	:	BACHELOR
TIME / DURATION	:	1.00pm – 3.30pm (2.5 HOURS)
DATE	:	03 MAY 2010

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. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This questions paper consists of TWO (2) sections. Section A and B. Answer ALL questions in section A. For section B, answer THREE (3) questions only.
6. Answer ALL questions in English.

THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

(a) Determine the mass of an object that has a weight of (a) 20 mN, (b) 150 kN, (c) 60 MN. Express the answer to three significant figures.

(3 marks)

(b) Water has a density of 1.94 slug/ ft^3. Define the density expressed in SI unit. Express the answer to three significant figures.

(2 marks)

(c) Determine the magnitude of the resultant force $\mathbf{F}_R = \mathbf{F}_1 + \mathbf{F}_2$ and its direction refer Figure 1, measured counterclockwise from the positive *u* axis.

Given:

$\mathbf{F}_1$ = 300 N

$\mathbf{F}_2$ = 500 N

$\alpha = 30^\circ$

$\beta = 45^\circ$

$\gamma = 70^\circ$

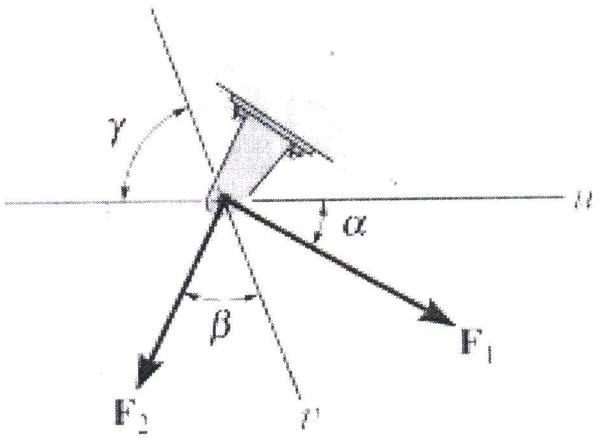

Figure 1

(5 marks)

Question 2

(a) The unstretched length of spring *AB* in Figure 2 is **δ**. If the block is held in the equilibrium position shown, determine the mass of the block at *D*.

Given:

δ = 2 m

a = 3 m

b = 3 m

c = 4 m

$\mathbf{k_{AB}}$ = 30 N/m

$\mathbf{k_{AC}}$ = 20 N/m

$\mathbf{k_{AD}}$ = 40 N/m

g = 9.81m/s^2

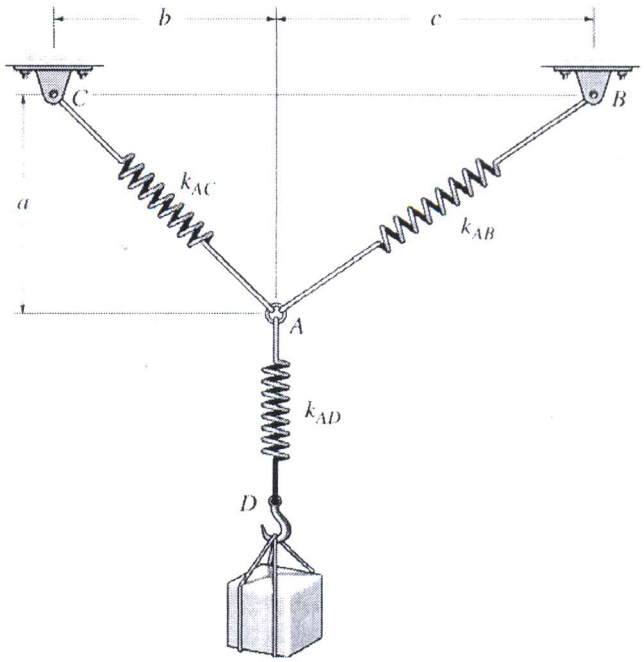

Figure 2

(6 marks)

(b) The crate shown in Figure 3 which of weight *F* is to be hoisted with constant velocity from the hold of a ship using the cable arrangement shown. Determine the tension in each of the three cables for equilibrium.

Given:

F = 2.5 kN

a = 3 m

b = 1 m

c = 0.75 m

d = 1 m

e = 1.5 m

f = 3 m

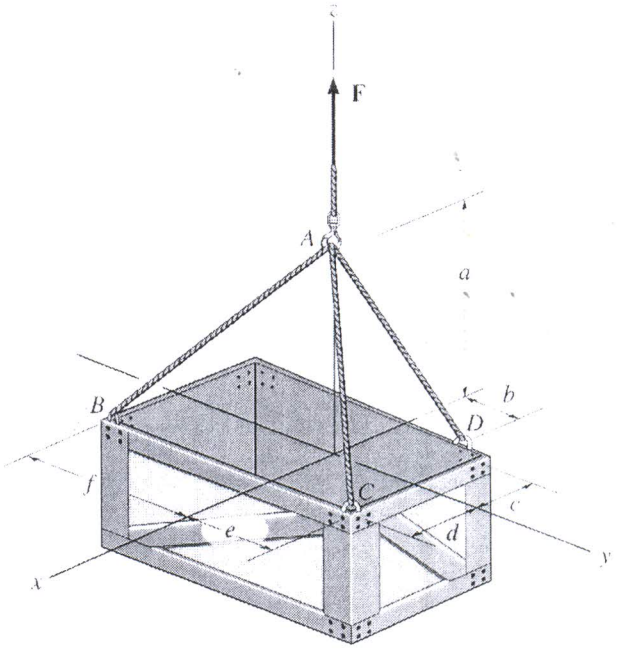

Figure 3

(6 marks)

(c) The mast *OA* is supported by three cables (refer Figure 4). If cable *AB* is subjected to tension *T*, determine the tension in cables *AC* and *AD* and the vertical force **F** which the mast exerts along its axis on the collar at *A*.

Given:

T = 500 N

a = 6 m

b = 3 m

c = 6 m

d = 3 m

e = 2 m

f = 1.5 m

g = 2 m

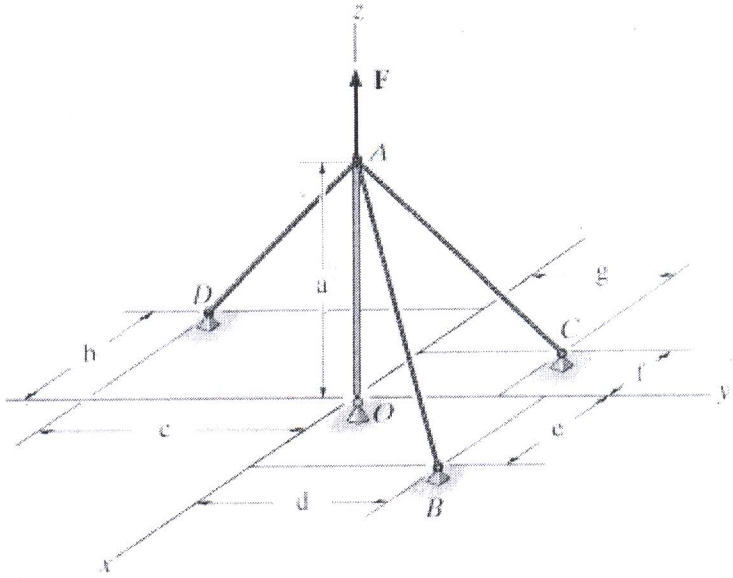

Figure 4

(6 marks)

Question 3

(a) Determine the smallest force *F* in Figure 5 that must be applied along the rope in order to cause the curved rod, which has radius *r*, to fail at the support *C*. This requires a moment to be developed at C of magnitude *M*.

Given:

r = 0.5 m

M = 200 N·m

θ = 60°

a = 0.7 m

b = 0.6 m

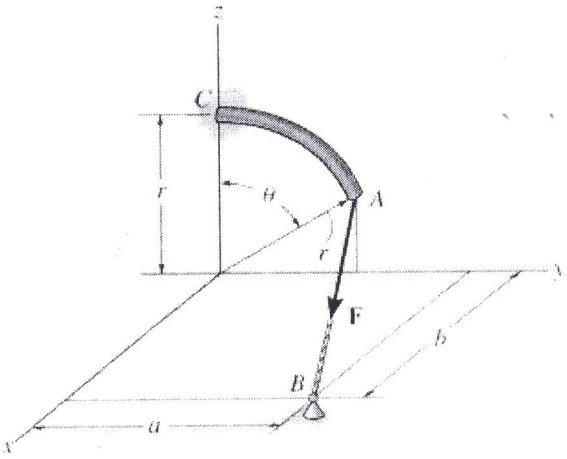

Figure 5

(6 marks)

(b) The tool at *A* in Figure 6 is used to hold a power lawnmower blade stationary while the nut is being loosened with the wrench. If a force *P* is applied to the wrench at *B* in the direction shown, determine the moment it creates about the nut at *C*. What is the magnitude of force **F** at *A* so that it creates the opposite moment about *C*?

Given:

P = 50 N	θ = 60°
a = 400 mm	**c** = 5
b = 300 mm	**d** = 12

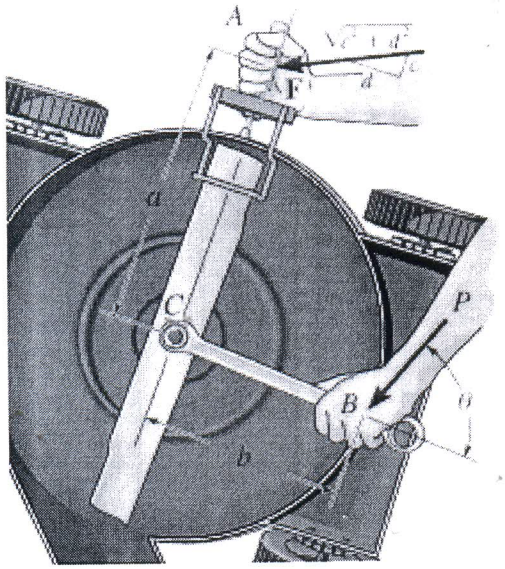

Figure 6

(6 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions only.
Please use the answer booklet provided.

Question 4

(a) Locate the centroid (*xc*, *yc*) of the exparabolic segment of area in Figure 7.

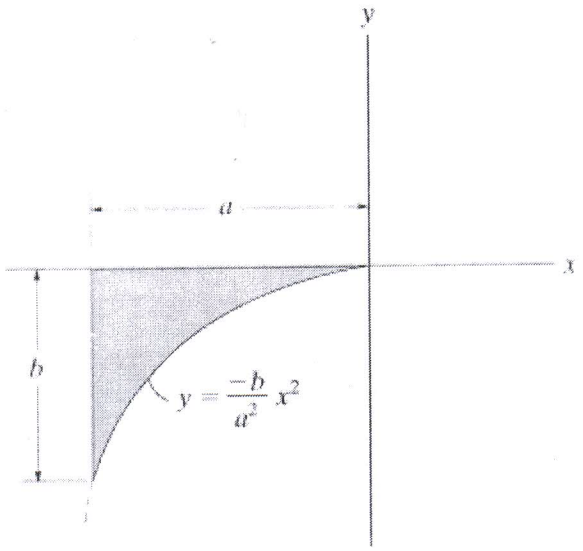

Figure 7

(5 marks)

(b) Determine the location y_c (refer Figure 8) of the centroidal axis $x_c x_c$ of the beam's cross-sectional area. Neglect the size of the corner welds at *A* and *B* for the calculation.

Given:

$r = 50$ mm
$t = 15$ mm
$a = 150$ mm
$b = 15$ mm
$c = 150$ mm

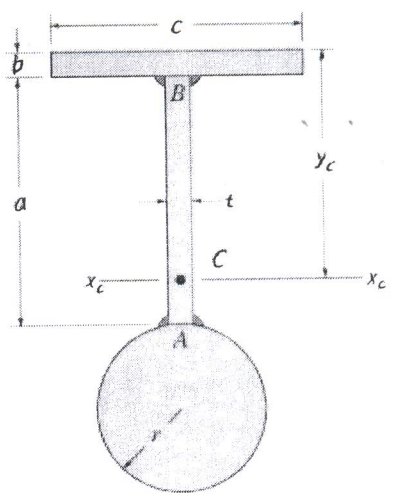

Figure 8

(5 marks)

(c) The wedge is used to level the member (in Figure 9). Determine the reversed horizontal force -**P** that must be applied to pull the wedge out to the left. The coefficient of static friction between the wedge and the two surfaces of contact is μ_s. Neglect the weight of the wedge.

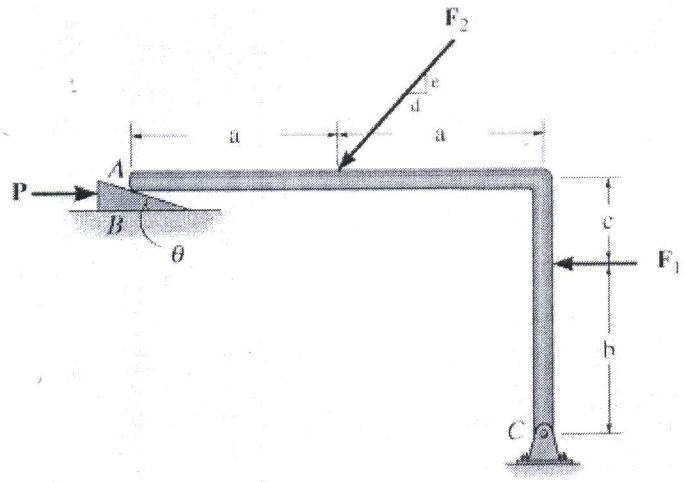

Figure 9

10marks)

Question 5

(a) A package shown in Figure 10 is dropped from the plane which is flying with a constant horizontal velocity v_A. Determine the normal and tangential components of acceleration and the radius of curvature of the path of motion (a) at the moment the package is released at *A*, where it has a horizontal velocity v_A, and (b) *just before* it strikes the ground at *B*.

Given:

$\mathbf{v_A}$ = 45 m/s

h = 450 m

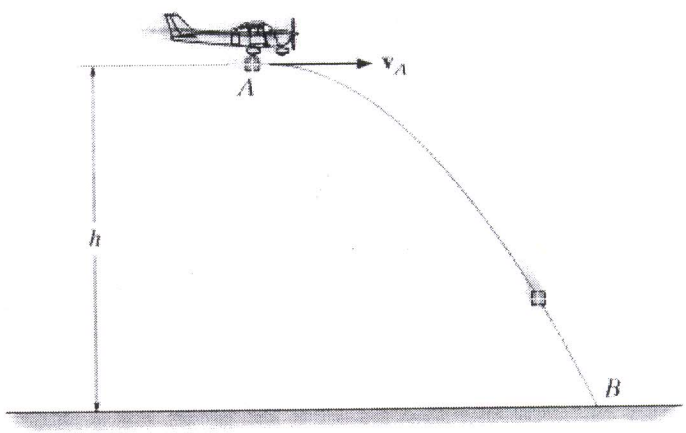

Figure 10

(10 marks)

(b) The motor shown in Figure 11 draws in the cable at C with a constant velocity v_C. The motor draws in the cable at D with a constant acceleration of a_D. If $v_D = 0$ when t = 0, determine (a) the time needed for block A to rise a distance h, and (b) the relative velocity of block A with respect to block B when this occurs.

Given:

$v_C = -4$ m/s

$a_D = 8$ m/s^2

h = 3 m

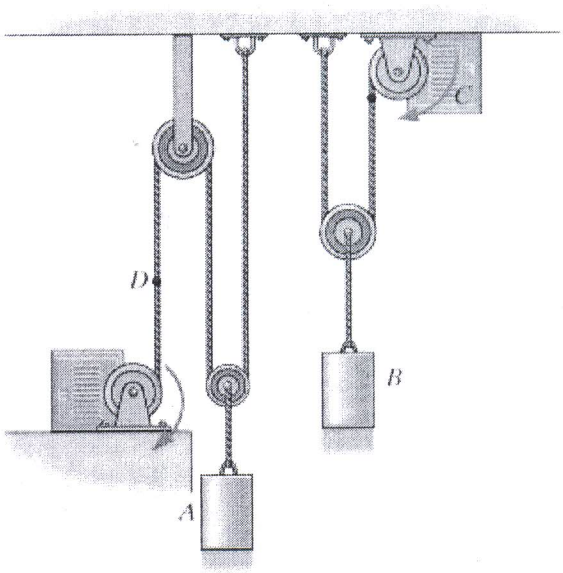

Figure 11

(10 marks)

Question 6

(a) A suitcase (in Figure 12) of weight *W* slides from rest a distance *d* down the smooth ramp. Determine the point where it strikes the ground at *C*. How long does it take to go from *A* to *C*?

Given:

W = 200 N

d = 6 m

h = 1.2 m

θ = 30°

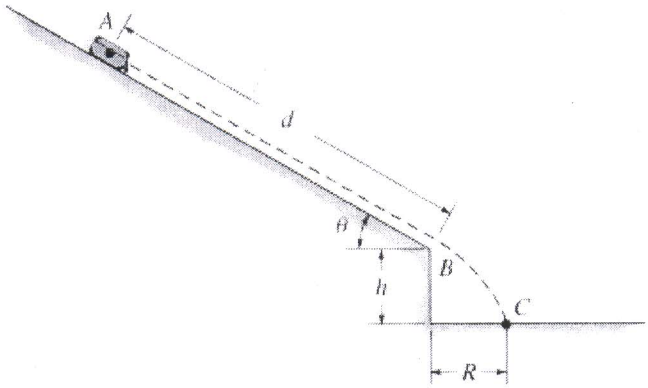

Figure 12

(10 marks)

(b) The boy in Figure 13 of mass M is sliding down the spiral slide at a constant speed such that his position, measured from the top of the chute, has components $r = r_0$, $\theta = bt$ and $z = ct$. Determine the components of force F_r, F_θ and F_z which the slide exerts on him at the instant $t = t_1$. Neglect the size of the boy.

Given:

M = 40 kg

$\mathbf{r_0}$ = 1.5 m

b = 0.7 rad/s

c = −0.5 m/s

$\mathbf{t_1}$ = 2 s

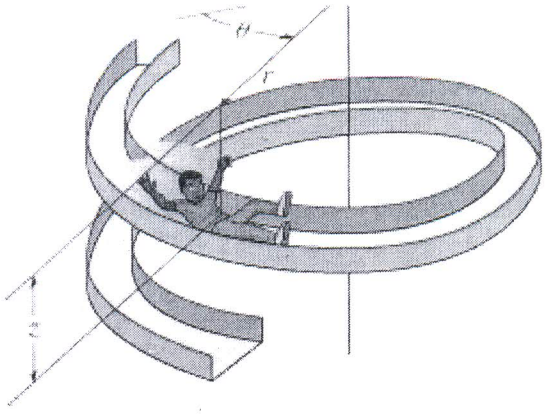

Figure 13

(10 marks)

Question 7

(a) The crate shown in Figure 14 has mass m_c and rests on a surface for which the coefficients of static and kinetic friction are μ_s and μ_k respectively. If the motor M supplies a cable force of $F = at^2 + b$, determine the power output developed by the motor when $t = t_1$.

Given:

$\mathbf{m_c}$ = 150 kg

a = 8 N/s^2

μ_s = 0.3 **b** = 20 N

μ_k = 0.2 $\mathbf{t_1}$ = 5 s

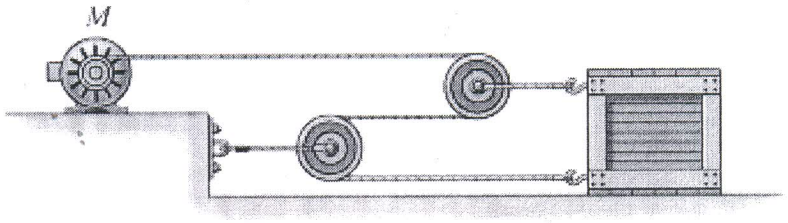

Figure 14

(10 marks)

(b) The collar of weight *W* shown in Figure 15 is released from rest at *A* and travels along the smooth guide. Determine its speed when its center reaches point *C* and the normal force it exerts on the rod at this point. The spring has an unstretched length *L*, and point *C* is located just before the end of the curved portion of the rod.

Given:

W = 25 N

L = 300 mm

h = 250 mm

k = 0.5 N/mm

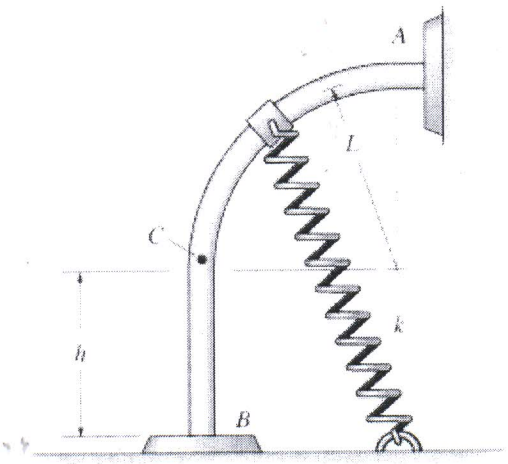

Figure 15

(7 marks)

END OF QUESTION