UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ENGINEERING MECHANICS
COURSE CODE	:	BDU 10503
PROGRAMME	:	BACHELOR OF AERONAUTICAL ENGINEERING TECHNOLOGY WITH HONOURS
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS. **TWO (2)** QUESTIONS FROM **SECTION A** AND **TWO (2)** QUESTIONS FROM **SECTION B**

THIS PAPER CONSISTS OF EIGHT (8) PRINTED PAGES

SECTION A

INSTRUCTION : ANSWER TWO (2) QUESTIONS ONLY.

Q1 (a) Explain briefly the following;

(i). Newton's first law
(ii) Newton's second law
(iii) Newton's third law

(6 marks)

(b) If the resultant force acting on the bracket shown in Figure Q1(a) is $\boldsymbol{F_R}$ = {-300**i** + 650**j** + 250**k**} **N** , determine the magnitude and coordinate direction angles of $\boldsymbol{F_2}$.

(12 marks)

(c) Using Figure Q1 (b), determine:

(i) the moment produced by $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$ about point O.
(ii) the resultant moment produced by the two forces about point O.

Express all the results in a Cartesian vector.

(7 marks)

Q2 (a) As an airplane's brakes are applied, the nose wheel exerts two forces on the end of the landing gear as shown in Figure Q2(a). Determine the horizontal and vertical components of reaction at the pin *C* and the force in strut *AB*.

(10 marks)

(b) Figure Q2(b) shows the shaft is supported by three smooth journal bearings at *A* and *B*. Determine the components of reaction at these bearings.

(7 marks)

(c) Due to an unequal distribution of fuel in the wing tanks, the centers of gravity for the airplane fuselage *A* and wings *B* and *C* are located as shown in Figure Q2(c). If these components have weights W_A = 202.5 kN, W_B = 36 kN and W_C = 27 kN, determine the normal reactions of the wheels *D*, *E*, and *F* on the ground.

(8 marks)

Q3 (a) Determine the forces in each member of the truss in Figure Q3 (a), and state if the members are in tension or compression.

(13 marks)

(b) The internal drag truss for the wing of a light airplane is subjected to the forces shown in Figure Q3(b). Determine the forces in members *BC*, *BH*, and *HC*, and state if the members are in tension or compression.

(12 marks)

SECTION B

INSTRUCTION : ANSWER TWO (2) QUESTIONS ONLY.

Q4 An Airbus 380-800 having wing area = 845 m^2 and maximum takeoff weight = 569,000 kg is about to takeoff from Kuala Lumpur International Airport. It is being propelled by four GP7270 engines, each providing 310 kN thrust.

(a) Calculate the minimum takeoff speed of the aircraft. (5 marks)

(b) Calculate the runway length needed for takeoff. (17marks)

(c) Calculate the time needed to takeoff. (3 marks)

Take μ=0.01; C_L and C_D at takeoff flap configuration as 3.22 and 0.34 respectively.

Q5 A boy operates a radio-controlled model aircraft. The position vector of the aircraft is given as

$$\mathbf{r} = (1.5t^2 + 3t)\mathbf{i} + (1.5t - t^2)\mathbf{j} + 1.2t^2\mathbf{k} \quad \text{[meter]}$$

where t is in seconds and (**i, j, k**) are unit vectors along xyz coordinate axes. The boy stands at the origin of the coordinate system, with the z axis directed vertically upward.

(a) Determine the (x, y, z) projections of the velocity, **v** and the acceleration, **a** at t = 2 seconds. (10 marks)

(b) Determine the speed, v of the aircraft at t = 2 seconds. (5 marks)

(c) Determine the distance traveled by the aircraft in the interval from t = 0 to 2 seconds. (10 marks)

Q6 Consider the system of three blocks shown below. The masses of the blocks are W_1 = 16kg, W_2 = 32 kg and W_3 = 96 kg. The masses and the friction of the small pulleys are negligible. The coefficient of friction, μ between the masses and the planes is 0.2. The blocks are released from rest and in the position shown in Figure Q6:

a) Draw the free-body diagrams of the blocks. (9 marks)

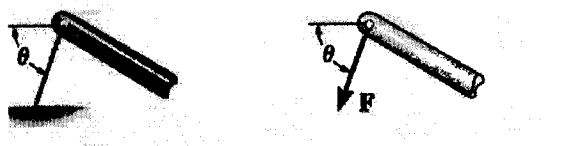
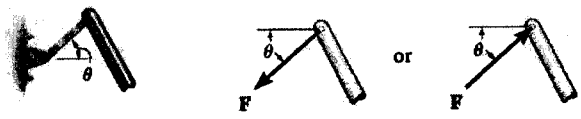
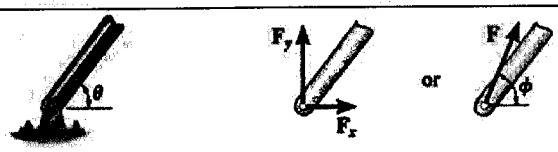
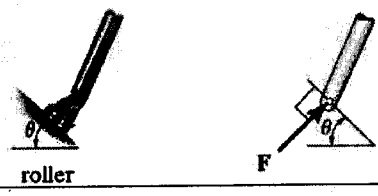
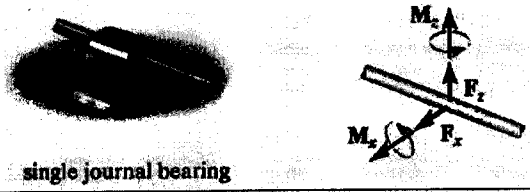
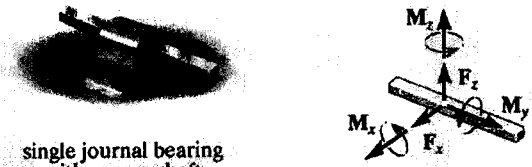
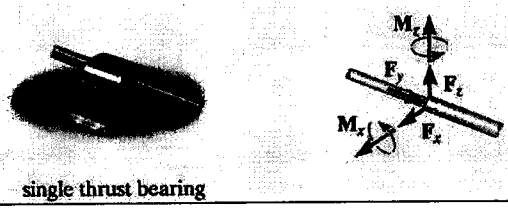
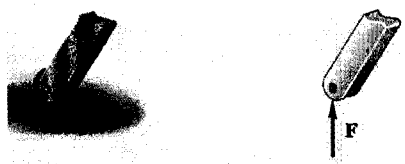
b) Determine the acceleration of the system of the blocks. (12 marks)

c) Determine the tensions in the strings. (4 marks)

FINAL EXAMINATION

SEMESTER / SESSION: SEM II / 2011/2012 PROGRAMME : BDM/BDC
COURSE NAME : ENGINEERING MECHANICS COURSE CODE : BDU 10503

Table of Supports for Rigid Bodies

 cable	 weightless link
 smooth pin or hinge	 roller
 single journal bearing	 single journal bearing with square shaft
 single thrust bearing	 roller

FINAL EXAMINATION

SEMESTER / SESSION:	SEM II / 2011/2012	PROGRAMME :	BDM/BDC
COURSE NAME :	ENGINEERING MECHANICS	COURSE CODE :	BDU 10503

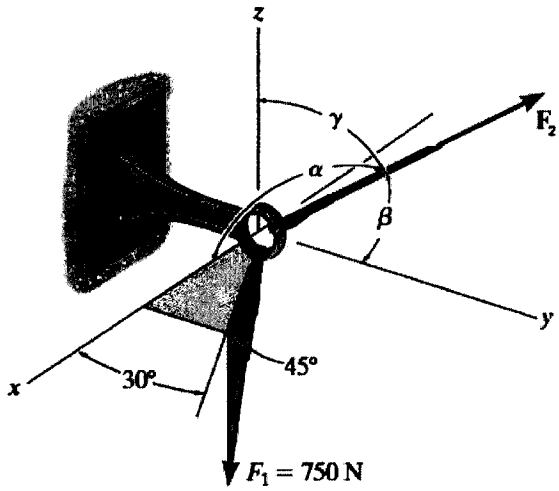


FIGURE Q1(a)

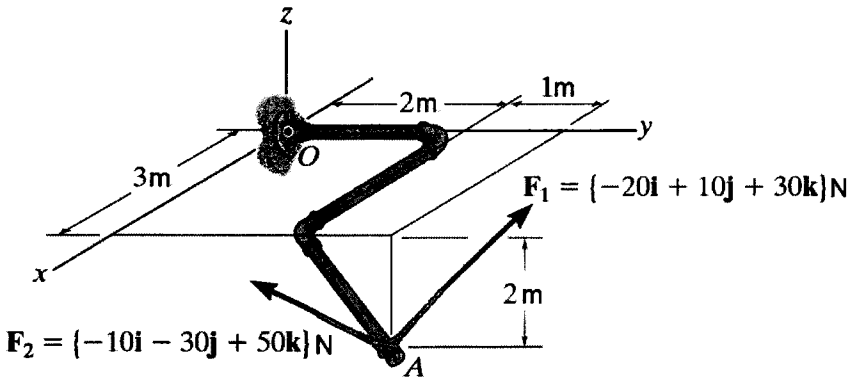


FIGURE Q1(b)

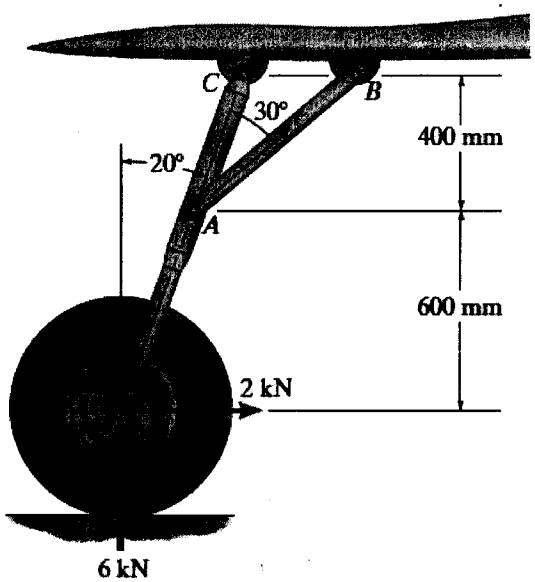


FIGURE Q2(a)

FINAL EXAMINATION

SEMESTER / SESSION:	SEM II / 2011/2012	PROGRAMME :	BDM/BDC
COURSE NAME :	ENGINEERING MECHANICS	COURSE CODE :	BDU 10503

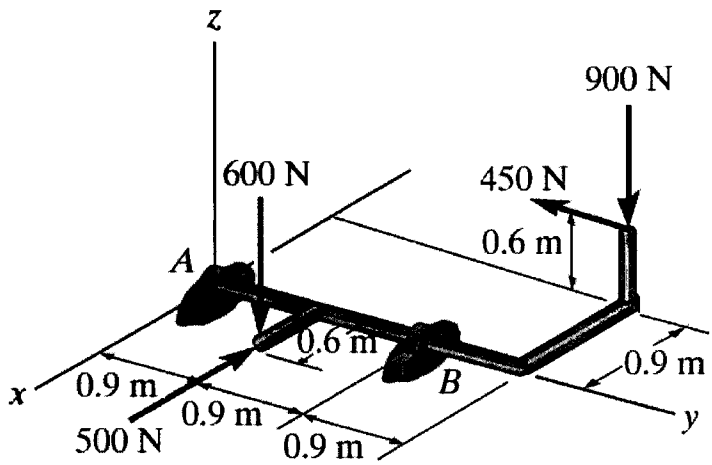


FIGURE Q2(b)

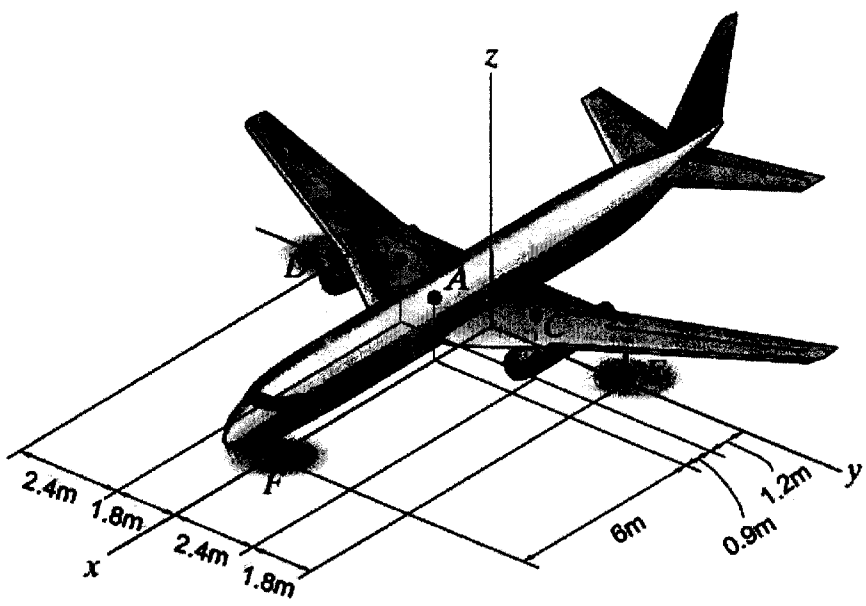


FIGURE Q2(c)

FINAL EXAMINATION

SEMESTER / SESSION:	SEM II / 2011/2012	PROGRAMME :	BDM/BDC
COURSE NAME :	ENGINEERING MECHANICS	COURSE CODE :	BDU 10503

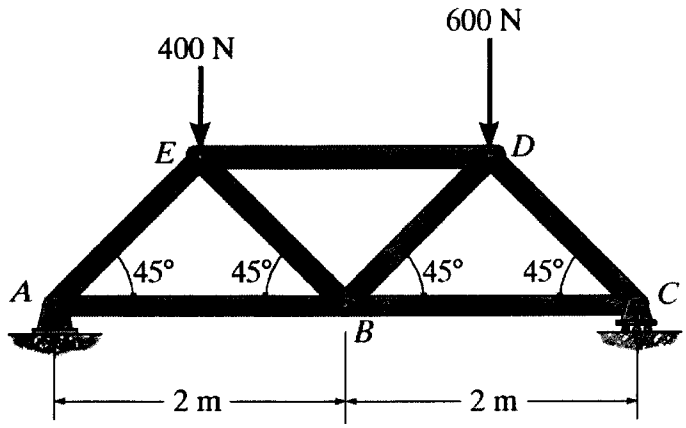


FIGURE Q3(a)

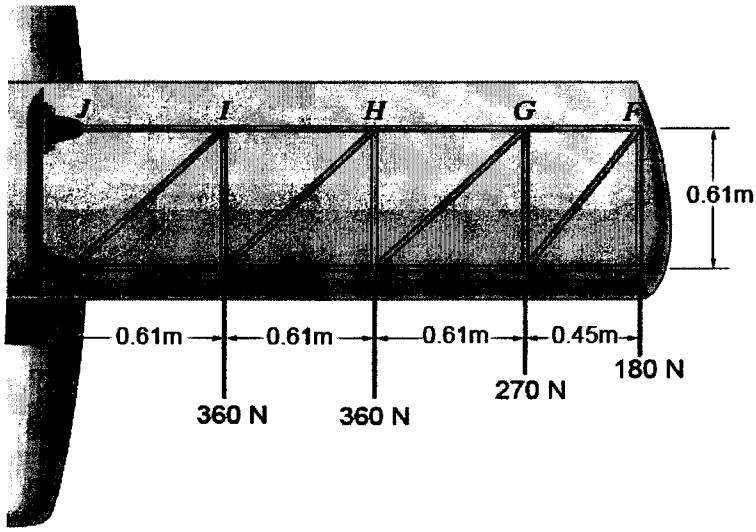


FIGURE Q3(b)

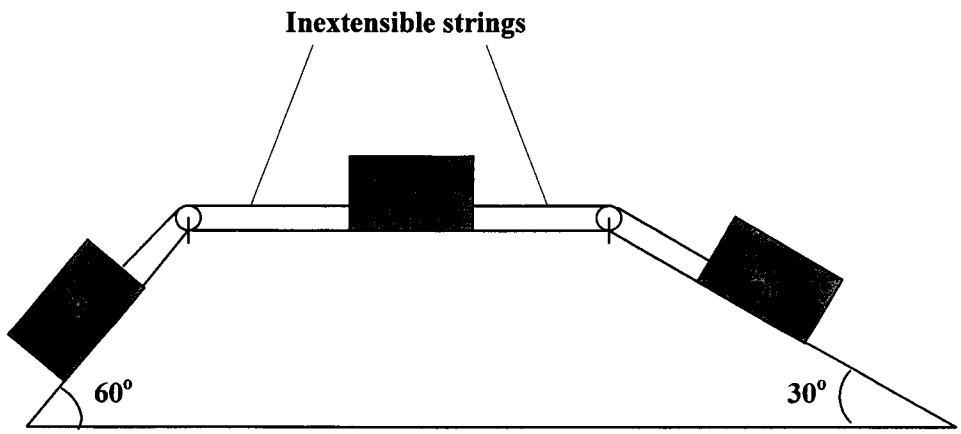


FIGURE Q6