University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER I EXAMINATIONS - 2007/2008

MEEN10030 Mechanics for Engineers

Professor J. Vander Sloten

Dr D. FitzPatrick

Professor M. Gilchrist

Dr. L. Cui

Time Allowed: 2 Hours

Instructions for Candidates

Answer Question 1 and any four other questions.
All questions carry equal marks.
The distribution of marks for each question is noted in ( ) brackets

Instructions for Invigilators

Question 1 – (20 Marks) equal marks for each part (i) through (x).

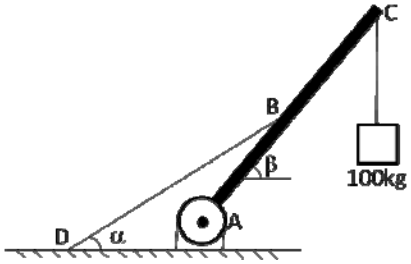
(i) Which one of the following parameters is NOT a vector?
a) Force
b) Mass
c) Acceleration
d) Velocity

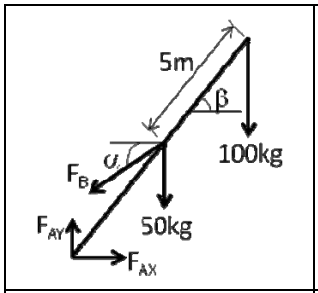
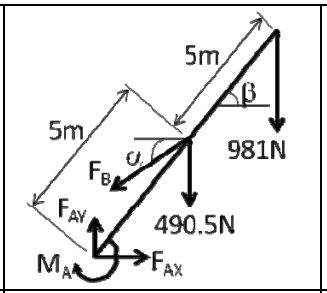
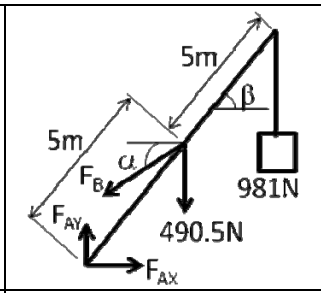
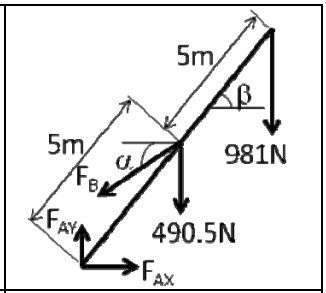
(ii) Which statement is TRUE?
a) A force applied on a rigid body can be freely moved to any point with the same effect
b) A couple applied on a rigid body can be freely moved to any point with the same effect
c) When the resultant of all the forces acting on a rigid body is zero, the rigid body is in equilibrium
d) Any system of forces acting on a rigid body can be reduced to an equivalent force

(iii) Which of the following actions CANNOT increase the friction force between two contact surfaces?
a) Increase the normal force
b) Increase the contact area
c) Increase the value of coefficient of friction between the two surfaces
d) Change one surface to a rougher surface

(iv) Which expression does NOT represent acceleration (x – position; v – velocity; t – time)?
a) dx/dt
b) dv/dt
c) d^2x/dt^2
d) $v\dfrac{dv}{dx}$

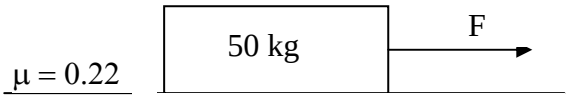
(v) Which is the correct free-body diagram for the system shown below if the 10 m long bar AC weights 50 kg:



			
(a)	(b)	(c)	(d)

(vi) What is the relationship between the normal reaction force R and the friction force F_f?
a) Directly proportional
b) Inversely proportional
c) Friction force is equal to normal reaction force squared
d) None

(vii) What is the minimum force F required to move the block shown below? (Assume g = 9.81m/s^2)
a) 107.91 N
b) 1079.1 N
c) 10.791 N
d) 84.52 N



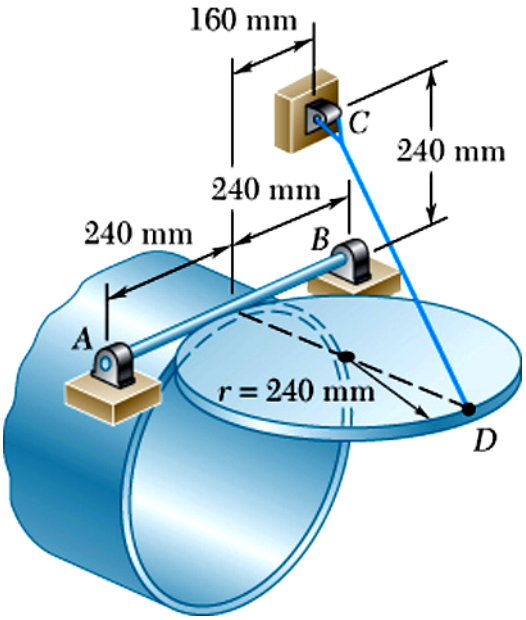
Horizontal surface

(viii) To maximise the horizontal distance a projectile will travel on flat ground, at what angle with respect to the horizontal should it be fired?
a) 30^o
b) 45^o
c) 60^0
d) 90^0

(ix) The vertical component of velocity for a projectile fired with initial velocity v_0 at an angle θ to the horizontal can be calculated by:
a) $v_y = (v_0 \sin\theta) - gt$
b) $v_y = (v_0 \sin\theta)t - (½)gt^2$
c) $v_y = (v_0 \cos\theta)t + (½)gt^2$
d) $v_y = (v_0 \cos\theta) + gt$

(x) The horizontal component of velocity for a projectile fired with initial velocity v_0 at an angle θ to the horizontal depends on which of the following:
a) Total time of flight
b) Gravity
c) Angle to the horizontal
d) Height above the ground

Question 2 - (20 Marks)

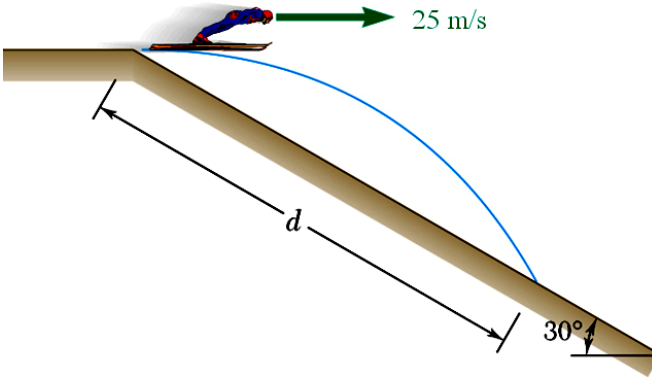


A uniform pipe cover of radius r = 240 mm and mass 30 kg is held in a horizontal position by the cable *CD*. Assume that the bearing at B does not exert any axial thrust, while the bearing at A does. The bearings are properly aligned and exert only a force reaction on the shaft.

(a) Draw the free-body diagram. (4 Marks)

(b) Determine the tension in the cable *CD* and the reactions at *A* and *B*. (16 Marks)

Question 3 - (20 Marks)

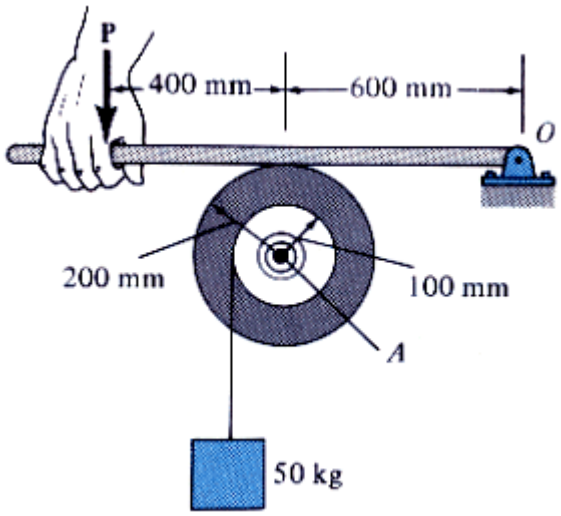


A ski jumper starts with a horizontal take off velocity of 25 m/s and lands on a straight landing hill inclined at 30°. Determine:

(a) the time between take-off and landing, and the length *d* of the jump (16 Marks)

(b) the maximum vertical distance between the jumper and the landing hill. (4 Marks)

Question 4 – (20 Marks)



The coefficients of static and kinetic friction between the drum and brake mechanism are $\mu_s = 0.4$, $\mu_k = 0.3$. Neglect the weight and thickness of the brake.

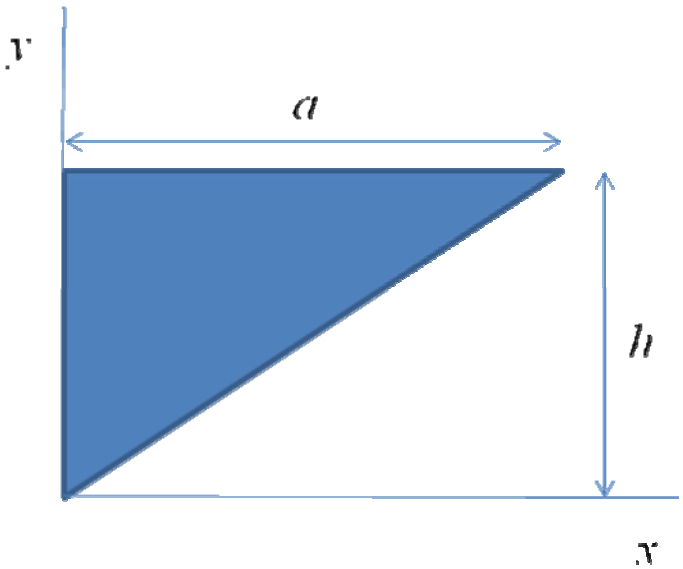
(a) Does the force ***P*** =150 N prevent the drum from rotating? (10 Marks)
(b) Determine the horizontal and vertical components of reaction at pin *O* when ***P*** = 150 N. (10 Marks)

Question 5 – (20 Marks)

Derive the moment of inertia for a rectangular shape about an axis defined by:
(a) one of its planes of symmetry and (10 Marks)
(b) one of its edges or sides. (10 Marks)

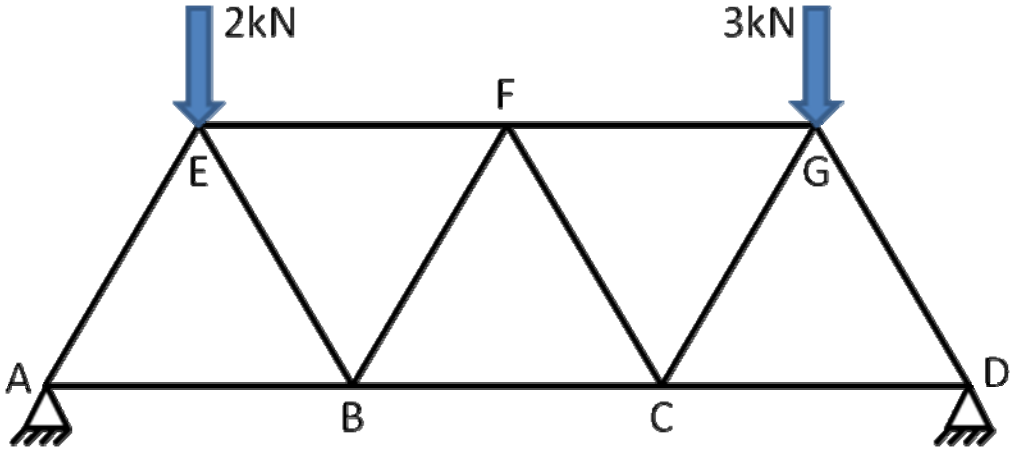
Question 6 – (20 Marks)

Determine by direct integration and express in terms of *a* and *h* the Cartesian coordinates of the centroid of the area shown:



Question 7 – (20 Marks)

This simple truss carries two loads and is composed of eleven members, all of which are 2m in length. Construct a free body diagram and thereby determine reaction forces at A and at D and the forces in member FC.



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