



MACHAKOS UNIVERSITY

University Examinations May 2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

**SECOND YEAR SECOND SEMESTER EXAMINATION FOR DEGREE BACHELOR
OF SCIENCE IN MECHANICAL ENGINEERING**

EMM 211: ENGINEERING MECHANICS II

DATE:.....

TIME: 2 Hours

Instructions to candidates:

- 1. This examination contains FIVE questions. Question ONE(1) is compulsory and carries 30 marks. All the other questions carry 20 marks each.**
- 2. Answer question ONE and any other TWO questions**

QUESTION ONE (Compulsory)—(30Marks)

- a) i) Distinguish between static and dynamic balancing
ii) State two conditions necessary for a system of rotating masses to be balanced (6marks)
- b) Four bodies P,Q,R and S are rigidly attached to a common shaft such that they all lie on the same plane. Their masses, radii of rotation and their relative angular positions are as follows;
P: 2Kg, 1.4m, 0^0 ; Q: 1.5Kg, 0.8m, 40^0 ; R:2.2Kg, 1.2m, 120^0 and S:3.2Kg, 0.6m, 170^0 .
Determine
i) the radial and angular position (relative to P) of a 3kg balance mass
ii) the out of balance force on the shaft bearings at a speed of 500rpm (8 marks)
- c) i) Distinguish between work and energy .
ii) A trolley of mass 4 kg slides along a rough horizontal surface where $\mu = 0.3$ at a speed of 1.5m/s. It then runs onto a spring loaded stopper of stiffness 450 N/m during which the trolley is momentarily stopped by the spring. By how much does the spring compress? (8 marks)
- d) A passenger of mass 72kg stands on a scale inside an elevator cabin.

For this motion; determine

- i) the scale reading when the cab is stationary
- ii) the scale reading when the cab is accelerating upwards at 3.20m/s^2
- iii) the acceleration when the scale reading is 477N .

(8 marks)

QUESTION TWO—(20 Marks)

a) A particle under constant deceleration is moving in a straight line and covers a distance of 20m in the first 2 seconds and 40m in the next 5 seconds. Determine

- i) The distance covered in the subsequent 3 seconds
- ii) The total distance covered before it comes to rest

(8 marks)

b) Show that for a body projected vertically upwards, its velocity at any height is the same during the upward and downward motion

(4 marks)

b) A steel ball is shot vertically upwards from the top of a building 25m above the ground with an initial velocity of 18m/s ; Determine

- i) The time it takes to reach the maximum height
- ii) The maximum height to which the ball rises above the building
- iii) The velocity with which the ball strikes the ground
- iv) The total time the ball is in flight

(8 marks)

QUESTION THREE —(20 Marks)

a)(i) State Newton's second law of motion

(ii) From Newton's second law stated in a(i) above , show that

$F = ma$ where the symbols have the usual meaning (6 marks)

b) Two bodies weighing 300N and 450N respectively are hung to the ends of a cable which passes over a frictionless pulley as shown in Figure Q3;

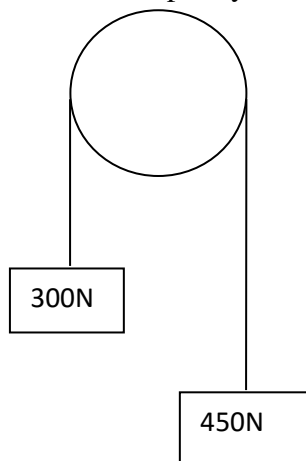


Fig Q3

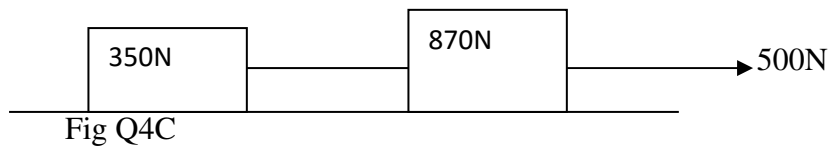
Determine:

- i) The acceleration of the 450N body
- ii) The tension in the cable

(7 marks)

c)i) State D'Alemberts principle

ii) Two bodies are connected and acted upon by a 500N force as shown in Fig Q.4C. Assuming a co-efficient of 0.25 between the surfaces in contact, determine the resulting acceleration of the system.



QUESTION FOUR—(20 Marks)

- a) i) outline the significance of Area moment of Inertia
 - ii) Explain the two theorems of moment of Inertia
 - iii) Derive the equation for the moment of inertia of a triangular section of base **b** and height **h**
- (10 Marks)
- b) The cross section of a structural member is as shown in **Fig.4b**

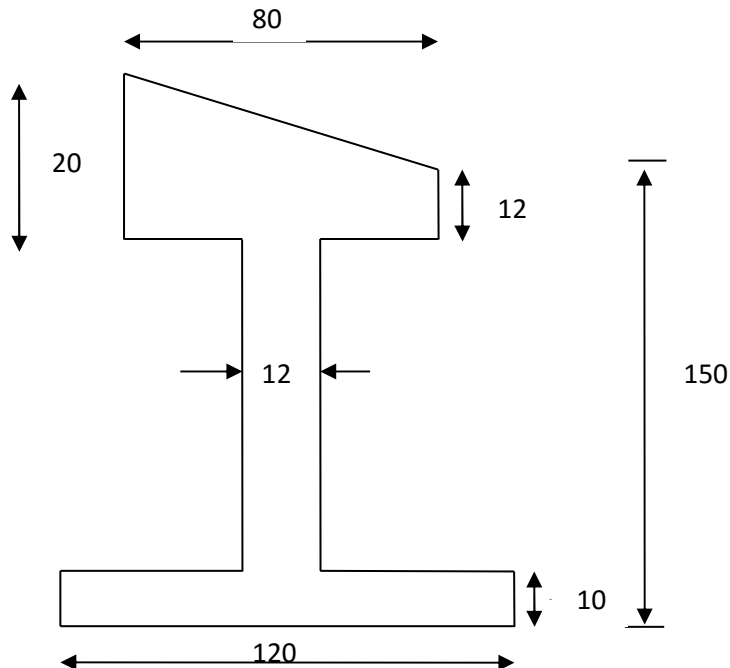


Fig.4b: All dimensions are in mm

Determine for this section area moment of inertia of the section about a centroidal axis parallel to the base (10 marks)

QUESTION FIVE—(20 Marks)

- a) i) Distinguish between angular and centripetal acceleration
ii) Show clearly that for a body revolving about a fixed centre of rotation, the centripetal acceleration, a_c and the linear velocity, v are governed by the relationship:

$$a_c = \frac{v^2}{r} \quad \text{where } r \text{ is the radius of rotation} \quad (8 \text{ marks})$$

b) A certain force gives an object of mass m_1 an acceleration of 12.0 m/s^2 and an object of mass m_2 an acceleration of 3.30 m/s^2 . Determine the acceleration which this force would impart to an object of mass;

i) $(m_1 + m_2)$

ii) $(m_2 - m_1)$ (6 marks)

c) A motorist travelling at 70Kph suddenly applies his brakes and brings his vehicle to a halt after skidding over a distance of 50m. Determine:

i) the time required to stop the vehicle

ii) the co-efficient of friction between the vehicle tires and the road surface. (6 marks)