



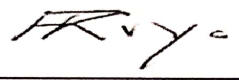
ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF
MECHANICAL, AUTOMOTIVE AND PRODUCTION ENGINEERING

FIRST SEMESTER EXAMINATIONS

2017/2018 ACADEMIC SESSION

COURSE: GNE 221 – Applied Mechanics (3 Units)
CLASS: 200 Level General Engineering
TIME ALLOWED: 3 Hours
INSTRUCTIONS: Answer any FOUR questions

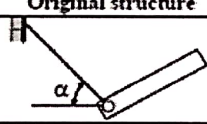
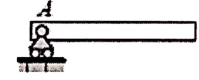
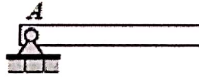
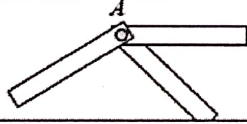
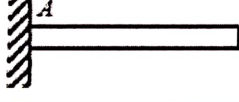
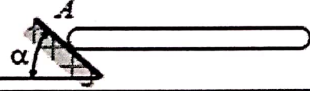

HOD'S SIGNATURE

Date: March, 2018

Question 1

- (a) State the principles of equilibrium. (2 marks)
- (b) State all the force and moment equilibrium equations. (3 marks)
- (c) Sketch the free body diagram and identify the unknown parameters of the original structures listed in Table Q1. (6 marks)

Table Q1: Boundary Conditions

	Original structure
Cable Support	
Roller support	
External Pin	
Pin Joint	
Fixed/Cantilever Support	
Smooth Support	

(d) The beam is subjected to a vertical force, a horizontal force and a heavy box of 30kN as shown in Figure Q1(d). Determine the reactions at the supports A and B. (4 marks)

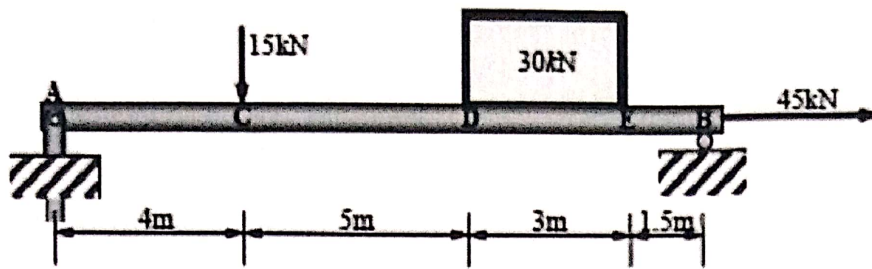


Figure Q1(d)

Question 2

(a) Determine the ground reactions at A and B of the structure shown in Figure Q2(a). (3 marks)

(b) Define the following terms: (i) Centre of gravity (ii) Centroid, (iii) Radius of gyration. (3 marks)

(c) Find the moment of inertia of the section shown in Figure Q2(c) about the centroidal axis X-X perpendicular to the web. (4 marks)

(d) State the law of parallelogram of forces. (2 marks)

(e) Prove that the Moment of inertia of a circular section about any reference axis passing through its centre is $\frac{\pi}{64}(d^4)$. (3 marks)

Question 3

(a) A body of weight 500N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by an effort P parallel to the plane as shown in Figure Q3(a). Determine the minimum and maximum values of P for which the equilibrium can exist, if the angle of friction is 20° . (4 marks)

(b) Two equal heavy spheres of 50 mm radius are in equilibrium within a smooth cup of 150 mm radius. Show that the reaction between the cup of one sphere is double than that between the two spheres. (4 marks)

(c) Two blocks A and B of weights 1kN and 2kN respectively are in equilibrium position as shown in Figure Q3(c). If the coefficient of friction between the two blocks as well as the block B and the floor is 0.3, Find the force (p) required to move the block B. (4 marks)

(d) A load of 500 N is lying on an inclined plane whose inclination with the horizontal is 30° . If the coefficient of friction between the load and the plane is 0.4, find the minimum and maximum horizontal force which will keep the load in equilibrium. (3 marks)

Question 4

(a) Explain the term acceleration and distinguish between uniform and variable acceleration. (3 marks)

(b) State Newton's first and second law for mechanics. (2 marks)

(c) A burglars car had a start with an acceleration of 2 m/s^2 . A police vigilant party came after 5 s and continued to chase the burglars car with a uniform velocity of 20 m/s. Find the time taken in which the police van will overtake the burglars car. (5 marks)

(d) Two electric trains A and B leaves the same station on parallel lines. The train A starts with a uniform acceleration of 0.2 m/s^2 and attains a speed of 45 kmph which is maintained constant afterwards. The train B leaves 1 minute after with a uniform acceleration of 0.4 m/s^2 to attain a maximum speed of 72 kmph which is maintained constant afterwards. When will the train B overtake the train A? (5 marks)

Question 5

(a) Three force $2P$, $3P$ and $4P$ act along the three sides of an equilateral triangle of side 100 mm taken in order. Find the magnitude and position of the resultant force. (3 marks)

(b) An inclined plane shown in Figure Q5(b) is used to unload slowly a safe weighing 400 N from a truck 1.2 m high into the ground. The coefficient of friction between the underside of the safe and the plank is 0.3 . State whether is necessary to push the safe down the plane or hold it back from sliding down. What minimum force is required parallel to the plane for this purpose? (4 marks)

(c) A uniform ladder of 4 m length rests against a vertical wall with which it makes an angle of 45° . The coefficient of friction between the ladder and the wall is 0.4 and that between the ladder and the floor is 0.5 . If a BEDC electricity service personnel whose weight is one-half of that of the ladder ascends it, how high will the man climbs the ladder before the ladder slips? (4 marks)

(d) The resultant of two the forces, when they act at an angle of 60° is 14 N . If the same forces are acting at right angle, their resultant is $\sqrt{136} \text{ N}$. Determine the magnitude of the two forces. (4 marks)

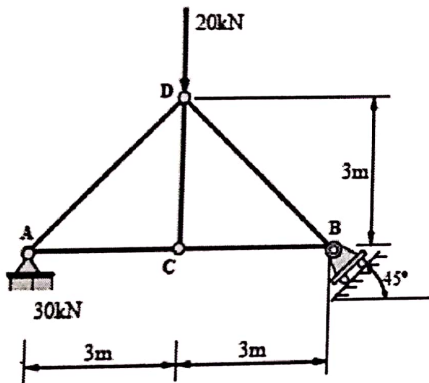


Figure Q2(a).

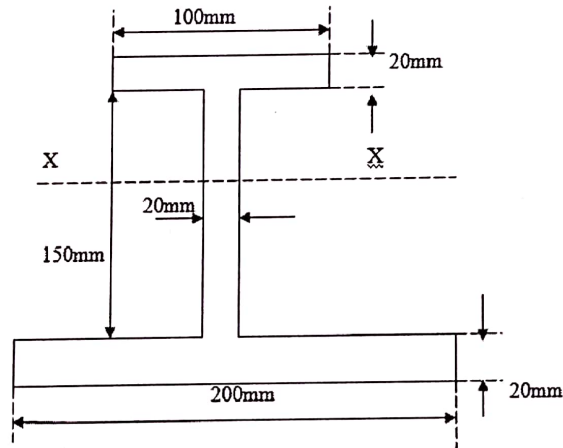


Figure Q2(c)

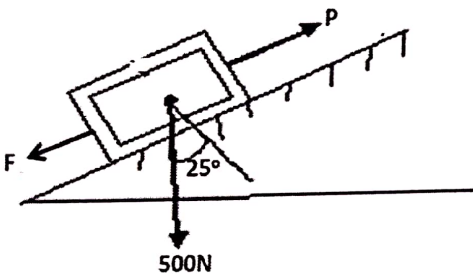


Figure Q3(a)

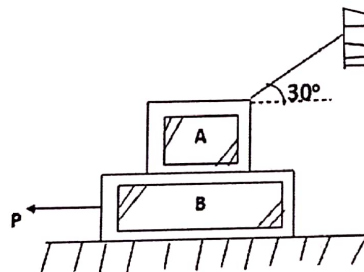


Figure Q3(c)

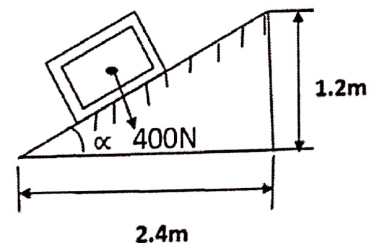


Figure Q5(b)