



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOME IN MARINE ENGINEERING (DMAE3)

EMR 2209 APPLIED MECHANICS I

END OF SEMESTER EXAMINATION

SERIES: DEC 2016 PAPER-A

TIME: 2 HOURS

DATE: 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

Do not write on the question paper.

Question ONE

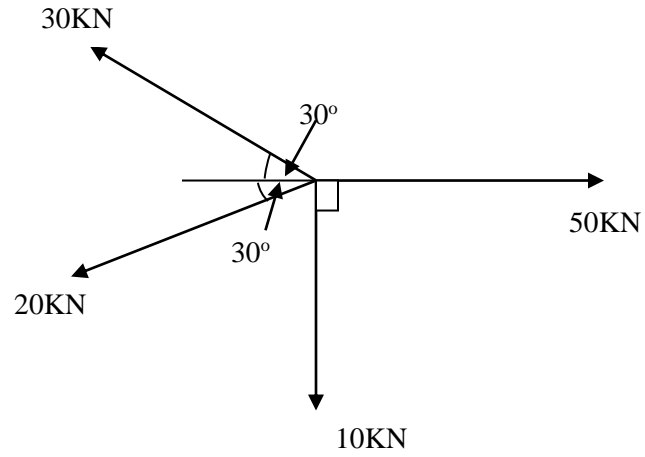
(a) Define the following terms:

- (i) Coplanar forces
- (ii) Couple
- (iii) Concurrent forces

(6 Marks)

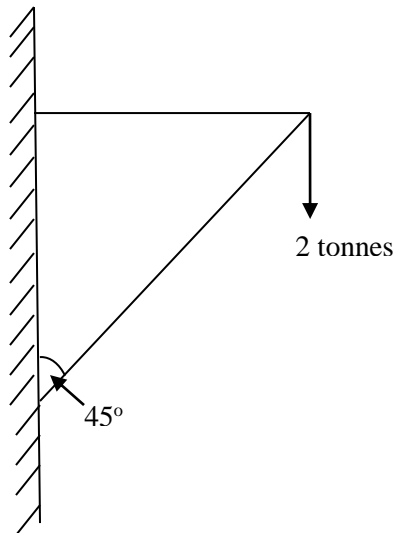
(b) Four forces of magnitudes 50KN, 30KN, 20KN and 10KN are acting at a point O as shown in the figure below. Determine, by drawing polygon of the forces, the value of the resultant force and its direction.

(8 Marks)



- (c) The figure below shows a wall crane which carries a maximum load of 2 tonnes. Determine the forces in the two members (links) of the cranes.

(6 Marks)



Question TWO

- (a) A car starts from rest and accelerates uniformly for a period of 12 seconds. It travels at a constant velocity for the next 8 minutes after which it comes to rest in a further 15 seconds. The total distance travelled by the car is 3.5Km. Sketch a velocity-time graph for the journey and determine:
- The constant velocity
 - The acceleration
 - The average retardation

(10 Marks)

- (b) A ball is projected upwards at an angle of 30° to the horizontal from the top of a tower which is 50m above the ground. If the initial velocity of the ball is 20m/s and air resistance is neglected, calculate:
- The time of flight
 - The horizontal range
 - The velocity and the angle with which the ball hits the ground

(10 Marks)

Question THREE

- (a) Define simple harmonic motion and with the aid of suitable diagrams, illustrate **THREE** types of this kind of motion.

(7 Marks)

- (b) A body performing simple harmonic motion has a velocity of 12 m/s when the displacement is 50mm and 3 m/s when the displacement is 100m, the displacement being measured from the mid-point. Calculate the following:
- Amplitude of the motion.
 - Frequency of the motion.

(iii) The acceleration when the displacement is 75mm.

(9 Marks)

(c) A wheel rotating about a fixed axis at 30rev/min is uniformly accelerated for 50 seconds during which it makes 40 revolutions. Find:

- (i) Angular velocity at the end of the interval.
- (ii) The time required for the speed to reach 80rev/min.

(4 Marks)

Question FOUR

- (a) (i) Distinguish between Momentum and Impulse of a force.
(ii) State the principle of conservation of momentum.

(4 Marks)

(b) Two trucks travelling in the same straight line collide and remain locked together after impact. Truck A has a mass of 100Kg and has a velocity of 12 m/s due east. Truck B has a mass of 150Kg and has a velocity of 6 m/s due west. Determine:

- (i) The magnitude and direction of the velocity of the trucks after impact.
- (ii) The total kinetic energy of the trucks:
 - Before impact
 - After impact

(6 Marks)

(c) A mass of 700Kg falling 0.2m from up is used to drive a pile of mass 500Kg into the ground. The pile is driven 75mm into the ground. If there is no rebound, find the:

- (i) Common velocity of pile and the pile hammer after impact.
- (ii) Loss of kinetic energy on impact.
- (iii) Efficiency of the pile driving operation.

(10 Marks)

Question FIVE

- (a) State the **FOUR** laws of solid friction.

(4 Marks)

- (b) A man wishing to slide a block of weight 100N over a horizontal concrete floor, ties a rope to the block and pulls it in a direction inclined upwards at an angle of 20° to the horizontal. Calculate the minimum pull necessary to slide the block if the coefficient of friction, $\mu=0.6$.

(5 Marks)

- (c) Determine the force required to push a block of weight 150N up an incline of 45° when the force is:
- (i) Parallel to the incline
 - (ii) Horizontal

Take coefficient of friction, $\mu=0.5$.

(11 Marks)

