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-B

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. Attemptany THREE questions.

Do not write on the question paper.

Question ONE

(a) Define the following terms:

(i) Mechanics

(ii) Moment of a force

(iii) Couple

(6 Marks)

(b) Three forces of magnitudes 40KN, 15KN and 20KN are acting at a point O. The angles made by the 40KN, 15KN and 20KN forces with the X-axis are 60^o, 120^o, and 240^o respectively. By graphical method, determine the magnitude and direction of the resultant.

(8 Marks)

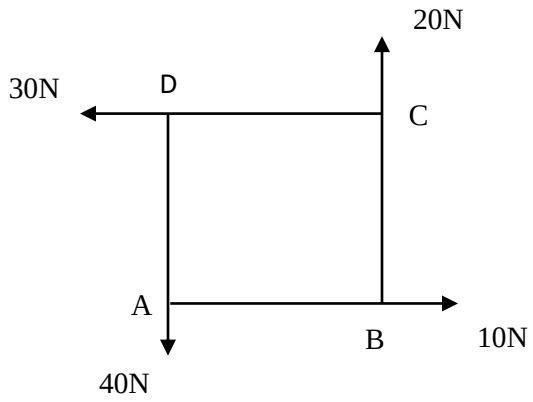
(c) Four forces of magnitudes 40KN, 10N, 20N and 30N are acting along the four sides of a square ABCD as shown below. Each side is 1.5m. Determine:

(i) The resultant moment about A.

(ii) The magnitude of the resultant force.

(iii) The direction of the resultant, i.e. the angle the resultant makes with the horizontal.

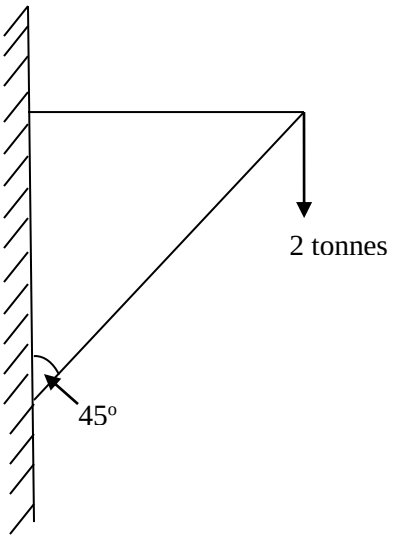
(6 Marks)



Question TWO

(a) 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)



(b) 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:

(i) The constant velocity

(ii) The acceleration

(8 Marks)

(c) A shell is fired vertically upwards at a velocity **u** m/s from the ground. If the shell reaches a maximum height of 1000m above the ground, determine:

(i) The actual initial velocity, **u**.

(ii) The time the shell will take to pass a point 480m above the ground while going up and while coming down

(6 Marks)

Question THREE

(a) Define the following terms and state the SI units for each:

(i) Centrifugal acceleration

(ii) Angular acceleration

(4 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:

(i) Amplitude of the motion.

(ii) Frequency of the motion.

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

(9 Marks)

(c) An electric motor, initially at rest, is caused to rotate with uniform angular acceleration of 31.42 rad/s^2. Find, after 3 seconds from the beginning of rotation:

(i) The speed of rotation of the motor in rev/min.

(ii) The number of revolutions through which the motor has turned.

(7 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 pile driver of mass 1.5 tonnes falls freely through a distance of 2m on to a pile whose mass is 0.5 tonnes. When the pile is nearly fully driven, the average resistance to motion is 800 KN. Determine the penetration per blow at this stage and the kinetic energy lost at impact.

(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^o 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^o when the force is:

(i) Parallel to the incline

(ii) Horizontal

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

(11 Marks)