



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Mechanical Engineering
EME 2102: Mechanical Engineering Science I
SPECIAL/ SUPPLEMENTARY EXAMINATION
SERIES: AUGUST 2019
TIME: 2 HOURS
DATE: Pick Date Aug 2019

Instruction to Candidates:

You should have the following for this examination

- *Student I.D. Card & Examination Pass*
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE (Compulsory)

a) Define the following terms as applied in Engineering science;

- Equilibrant
- Concurrent forces
- Resultant
- Coplanar forces

(6 marks)

b) Explain briefly the assumptions made when solving problems in frameworks.

(4 marks)

c) A truss of span 10m is loaded as shown in **Figure 1**. Determine the reactions, forces in the members and state each member's senses.

(10 marks)

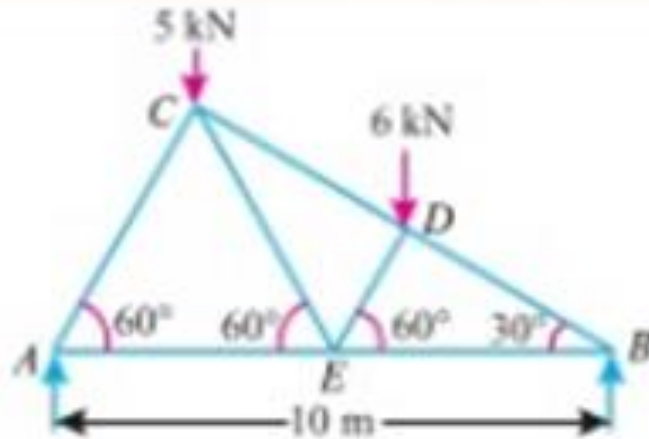


Figure 1

Question TWO

- a) A tennis player serves a ball with a speed of 30 m/s. The ball leaves the racquet from a height of 2.5 m and a horizontal distance of 13.5 m from the net. The height of the net is 1.2 m.
- i. If the ball leaves the racquet horizontally, determine whether the ball will clear the net.
 - ii. If the ball leaves the racquet at an angle of 10° below the horizontal, determine whether the ball will clear the net.
 - iii. What is the minimum angle at which the ball must leave the racquet for it to clear the net?

(10 marks)

- b) **Figure 2** shows a system of coplanar forces. Determine the magnitude and direction of the resultant force.

(10 marks)

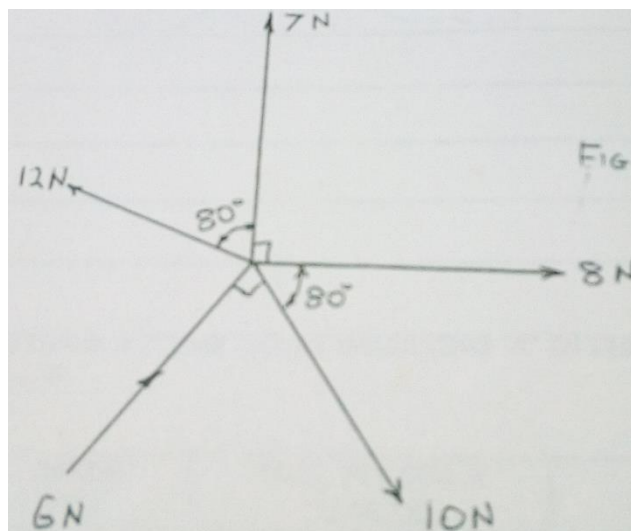


Figure 2

Question THREE

- a) An air rifle that shoots pellets with a speed of 100 m/s is to be aimed at an apple placed 100 m away. The centre of the apple is at the same height as the muzzle.
- At what angle above the horizontal must the rifle be pointed so that the pellet hits the apple dead center?
 - How high above the centre of the apple should the rifle be aimed?
 - What is the maximum vertical displacement of the pellet when it follows the required trajectory?
 - What is the velocity of the pellet 0.25 sec before it hits the target?
- (10 marks)
- b) A flywheel 1.2 m in diameter is uniformly accelerated from rest and revolves completely sixty times in reaching a speed of 120 revolutions per minute. Determine:
- The time taken
 - The angular acceleration
 - The linear acceleration of a point on the rim.

(10 marks)

Question FOUR

- a) The engine mechanism shown in **Figure 3** has a crank 200 mm and connecting rod 500 mm long. If the crank speed is 50 revolutions per second clockwise, determine for the position shown:
- The piston velocity
 - The angular velocity of the connecting rod
 - The velocity of a point C on the rod 200 mm from the crankpin.

(12 marks)

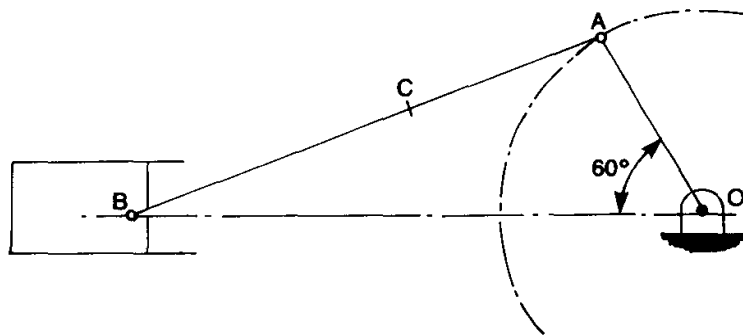


Figure 3

- b) Two trains pass each other on parallel tracks. The first train is 180 m long and travels at 60 km/h, the second is 120 m long and travels at 40 km/h. Calculate the total time taken to pass each other completely:
- If travelling in the same direction
 - If travelling in opposite directions.

(8 marks)

Question FIVE

A beam carries a dead load of 200 kg and is subject to a vertical force of 2 kN and to an inclined force of 1 kN acting at the points shown in **Figure 4**. The beam is encastre, i.e. built in to a wall, at each end and due to the fixing there are moments of 2 kN·m and 1.6 kN·m acting in the directions shown. Determine the reactions R, L and H. (20 marks)

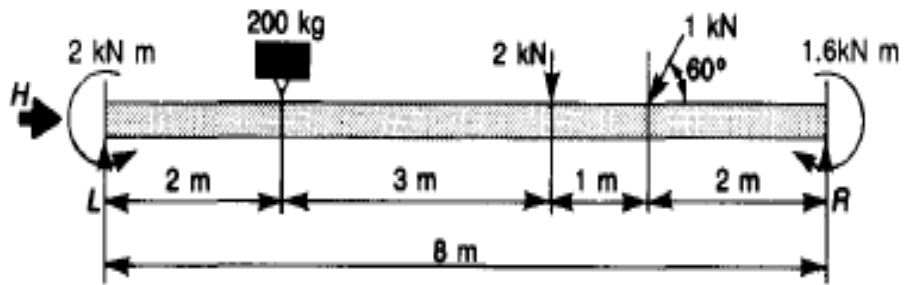


Figure 4