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
END OF SEMESTER 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*
- *A2 size Drawing paper*
- *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 Mechanical Engineering science; **(6 marks)**
   Resultant
   Coplanar forces
   Equilibrant

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 the sense of the force in each member. **(10 marks)**

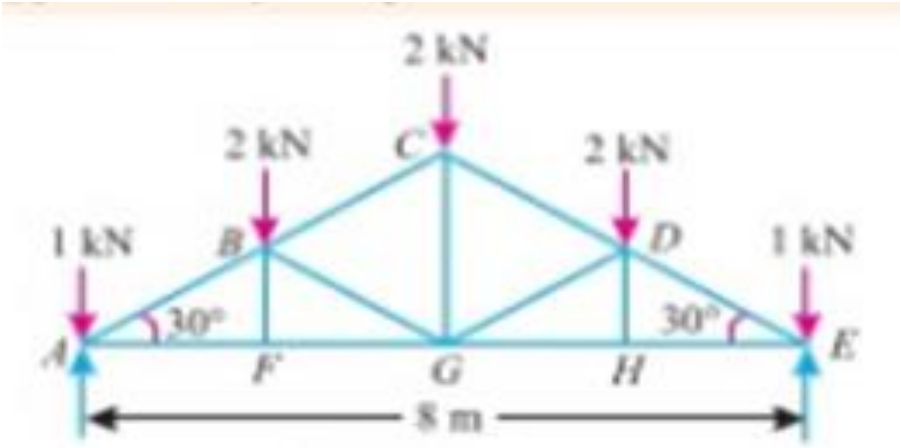

Figure 1

Question TWO

a) State the THREE Newton's laws of motion. **(6 marks)**

b) The simple crack and connecting rod mechanism in **Figure 2** has a crank 50 mm long and the connecting rod is 350 mm long. When the crank is 30^{o} from the top dead centre position;

i. Find the velocity and acceleration of the piston at 10 revolutions per second.

ii. Assuming the motion of the piston to be simple harmonic, determine the maximum velocity and acceleration of the piston.

(14 marks)

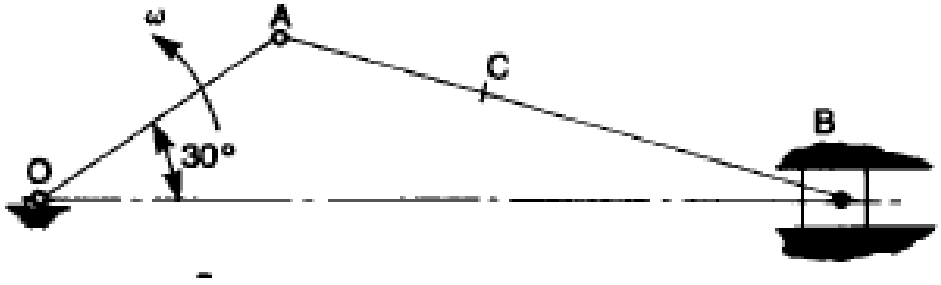

Figure 2

Question THREE

a) Analysis of the loading on a beam shows that it is subjected to couples of 5 kN·m, 10 kN·m and 20 kN·m acting in the planes shown in **Figure 3**. The beam carries a mass of 1Mg which may be assumed to be supported at a single point 2m from the right-hand end, and is also subjected to a force of 2 kN inclined at 45˚ to the beam as shown. Determine:

i. The vertical force **L**.

ii. The magnitude and directions of the vertical and horizontal forces required at the right –hand end to maintain equilibrium.

(10 marks)

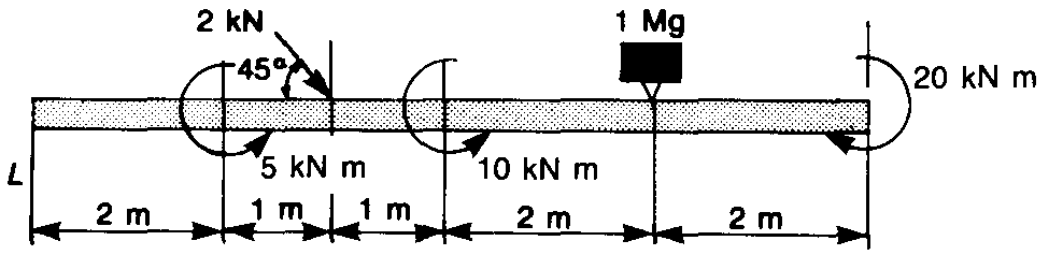

Figure 3

b) A bowling ball is thrown downward at 22 m/s from a balcony on the Tower of Pisa that is 18 m above the ground.

i. What will its speed be when it reaches the ground?

ii. How long will it take to reach the ground?

(10 marks)

Question FOUR

a) The driver of a train shuts off the power and the train is then uniformly retarded. In the first 30 seconds the train covers 110 meters and it then comes to rest in a further 30 seconds. Determine:

i. The initial speed of the train before power is cut off.

ii. The total distance travelled in coming to rest.

(10 marks)

b) **Figure 4** shows a system of coplanar forces. Determine the magnitude and direction of the resultant force. **(10 marks)**

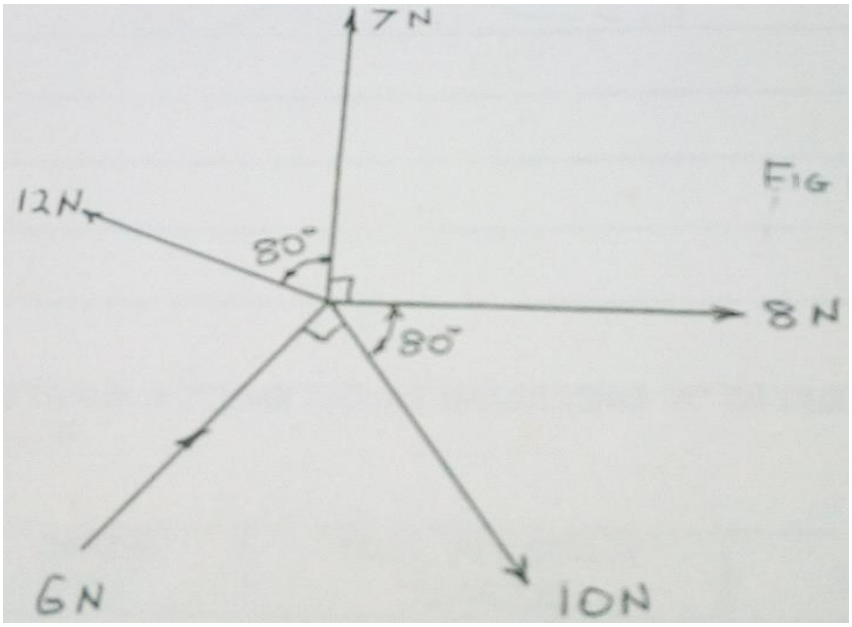

Figure 4

Question FIVE

a) The power to a shaft was shut off and the shaft described 120 revolutions in the first 30 seconds. The shaft then finally came into rest in further 30 seconds. If the retardation was uniform, calculate the initial angular velocity in revolutions per minute and the retardation in radians per second squared. **(10 marks)**

b) State three parameters an object must have to be a true projectile. **(3 marks)**

c) A football is thrown with an initial speed of 25.0 m/s at an angle of 32˚ from the ground.

   i. How far will the ball fly before hitting the ground?

   ii. What will be the maximum height reached by the ball?

(7 marks)