



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING (TVET)

MECHANICAL ENGINEERING SCIENCE

DATE:

TIME:

INSTRUCTIONS

This paper contains FIVE questions

Answer all questions.

QUESTION ONE

- (a) State the following theorems with reference to forces
- (i) Parallelogram law of forces. (2 marks)
 - (ii) Triangle law of forces. (2 marks)
- (b) Find the magnitude and direction of the resultant force for the following forces 8N, 12N, 15N and 20N making angles of 130° , 85° , 50° and 320° respectively from a fixed point. (6 marks)
- (c) A vehicle covers a distance of 2km while travelling with uniform velocity of 70km/h. It is then uniformly accelerated and covers a distance of 400m in 15 seconds. The vehicle then decelerates uniformly to rest in a time of 40 seconds. Sketch the velocity – Time graph for this motion and determine;
- (i) Acceleration and deceleration of the vehicle.
 - (ii) Total distance covered.
 - (iii) Average velocity for the whole journey. (10 marks)

QUESTION TWO

- (a) The figure below shows a system of forces acting on a particle. Determine by analytical method of resolution of forces the magnitude and direction of their resultant force. (10 marks)
- (b) Four members of a frame structure meet at a joint as shown below. If the joint is in equilibrium, Determine graphically the magnitude of the forces P and Q in the members shown. (10 marks)

QUESTION THREE

- (a) Define the following terms, giving their units of measurements.
- (i) Law of moments. (2 marks)
 - (ii) Moment of a force (2 marks)
- (b) A uniform steel beam of mass 200kg and a length of 8m is supported at each of its ends by vertical columns. The beam carries loads of 1000kg and 2500kg acting respectively 2m and 6m from the left end support. Calculate the reaction force at each supporting column. Take g as 9.81N/kg . (6 marks)
- (c) A uniform beam AB 3m long is simply supported at its ends. The force due to gravity on the beam is 2kN and loads of 3kN and 5kN are placed on the beam at distances of 0.5m and 2m respectively from end A. Where must an additional load of 2kN be placed in order to make the support reactions equal. (10 marks)

QUESTION FOUR

- (a) Determine graphically then magnitude and direction of the resultant force for the system of forces shown below. (10 marks)
- (b) A uniform beam 4m long is simply supported at two points A and B, point A being 0.5m from the left hand end and B 1.5m from the right hand end. The beam carries loads of 600N at the left hand end, 800N at the centre and 400N at the right hand end. Determine;
- (i) The magnitude of the support reactions at A and B. (5 marks)
 - (ii) At what point should the load of 800N be applied to make the support reactions equal. (5 marks)

QUESTION FIVE

- (a) A vehicle travelling at a constant velocity of 45km/h maintains this speed for $2\frac{3}{4}$ minutes before it is uniformly accelerated to 180km/h in 25 seconds. It is then brought to rest uniformly in a further distance of 150m. Draw a velocity – Time graph and determine;
- (i) Total distance travelled.
 - (ii) Deceleration of the vehicle.
 - (iii) Average velocity of the vehicle. (10 marks)

- (b) The armature of an electric motor is rotating at 5000rev/min. The motor come to rest in 10 seconds after the current is switched off. Calculate;
- (i) The average angular retardation of the armature. (5 marks)
 - (ii) The number of revolutions made by the armature after the current is switched off. (5 marks)