TEVETA

Technical Education, Vocational and Entrepreneurship Training Authority

DIPLOMA IN BIOMEDICAL ENGINEERING

LEVEL 6 YEAR 1 EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATIONS

SITTING: JULY/AUGUST 2025

SUBJECT: ENGINEERING SCIENCE

TIME: THREE (3) HOURS **TOTAL MARKS: 100**

INSTRUCTIONS TO CANDIDATE **PASS MARK: 50**

1. Write your Examination number and National Registration Card (NRC) number on the answer booklet provided. Ensure you append your signature in the space provided on the answer booklet.
2. Write the ANSWER SCRIPT SERIAL NUMBER on the examination register and on the entry slip.
3. This paper has EIGHT (8) questions. Answer FIVE (5) questions.
4. Diagrams may be used where necessary to clarify your answer.
5. Cell phone and programmable calculators are not allowed in the examination room

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

QUESTION ONE

(a) Express the following in prefix form

(i) 5.7×10^{-8}s **[3 Marks]**

(ii) 1.25×10^{-10}F **[3 Marks]**

(iii) 9×10^{10}Hz **[3 Marks]**

(b) Reduce the SI units of force multiplied by the SI units of distance to the simplest form. **[4 Marks]**

(c) Show the correctness of the following equations dimensionally

(i) $Energy = \frac{1}{2} mass\ x\ velocity^{2}$ **[4 Marks]**

(ii) $Force = mass\ x\ velocity$ **[3 Marks]**

[Total: 20 Marks]

QUESTION TWO

(a) Define the term acceleration due to gravity. **[2 Marks]**

(b) A particle is thrown vertically upwards with a velocity of 20 m/s.
Calculate:

(i) The time taken to reach the maximum height **[3 Marks]**

(ii) The total distance covered **[4 Marks]**

(iii) The total displacement **[2 Marks]**

(iv) The velocity when it is half way the rise **[4 Marks]**
(Ignore air resistance)

(c) Calculate the minimum net average force required to increase the velocity of a particle of mass 600 kg from 30 km/h to 60 km/h in 6.0 s. **[5 Marks]**

[Total: 20 Marks]

QUESTION THREE

(a) Calculate the resultant of a vector system acting on a common point when a 10 N is acting horizontally to the right and an 8 N incline at 30° upwards above the 10 N force. **[8 Marks]**

(b) Calculate the magnitude of the torque exerted on a wheel of diameter d = 0.60 m by a tangential force F = 960 N on its rim. **[3 Marks]**

(c) The system shown in **Figure Q3 (c)** is in equilibrium.

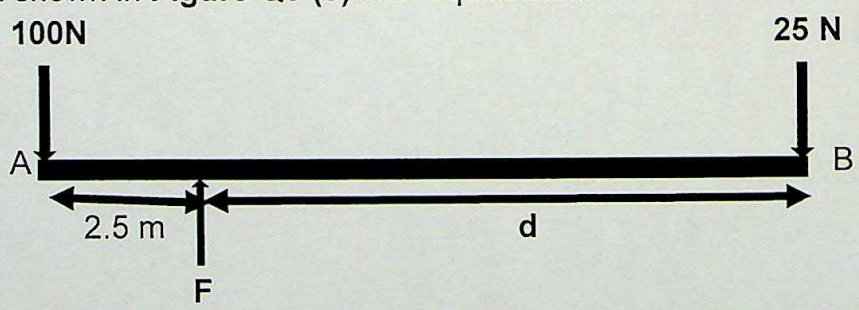


Figure Q3 (c)

Calculate:

(i) The magnitude of the force **F** **[4 Marks]**

(ii) The distance **d** **[5 Marks]**

[Total: 20 Marks]

QUESTION FOUR

(a) Levers belong to **three (3)** classes

State:

(i) the three (3) classes of levers. **[3 Marks]**

(ii) two (2) examples of each class **[6 Marks]**

(b) A chain hoist has upper pulleys of diameter of 20 cm and 16 cm and an efficiency of 92 % is used to raise a 100 kg machine through 1.00 m.

Calculate:

(i) The length of the belt that must be pulled through the system by the applied force. **[6 Marks]**

(ii) The minimum applied force required **[5 Marks]**

[Total: 20 Marks]

QUESTION FIVE

(a) Define the meaning of the following terms:

(i) Heat **[2 Marks]**

(ii) Temperature **[2 Marks]**

(b) Convert 362 °C to Fahrenheit **[4 Marks]**

If 0.430 kg of copper at 200°C are added to a 100 g glass calorimeter that contains 500 g of water at 20°C and there are no external heat influences, calculate the final temperature in equilibrium given that the specific heat capacities are

For copper: $C_{cu} = 390 \frac{J}{kg.K}$

For glass: $C_{glass} = 880 \frac{J}{kgK}$

For water: $C_{water} = 4186 \frac{J}{kg.K}$

[12 Marks]

[Total: 20 Marks]

QUESTION SIX

(a) Define the following terms:

(i) Tensile force **[2 Marks]**

(ii) Compressive force **[2 Marks]**

(iii) Shear force **[2 Marks]**

(b) Calculate the tensile stress in a nylon rope that has a diameter d = 1.2 cm when it is used to lift a 75 kg load. **[5 Marks]**

(c) A coil of elastic spring is stretched 2.00 cm when a 5.00 kg load is suspended from it

Calculate the:

(i) Force constant **[5 Marks]**

(ii) Elongation produced when a mass of 8 kg is attached at its free end. **[4 Marks]**

[Total: 20 Marks]

QUESTION SEVEN

(a) State Hooke's law. **[2 Marks]**

(b) A 3.0 m wire with a diameter of 1.5 mm is elongated by 0.60 mm when a 6.0 kg load is hung from one end.
Calculate the:

(i) Tensile stress induced **[4 Marks]**

(ii) Strain induced **[3 Marks]**

(iii) Young's modulus of elasticity of the wire used **[4 Marks]**

(c) Draw a well – labelled graph showing the variation of load and extension of a material that obeys Hooke's law up to fracture. **[7 Marks]**

[Total: 20 Marks]

QUESTION EIGHT

(a) Explain the effects of environmental factors on the degradation of materials. **[5 Marks]**

(b) Describe the following non-destructive material testing

(i) Visual **[5 Marks]**

(ii) Dye penetrant **[5 Marks]**

(iii) Ultrasonic **[5 Marks]**

[Total: 20 Marks]