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TEVETA
Technical Education, Vocational and Entrepreneurship Training Authority

# DIPLOMA IN PRODUCTION AND OPERATIONS MANAGEMENT

## LEVEL 6 YEAR I EXAMINATIONS

## FINAL INTEGRATED SUMMATIVE EXAMINATION

## SITTING: JULY/AUGUST 2025

## SUBJECT: ENGINEERING SCIENCE

**TIME: 3 HOURS** **TOTAL MARKS: 100**

**PASS MARK: 50**

## INSTRUCTIONS TO THE CANDIDATE

1. Write your examination number and national registration card number on the answer booklet provided. Ensure to append your signature in the space provided on the answer booklet.
2. Write your answer SCRIPT SERIAL NUMBER on the examination register provided and the entry slip.
3. There are TWO (2) Sections in this paper, Sections A and B.
4. Section A consists of TEN (10) multiple choice questions carrying TWO (2) marks each. Answer all questions in this section.
5. Section B has SIX (6) questions. Answer question TWO (2) which is compulsory and any other FOUR (4) questions of your choice from the remaining FIVE (5)
6. Use pencils and graph papers (provided) for drawings and graphs.
7. Cell phones are not allowed in the examination room.

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

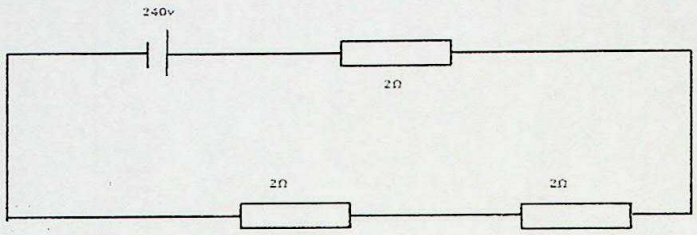
## SECTION A MULTIPLE CHOICE QUESTIONS

## ANSWER ALL QUESTIONS IN THIS SECTION

### QUESTION 1

**Write the letter of the correct answer in the answer booklet provided.**

1.1 The diagram below shows an electric circuit. Calculate the total resistance.




a) $\frac{4}{3}\ \Omega$

b) 0.75 Ω

c) 6 Ω

d) 8 Ω (2 marks)

1.2 Calculate the total current in question 1.1.

a) 320 A

b) 40 A

c) 30 A

d) 180 A (2 marks)

1.3 A force of 100 N is applied to the rim of a pulley wheel of diameter 200 mm. The torque is:

a) 2 N m

b) 20 kN m

c) 10 N m

d) 20 N m (2 marks)

1.4 A motor has an efficiency of 25% when running at 3000 rev/min. If the output torque is 10 N m, the power input is:

a) $4\pi$ kW

b) $0.25\pi$ kW

c) $15\pi$ kW

d) $75\pi$ kW (2 marks)

1.5 A lorry of mass 1350 kg accelerates uniformly from 9 km/h to reach a velocity of 45 km/h in 18 s. Calculate the acceleration of the lorry

a) 5.56 $m/s^2$

b) 0.556 $m/s^2$

c) 55.6 $m/s^2$

d) 556 $m/s^2$ (2 marks)

1.6 Determine the heat energy required to change 8 kg of water at 100 °C to superheated steam at 100 °C. Assume the specific latent heat of vaporization of water is 2260 kJ/kg.

a) 18.08 MJ

b) 18.08 MJ

c) 1.808 KJ

d) 1.808 MJ (2 marks)

1.7 An engine is travelling along a straight, level track at 15 m/s. The driver switches off the engine and applies the brakes to bring the engine to rest with uniform retardation in 5 s. The retardation of the engine is:

a) 4 $m/s^2$

b) $\frac{1}{3} m/s^2$

c) $3 \frac{m^2}{s}$

d) 75 $m/s^2$ (2 marks)

1.8 A car is travelling at 64.8 km/h and has wheels of diameter 600 mm. Find the angular velocity of the wheels in both rad/s

a) 6 rad/s

b) 60 rad/s

c) 600 rad/s

d) 6000 rad/s (2 marks)

1.9 A machine using a power of 1 kW requires a force of 100 N to raise a mass in 10 s. The height the mass is raised in this time is:

a) 100 m

b) 1 km

c) 10 m

d) 1 m (2 marks)

1.10 A small motor requires 50 W of electrical power in order to produce 40 W of mechanical energy output. The efficiency of the motor is:

a) 10%

b) 80%

c) 40%

d) 90% (2 marks)

**Total (20 marks)**

**SECTION B**

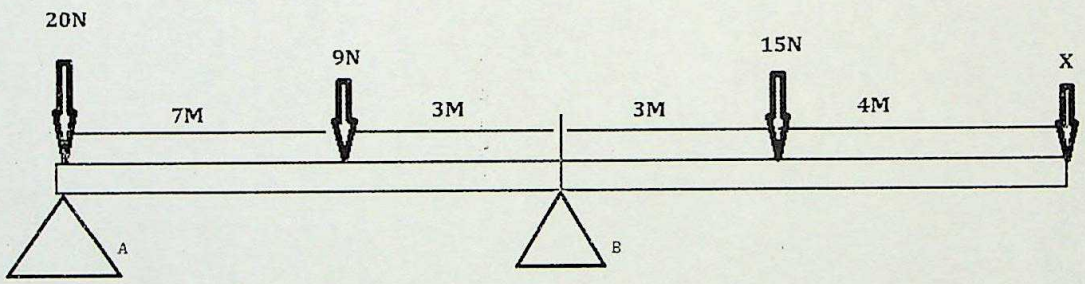
**ATTEMPT QUESTION TWO (2) AND ANY OTHER FOUR (4) QUESTIONS.**

**QUESTION 2 (COMPULSORY)**

a) Define Moment. (2 Marks)

b) The diagram below shows the Moment. Calculate the reaction force $R_A$ and $R_b$.

(8 Marks)




c) A moment of 25 N m is required to operate a lifting jack. Determine the effective length of the handle of the jack if the force applied to it is:

i. 130 N. (2 Marks)

ii. 0.8 kN. (2 Marks)

d) A moment of 7.5Nm is required to turn a wheel. If a force of 37.5N is applied to the rim of the wheel, calculate the effective distance from the rim to the hub of the wheel.

(6 Marks)

**Total (20 Marks)**

**QUESTION 3**

a) Define efficiency in terms of energy input and energy output. (2 marks)

b) Explain the difference between transverse wave and longitudinal wave. (6 marks)

c) Describe energy and its Unit. (4 marks)

d) State Hooke's Law. (2 marks)

e) Describe **three (3)** methods of power transmission commonly used in a vehicle.

(6 marks)

**Total (20 marks)**

**QUESTION 4**

a) Define the following terms:

i. Conduction. (2 mark)

ii. Convection. (2 mark)

iii. Radiation. (2 mark)

b) 273kJ of heat energy are required to raise the temperature of 10 kg of copper from 15 °C to 85°C. Determine the Specific Heat Capacity of copper. (4 Marks)

c) Convert the following temperatures into Fahrenheit:

i. 37 °k (2 Marks)

ii. −28 °k (2 Marks)

iii. 58 °k (2 Marks)

d) 5.7 of heat energy are supplied to 30 kg of aluminium that is initially at a temperature of 20 °C. If the specific heat capacity of aluminium is 950 J/(kg °C), determine its final temperature. (4 Marks)

**Total (20 marks)**

**QUESTION 5**

a) Describe the following terms:

i. Strength. (2 Marks)

ii. Elasticity. (2 Marks)

iii. Ductility. (2 Marks)

b) A split pin requires a force of 400 N to shear it. The maximum shear stress before shear occurs is 120 MPa. Determine the minimum diameter of the pin. (4 Marks)

c) A circular bar is 2.5 m long and has a diameter of 60 mm. When subjected to a Compressive load of 30 kN. It shortens by 0.20 mm. Determine Young's modulus of elasticity for the material of the bar. (6 Marks)

d) A circular piston exerts a pressure of 80 kPa on a fluid, when the force applied to the piston is 0.2 kN. Find the diameter of the piston. (4 Marks)

**Total (20 Marks)**

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**QUESTION 6**

a) State Newton's First Law of Motion. (2 mark)

b) Describe the following terms:

i. Acceleration. (2 marks)

ii. Velocity. (2 marks)

iii. Displacement. (2 marks)

c) Calculate the force needed to accelerate a boat of mass 20 tonnes uniformly from rest to a speed of 21.6 km/h in 10minutes. (4 marks)

d) A lorry of mass 1350 kg accelerates uniformly from 9 km/h to reach a velocity of 45 km/h in 18 s. Determine:

i. The acceleration of the lorry. (4 marks)

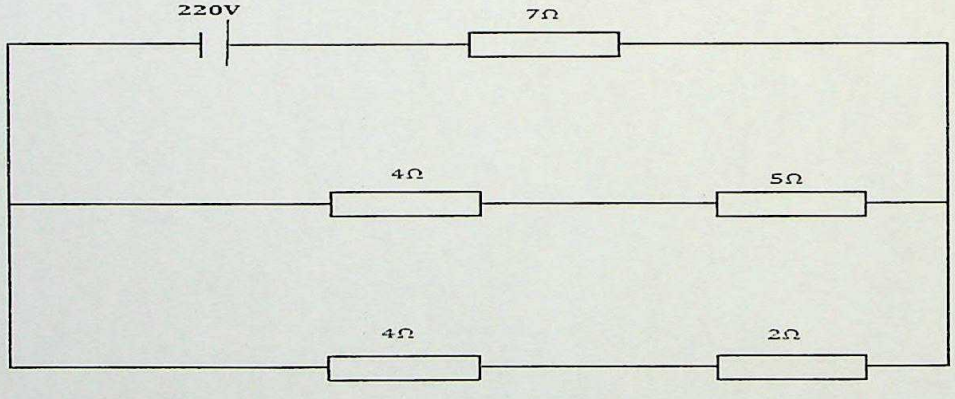
ii. The uniform force needed to accelerate the lorry. (4 marks)

**Total (20 marks)**

**QUESTION 7**

a) Define electricity. (2 marks)

b) The diagram below shows an electrical circuit.




i. Calculate the total resistance in the circuit. (8 Marks)

ii. Find the Current (5 Marks)

iii. Power (5 Marks)

**Total (20 Marks)**