31.4.12.24

TEVETA

Technical Education Vocational and Entrepreneurship Training Authority

DIPLOMA IN PRODUCTION AND OPERATIONS MANAGEMENT

LEVEL 6 YEAR I EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATION

SITTING: NOVEMBER/DECEMBER 2024

SUBJECT: ENGINEERING SCIENCE

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

PASS MARK: 50

INSTRUCTIONS TO CANDIDATES

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 three (3) questions from the remaining.
6. Use pencils and graph paper (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 by writing the letter of the correct answer in the Answer Booklet provided.

QUESTION 1

1.1 Convert 120 km/h to m/s

a) 432 m/s

b) 33.3 m/s^2

c) 432 m/s^2

d) 33.3 m/s (2 marks)

1.2 The SI units for temperature is:

a) Degree Celsius

b) Kelvins

c) Fahrenheit

d) Temperature (2 marks)

1.3 Calculate the work done when a mass is lifted vertically by a crane to a height of 5cm, the force required to lift the mass being 98 N.

a) 490 J

b) 4.9 J

c) 19.6 J

d) 1960 J (2 marks)

1.4 If a car accelerates from rest, the acceleration is defined as the rate of change of:

a) Energy

b) Mass

c) Displacement

d) Velocity (2 marks)

1.5 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 m/s^2

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

1.6 Which of the following statements is false?

a) Scalar quantities have size or magnitude only

b) Vector quantities have both magnitude and direction

c) Mass, length and time are all scalar quantities

d) Distance, velocity and acceleration are all vector quantities (2 marks)

1.7 A machine exerts a force of 100N in lifting a mass through a height of 5m. If 1 kJ of energy is supplied, the efficiency of the machine is:

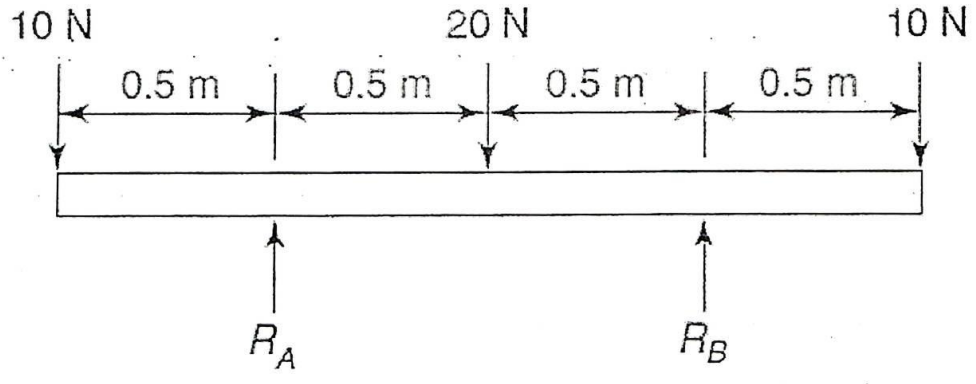
a) 10%

b) 20%

c) 100%

d) 50% (2 marks)

1.8 With reference to the diagram below when moments are taken about the right-hand end, the sum of the clockwise moments is:



a) 10 Nm

b) 20 Nm

c) 30 Nm

d) 40 Nm (2 marks)

1.9 A wire is stretched 3mm by a force of 150 N. Assuming the elastic limit is not exceeded, the force that will stretch the wire 5mm is:

a) 150 N

b) 250 N

c) 90 N

d) 450 N (2 marks)

1.10 A container holds water of density 1000 kg/m3. Taking the gravitational acceleration as 10 m/s2, the pressure at a depth of 100 mm is:

a) 1 kPa
b) 1 MPa
c) 100 Pa
d) 1 Pa (2 marks)

Total (20 marks)

SECTION B

Answer question **two (2)** which is compulsory and any other **three (3)** questions of your choice.

QUESTION 2 - COMPULSORY

a) Explain the following terms in relation to strength of materials:

i) Shear Stress (4 marks)
ii) Compressive Stress (4 marks)
iii) Tensile Stress (4 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. (8 marks)

Total (20 Marks)

QUESTION 3

a) With the aid examples in each case, explain five (5) types of mechanical force that can act on a body. (10 marks)

b) A metal bar 2.5 m long extends by 0.05 mm when a tensile load is applied to it. Determine

i) The Strain (5 marks)
ii) The Percentage Strain (5marks)

Total (20 marks)

QUESTION 4

a) Define the following terms:

i) Efficiency (2 marks)
ii) Work (2 marks)
iii) Power (2 marks)

b) 4kJ of energy is supplied to a machine used for lifting a mass. The force required is 800 N. If the machine has an efficiency of 50%, to what height will it lift the mass? (4 marks)

c) To what height will a mass of weight 981 N be raised in 40 s by a machine using a power of 2 kW? (4 marks)

d) 10 kJ of work is done by a force in moving a body uniformly through 125 m in 50 s. Determine:

i) The Value of the Force (3 marks)

ii) The Power. (3 marks)

Total (20 Marks)

QUESTION 5

a) Explain the difference between Velocity and Acceleration. (4 marks)

b) A cyclist accelerates uniformly at 0.3m/S^2 for 10 s, and his speed after accelerating is 20 km/h. Calculate his initial speed. (4 marks)

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

d) The speed of a shaft increases uniformly from 300 revolutions per minute to 800 revolutions per minute in 10s. Find the angular acceleration. (4 marks)

e) 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)

QUESTION 6

a) Define Electricity. (2 marks)

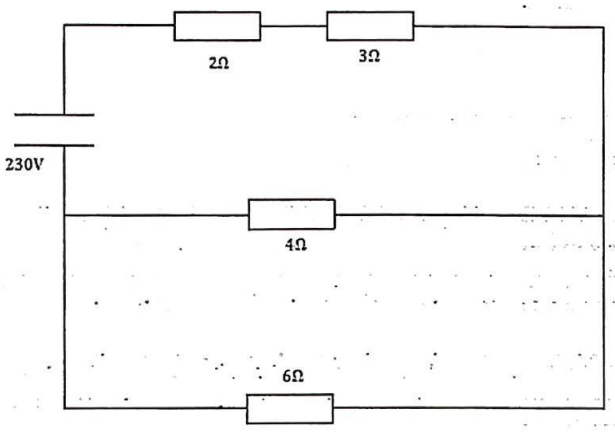
b) Explain the following terms:

i. Voltage (3 marks)

ii. Current (3 marks)

iii. Resistance (3 marks)

c) The diagram below shows an electrical circuit.



Calculate:

i. Total Resistance in the circuit (3 marks)

ii. The Current (3 marks)

iii. Total Power (3 marks)

Total (20 Marks)

QUESTION 7

a) Distinguish between heat and temperature. (3 marks)

b) Convert the following temperatures into the Kelvin scale:

i) 37 °C (3 marks)

ii) −28 °C (3 marks)

c) Calculate the quantity of heat required to raise the temperature of 5 kg of water from 0 °C to 100 °C. Assume the specific heat capacity of water is 4200 J/(kg °C). (3 marks)

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

e) Some lead having a specific heat capacity of 130 J/(kg °C) is heated from 27°C to its melting point at 327 °C. If the quantity of heat required is 780 kJ, determine the mass of the lead. (4 marks)

Total (20 Marks)