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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: APRIL/MAY 2026

SUBJECT: ENGINEERING SCIENCE

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

PASS MARK: 50

INSTRUCTIONS TO 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. Answer all Questions.
5. In Section B answer Question Two (2) which is compulsory and any other Three (3) Questions 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)

QUESTION 1

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

1.1. A physical quantity which has direction and magnitude is known as a: (2 marks)

a) Force
b) Vector
c) Scalar
d) Weight

1.2. Which of the following is not a scalar quantity? (2 marks)

a) velocity
b) potential energy
c) work
d) kinetic energy

1.3. Which of the following is not a vector quantity? (2 marks)

a) Displacement
b) Density
c) Velocity
d) Acceleration

1.4. State which of the following is incorrect: (2 marks)

a) $1\ W = 1\frac{J}{s}$
b) $1J = 1\ N/m$
c) $\eta = \frac{\text{output energy}}{\text{input energy}}$
d) $\text{Energy} = \text{power} \times \text{time}$

1.5. An object is lifted 2000 mm by a crane. If the force required is 100 N. Calculate work done by a crane. (2 marks)

a) 20 Nm
b) 200 KNm
c) 200 Nm
d) 20 J

1.6. A motor having an efficiency of 0.8 uses 800 J of electrical energy. Calculate the output energy of the motor. (2 marks)

a) 800 J
b) 1000 J
c) 640 J
d) 6.4 J

13

1.7. A block of metal requires a frictional force F to keep it moving with constant velocity across a surface. If the coefficient of friction is μ, then the normal force N is given by: (2 marks)

a) $\frac{\mu}{F}$

b) μF

c) $\frac{F}{\mu}$

d) F

1.8. A wire is stretched 3mm by a force of 150 N. Assuming the elastic limit is not exceeded. Determine the force that will stretch the wire by 5mm. (2 marks)

a) 150N

b) 250N

c) 90N

d) 450N

1.9. A 5kW electric motor is turning at 50 rad/s. Calculates the torque developed at this speed. (2 marks)

a) 100Nm
b) 250Nm
c) 0.01Nm
d) 0.1Nm

1.10. A gas occupies a volume of $4m^3$ at a pressure of 400KPa at constant temperature, the pressure is increased to 500KPa. What will be the new volume occupied by the gas? (2 marks)

a) $5\ m^3$

b) $0.3\ m^3$

c) $0.2\ m^3$

d) $3.2\ m^3$

Total (20 marks)

SECTION B

ANSWER QUESTION 2 WHICH IS COMPULSORY AND ANY OTHER THREE (3) QUESTIONS IN THIS SECTION.

QUESTION 2

a) Define the following:
   i) Derived Units (2 marks)
   ii) Fundamental quantity. (2 marks)

b) State **two (2)** examples of derived quantities and **two (2)** examples of base quantities. (4 marks)

c) Carry out the following conversion.
   i) 25 km/h to m/s. (3 marks)
   ii) 25 $\mu N/m^2$ to N/m^2. (3 marks)

d) Using dimension algebra prove the dimension correctness of the following equation.

$$velocity = \frac{power}{force}$$ (6 marks)

Total (20 marks)

QUESTION 3

a) Define the following terms:
   i) Displacement. (2 marks)
   ii) Average velocity. (2 marks)
   iii) Acceleration. (2 marks)

b) A car starts from rest with an acceleration of 4 m/s^2. Find the distance travelled in the 8^{th} second. (4 marks)

Two electric trains A and B leave the same station on parallel lines. The train A starts from rest with a uniform acceleration of 0.2 m/s^2 and attains a speed of 45 km/h which is maintained afterwards. The train B leaves 1 minute after with a uniform acceleration of 0.4 m/s^2 to attain a maximum speed of 72 km/h which is maintained afterwards. Calculate time that will be taken for train B to overtake train A. (10 marks)

Total (20 marks)

QUESTION 4

a) Define the following terms:
   i) Work. (2 marks)
   ii) Power. (2 marks)
   iii) Gravitational Potential Energy. (2 marks)

b) State the Law of Conservation of Energy. (3 marks)

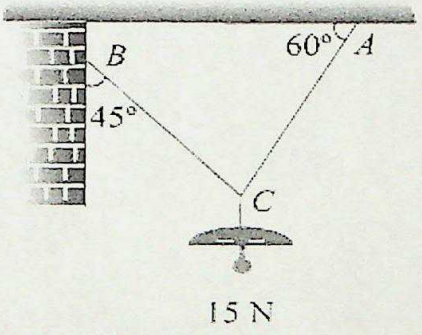
c) Using schematic diagrams show the energy transformed in the following devices:
   i) Solar panel. (3 marks)
   ii) Electric motor. (3 marks)

d) Water is pumped vertically upwards through a distance of 50.0m and the work done is 294.3 kJ. Determine the number of litres of water pumped. (1 litre of water has a mass of 1 kg). (5 marks)

Total (20 marks)

QUESTION 5

a) Define the following terms
   i) Torque. (2 marks)
   ii) Moment of a Force. (2 marks)
   iii) A Couple. (2 marks)
b) State the Principle of Moment. (3 marks)
c) An electric light fixture weighing 15 N hangs from a point C, by two strings AC and BC.
d) The string AC is inclined at 60° to the horizontal and BC at 45° to the horizontal as shown in the figure below. (11 marks)



Total (20 marks)

QUESTION 6

a) Define the following thermodynamic terms:
   i) Temperature. (2 marks)
   ii) Sensible heat. (2 marks)
   iii) Latent heat of vaporization. (3 marks)
b) A thermostat is an automated switch. With the aid of a diagram, explain the operation of a thermostat in line with thermos expansion. (5 marks)
c) A vessel has a volume of 0.80 m3 and contains a mixture of helium and hydrogen at a pressure of 450 kPa and a temperature of 17°C. If the mass of helium present is 0.40 kg. Determine:
   i) The partial pressure of each gas. (4 marks)
   ii) The mass of hydrogen present. (4 marks)

Assume the characteristic gas constant for helium to be 2080 J/(kg K) and for hydrogen 4160 J/(kg K).

Total (20 marks)

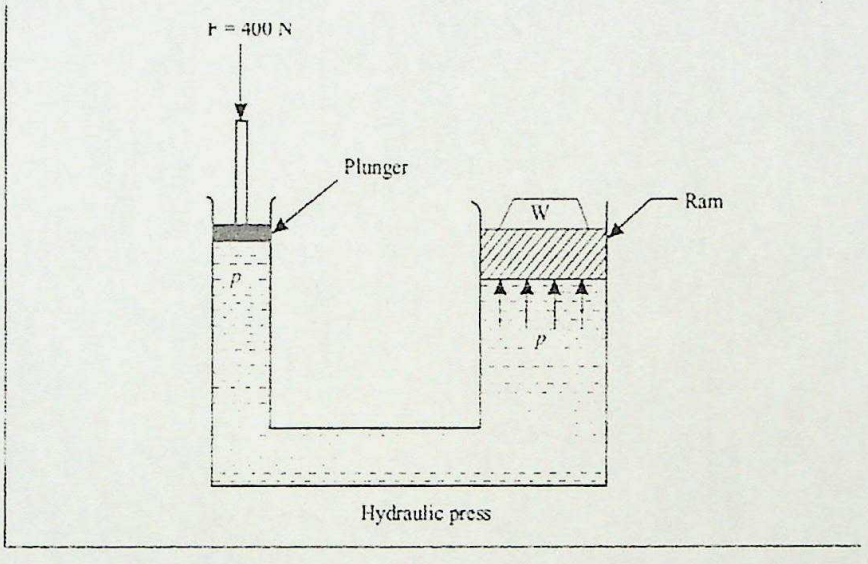
QUESTION 7

a) Define the following terms:
   i) Electric Current. (2 marks)
   ii) Electric Charge. (2 marks)

b) Compare electrical voltage and electromagnetic force (emf). (4 marks)

c) State Ohms Law. (2 marks)

d) The diameter of the ram and plunger of a hydraulic press are 200 mm and 30 mm respectively. Calculate the weight lifted by the hydraulic press when the force applied at the plunger is 400N. (10 marks)



Total (20 marks)

17