TEVETA

Technical Education Vocational and Entrepreneurship Training Authority

DIPLOMA IN BIOMEDICAL ENGINEERING TECHNOLOGY

LEVEL 6 YEAR II EXAMINATIONS

FINAL INTEGRATED SUMMATIVE EXAMINATIONS

SITTING: JULY/AUGUST 2025

SUBJECT: APPLIED MECHANICS

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

PASS MARK: 50

INSTRUCTIONS TO CANDIDATE

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. There are EIGHT (8) questions in this paper. Answer FIVE (5) questions.
4. Diagrams may be used where necessary to clarify your answer.
5. Cell phones and programmable calculators are not allowed in the examination room.

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

QUESTION 1

a) A circuit schematic for some pneumatic device is shown in Figure Q1.

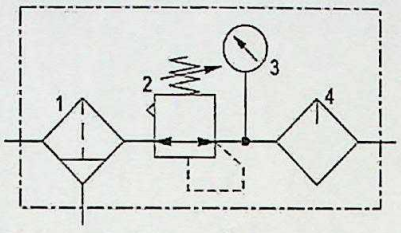


Figure Q1: Pneumatic device

i) Identify the device [2 marks]
ii) Identify the features numbered 1 to 4. [4 marks]
iii) Explain the functions of the features numbered 1 to 4. [8 marks]

b) State **three (3)** advantages of using air as the working medium in pneumatic systems. [3 marks]

c) Indicate **three (3)** disadvantages of using oil as the working medium in hydraulic systems. [3 marks]

[TOTAL MARKS 20]

QUESTION 2

a) A particle travels along a straight line with a velocity $\boldsymbol{v = (12 - 3t^2)}$, where $\boldsymbol{t}$ is in seconds. When $\boldsymbol{t = 1\ s}$, the particle is located 10 m to the left of the origin. Determine the:

i) Acceleration when $\boldsymbol{t = 4\ s}$ [4 marks]
ii) Displacement from $\boldsymbol{= 0\ s}$ to $\boldsymbol{t = 10\ s}$ [4 marks]
iii) Distance the particle travels during this time period [4 marks]

b) A ball is released from the bottom of an elevator which is traveling upward with a velocity of 6 ft/s. If the ball strikes the bottom of the elevator shaft in 3 s, determine the:

i) Height of the elevator from the bottom of the shaft at the instant the ball is released. [4 marks]
ii) Velocity of the ball when it strikes the bottom of the shaft [4 marks]

[TOTAL MARKS 20]

QUESTION 3

A mass of 350 kg was pulled upward by a force that act 20° to the incline plane. The ratio of incline plane is 3 in 5. The coefficient of friction between the mass and incline plane is 0.38. Calculate the:

a) Force required to pull the mass upward [16 marks]
b) Friction force [4 marks]

[TOTAL MARKS 20]

QUESTION 4

A hoist drum has a moment of inertia of 65 kgm^2 and is used to elevate a lift of mass 800 kg with an upward acceleration of 1.5 m/s^2 by mean of a light cable. The cable is wound onto the drum with diameter of 600 mm and the other end is fixed with a balance mass of 200 kg to form a balance mass hoisting machine. If the friction force is neglected, calculate the driving torque required to move the lift upward. [20 marks]

[TOTAL MARKS 20]

QUESTION 5

a) Define balancing of rotating machine parts. [2 marks]
b) State two (2) effects of operating unbalanced rotating machine parts. [2 marks]
c) Explain the difference between static imbalance and dynamic imbalance. [4 marks]
d) Describe two (2) effects of imbalance in rotating machine parts. [2 marks]
e) List two (2) medical equipment in which rotational imbalance should be minimized. [2 marks]
f) Explain the concept of mechanical compensation used in balancing rotating mechanical machine parts. [4 marks]
g) Indicate the method of mechanical compensation suitable for a range of rotational speeds. [2 marks]
h) Identify the two (2) parts of machines a mechanical compensation is commonly applied. [2 marks]

[TOTAL MARKS 20]

QUESTION 6

a) State Pascal's law in relation to fluid systems. [4 marks]
b) A single hydraulic cylinder vertically positioned to a car lifting platform has a bore diameter of 152.4 mm. A 40 kg force is applied to squeeze hydraulic oil through a 25.4 mm hydraulic horse to the lifting cylinder. Compute the:
    i) Largest weight which the lifting cylinder can withstand. Assume the system has minimal losses. [12 marks]
    ii) Height through which the load is lifted when the hand operated plunger moves through 50.8 mm. [4 marks]

[TOTAL MARKS 20]

QUESTION 7

A driving pulley with diameter of the 1750 mm and a driven pulley with a diameter of 500 mm are arranged with the distance of 6 m between the centres. Calculate the length of the belt for open belt drive. [20 marks]

[TOTAL MARKS 20]

QUESTION 8

A part of a machine of mass 4.54 kg has a reciprocating motion which is simple harmonic in character. It makes 200 complete oscillations in 1 minute. If its total stroke is 225 mm, determine the:

a) Accelerating force when it is 75 mm from mid-stroke [5 marks]
b) Velocity when it is 75 mm from mid-stroke [5 marks]
c) Maximum accelerating force [6 marks]
d) Maximum velocity [4 marks]

[TOTAL MARKS 20]