THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

DIPLOMA IN TECHNICAL EDUCATION EXAMINATION

781 ENGINEERING SCIENCE

Time: 3 Hours **Year: 2019**

Instructions

1. This paper consists of **seven (7)** questions**.**
2. Answer **any five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Any communication devices and unathorized materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet (s)

1. (a) Differentiate between Archimedes' Principle and Torricelli's theorem as applied in fluid mechanics.

(b) Water is flowing through tapper pipe of length 150m with the slope of 1 in 20 at rate of 75litres/sec. If the diameters of that pipe are 600mm at the upper end and 200mm at the lower end; find the pressure at the lower end if the pressure at the higher end is 25N/cm2 . Support your answer with a neat sketch.

2. (a) Briefly explain the term "stress" as used in engineering science.

(b) A piece of steel 10mm diameter is subjected to a load of 9kN which causes a length of 100mm to increase to 100.055mm.

Calculate the:

(i) Stress

(ii) Strain and

(iii) Young's Modulus .

(c) A sample of rectangular block rubber material of 300mm x 200mm x 20mm (length x height x width respectively) was firmly fastened to a vertical wall as shown in **Figure 1**. When the downward load of 48N applied to the free vertical-face, the vertical deflection of 2mm was obtained. Determine the modulus of rigidity of this block.

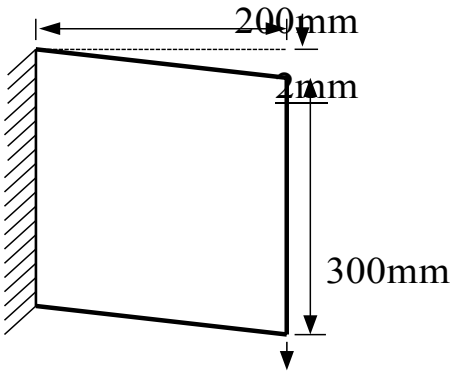


Figure 1 **48kN**

3. (a) The surface tension of liquid depends upon three factors; that is, its nature, contamination and temperature. With one valid example, explain how these factors affect the surface tension.

(b) In hydraulic press the plunger is 30mm diameter and the ram 300mm diameter.

(i) Determine the total force exerted by the ram when a force of 400N is applied to the plunger (Neglect all losses)

(ii) Use a well labeled sketch to show the plunger, ram and direction of fluid flow.

4. (a) Explain the term "coefficient of utilization" as applied in illumination.

(b) Mention four factors of which the value of coefficient of utilization depends upon.

(c) Determine the value of coefficient of utilization for a lecture room of 8m x 12m is lighted by 15 lamps to fairly uniform illumination of 100lm/m2 , given that the power output of the lamp is 1600lm.

(d) (i) Differentiate luminous intensity from luminous flux and

(ii) Determine the luminous intensity of a lamp which will produce an illumination of 10lm/m2 at a point 3m vertically below it.

5. (a) Draw T-S diagrams of heat transfer (Q) at constant volume, pressure and temperature to illustrate quantity of heat, absolute temperature, entropy and adiabatic process.

(b) Determine

(i) The pressure of the water on the base of the tank in kN/m2 ,

(ii) The total force on the base of the tank in kN and

(iii) The total force on the side of the tank in kN for storage tank of 3m square contain water to a depth of 2m. If the base of the tank is horizontal and the density of water is 1000kg/m^3 .

6. (a) Explain the importance of Coefficient of Performance (COP) in heat exchanger.

(b) The results of a laboratory experiment in steam engine show that, the steam at

the beginning of the expansion process is at 7 bar, dryness fraction is 0.98 and the expansion follow the law $pv^{\gamma} =$ constant down to a pressure of 0.34 bar (where: $\gamma = 1.1$).With the aid of a sketch find;

(i) The volume rate (m3 /kg) of the engine.

(ii) The work done in kilojoules during expansion and

(iii)The heat flow to or from the cylinder walls during expansion. For a given pressure at the steam at the beginning of the expansion process as 7bar, dryness fraction is 0.98 and expansion follows the law pvγ = constant down to a pressure of 0.34bar (where $\gamma = 1.1$).

7. (a) Explain the meaning of open system, closed system which adiabatically isolated system as applied in fluid system.

(b) The molecular weight of carbon dioxed (CO_2) is 44. In an experiment the value of γ for CO_2 was found to be 1.3. Assuming that CO_2 is a perfect gas,

Determine the:

(i) Gas constant (R),

(ii) Specific heat at constant pressure (C_p) and

(iii) Specific heat at constant volume(C_v).

(d) A certain heat exchanger has $0.3m^3$ of air at a temperature of 45^oC and pressure of $1MN/m^2$ is allowed to expand according to the law $PV^{1.25}$ = constant. By considering C_p =1.006kJ/kgK and C_v = 0.717kJ/kgK,

calculate;

(i) The work done,

(ii) The internal energy change,

(iii) The heat trnsfer.