2014

Engg. Thermodynamics & Fluid Mechanics

Time Alloted : 3 Hours ***Full Marks : 70***

The figure in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP - A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following: 10x1=10

i) For an irreversible process entropy change is

a) greater than $\Delta Q/T$ b) equal to $\Delta Q/T$

c) less than $\Delta Q/T$ d) equal to zero

ii) Which of the following is a intensive thermodynamic property?

a) Volume b) Mass c)Temperature d) energy

iii) Work done in a free expansion is

a) Positive b) Negetive Maximum d) Zero

iv) The latent heat of vaporization at critical point

a) Equal to zero b) greater than zero

c) less than zero d) none of these

v) Newton's law of viscosity relates to

a) pressure, velocity and viscosity

b) shear stress and rate of angular deformation in a fluid

c) shear stress temperature, velocity and viscosity

d) preaure, viscosity, and rate of angular defernation in a fluid

vi) Euler's equation is written as

a) $dp/\rho + v^2dv + gdz = 0$ b) $dp/\rho + vdv + gdz = 0$

c) $dp/p + v^2dv + gdz = 0$ d) $dp/\rho^2 + v^2dv + gdz = 0$

vii) Kinematic viscosity is defined as

a) dynamic viscosity X density

b) dynamic viscosity / density

c) dynamic viscosity X pressure

d) pressure X density

viii) Dynamic viscosity has dimension

a) $M L T^{-2}$ b) $M L^{-1} T^{-1}$

c) $M L^{-1} T^{-1}$ d) $M^{-1} L^{-1} T^{-2}$

ix) The change of entropy when heat is absorebed by the gas is

a) Positive b) negetive

c) positive or negetive d) none of these

x) A stagnation point is a point in fluid flow where

a) Pressure is zero b) Velocity of flow is zero

c) total energy is zero d) total energy is maximum

GROUP - B
(Short Answer Type Questions)

Answer any *three* questions

3x5=15

A solid cube weighing 5 N and having a 45 cm edge is allowed to slide down an inclined plane surface making an angle of 30° with the horizontal. There is an uniform oil fil, of 0.008 cm thick. if the cube is having a velocity of 13 cm/s, determine the viscosity of the oil. Aslo find out the kinematic viscosity in stokes if the oil has

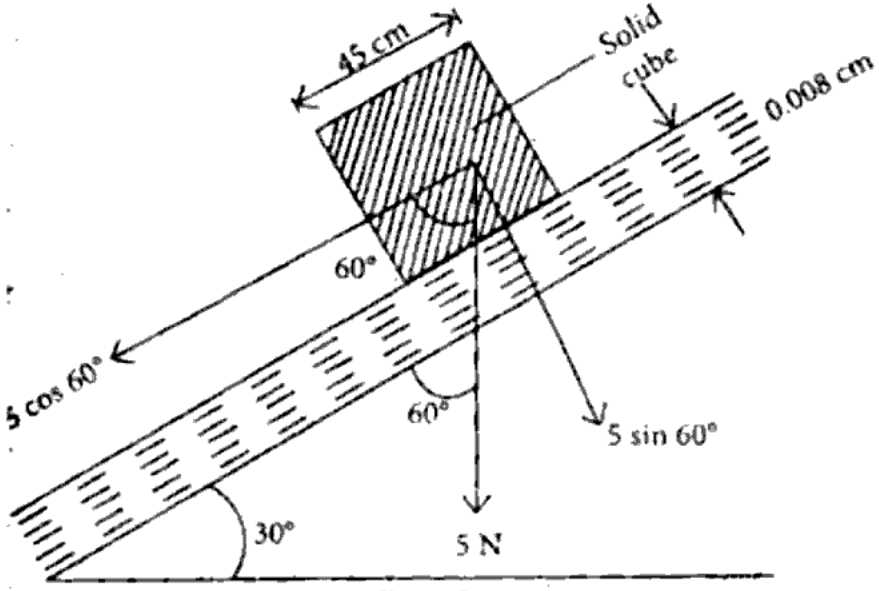


Fig. 1.8

density of 850 kg/m³. (Ref Fig 1.8)

3. a) What is Euler's Equation of motion? How will you obtain Bernoullis's equation from that? 2

b) A incompresaible fluid is flowing through a pipe of 10 cm diamete under a guage pressure of 40 N/cm² and with a mean velocity o 5 m/s. Find the total head of water at cross section which is 8 m above line.

4. a) What do u mean by vacuum pressure?

b) In a condenser, the vacuum pressure is found to be 145 mm o Hg and barometer reads 735 mm of Hg. Find the absolute pressur in kpa?

5. The fluid is given by $V = x^2yi + y^2zj - (2xyz+yz^2)k$. Show that thi is a case of possible steady incompressible flow. Calculate th velocity and acceleration at (2, 1, 3).

6. Drew a block diagram of vapour compression refrigeration cycl and also show the corresponding p-v and T-S plots.

GROUP - C

(Long Answer Type Questions)

Answer any *three* questions

3x15=45

7. a) Deriver the Euler's equation. How you can obtain Bernoulli's equation from it. 5

b) Water if flowing throgh a taper pipe of length 100m having dia 600mm at upper end and 300 mm at lower end at the rate of 50 ltr sec. The pipe has a slope of 1 in 30. Find the pressure a lower end if pressure at higher end is 19.62 N/m². 5

c) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp.gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Sketch the arrangement and find the pressure of fluid in the pipe the difference of mercury level in the two limbs is 20 cm. 4

a) Explain intensive and extensive properties. 2

b) Prove that for polytropic process $W = (P_1V_1 - P_2V_2)/(1-n)$ 5

c) Air at 14 bar having 0.085 m³ and 627° C is supplied with heat at constant temperature till its volume becomes double. The air is then expanded isentripically till its pressure drops to 1 bar. Calculate the heat supplied and work done and change in internal enrgy during constant pressure heating.Also find the total work done / kg of air. 8

a) Define Kelvin-Planck and Calusius Statement. 3

b) Establish the equivalence Kelvin- planck and clausius staement. 6

c) Two carnot Engines work in series between the source and sink temperature of 600 K and 300 K.If both engines developed equal powder, determine the intermediate temoature. 7

8. a) Water is flowing through two different pipes A and B to which an inverted differntial monometer having an oil of specification gravity 0.9 is connected. The pressure in the pipe A is 2.5m of water. Find the pressure in the pipe B for the manometer reading as shown in figure 1.

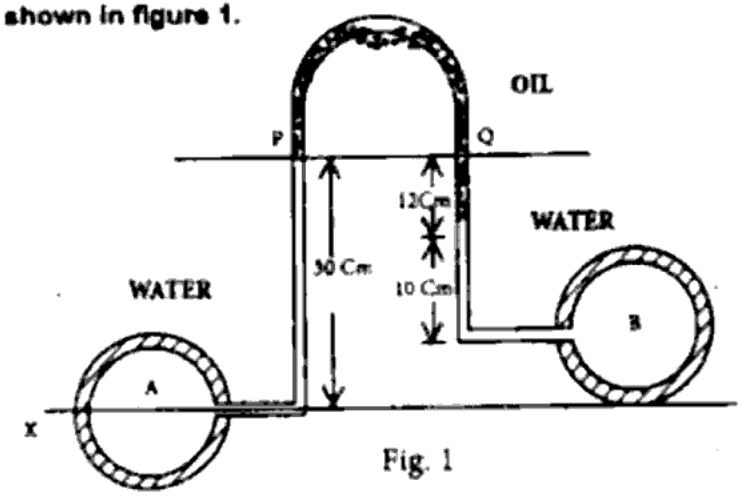


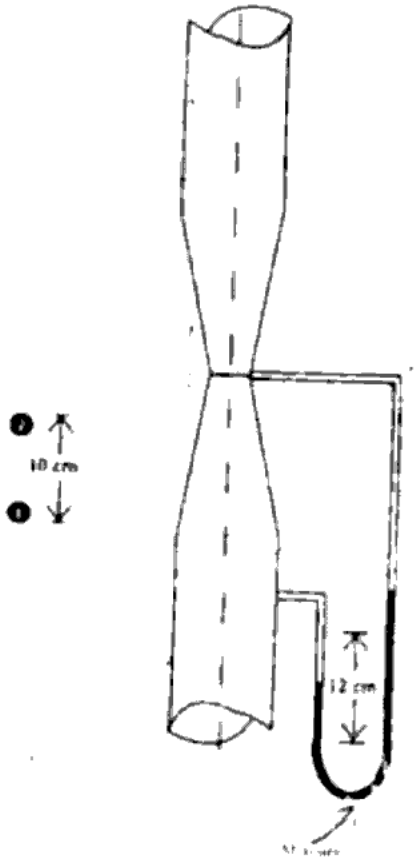
Fig. 1

b) The velocity vector for a 2D incompressible flow is given by

$$\vec{V} = \frac{x}{x^2 + y^2}\hat{i} + \frac{y}{x^2 + y^2}\hat{j}$$

State whether the flow is steady or unsteady? 3

c) A vertical venturimeter show in Figure has an area ration 5. It has a throat diameter of 1om. When oil of specific gravity 0.8 flowa through it the mercury in the differntial gauge indicates the differnce in height of 12 cm. Find the discharge through the venturimeter.



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1. a) Derive the expression for efficiency of an Otto cycle and show the process on T-S planes. 7

b) For the same compression ratio, explain why the efficiency of Otto cycle is greater than that of Diesel cycle. 3

c) An engine working on the Otto cycle is supplied with at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and the mean effective pressure. 5