

**FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI
DEPARTMENT OF MECHANICAL ENGINEERING
HARMATTAN SEMESTER EXAMINATIONS 2014/2015 SESSION**

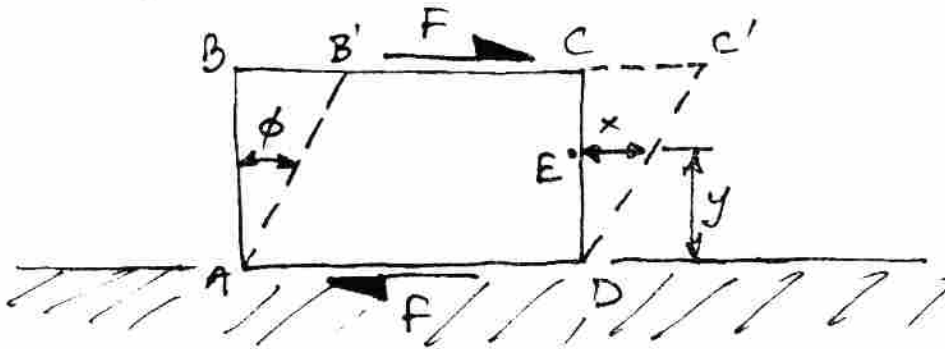
**YEAR: 3
COURSE: ENG 309 FLUID MECHANICS I**

**DATE: 24:04:15
TIME: 3HOURS**

**INSTRUCTIONS TO CANDIDATES
ANSWER ALL QUESTIONS.**

SECTION A

1. The diagram below shows a fluid element ABCD under the action of shearing forces. What does the angle ϕ depict?



(a) Measure of shear strain (b) Measure of shear stress (c) a and b (d) constant of proportionality.

2. What is the major difference between a solid and fluid in terms of the angle ϕ ?

(a) It increases for solids and remains fixed for fluids (b) It is constant in both solids and fluids (c) It is fixed for solids but varies for fluids (d) none of the above.

Shown below is a fluid flowing over a fixed solid boundary. Use it to answer questions 3 and 4.

3. The fluid adjacent to the boundary

(a) adheres to the boundary and has the highest velocity (b) adheres to the boundary and moves at a fairly higher velocity than that of the boundary (c) adheres to the boundary and moves at the same velocity with the boundary (d) all of the above.

4. As y increases, what do you think would happen to the successive layers of fluid parallel to the boundary?

(a) The layers will move with different but decreasing velocities (b) The layers will move with different but increasing velocities (c) The layers will maintain a uniform velocity (d) The layers will maintain the conditions at the boundary

5. In the consideration of fluids as a continuum, the Knudsen number (Kn) plays a significant role. This non-dimensional parameter is given as

(a) the ratio of mean free path of the fluid molecules to the kinematic viscosity of the fluid (b) the ratio of the mean free path of the molecules to the pressure of the fluid (c) the ratio of the mean free path of the molecules of the fluid to the characteristic length scale of observation (d) the ratio of the mean free path to the rarefaction effect of the molecules

6. At what value of Kn should we conveniently uphold the continuum assumption in the treatment of fluids?

- (a) $Kn \leq 0.001$ (b) $0.001 \leq Kn \leq 0.1$ (c) $Kn = 0.1$ (d) $Kn > 10$

If 6m^3 of oil weighs 47kN, calculate:

7. the specific weight of the oil.....
 8. the density of the oil.....
 9. the relative density of the oil.....
 10. A 100m deep stream of water is flowing over a boundary. It is considered to have zero velocity at the boundary and 1.5m/s at the free surface. Assuming a linear velocity profile, what is the shear stress.....? Take the dynamic viscosity of oil to be $1.3 \times 10^{-3} \text{ N}\cdot\text{s}/\text{m}^2$.



SECTION B

11. Power of a stream of fluid is
 (a) rate of energy transfer (b) weight per unit time (c) energy per unit weight (d) none of the above.
12. Laminar flow is the flow regime when fluids flow at
 (a) low velocities (b) high velocities (c) low velocities with lateral mixing (d) low velocities without lateral mixing.
13. Turbulent flow is the flow regime when fluids flow at
 (a) high velocities (b) low velocities (c) low velocities with lateral mixing (d) high velocities with lateral mixing.
14. For compressible fluids, mach number > 1 characterizes
 (a) Sonic flow (b) supersonic flow (c) subsonic flow
15. For compressible fluids mach number < 1 characterizes
 (a) sonic flow (b) supersonic flow (c) subsonic flow
16. Reynold's number is used to characterize flow in incompressible fluids.
 (a) True (b) False
17. Velocity of a flowing fluid through a pipe at the solid fluid interface is
 (a) zero (b) < 1 (c) > 1 .
18. In uniform flow, the velocity of fluid at a given instant at any point is different
 (a) True (b) False
19. In unsteady state uniform flow, velocity of a flowing fluid is the same at every point but does not change with time. (a) True (b) False
20. In steady state uniform flow, velocity of a flowing fluid is the same at every point but does not change with time. (a) True (b) False
21. A boundary layer is part of a moving fluid in which the fluid motion is influenced by the presence of a solid boundary. (a) True (b) False
22. Cavitation occurs due to formation and collapse of bubbles in pumps. (a) True (b) False
23. Shear rate unit is (a) sec (b) sec^{-1} (c) sec^{-2} (d) sec^2 .

24. Cavitation causes abnormal sound and vibration in pumps. (a) True (b) False
25. Velocity of a real fluid flowing in a pipe is the same at every point of the cross section.
(a) True (b) False
26. Shear rate is (a) velocity gradient (b) acceleration gradient (c) none of the above.
27. Shear stress is the force in the flowing fluid which (a) opposes flow (b) supports flow (c) is static
28. Viscosity is the ratio of the (a) shear stress to shear rate (b) shear rate to shear stress (c).
29. Control volume is used for closed system analysis (a) True (b) False.
30. Power input of a pump is power output multiplied by efficiency. (a) True (b) False
31. In orifice meter, actual gas flow rate is obtained as the product of theoretical flow rate and orifice coefficient. (a) True (b) False
32. Acceleration due to movement of the fluid particle from one point to another point at which the velocity at the given instant is different is called (a) convective acceleration (b) local acceleration.
33. Acceleration due to change of velocity at every point with time is called
(a) convective acceleration (b) local acceleration.
34. $V^2/2g$ in energy equation is called (a) mechanical kinetic energy (b) pressure energy (c) dynamic energy (d) none of the above.
35. Potential flow is flow of an ideal fluid which is (a) incompressible and has zero viscosity (b) compressible and has zero viscosity. (c) incompressible. (d) compressible.
- In a pipe of 600 mm diameter and 3000 m length, provided with a valve at its end, water is flowing with a velocity of 2 m/s. Assuming velocity of pressure wave = 1500 m/s, find:
36. The rise in pressure if the valve is closed in 20 seconds:
a. 200 KN/m² b. 300 KN/m² c. 150 KN/m² d. 600 KN/m²
37. The rise in pressure if the valve is closed in 2.5 seconds. Assume the pipe to be rigid one and take bulk modulus of water as 2 GN/m²
a. 1140 KN/m² b. 2104 KN/m² c. 1414 KN/m² d. 2461 KN/m²
38. In a laminar flow, Reynold's number is
a. Less than 2000 b. More than 2000 c. More than 2000 but less than 4000 d. None of the above
39. Under which of the following conditions the closure of valve is considered rapid
The duration of valve closure is greater than $\frac{2L}{c}$ b. The duration of valve closure is less than $\frac{2L}{c}$
c. The duration of valve closure is less than $\frac{L}{c}$ d. None of the above
40. Due to which of the following phenomena water hammer is caused
Incompressibility of fluid b. Sudden opening of a valve in a pipeline c. The material of the pipe being elastic d. Sudden closure (partial or complete) of a valve in pipe flow
- Three pipes of diameters 300 mm, 200 mm and 400 mm and lengths 300 m, 170 m and 210 m respectively are connected in series. The difference in water surface levels in two tanks is 12 m.
41. Determine the rate of flow if co-efficients of frictions are 0.005, 0.0052 and 0.0048 respectively, considering minor losses
a. 0.9945 m³/s b. 1.945 m³/s c. 1.205 m³/s d. 0.4505 m³/s
42. Determine the rate of flow if co-efficients of frictions are 0.005, 0.0052 and 0.0048 respectively, neglecting minor losses
0.1905 m³/s b. 0.945 m³/s c. 1.205 m³/s d. 0.1021 m³/s
43. For a pipe of uniform cross-section the slope of the hydraulic gradient line is/has to the slope of energy gradient line