1. Which time derivative represents the local change of a quantity with time at a fixed point?
a) Partial time derivative
b) Substantial time derivative
c) Total time derivative
d) None of the above

Answer: (a) Suppose variable is density (ρ), therefore the partial time derivative of density at a fixed point say x,y,z will be $\partial\rho/\partial t$.

2. Which time derivative represents the rate of change of momentum as experienced by an observer that is moving along with the flow?
a) Partial time derivative
b) Substantial time derivative
c) Total time derivative
d) None of the above

Answers: (b) As already explained in the video by giving an example of density, substantial time derivative can be observed when 'floating along' with the Fluid.

3. 8 m^3/h of liquid flows through a pipe of 80 mm inside diameter is reduced to an inside dimension of 30 mm at steady state. What will be the velocity in 30 mm pipe?
a) 3.145 m/s
b) 0.442 m/s
c) 2.544 m/s
d) 0.884 m/s

Answers: (a) the velocity in the 30 mm pipe can be calculated as:
$v_{30} = (8m^3/h)\ (1/3600) / (3.14 \times 0.03\ (m) \times 0.03\ (m)\ /4) = 3.145$ m/s

4. Which of the following is true in the case of compressible fluid?.

a) $\frac{D\rho}{Dt} = 0$

b) $\frac{D\rho}{Dt} \neq 0$

c) $\partial v_x / \partial x + \partial v_y / \partial y + \partial v_z / \partial z = 0$

d) None of the above

Answer: (b) change in density w.r.t. time is equal to zero in case of incompressible fluid and therefore the final equation becomes

5. Milk is flowing through a pipe of 80 mm inside diameter at the velocity of 2 m/s. If the diameter of inside tube is reduces to 50 mm, what will be the velocity?

a) 4.25 m/s
b) 6.35 m/s
c) 5.12 m/s
d) 8.24 m/s

Answer: (c) From the equation of continuity,

$A_1v_1 = A_2v_2$

$$\left(\frac{d_1^2}{d_2^2}\right) = \frac{v_2}{v_1}$$

$$\left(\frac{80}{50}\right)^2 = \frac{v_2}{2}$$

$v_2 = 5.12$ m/s

6. Momentum flux can be achieved by

a) Multiplying concentration of momentum/m^3 by velocity
b) Dividing concentration of momentum/m^3 by velocity
c) Concentration of momentum/m^3
d) None of those

Ans. (a)

Concentration of momentum per m^3 is $v_x\rho$.

Momentum flux is multiplication of $v_x\rho$ and velocity.

7. Conservation of momentum can be written as

a) (Rate of momentum in) – (Rate of momentum out) = (Sum of forces acting on system) – (Rate of momentum accumulation)
b) (Rate of momentum in) – (Rate of momentum out) - (Sum of forces acting on system) = (Rate of momentum accumulation)
c) (Rate of momentum out) – (Rate of momentum in) = (Sum of forces acting on system) – (Rate of momentum accumulation)
d) (Rate of momentum out) – (Rate of momentum in) = (Sum of forces acting on system) + (Rate of momentum accumulation)

Ans. (c)

(Rate of momentum in) + (Sum of forces acting on system)

= (Rate of momentum out) + (Rate of momentum accumulation)

8. The rate at which the y component of momentum enters the face at in the x direction by convection is:

a) $\rho v_x v_y |_x \Delta y \Delta z$

b) $\rho v_x v_x |_x \Delta y \Delta z$

c) $\rho v_y v_x |_x \Delta y \Delta z$

d) $\rho v_x v_x |_x \Delta x \Delta z$

Ans. (a)

9. Equation of continuity for incompressible liquid can be written as:

a) $\partial v_x/\partial x + \partial v_y/\partial x + \partial v_z/\partial x = 0$

b) $\partial v_x/\partial x + \partial v_y/\partial y + \partial v_z/\partial z = 0$

c) $\partial v_x/\partial x + \partial v_x/\partial y + \partial v_x/\partial z = 0$

d) $\partial v_x/\partial x + \partial v_y/\partial z = 0$

Ans. (b)

10. An incompressible fluid flows past one side of a flat plate. The flow in the x direction is parallel to the flat plate. At the leading edge of the plate the flow is uniform at the free stream velocity v_{xo}. There is no velocity in the z direction. The y direction is the perpendicular distance from the plate. For this case find the true statement?

a) $\partial v_x/\partial x$ is negative

b) $\partial v_y/\partial y$ is positive

c) $\partial \rho/\partial t$ is zero

d) all the above

Ans. (d)

Fluid is incompressible, so ρ is constant and $\partial \rho/\partial t$ will turn zero.

Since there is no velocity in the z direction, we obtain

$\partial v_x/\partial x = - \partial v_y/\partial y$

At a given small value of y close to the plate, the value of v_x must decrease from its free stream velocity $v_{xo,}$ as it passes the leading edge in the x direction because of fluid friction. Hence, $\partial v_x/\partial x$ is negative. Then, $\partial v_y/\partial y$ is positive and there is a component of velocity away from the plate.