Mechanical Properties of Fluids

Assertion Reason Questions

Two statements are given one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

1. Assertion (A): The velocity increases, when water flowing in a broader pipe enters a narrow pipe.
Reason (R): According to the equation of continuity, product of the area of the cross-section and velocity is constant.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: According to the equation of continuity, Av = constant, in a liquid streamline flow. Where A is the cross-sectional area and v is the liquid flow velocity. When water flowing in a larger pipe enters a smaller pipe, the area of the cross-section of the water reduces and the velocity of the stream rises.

2. Assertion (A): A parachute descends slowly, whereas a stone dropped from the same height descends quickly.
Reason (R): The viscous force of air on a parachute is greater than the viscous force of a falling stone.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: Gravity is pulling the man down while friction with the air slows him down. With the parachute out it adds more friction slowing him down because air resistance works against the very large surface area of the parachute. A free-falling skydiver that has not yet opened his parachute can make his downward speed vary between about 110 mph and 225 mph using air resistance. A spread-eagled position presents the maximum area and we fall the slowest.

3. Assertion (A): With increasing temperature, the angle of contact of a liquid decreases.
Reason (R): The surface tension of a liquid increases as its temperature rises.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: Angle of contact decreases with the addition of impurities whereas it increases if the temperature is increased. Surface tension causes an increase in cohesive forces. When the temperature rises, surface tension decreases and angle of contact increases.

4. Assertion (A): Surface tension of liquid dec- reases with an increase in temperature.
Reason (R): Cohesive force between liquid molecules increases with an increase in temperature.

Ans. (c) A is true but R is false.
Explanation: Surface tension decreases when temperature increases because cohesive forces decrease with an increase of molecular thermal
activity. The influence of the surrounding environment is due to the adhesive action liquid molecules have at the interface. The impact of increasing the temperature of a liquid is to reduce the cohesive forces while simultaneously increasing the rate of molecular interchange. The former effect causes a decrease in the shear stress while the latter causes it to increase.

5. Assertion (A): The blood pressure in human is greater at the feet than at brain.
Reason (R): Pressure of liquid at any point is proportional to height, density of liquid and acce- leration due to gravity.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: The blood column in the human body is higher at the feet than at the brain.
As, P = hpg.
As a result, blood exerts greater pressure on the feet than on the brain.

6. Assertion (A): The front of an automobile is designed to resemble the flow line pattern of the fluid through which it moves.
Reason (R): The shape of an automobile is streamlined to reduce the resistance provided by the fluid.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: The cars or planes are given such shape (known as streamlined shape) so that air friction is minimum. Rather the movement of air layers on the upper and lower side of the streamlined shape provides a lift which helps in increasing the speed of the car. When cars and planes move through air, their motion is opposed by air friction, which in turn, depends upon the shape of the body. It is due to this reason that cars or planes are given such shapes (known as streamlined shapes) so that air friction is minimum.

7. Assertion (A): Where pressure is high, the velocity of the horizontal flow of an ideal liquid is lower and vice versa.
Reason (R): The total energy per unit mass remains constant in the streamlined flow of an ideal liquid, according to Bernoulli's theorem.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: According to Bernoulli's theorem, for the streamlined flow of an ideal liquid, the total energy per unit mass is constant so if pressure is increased then the velocity of the flow has to decrease.

That is, $P+\frac{\rho V^2}{2}+\rho gh=C$

8. Assertion (A): The velocity of the flow of a liquid is smaller when pressure is larger and vice versa.
Reason (R): According to Bernoulli's theo- rem for the streamline flow of an ideal fluid, the total energy per unit mass remains constant.

Ans. (d) A is false and R is also false.
Explanation: According to Bernoulli's theorem, "The total energy per unit mass in the stream line flow of an ideal liquid is constant."

That is $P+\frac{\rho v^2}{2}+\rho gh=C$

The velocity of a liquid is determined by its pre- ssure as well as the potential height available.

9. Assertion (A): With increasing temperature, the angle of contact of a liquid decreases.
Reason (R): The surface tension of a liquid increases as its temperature rises.

Ans. (c) A is true but R is false.
Explanation: The surface tension of liquid decreases with the increase in temperature. As the temperature of the liquid increases, the surface tension and viscosity of the liquid decrease, which decreases the fluid tendency to hold molecules at a higher angle of contact.

10. Assertion (A): Soil particles inside water are freely placed but they stick together when taken out of water.
Reason (R): Thin films formed create pre- ssure differences.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: When taken out between the molecules a thin layer of the liquid film is formed and due to the contraction nature of the liquid surface, they come closer. When we take out soil from the river, we notice that all the particles stick together whereas when we look at the soil at the bottom of the river, we notice that they do not stick together. This happens mainly because of the pheno- menon of surface tension.

11. Assertion (A): Under the steady flow, the velocity of the particle of fluid is not constant at a point.
Reason (R): Ideal fluids are compressible.

Ans. (d) A is false and R is also false.
Explanation: In a steady fluid flow, the velocity of all particles at a point is the same. The path taken by a fluid particle under a steady flow is streamline. It is defined as a curve whose tangent at any point is in the direction of the
fluid velocity at that point. Ideal fluids are not compressible. An ideal fluid
(also called Perfect Fluid) is incompressible and has no viscosity. Ideal fluids do not exist but sometimes it is useful to consider what would happen to an ideal fluid in a particular fluid flow problem to simplify the problem.