

विध्न विचारत भीरु जन, नहीं आरम्भे काम,
विपति देख छोड़े तुरंत मध्यम मन कर श्याम।
पुरुष सिंह संकल्प कर, सहते विपति अनेक,
'बना' न छोड़े ध्येय को, रघुबर राखे टेक।।

रचित: मानव धर्म प्रणेता

सद्गुरु श्री रणछोड़दासजी महाराज

ELASTICITY & FLUIDS

Some questions (Assertion–Reason type) are given below. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. So select the correct choice :

Choices are :

- (A) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(B) Statement – 1 is True, Statement – 2 is True; Statement – 2 is **NOT** a correct explanation for Statement – 1.
(C) Statement – 1 is True, Statement – 2 is False.
(D) Statement – 1 is False, Statement – 2 is True.

204. STATEMENT – 1

If a metal wire is attached to the ceiling of a room and mass m is attached to another end, the energy stored in the stretched wire is $\frac{mg\ell}{2}$ where ℓ is the increment in length of wire.

STATEMENT – 2

In the above statement loss in gravitational energy is $mg\ell$ while the loss in energy to surrounding is $\frac{mg\ell}{2}$.

205. STATEMENT – 1

Property of elasticity does not depend upon the shape and size of metal wire.

STATEMENT – 2

Elasticity of steel is more than that of rubber.

206. STATEMENT – 1

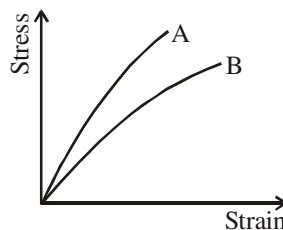
Identical springs of steel and copper are equally stretched. More work will be done on the steel spring.

STATEMENT – 2

Steel is more elastic than copper.

207. STATEMENT – 1

The stress–strain graphs are shown in the figure for two materials A and B are shown in figure. Young's modulus of A is greater than of B.

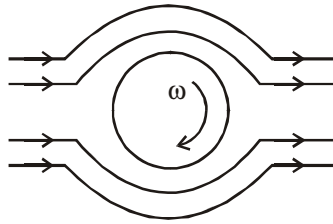


STATEMENT – 2

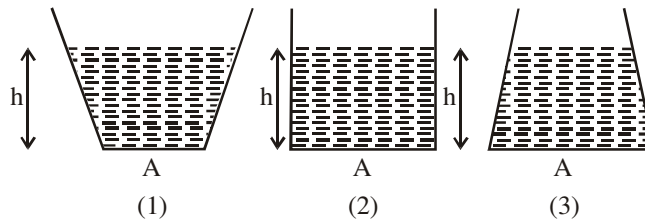
The Young's modulus for small strain is,

$$Y = \frac{\text{stress}}{\text{strain}} = \text{slope of linear portion, of graph; and slope of A is more than slope that of B.}$$

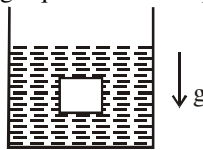
- 208. STATEMENT – 1**
If a body is floating in a liquid, the density of liquid is always greater than the density of solid.
- STATEMENT – 2**
Surface tension is the property of liquid surface.
- 209. STATEMENT – 1**
Viscosity of liquid increases rapidly with the rise of temperature.
- STATEMENT – 2**
Viscosity of liquid is the property of liquid by virtue of which it opposes the relative motion amongst its different layers.
- 210. STATEMENT – 1**
Falling raindrops acquire a terminal velocity.
- STATEMENT – 2**
A constant force in the direction of motion and a velocity dependent force opposite to the direction of motion, always result in the acquisition of terminal velocity.
- 211. STATEMENT – 1**
In the steady flow of an ideal fluid, the velocity at any point is same for different fluid particles.
- STATEMENT – 2**
Steady fluid flow is the unaccelerated fluid flow.
- 212. STATEMENT – 1**
The buoyant force on a submerged rigid object can be considered to be acting at the centre of mass of the object.
- STATEMENT – 2**
For a rigid body a force field distributed uniformly through its volume can be considered to be acting at the centre of mass of the body.
- 213. STATEMENT – 1**
1 kg of cotton fibre will weight less lens in air when made more fluffy.
- STATEMENT – 2**
Weight of air in cotton will cancel out with the force of extra buoyancy acting on it.
- 214. STATEMENT – 1**
Steel is more elastic than rubber.
- STATEMENT – 2**
When same deformation is produced in two identical bodies of these material greater restoring force develops in the steel body.
- 215. STATEMENT – 1**
Two identical beakers contains water to the same level. A wooden block is floating in one of the beakers. The total weight of both beakers is same.
- STATEMENT – 2**
Volume of the displaced water is equal to the volume of the block.
- 216. STATEMENT – 1**
A rain drop after falling through a certain distance attains a constant velocity.
- STATEMENT – 2**
The viscous force for spherical body is proportional to its speed. Hence after falling through a certain distance viscous drag and buoyant forces balance the gravitational force.
- 217. STATEMENT – 1** : As wind flows left to right and a ball is spinned as shown, there will be a lift of the ball.
- STATEMENT – 2** : Decrease in velocity of air below the ball, increases the pressure more than that above the ball.



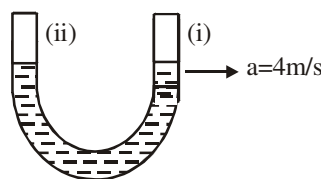
218. **STATEMENT – 1** : Ratio of normal stress to volumetric strain is bulk modulus of given gas.
STATEMENT – 2 : Compressibility is the reciprocal of bulk modulus.
219. **STATEMENT – 1** : In the three cases shown in the figure force exerted by liquid on three vessels is same.
STATEMENT – 2 : Pressure at the bottom in each case is same.



220. **STATEMENT – 1** : A block is immersed in a liquid inside a beaker, which is falling freely. Buoyant force acting on block is zero.
STATEMENT – 2 : In case of freely falling liquid there is no pressure difference between any two points.



221. **STATEMENT – 1** : The velocity increase, when water flowing in broader pipe enter a narrow pipe.
STATEMENT – 2 : According to equation of continuity, product of area and velocity is constant.
222. **STATEMENT – 1** : Pascal's Law is the working principle of a hydraulic lift.
STATEMENT – 2 : Pressure is equal to thrust acting per unit area.
223. **STATEMENT – 1** : Two row boats moving parallel to one another are pulled towards one another.
STATEMENT – 2 : When the boats are close to each other, the velocity of water between them increases and pressure falls according to Bernoulli's theorem.
224. **STATEMENT – 1** : When there is a thin layer of water between two glass plates, there is a strong attraction between them.
STATEMENT – 2 : The pressure between the plates becomes less than atmospheric pressure because pressure inside a bubble or drop is greater than outside pressure.
225. **STATEMENT – 1** : In the given figure the liquid level in (ii) is more than in (1).
STATEMENT – 2 : The surface tension in tube I is lesser than in tube II.



226. **STATEMENT – 1** : Strain causes the stress in an elastic body.
STATEMENT – 2 : An elastic rubber is more plastic in nature.
227. **STATEMENT – 1** : Surface tension of a liquid decreases with contamination.
STATEMENT – 2
 If we add salt to water; its surface tension increases.
228. **STATEMENT – 1** : Terminal velocity is same as the critical velocity.
STATEMENT – 2 : The constant velocity of fall of a body through a viscous fluid is called terminal velocity.
229. **STATEMENT – 1** : The velocity of flow of a liquid is smaller when pressure is larger and vice-versa.
STATEMENT – 2 : According to Bernoulli's theorem, for the stream line flow of an ideal liquid, the total energy per unit mass remains constant.
230. **STATEMENT – 1** : A block floats in water with some part outside water. When whole system is given a constant upward acceleration then volume of block inside water remains unchanged in equilibrium.
STATEMENT – 2 : Net force on block in both cases is zero.
231. **STATEMENT – 1** : Water is filled in a container upto its brim end. An orifice is made at its bottom. Now water is replaced by oil. Then velocity of efflux in both cases is observed to be different.
STATEMENT – 2 : Coefficient of viscosity is different for both liquids.
232. **STATEMENT – 1** : An ice cube is floating in water in a vessel at 0°C. When ice cube melts, level of water in the vessel remain same.
STATEMENT – 2 : Volume of melted ice is same as volume of water displaced by ice.
233. **STATEMENT – 1** : When spinning ball is thrown it deviates from its usual path in flight.
STATEMENT – 2 : Time of flight will remains same if axis of rotation is vertical.
234. **STATEMENT – 1** : Water is more elastic than air.
STATEMENT – 2 : Air is more compressible than water.
235. **STATEMENT – 1** : Elastic potential energy stored in a wire is equal to $1/2$ stress \times strain.
STATEMENT – 2 : Work done by stretching force will be stored in the form of energy in the wire.
236. **STATEMENT – 1** : The viscosity of liquid increases rapidly with rise of temperature.
STATEMENT – 2 : Viscosity of a liquid is the property of the liquid by virtue of which it opposes the relative motion amongst its different layers.

Hint & Solution

- | | | | | | | | |
|------|-----|------|-----|------|-----|------|-----|
| 204. | (A) | 206. | (A) | 207. | (A) | 208. | (D) |
| 205. | (B) | 210. | (A) | 211. | (C) | 212. | (D) |
| 209. | (D) | 214. | (A) | 215. | (C) | 216. | (A) |
| 213. | (D) | 218. | (B) | 219. | (D) | 220. | (A) |
| 217. | (A) | 222. | (B) | 223. | (A) | 224. | (A) |
| 221. | (A) | 226. | (B) | 227. | (D) | 228. | (D) |
| 225. | (C) | 230. | (C) | 231. | (A) | 232. | (A) |
| 229. | (A) | 234. | (A) | 235. | (D) | 236. | (D) |
| 233. | (B) | | | | | | |

204. Work done in stretching wire $\frac{1}{2} mg\ell$.

206. Work done = $\frac{1}{2} \times \text{stress} \times \text{strain}$

$$= \frac{1}{2} \times y \times (\text{strain})^2$$

Since, elasticity of steel is more than that of copper, more work has to be done in order to stretch the steel.

208. A body can float into liquid even if the density of liquid is less than the density of solid.

209. Statement 1 is incorrect as viscosity decreases in the rise of temperature and statement 2 is true.

212. The buoyant force acts at the centre of buoyancy of the body i.e., at the centre of mass of the fluid displaced.

213. Weight of fluffy cotton will include the weight of air trapped in it. It will however exactly cancel out by the extra buoyant force acting on the trapped air.

218. Force exerted by liquid on vessel is force exerted on bottom + force exerted on the walls. Force on bottom in three cases is same but force on walls is different.

219. In freely falling liquid pressure difference between any two points is zero. So force exerted by liquid on bottom of box is equal to force exerted on top. So Buoyant force acting on block is zero.

220. According to equation of continuity $av = \text{constant}$.

221. According to Pascal's Law the pressure at every point of liquid in equilibrium of rest is same.

$$\text{If } P_1 = P_2 \Rightarrow \frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow F_2 = \frac{A_2}{A_1} F_1$$

$$\text{So } A_2 > A_1 \Rightarrow F_2 > F_1$$

222. $P + \frac{1}{2} \rho v^2 = \text{constant}$

v increases then p decreases.

Thus pressure falls and boats come close together.

223. The atmospheric pressure from the sides of two plates press them towards each other.

224. Surface tension is a property of liquid and it does not change with container in which it is kept.

225. $\text{elasticity} \propto \frac{1}{\text{deformation}}$.

226. Less soluble solvent decreases the surface tension; while highly solvent ference increases the surface tension, when adding to a liquid.

227. Terminal velocity and critical velocity are not same. Critical velocity is the velocity below which the flow of liquid is streamlined.

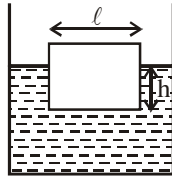
228. According to Bernoulli's Theorem

$$P + \frac{1}{2} \rho v^2 = a(\text{constant})$$

229. Volume of block inside liquid remains unchanged.

230. Velocity of efflux depends on coefficient of viscosity.

231.



Weight = up-thrust force

$$l^3 \rho_i g = l^2 h \rho_w g$$

$$l \rho_i = h \rho_w \quad \dots(i)$$

mass of melted water = mass of the ice

$$= l^3 \rho_i = l^2 h \rho_w$$

$$= (l^2 h) \rho_w$$

\therefore volume of melted water \times density of water

($l^2 h$ = volume displaced by ice cube)

232. Due to pressure difference across two sides of the ball, it deviates from its usual path. Force in vertical direction will remain same.

233. Bulk Modulus = $\frac{1}{\text{compressibility}}$.

234. Potential energy = $\frac{1}{2} \times \text{stress} \times \text{strain} \times \text{volume}$.

235. The viscosity of liquid decreases rapidly with rise of temperature.

$$n_t = n_0 (1 + \alpha t + \beta t^2)$$

Where n_t and n_0 are the coefficient of viscosities at $t^\circ\text{C}$ and 0°C and α , β are constants.