QB365 Question Bank Software Study Materials

Properties of Matter Important 2 Marks Questions With Answers (Book Back and Creative)

11th Standard

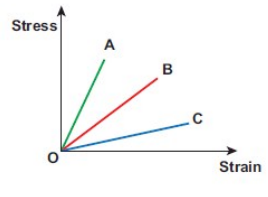
Physics

Total Marks : 60

2 Marks

30 x 2 = 60

1) Within the elastic limit, the stretching strain produced in wires A, B, and C due to stress is shown in the figure. Assume the load applied are the same and discuss the elastic property of the material.



Write down the elastic modulus in ascending order

Answer : Here, the elastic modulus is Young modulus and due to stretching, stress is tensile stress and strain is tensile strain. Within the elastic limit, stress is proportional to strain (obey Hooke's law). Therefore, it shows a straight line behaviour. So, Young modulus can be computed by taking slope of these straight lines. Hence, calculating the slope for the straight line, we get

Slope of A > Slope of B > Slope of C

Which implies,

Young modulus of C < Young modulus of B < Young modulus of A

Notice that larger the slope, lesser the strain (fractional change in length). So, the material is much stiffer. Hence, the elasticity of wire A is greater than wire B which is greater than C. From this example, we have understood that Young's modulus measures the resistance of solid to a change in its length.

2) A wire 10 m long has a cross-sectional area 1.25×10^{-4} m^2. It is subjected to a load of 5 kg. If Young's modulus of the material is 4×10^{10} N m^{-2}, calculate the elongation produced in the wire. Take g = 10 ms^{-2}.

Answer : We know that $\frac{F}{A} = Y\times\frac{\Delta L}{L}$

$$\frac{\Delta L}{L}=\left(\frac{F}{A}\right)\left(\frac{L}{Y}\right)$$
$$=\left(\frac{50}{1.25\times10^{-4}}\right)\left(\frac{10}{4\times10^{10}}\right)=10^{-4}m$$

3) A metallic cube of side 100 cm is subjected to a uniform force acting normal to the whole surface of the cube. The pressure is 10^6 pascal. If the volume changes by 1.5×10^{-5} m^3, calculate the bulk modulus of the material.

Answer : By definition, $K=\frac{\frac{F}{A}}{\frac{\Delta V}{V}}=P\frac{V}{\Delta V}$

$$K=\frac{10^6\times1}{1.5\times10^{-5}}=6.67\times10^{10}N\ m^{-2}$$

4) A metal cube of side 0.20 m is subjected to a shearing force of 4000 N. The top surface is displaced through 0.50 cm with respect to the bottom. Calculate the shear modulus of elasticity of the metal.

Answer : Here, L = 0.20 m, F = 4000 N, x = 0.50 cm

= 0.005 m and Area A = L^2 = 0.04 m^2

Therefore,

$$\eta_R=\frac{F}{A}\times\frac{L}{x}=\frac{4000}{0.04}\times\frac{0.20}{0.005}=4\times10^6N\ m^{-2}$$

5) Water rises in a capillary tube to a height of 2.0cm. How much will the water rise through another capillary tube whose radius is one-third of the first tube?

Answer : From equation (7.34), we have

$h\propto\frac{1}{r}\Rightarrow hr=$constant

Consider two capillary tubes with radius r_1 and r_2 which on placing in a liquid, capillary rises to height h_1 and h_2, respectively.

Then,

$h_1r_1 = h_2r_2$ = constant

$$\Rightarrow h_2=\frac{h_1r_1}{r_2}=\frac{\left(2\times10^{-2}m\right)}{\frac{r}{3}}\Rightarrow h_2=6\times10^2m$$

6) Mercury has an angle of contact equal to 140° with soda lime glass. A narrow tube of radius 2 mm, made of this glass is dipped in a trough containing mercury. By what amount does the mercury dip down in the tube relative to the liquid surface outside?. Surface tension of mercury T = 0.456 N m^{-1}; Density of mercury ρ = 13.6×10^3 kg m^{-3}

Answer : Capillary descent, cos140 = cos(90+50)–sin50 = –0.7660

$$h = \frac{2T cos\theta}{r\rho g} = \frac{2\times(0.465N\,m^{-1})(cos\ 140^0)}{(2\times10^{-3}m)(13.6\times10^3)(9.8ms^{-2})}$$
$$= \frac{2\times0.456\times(-0.7660)}{2\times13.6\times9.8}$$
$$= \frac{-0.6986}{266.56} = -2.62\times10^{-3}\ \text{m}$$

where, negative sign indicates that there is fall of mercury (mercury is depressed) in glass tube.

7) In a normal adult, the average speed of the blood through the aorta (radius r = 0.8 cm) is 0.33 ms^{-1}. From the aorta, the blood goes into major arteries, which are 30 in number, each of radius 0.4 cm. Calculate the speed of the blood through the arteries.

Answer : $a_1v_1 = 30a_2v_2 \Rightarrow \pi r_1^2v_1 = 30\pi r_2^2v_2$

$$v_2 = \frac{1}{30}\left(\frac{r_1}{r_2}\right)^2 v_1 \Rightarrow v_2 = \frac{1}{30}\times\left(\frac{0.8\times10^{-2}m}{0.4\times10^{-2}m}\right)^2\times\left(0.33ms^{-1}\right)$$

v_2 = 0.044 m s^{-1}

8) Define stress and strain.

Answer : **Stress:** Stress is defined as the restoring force per unit area.

Stress, $\sigma = \frac{Force}{Area}$

Strain: Strain is defined as the rates of change in size to the original size if an object.

Strain, $\varepsilon = \frac{\Delta l}{l}$

9) State Archimedes principle.

Answer : Archimedes principle states that when a body is partially or wholly immersed in a fluid, it experiences an upward thrust equal to the weight of the fluid displaced by it and its up thrust acts through the centre of gravity of the liquid displaced.

10) State the law of floatation.

Answer : The law of floatation states that a body will float in a liquid if the weight of the liquid displaced by the immersed part of the body equals the weight of the body.

11) Define terminal velocity.

Answer : Terminal velocity of a body is defined as the constant velocity acquired by a body while falling through a viscous liquid, in such a way that there is a net force acting on the body and it moves down with a constant velocity.

12) State Bernoulli's theorem.

Answer : According to Bernoulli's theorem, the sum of pressure energy, kinetic energy, and potential energy per unit mass of an incompressible, nonviscous fluid in a streamlined flow remains a constant.

13) Define surface tension of a liquid. Mention its S.I unit and dimension.

Answer : Surface tension of a liquid is defined as the force of tension acting on a unit length of an imaginary line drawn on the free surface of the liquid, the direction of force being perpendicular to the line so drawn and acting parallel to the surface.
Unit is Nm^{-1} and dimension is MT^{-1}

14) Define angle of contact for a given pair of solid and liquid.

Answer : Angle of contact is defined as the angle between the tangent to the liquid surface at the point of contact and the solid surface inside the liquid.

15) What happens to the pressure inside a soap bubble when air is blown into it?

Answer : A soup bubble has two free surfaces one internal and another external. When air is blown into it, the internal surface tries to have a minimum surface area. For a given volume, the area of a sphere is minimum. Hence the pressure will be increased.

16) A capillary of diameter dmm is dipped in water such that the water rises to a height of 30mm. If the radius of the capillary is made $\left(\frac{2}{3}\right)$ of its previous value, then compute the height up to which water will rise in the new capillary?

Answer : Diameter of a capillary tube = d mm

Height of water level = h_1 = 30 mm

= 30 x 10^{-3} m

Let the radius of a capillary tube = r mm

Then the radius of a new capillary = $\frac{2}{3}r$

Surface tension $T = \frac{r\rho gh}{2\cos\theta}$

Let height of water level in the new capillary tube be h_2.

$h \propto \frac{1}{r}$

$\frac{h_1}{h_2} = \frac{r_2}{r_1}$

$\frac{30}{h_2} = \frac{\frac{2}{3}r}{r} = \frac{2}{3}$

$\therefore h_2 = \frac{3\times30}{2} = 45 \text{ mm}$

$\therefore$ Height of water level in new capillary tube h_2 = 45 mm

17) The reading of pressure meter attached with a closed pipe is 5×10^5 N m-2. On opening the valve of the pipe, the reading of the pressure meter is 4.5×10^5 Nm^{-2}. Calculate the speed of the water flowing in the pipe.

Answer : Before opening the valve $P_1 = 5\times10^5 Nm^{-2}; \quad v_1 = 0$

After opening the valve $P_2 = 4.5\times10^5 Nm^{-2}; \quad v_2 = ?$

In horizontal flow potential energy remains unchanged. So Bernoulli's theorem can be written as

$P_2 + \frac{1}{2}\rho V_2^2 = P_1 + \frac{1}{2}\rho V_1^2$

$\rho =$ Density of water $= 10^3 \text{ kg/m}^3$

$5\times10^5 + \frac{1}{2}\times10^3 V_2^2 = 4.5\times10^5 + \frac{1}{2}\times10^3\times(0)^2$

$\frac{1}{2}\times10^3 V_2^2 = (5-4.5)\times10^5$

$\frac{1}{2}\times10^3 V_2^2 = 0.5\times10^5$

$v_2^2 = \frac{2\times0.5\times10^5}{10^3}$

$v_2^2 = 1\times10^{5-3}$

$= 1\times10^2 = 100 \text{ ms}^{-1}$

$\therefore v_2 = \sqrt{100} \text{ ms}^{-1}$

$= 10 \text{ ms}^{-1}$

$\therefore$ Speed of the water flowing in the pipe = 10 ms^{-1}

18) Why coffee runs up into a sugar lump (a small cube of sugar) when one corner of the sugar lump is held in the liquid?

Answer : The sugar lump dissolves more rapidly at some points than at others. Where it dissolves, the surface tension of the liquid is reduced. As the force of surface tension reduces by different amounts in different points of the sugar lump, coffee runs up into a sugar lumb when one corner of it is held in the liquid.

19) We use straw to suck soft drinks, why?

Answer : When we suck through the straw, the pressure inside the straw becomes less than the atmospheric pressure. Due to the pressure different the soft drink rises in the straw and we are able to take the soft drink easily.

20) What do you mean by capillarity or capillary action?

Answer : The rise or fall of a liquid in a narrow tube is called capillarity or capillary action.

21) What is Bulk modulus for a Perfectly rigid body?

Answer : Bulk modulus (B)= $\frac{P}{\Delta V/V} = \frac{PV}{\Delta V}$

For perfectly rigid body, change in volume $\Delta V = B = \frac{PV}{0} = \infty$

Therefore, Bulk modulus for a Perfectly rigid body is ∞.

22) The average depth of Indian ocean is about 3000 m. What is the fractional compression, ΔVN of water at the bottom of ocean? (bulk modulus of water = 2.2×10^9 Nm^{-2} & g = 10 ms^{-2})

Answer : Pressure = hpg= $3000\times1000\times10$

= 3×10^7 Nm^2

Fraction all compression

$\frac{\Delta V}{V} = \frac{\rho}{B} = \frac{3\times10^7 Nm^{-2}}{2.2\times10^9 Nm^{-2}}$

$=1.36\times10^{-2}$ or 13.6%

23) Are the intermolecular forces involved in the formation of liquid & solids different in nature? If yes how?

Answer : Yes, the intermolecular forces involved in the formation of liquids are attractive in nature while in the formation of solids, the repulsive intermolecular forces are more important.

24) Explain the classification of longitudinal stress?

Answer : Longitudinal stress can be classified into two types, tensile stress and compressive stress.
Tensile stress: Internal forces on the two sides of ΔA may pull each other, i.e., it is stretched by equal and opposite forces. Then, the longitudinal stress is called tensile stress.
Compressive stress: When forces acting on the two sides of ΔA push each other, M is pushed by equal and, opposite forces at the two ends. In this case, ΔA is said to be under compression. Then, the longitudinal stress is called compressive stress.

25) Define elastic limit?

Answer : **Elastic limit:** The maximum stress within which the body regains its original size and shape after the removal of deforming force is called the elastic limit.

26) Write the examples of floating bodies?

Answer : (i) A person can swim in sea water more easily than in river water.
(ii) Ice floats on water.
(iii) The ship is made of steel but its interior is made hollow by giving it a concave

27) A needle floats in clean water but sinks in soap solution. Give reason.

Answer : The surface tension of water being large as compared to soap solution. When the surface tension is high, the upper surface of water acts as a stretched membrane. It can support the weight of the needle.

28) How can submarines be raised to the level of sea water?

Answer : To achieve this, submarine have tallest tanls that can be filled with water or air, the overall density of the submarine becomes lesser than the surrounding water. Hence submarine rise to the level of sea water.

29) The liquid drops becomes spherical, Why?

Answer : The surface of drops will have a minimum energy with least area. Hence they become spherical.

30) The clothes are better cleaned with hot water than with cold water. Give reason.

Answer : Surface tension decreases with the increase of temperature. Lesser the surface tension more is the wetting and hence more the washing power of water.