DPP
DAILY PRACTICE PRODUCTS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 1

Topic :- MECHANICAL PROPERTIES OF SOLIDS

1 **(a)**
$Y = 3K(1 - 2\sigma), Y = 2\eta(1 + \sigma)$
For $Y = 0$, we get $1 - 2\sigma = 0$, also $1 + \sigma = 0$
$\Rightarrow \sigma$ lies between $\frac{1}{2}$ and - 1

2 **(b)**
$W = \frac{1}{2} \times F \times l = \frac{1}{2} mgl = \frac{1}{2} \times 10 \times 10 \times 1 \times 10^{-3} = 0.05\, J$

4 **(a)**
Elastic potential energy per unit volume is given as
$U = \frac{1}{2} \times \text{stress} \times \text{strain}$
From definition of Young's modulus of wire
$Y = \frac{\text{stress}}{\text{strain}}$
$\Longrightarrow \text{stress} = \text{Y} \times \text{strain}$
Given, strain $= X$
Therefore, $U = \frac{1}{2} \times YX^2$
$\Longrightarrow U = 0.5\, YX^2$

5 **(d)**
Increase in length due to rise in temperature $\Delta L = aL\Delta T$
As $Y = \frac{FL}{A_\Delta L'}$, so, $F = \frac{YA_\Delta l}{L} = \frac{YA \times aL_\Delta T}{L} = YAa\Delta T$
$\therefore \quad F = 2 \times 10^{11} \times 10^{-6} \times 1.1 \times 10^{-5} \times 20 = 44$ N.

6 **(a)**
When strain is small, the ratio of the longitudinal stress to the corresponding longitudinal strain is called the Young's modulus (Y) of the material of the body.
$Y = \frac{\text{stress}}{\text{strain}} = \frac{F/A}{l/L}$
Where F is force, A the area, l the change in length and L the original length.

$\therefore\ Y = \frac{FL}{\pi r^2 l}$

r being radius of the wire.

Given $r_2 = 2r_1,\ L_2 = 2L_1, F_2 = 2F_1$

Since, Young's modulus is a property of material, we have

$Y_1 = Y_2$

$\therefore \frac{F_1 L_1}{\pi r_1^2 l_1} = \frac{2F_1 \times 2L_1}{\pi (2r_1)^2 l_2}$

$l_2 = l_1 = l$

Hence, extension produced is same as that in the other wire.

7 **(b)**

$\text{Stress} = \frac{\text{force}}{\text{Area}} \therefore \text{Stress} \propto \frac{1}{\pi r^2}$

$\frac{S_B}{S_A} = \left(\frac{r_A}{r_B}\right)^2 = (2)^2 \Rightarrow S_B = 4S_A$

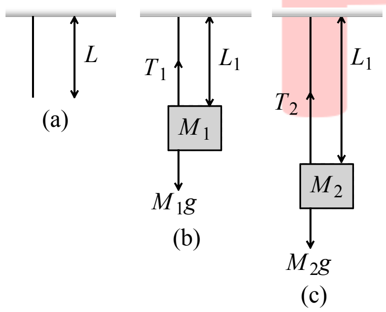
8 **(d)**

$A = 10^{-6} m^2$

$Y = \frac{\left(\frac{T}{A}\right)}{\frac{\Delta l}{l}} = \frac{\left(\frac{100}{10^{-6}}\right)}{\left(\frac{0.1}{100}\right)} = \frac{100}{10^{-6}} \times \frac{100}{0.1} = \frac{10^4}{10^{-7}} = 10^{11} N/m^2$

9 **(d)**

L be original length of the wire



When a mass M_1 is suspended from the wire, change in length of wire is $\Delta L_1 = L_1 - L$

When a mass M_2 is suspended from it, change in length of wire is $\Delta L_2 = L_2 - L$

From figure (b), $T_1 = M_1 g$ ...(i)

From figure (c), $T_2 = M_2 g$ ...(ii)

As young's modulus, $Y = \frac{T_1 L}{A \Delta L_1} = \frac{T_2 L}{A \Delta L_2}$

$\frac{T_1}{\Delta L_1} = \frac{T_2}{\Delta L_2} \Rightarrow \frac{T_1}{L_1 - L} = \frac{T_2}{L_2 - L}$

$\frac{M_1 g}{L_1 - L} = \frac{M_2 g}{L_2 - L}$ [Using (i) and (ii)]

$M_1(L_2 - L) = M_2(L_1 - L)$

$M_1 L_2 - M_1 L = M_2 L_1 - M_2 L$

$$L(M_2 - M_1) = L_1M_2 - L_2M_1 \Rightarrow L = \frac{L_1M_2 - L_2M_1}{M_2 - M_1}$$

10 **(b)**

Adiabatic elasticity $E = \gamma P$

For argon $E_{Ar} = 1.6\ P$ ...(i)

For hydrogen $E_{H_2} = 1.4P'$ ...(ii)

As elasticity of hydrogen and argon are equal

$\therefore 1.6P = 1.4P' \Rightarrow P' = \frac{8}{7}P$

11 **(c)**

$l = \frac{FL}{AY} \Rightarrow l \propto \frac{L}{r_2} \Rightarrow \frac{l_1}{l_2} = \frac{L_1}{L_2} \times \frac{r_2^2}{r_1^2}$

or $\frac{l_1}{l_2} = \frac{1}{2}$

Therefore, strain produced in the two wires will be in the ratio 1:2.

12 **(a)**

$Y = \frac{Fl}{A\Delta l}$ or $\Delta l \propto \frac{F}{r^2}$

Or $\frac{\Delta l_2}{\Delta l_1} = \frac{F_2}{F_1} \times \frac{r_1^2}{r_2^2}$

Or $\frac{\Delta l_2}{\Delta l_1} = 2 \times 2 \times 2 = 8$

Or $\Delta l_2 = 8\Delta l_1 = 8 \times 1\ \text{mm} = 8\ \text{mm}$

14 **(b)**

$K = \frac{pV}{\Delta V} = \frac{pV}{\gamma \Delta T} = \frac{p}{3\alpha T}$ or $T = \frac{p}{3K\alpha}$

15 **(c)**

$K = \frac{100}{0.01/100} = 10^6 atm = 10^{11} N/m^2 = 10^{12} dyne/cm^2$

16 **(b)**

Work done in stretching the wire

$W = \frac{1}{2} \times \text{force constant} \times x^2$

For first wire, $W_1 = \frac{1}{2} \times kx^2 = \frac{1}{2}kx^2$

For second wire, $W_2 = \frac{1}{2} \times 2k \times x^2 = kx^2$

Hence , $W_2 = 2W_1$

17 **(b)**

$B = \frac{\Delta P}{\Delta V/V} \Rightarrow \frac{1}{B} \propto \frac{\Delta V}{V}$ [$\Delta p =$ constant]

18 **(a)**

$\tau = \frac{\pi \eta r^4}{2l}\ \theta$

In the given problem, $r^4\theta =$ constant

$\therefore \quad \frac{\theta_A}{\theta_B} = \frac{r_2^4}{r_1^4}$

19 **(c)**

Young's modulus of wire depends only on the nature of the material of the wire

20 **(b)**

For most materials, the modulus of rigidity, G is one third of the Young's modulus, γ

$G = \frac{1}{3}\gamma$ or $\gamma = 3G$

$\therefore n = 3$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	B	A	A	D	A	B	D	D	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	A	D	B	C	B	B	A	C	B