9. Elasticity – Multiple Choice Questions

1. Young's Modulus and Breaking Stress

1. The material which practically does not show elastic after effect is

(a) Copper (b) Rubber

(c) Steel (d) Quartz

2. The general form of potential energy curve for atoms or molecules can be represented by the following equation $U(R) = \frac{A}{R^n} - \frac{B}{R^m}$. Here, R is the interatomic or molecular distance, A and B are coefficients, n and m are the exponents. In the above equation

(a) First term represents the attractive part of the potential

(b) Second term represents the attractive part to the potential

(c) Both terms represents the attractive part of the potential

(d) Second term represents the repulsive part of the potential

3. The Young's modulus of a wire of length L and radius r is Y N/m^2. If the length and radius are reduced to $L/2$ and $r/2$, then its Young's modulus will be

(a) $Y/2$ (b) Y

(c) $2Y$ (d) $4Y$

4. A wire is loaded by 6 kg at its one end, the increase in length is 12 mm. If the radius of the wire is doubled and all other magnitudes are unchanged, then increase in length will be

(a) 6 mm (b) 3 mm

(c) 24 mm (d) 48 mm

5. Which one of the following statements is wrong?

(a) Young's modulus for a perfectly rigid body is zero

(b) Bulk modulus is relevant for solids, liquids and gases

(c) Rubber is less elastic than steel

(d) The Young's modulus and shear modulus are relevant for solids

(e) The stretching of a coil spring is determined by its shear modulus

6. There are two wires of same material and same length while the diameter of second wire is 2 times the diameter of first wire, then ratio of extension produced in the wires by applying same load will be

(a) 1 : 1 (b) 2 : 1

(c) 1 : 2 (d) 4 : 1

7. A weight of 200 kg is suspended by vertical wire of length 600.5 cm. The area of cross-section of wire is $1\,mm^2$. When the load is removed, the wire contracts by 0.5 cm. The Young's modulus of the material of wire will be

(a) $2.35 \times 10^{12}\ N/m^2$ (b) $1.35 \times 10^{10}\ N/m^2$

(c) $13.5 \times 10^{11}\ N/m^2$ (d) $23.5 \times 10^{9}\ N/m^2$

8. Longitudinal stress of 1 N/mm^2 is applied on a wire. The percentage increase in length is $(Y = 10^{11}\ N/m^2)$

(a) 0.002 (b) 0.001

(c) 0.003 (d) 0.01

9. Two wires A and B are of same materials. Their lengths are in the ratio $1:2$ and diameters are in the ratio $2:1$ when stretched by force F_A and F_B respectively they get equal increase in their lengths. Then the ratio F_A / F_B should be

(a) $1:2$ (b) $1:1$

(c) $2:1$ (d) $8:1$

10. A uniform plank of Young's modulus Y is moved over a smooth horizontal surface by a constant horizontal force F. The area of cross section of the plank is A. The compressive strain on the plank in the direction of the force is

(a) F/AY (b) $2F/AY$

(c) $\frac{1}{2}(F/AY)$ (d) $3F/AY$

11. An iron rod of length 2m and cross section area of $50\,mm^2$, stretched by 0.5mm, when a mass of 250kg is hung from its lower end. Young's modulus of the iron rod is

(a) $19.6 \times 10^{10}\ N/m^2$ (b) $19.6 \times 10^{15}\ N/m^2$

(c) $19.6 \times 10^{18}\ N/m^2$ (d) $19.6 \times 10^{20}\ N/m^2$

12. A 5 m long aluminium wire ($Y = 7 \times 10^{10}\ N/m^2$) of diameter 3 mm supports a 40 kg mass. In order to have the same elongation in a copper wire ($Y = 12 \times 10^{10}\ N/m^2$) of the same length under the same weight, the diameter should now be, in mm.

(a) 1.75 (b) 1.5

(c) 2.5 (d) 5.0

13. A rigid bar of mass M is supported symmetrically by three wires each of length l. Those at each end are of copper and the middle one is of iron. The ratio of their diameters, if each is to have the same tension, is equal to

(a) Y_{copper} / Y_{iron} (b) $\sqrt{\frac{Y_{iron}}{Y_{copper}}}$

(c) $\frac{Y^2_{iron}}{Y^2_{copper}}$ (d) $\frac{Y_{iron}}{Y_{copper}}$

14. Consider two cylindrical rods of identical dimensions, one of rubber, and the other of steel. Both the rods are fixed rigidly at one end to the roof. A mass M is attached to each of the free ends at the centre of the rods

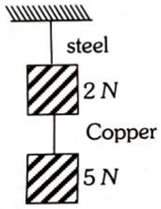
(a) Both the rods will elongate but there shall be no perceptible change in shape

(b) The steel rod will elongate and change shape but the rubber rod will only elongate

(c) The steel rod will elongate without any perceptible change in shape, but the rubber rod will elongate and the shape of the bottom edge will change to an ellipse

(d) The steel rod will elongate, without any perceptible change in shape, but the rubber rod will elongate with the shape of the bottom edge tapered to a tip at the centre

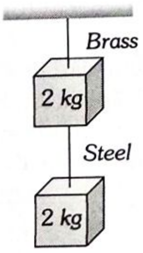
15. If the ratio of diameters, lengths and Young's modulus of steel and copper wires shown in the figure are p, q and s respectively, then the corresponding ratio of increase in their lengths would be



(a) $\frac{5q}{(7sp^2)}$ (b) $\frac{7q}{(5sp^2)}$

(c) $\frac{2q}{(5sp)}$ (d) $\frac{7q}{(5sp)}$

16. If the ratio of lengths, radii and Young's modulus of steel and brass wires shown in the figure are a, b and c, respectively. The ratio between the increase in lengths of brass and steel wires would be



(a) $\frac{b^2a}{2c}$ (b) $\frac{bc}{2a^2}$

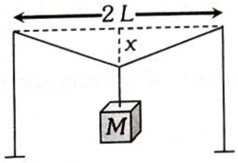
(c) $\frac{ba^2}{2c}$ (d) $\frac{a}{2b^2c}$

17. The temperature of a wire is doubled. The Young's modulus of elasticity

(a) Will also double (b) Will become four times

(c) Will remain same (d) Will decrease

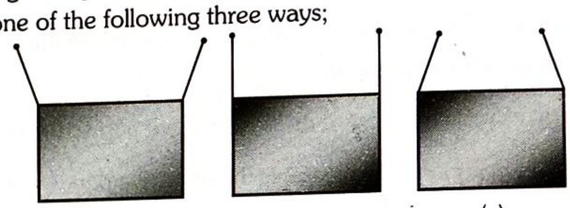
18. A mid steel wire of length $2L$ and cross-sectional area A is stretched, well within elastic limit, horizontally between two pillars (figure). A mass m is suspended from the mid-point of the wire. Strain in the wire is



(a) $\frac{x^2}{2L^2}$ (b) $\frac{x}{L}$

(c) x^2/L (d) $x^2/2L$

19. A rectangular frame is to be suspended symmetrically by two strings of equal length on two supports (figure). It can be done in one of the following three ways;



(a) (b) (c)

The tension in the strings will be

(a) The same in all cases

(b) Least in (a)

(c) Least in(b)

(d) Least in (c)

20. A steel rod has a radius $R = 9.5\,mm$ and length $L = 81\,cm$. A force $F = 6.2\times10^4\,N$ stretches it along its length. What is the stress in the rod

(a) $0.95\times10^8\,N/m^2$ (b) $1.1\times10^8\,N/m^2$

(c) $2.2\times10^8\,N/m^2$ (d) $3.2\times10^8\,Nm^2$

21. To break a wire, a force of $10^6\,N/m^2$ is required. If the density of the material is $3\times10^3\,kg/m^3$, then the length of the wire which will break by its own weight will be

(a) 34 m (b) 30 m

(c) 300 m (d) 3 m

22. A steel wire of cross-sectional area $3\times10^{-6}\,m^2$ can withstand a maximum strain of 10^{-3}. Young's modulus of steel is $2\times10^{11}\,N/m^2$. The maximum mass the wire can hold is (Take $g = 10m/s^2$)

(a) 40 kg (b) 60 kg

(c) 80 kg (d) 100 kg

23. The maximum load a wire can withstand without breaking, when its length is reduced to half of its original length, will

(a) Be double (b) Be half

(c) Be four times (d) Remain same

24. The temperature of a wire of length 1 *metre* and area of cross-section $1\,cm^2$ is increased from 0°C to 100°C. If the rod is not allowed to increase in length, the force required will be ($\alpha = 10^{-5}/°C$ and $Y = 10^{11}\,N/m^2$)

(a) $10^3 N$ (b) $10^4 N$

(c) $10^5 N$ (d) $10^9 N$

25. A force of 200 *N* is applied at one end of a wire of length 2 *m* and having area of cross-section $10^{-2}\,cm^2$. The other end of the wire is rigidly fixed. If coefficient of linear expansion of the wire $\alpha = 8\times10^{-6}/°C$ and Young's modulus $Y = 2.2\times10^{11}\,N/m^2$ and its temperature is increased by 5°C, then the increase in the tension of the wire will be

(a) 4.2 *N* (b) 4.4 *N*

(c) 2.4 *N* (d) 8.8 *N*

26. If the interatomic spacing in a steel wire is 3.0Å and $Y_{steel} = 20\times10^{10}\,N/m^2$ then force constant is

(a) $6\times10^{-2}\,N/Å$ (b) $6\times10^{-9}\,N/Å$

(c) $4\times10^{-5}\,N/Å$ (d) $6\times10^{-5}\,N/Å$

27. A toy cart is tied to the end of an unstretched string of length '*l*', when revolved, the toy cart moves in horizontal circle with radius '2*l*' and time period *T*. If it is speeded until it moves in horizontal circle of radius '3*l*' with period T_1, relation between *T* and T_1 is (Hooke's law is obeyed)

(a) $T_1 = \frac{2}{\sqrt{3}}$ (b) $T_1 = \sqrt{\frac{3}{2}}T$

(c) $T_1 = \sqrt{\frac{2}{3}}T$ (d) $T_1 = \frac{\sqrt{3}}{2}T$

28. A bob of mass 10 *kg* is attached to wire 0.3 *m* long. Its breaking stress is $4.8\times10^7\,N/m^2$. The area of cross section of the wire is $10^{-6}\,m^2$. The maximum angular velocity with which it can be rotated in a horizontal circle

(a) 8 rad/sec (b) 4 rad/sec

(c) 2 rad/sec (d) 1 rad/sec

29. A rope 1 *cm* in diameter breaks if tension in it exceeds 500 *N*. The maximum tension that may be given to a similar rope of diameter 2 *cm* is

(a) 2000 *N* (b) 1000 *N*

(c) 500 *N* (d) 250 *N*

2. Work Done in Stretching a Wire

1. A wire of initial length L and radius r is stretched by a length ℓ. Another wire of same material but with initial length 2L and radius 2r is stretched by a length 2ℓ. The ratio of the stored elastic energy per unit volume in the first and second wire is

(a) 1 : 4 (b) 1 : 2

(c) 2 : 1 (d) 1 : 1

2. Wires *A* and *B* are made from the same material. *A* has twice the diameter and three times the length of *B*. If the elastic limits are not reached, when each is stretched by the same tension, the ratio of energy stored in *A* to that in *B* is

(a) 2 : 3 (b) 3 : 4

(c) 3 : 2 (d) 6 : 1

3. A wire of length *L* and cross-sectional area *A* is made of a material of Young's modulus *Y*. It is stretched by an amount *x*. The work done (or energy stored) is

(a) $\frac{YxA}{2L}$ (b) $\frac{Yx^2A}{L}$

(c) $\frac{Yx^2A}{2L}$ (d) $\frac{2Yx^2A}{L}$

4. The work per unit volume to stretch the length by 1% of a wire with cross sectional area of $1mm^2$ will be. [$Y=9\times10^{11}\,N/m^2$]

(a) $9\times10^{11}\,J$ (b) $4.5\times10^7\,J$

(c) $9\times10^7\,J$ (d) $4.5\times10^{11}\,J$

5. When a force is applied on a wire of uniform cross-sectional area $3\times10^{-6}\,m^2$ and length 4*m*, the increase in length is 1 *mm*. Energy stored in it will be ($Y = 2\times10^{11}\,N/m^2$)

(a) 6250 *J* (b) 0.177 *J*

(c) 0.075 *J* (d) 0.150 *J*

6. Two spring P and Q of force constants k_p and $k_Q\left(k_Q = \frac{k_p}{2}\right)$ are stretched by applying forces of equal magnitude. If the energy stored in Q is *E*, then the energy stored in *P* is

(a) *E* (b) 2*E*

(c) *E*/8 (d) *E*/4

(e) *E*/2

7. A rubber cord catapult has cross-sectional area $25\,mm^2$ and initial length of rubber cord is $10\,cm$. It is stretched to $5\,cm$ and then released to project a missile of mass 5*gm*. Taking $Y_{rubber} = 5\times10^8\,N/m^2$ velocity of projected missile is

(a) $20\,ms^{-1}$ (b) $100\,ms^{-1}$

(c) $250\,ms^{-1}$ (d) $200\,ms^{-1}$

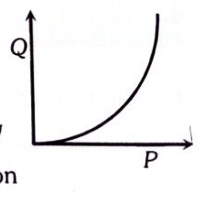
8. The graph shows the behaviour of a length of wire in the region for which the substance obeys Hooke's law. *P* and *Q* represent

(a) *P* = applied force, *Q* = extension

(b) *P* = extension, *Q* = applied force

(c) *P* = extension, *Q* = stored elastic energy

(d) *P* = stored elastic energy, *Q* = extension



3. Bulk Modulus

1. If the volume of a block of aluminium is decreased by 1%, the pressure (stress) on its surface is increased by (Bulk modulus of $Al = 7.5\times10^{10}\ Nm^{-2}$)

(a) $7.5\times10^{10}\ Nm^{-2}$ (b) $7.5\times10^{8}\ Nm^{-2}$

(c) $7.5\times10^{6}\ Nm^{-2}$ (d) $7.5\times10^{4}\ Nm^{-2}$

(e) $7.5\times10^{2}\ Nm^{-2}$

2. To what depth below the surface of sea should a rubber ball be taken as to decrease its volume by 0.1% [Take: density of sea water=$1000 kgm^{-3}$, Bulk modulus of rubber=$9\times10^{8} Nm^{-2}$; acceleration due to gravity=$10\ ms^{-2}$]

(a) 9 m (b) 18 m

(c) 180 m (d) 90 m

3. If a rubber ball is taken at the depth of 200 m in a pool, its volume decreases by 0.1%. If the density of the water is $1\times10^3\ kg/m^3$ and $g = 10\ m/s^2$, then the volume elasticity in N/m^2 will be

(a) 10^8 (b) 2×10^8

(c) 10^9 (d) 2×10^9

4. The average depth of Indian ocean is about 3000m. The fractional compression, $\frac{\Delta V}{V}$ of water at the bottom of the ocean (given that the bulk modulus of the water $= 2.2\times10^9\ Nm^{-2}$ and $g = 10ms^{-2}$) is

(a) 0.82% (b) 0.91%

(c) 1.36% (d) 1.24%

(e) 1.52%

5. The Bulk modulus for an incompressible liquid is

(a) Zero (b) Unity

(c) Infinity (d) Between 0 to 1

6. The pressure applied from all directions on a cube is P. How much its temperature should be raised to maintain the original volume? The volume elasticity of the cube is β and the coefficient of volume expansion is α

(a) $\frac{P}{\alpha\beta}$ (b) $\frac{P\alpha}{\beta}$

(c) $\frac{P\beta}{\alpha}$ (d) $\frac{\alpha\beta}{P}$

4. Rigidity Modulus

1. Modulus of rigidity of a liquid

(a) Non zero constant (b) Infinite

(c) Zero (d) Can not be predicted

2. A 2 m long rod of radius 1 cm which is fixed from one end is given a twist of 0.8 radians. The shear strain developed will be

(a) 0.002 (b) 0.004

(c) 0.008 (d) 0.016

3. Modulus of rigidity of ideal liquids is

(a) Infinity

(b) Zero

(c) Unity

(d) Some finite small non-zero constant value

4. A spring is stretched by applying a load to its free end. The strain produced in the spring is

(a) Volumetric (b) Shear

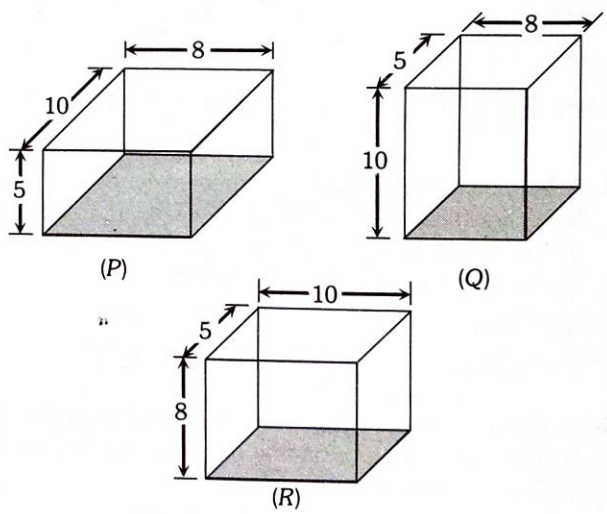
(c) Longitudinal and shear (d) Longitudinal

5. The upper end of a wire of radius 4 mm and length 100 cm is clamped and its other end is twisted through an angle of 30°. Then angle of shear is

(a) 12° (b) 0.12°

(c) 1.2° (d) 0.012°

6. A rectangular block of size $10\ cm\times8\ cm\times5\ cm$ is kept in three different positions P, Q and R in turn as shown in the figure. In each case, the shaded area is rigidly fixed and a definite force F is applied tangentially to the opposite face to deform the block. The displacement of the upper face will be



(a) Same in all the three cases

(b) Maximum in P position

(c) Maximum in Q position

(d) Maximum in R position

7. A rod of length l and radius r is joined to a rod of length l/2 and radius r/2 of same material. The free end of small rod is fixed to a rigid base and the free end of larger rod is given a twist of $\theta°$, the twist angle at the joint will be

(a) $\theta/4$ (b) $\theta/2$

(c) $5\theta/6$ (d) $8\theta/9$

8. The possible value of Poisson's ratio is

(a) 1 (b) 0.9

(c) 0.8 (d) 0.4

9. If longitudinal strain for a wire is 0.03 and its Poisson's ratio is 0.5, then its lateral strain is

(a) 0.003 (b) 0.0075

(c) 0.015 (d) 0.4

10. A material has Poisson's ratio 0.50. If a uniform rod of it suffers a longitudinal strain of 2×10^{-3}, then the percentage change in volume is

(a) 0.6 (b) 0.4

(c) 0.2 (d) Zero

11. Which statement is true for a metal

(a) $Y<\eta$ (b) $Y=\eta$

(c) $Y>\eta$ (d) $Y<1/\eta$

12. For a given material, the Young's modulus is 2.4 times that of rigidity modulus. Its Poisson's ratio is

(a) 2.4 (b) 1.2

(c) 0.4 (d) 0.2

13. On all the six surfaces of a unit cube, equal tensile force of F is applied. The increase in length of each side will be (Y = Young's modulus, σ = Poisson's ratio)

(a) $\frac{F}{Y(1-\sigma)}$ (b) $\frac{F}{Y(1+\sigma)}$

(c) $\frac{F(1-2\sigma)}{Y}$ (d) $\frac{F}{Y(1+2\sigma)}$

14. If the compressibility of water is σ per unit atmospheric pressure, then the decrease in volume V due to P atmospheric pressure will be

(a) $\sigma P/V$ (b) σPV

(c) σ/PV (d) $\sigma V/P$

15. The relation between Y,η and β for a elastic material is

(a) $\frac{1}{\eta}=\frac{1}{3Y}+\frac{1}{9\beta}$ (b) $\frac{1}{\beta}=\frac{1}{3Y}+\frac{1}{9\eta}$

(c) $\frac{1}{Y}=\frac{1}{3\beta}+\frac{1}{9\eta}$ (d) $\frac{1}{Y}=\frac{1}{3\eta}+\frac{1}{9\beta}$

5. IIT-JEE/AIEEE

1. The dimensions of four wires of the same material are given below. In which wire the increase in length will be maximum when the same tension is applied **[1981]**

(a) Length 100 *cm*, Diameter 1 *mm*

(b) Length 200 *cm*, Diameter 2 *mm*

(c) Length 300 *cm*, Diameter 3 *mm*

(d) Length 50 *cm*, Diameter 0.5 *mm*

2. One end of a horizontal thick copper wire of length $2L$ and radius $2R$ is welded to an end of another horizontal thin copper wire of length L and radius R. When the arrangement is stretched by a applying forces at two ends, the ratio of the elongation in the thin wire to that in the thick wire is **[2013]**

(a) 0.25 (b) 0.50

(c) 2.00 (d) 4.00

3. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectional area $3A$. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount **[2009]**

(a) F (b) $4F$

(c) $6F$ (d) $9F$

4. A wire elongates by l *mm* when a load W is hanged from it. If the wire goes over a pulley and two weights W each are hung at the two ends, the elongation of the wire will be (in *mm*) **[2006]**

(a) $2l$ (b) Zero

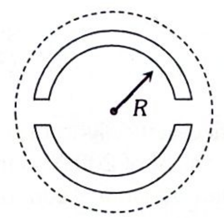
(c) $l/2$ (d) l

5. A student performs an experiment to determine the Young's modulus of a wire, exactly 2 *m* long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 *mm* with an uncertainty of ± 0.05 *mm* at a load of exactly 1.0 *kg*. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ± 0.01*mm*. Take g=9.8 m/s^2 (exact). The Young's modulus obtained from the reading is **[2007]**

(a) $(2.0\pm0.3)\times10^{11}\ N/m^2$ (b) $(2.0\pm0.2)\times10^{11}\ N/m^2$

(c) $(2.0\pm0.1)\times10^{11}\ N/m^2$ (d) $(2.0\pm0.05)\times10^{11}\ N/m^2$

6. A wooden wheel of radius R is made of two semicircular parts (see figure). The two parts are held together by a ring made of a metal strip of cross sectional area S and length L. L is slightly less than $2\pi R$. To fit the ring on the wheel, it is heated so that its temperature rises by ΔT and it just steps over the wheel. As it cools down to surrounding temperature, it presses the semicircular parts together. If the coefficient of linear expansion of the metal is α, and its Young's modulus is Y, the force that one part of the wheel applies on the other part is **[2012]**



(a) $2\pi SY\alpha\Delta T$ (b) $SY\alpha\Delta T$

(c) $\pi SY\alpha\Delta T$ (d) $2SY\alpha\Delta T$

7. One end of a uniform wire of length L and of weight W is attached rigidly to a point in the roof and a weight W_1 is suspended from its lower end. If S is the area of cross-section of the wire, the stress in the wire at a height $3L/4$ from its lower end is **[1992]**

(a) $\frac{W_1}{S}$ (b) $\frac{W_1+(W/4)}{S}$

(c) $\frac{W_1+(3W/4)}{S}$ (d) $\frac{W_1+W}{S}$

8. Two rods of different materials having coefficients of linear expansion α_1, α_2 and Young's moduli Y_1 and Y_2 respectively are fixed between two rigid massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of rods. If $\alpha_1:\alpha_2=2:3$, the thermal stresses developed in the two rods are equally provided $Y_1:Y_2$ is equal to **[1989]**

(a) 2 : 3 (b) 1 : 1

(c) 3 : 2 (d) 4 : 9

9. A highly rigid cubical block A of small mass M and side L is fixed rigidly onto another cubical block B of the same dimensions and of low modulus of rigidity η such that the lower face of A completely covers the upper face of B. The lower face of B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A. After the force is withdrawn, block A executes small oscillations. The time period of which is given by **[1992]**

(a) $2\pi\sqrt{\frac{M\eta}{L}}$ (b) $2\pi\sqrt{\frac{L}{M\eta}}$

(c) $2\pi\sqrt{\frac{ML}{\eta}}$ (d) $2\pi\sqrt{\frac{M}{\eta L}}$

10. A man grows into a giant such that his linear dimensions increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by factor of **[2017]**

(a) $\frac{1}{81}$ (b) 9

(c) $\frac{1}{9}$ (d) 81

11. An elastic material of Young's modulus Y is subjected to a stress S. The elastic energy stored per unit volume of the material is **[1992]**

(a) $\frac{2Y}{S^2}$ (b) $\frac{S^2}{2Y}$

(c) $\frac{S}{2Y}$ (d) $\frac{S^2}{Y}$

12. A wire suspended vertically from one of its ends is stretched by attaching a weight of 200 N to the lower end. The weight stretches the wire by 1mm. Then the elastic energy stored in the wire is **[2003]**

(a) 0.1 J (b) 0.2 J

(c) 10 J (d) 20 J

13. An external pressure P is applied on a cube at 0°C so that it is equally compressed from all sides. K is the bulk modulus of the material of the cube and α is its coefficient of linear expansion. Suppose we want to bring the cube to its original size by heating. The temperature should be raised by **[2017]**

(a) $3PK\alpha$ (b) $\frac{P}{3\alpha K}$

(c) $\frac{P}{\alpha K}$ (d) $\frac{3\alpha}{PK}$

14. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, is **[2018]**

(a) $\frac{mg}{3Ka}$ (b) $\frac{mg}{Ka}$

(c) $\frac{Ka}{mg}$ (d) $\frac{Ka}{3mg}$

6. NEET/AIPMT

1. Two Young's modulus of steel is twice that of brass. Two wires of same length and of same area of cross section, one of steel and another of brass are suspended from the same root. If we want the lower ends of the wires to be at the same level, then the weights added to the steel and brass wires must be in the ratio of **[2015]**

(a) 2 : 1 (b) 4 : 1

(c) 1 : 1 (d) 1 : 2

2. The approximate depth of an ocean is 2700 m. The compressibility of water is $45\times10^{-11} Pa^{-1}$ and density of water is $10^3 kg/m^3$. What fractional compression of water will be obtained at the bottom of the ocean **[2015]**

(a) 1.0×10^{-2} (b) 1.2×10^{-2}

(c) 1.4×10^{-2} (d) 0.8×10^{-2}

3. The bulk modulus of a spherical object is 'B'. If it is subjected to uniform pressure 'P', the fractional decrease in radius is **[2017]**

(a) $\frac{P}{B}$ (b) $\frac{B}{3P}$

(c) $\frac{3P}{B}$ (d) $\frac{P}{3B}$

7. AIIMS

1. Which of the following affects the elasticity of a substance? **[1999]**

(a) Hammering and annealing

(b) Change in temperature

(c) Impurity in substance

(d) All of these

2. According to Hooke's law of elasticity, if stress is increased, the ratio of stress to strain **[2001]**

(a) Increases (b) Decreases

(c) Becomes zero (d) Remains constant

3. A wire of length L and radius r is rigidly fixed at one end. On stretching the other end of the wire with a force F, the increase in its length is l. If another wire of same material but of length $2L$ and radius $2r$ is stretched with a force of $2F$, the increase in its length will be **[1980]**

(a) l (b) $2l$

(c) $\frac{l}{2}$ (d) $\frac{l}{4}$

4. The breaking stress of a wire depends upon **[2002]**

(a) Length of the wire

(b) Radius of the wire

(c) Material of the wire

(d) Shape of the cross section

5. In steel, the Young's modulus and the strain at the breaking point are $2\times10^{11}\ Nm^{-2}$ and 0.15 respectively. The stress at the breaking point for steel is therefore **[2010]**

(a) $1.33\times10^{11}\ Nm^{-2}$ (b) $1.33\times10^{12}\ Nm^{-2}$

(c) $7.5\times10^{-13}\ Nm^{-2}$ (d) $3\times10^{10}\ Nm^{-2}$

6. A stretched rubber has **[2000]**

(a) Increased kinetic energy

(b) Increased potential energy

(c) Decreased kinetic energy

(d) Decreased potential energy

7. If a spring extends by x on loading, then the energy stored by the spring is (if T is tension in the spring and k is spring constant) **[1997]**

(a) $\frac{T^2}{2x}$ (b) $\frac{T^2}{2k}$

(c) $\frac{2x}{T^2}$ (d) $\frac{2T^2}{k}$

8. If x longitudinal strain is produced in a wire of Young's modulus Y, then energy stored in the material of the wire per unit volume is **[2001]**

(a) Yx^2 (b) $2Yx^2$

(c) $\frac{1}{2}Y^2x$ (d) $\frac{1}{2}Yx^2$

9. The isothermal bulk modulus of a gas at atmospheric pressure is **[2000]**

(a) 1 *mm* of *Hg* (b) 13.6 *mm* of *Hg*

(c) $1.013\times10^5\ N/m^2$ (d) $2.026\times10^5\ N/m^2$

10. The value of Poisson's ratio lies between **[1985]**

(a) -1 to $\frac{1}{2}$ (b) $-\frac{3}{4}$ to $-\frac{1}{2}$

(c) $-\frac{1}{2}$ to 1 (d) 1 to 2

8. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : The stretching of a coil is determined by its shear modulus.

Reason : Shear modulus change only shape of a body keeping its dimensions unchanged.

2. Assertion : Steel is more elastic than rubber.

Reason : Under given deforming force, steel is deformed less than rubber.

3. Assertion : Bulk modulus of elasticity (K) represents incompressibility of the material.

Reason : Bulk modulus of elasticity is proportional to change in pressure.

4. Assertion : The bridges are declared unsafe after a long use.

Reason : Elastic strength of bridges decreases with time.

5. Assertion : Two identical solid balls, one of ivory and the other of wet-clay are dropped from fhe same height on the floor. Both the balls will rise to same height after bouncing.

Reason : Ivory and wet-clay have same elasticity.

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

Reason : Steel is more elastic than copper.

9. Elasticity – Answers Keys

1. Young's Modulus and Breaking Stress

1	d	2	b	3	b	4	b	5	a
6	d	7	a	8	b	9	d	10	a
11	a	12	c	13	b	14	d	15	b
16	d	17	d	18	a	19	c	20	c
21	a	22	b	23	d	24	b	25	d
26	b	27	b	28	b	29	a		

2. Work Done in Stretching a Wire

1	d	2	b	3	c	4	b	5	c
6	e	7	c	8	c				

3. Bulk Modulus

1	b	2	d	3	d	4	c	5	c
6	a								

4. Rigidity Modulus

1	c	2	b	3	b	4	c	5	b
6	c	7	d	8	d	9	c	10	d
11	c	12	d	13	c	14	b	15	d

5. IIT-JEE/AIEEE

1	d	2	c	3	d	4	d	5	b
6	d	7	c	8	c	9	d	10	b
11	b	12	a	13	b	14	a		

6. NEET/AIPMT

1	a	2	b	3	d

7. AIIMS

1	a	2	d	3	a	4	c	5	d
6	b	7	b	8	d	9	c	10	a

8. Assertion & Reason

1	a	2	a	3	a	4	a	5	d
6	a								