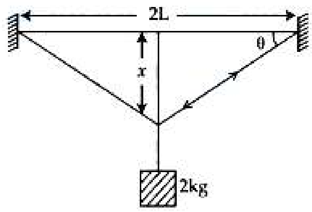
**Q1.** Two persons pull a wire towards themselves. Each person exerts a force of 200 N on the wire. Young's modulus of the material of wire is $1 \times 10^{11}$ N m$^{-2}$. Original length of the wire is 2 m and the area of cross section is 2 cm$^2$. The wire will extend in length by ______ $\mu$m. *09 Apr 2024 (M)*

**Q2.** A wire of cross sectional area A, modulus of elasticity $2 \times 10^{11}$Nm$^{-2}$ and length 2 m is stretched between two vertical rigid supports. When a mass of 2 kg is suspended at the middle it sags lower from its original position making angle $\theta = \frac{1}{100}$ radian on the points of support. The value of A is _____ $\times 10^{-4}$ m$^2$ (consider $x << L$). (given : $g = 10$ m/s$^2$)




*06 Apr 2024 (E)*

**Q3.** Match List-I with List-II :

| | List-I | | List-II |
|---|---|---|---|
| (A) | A force that restores an elastic body of unit area to its original state | (I) | Bulk modulus |
| (B) | Two equal and opposite forces parallel to opposite faces | (II) | Young's modulus |
| (C) | Forces perpendicular everywhere to the surface per unit area same everywhere | (III) | Stress |
| (D) | Two equal and opposite forces perpendicular to opposite faces | (IV) | Shear modulus |

Choose the correct answer from the options given below : *05 Apr 2024 (E)*

(1) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
(2) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
(3) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
(4) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

**Q4.** The density and breaking stress of a wire are $6 \times 10^4$ kg/m$^3$ and $1.2 \times 10^8$ N/m$^2$ respectively. The wire is suspended from a rigid support on a planet where acceleration due to gravity is $\frac{1}{3}^{\text{rd}}$ of the value on the surface of earth. The maximum length of the wire with breaking is _____ m (take, $g = 10$ m/s$^2$ ). *05 Apr 2024 (M)*

**Q5.** An elastic spring under tension of 3 N has a length $a$. Its length is $b$ under tension 2 N. For its length $(3a - 2b)$, the value of tension will be______N. *04 Apr 2024 (M)*

**Q6.** With rise in temperature, the Young's modulus of elasticity *01 Feb 2024 (M)*

(1) changes erratically
(2) decreases
(3) increases
(4) remains unchanged

**Q7.** One end of a metal wire is fixed to a ceiling and a load of 2 kg hangs from the other end. A similar wire is attached to the bottom of the load and another load of 1 kg hangs from this lower wire. Then the ratio of longitudinal strain of upper wire to that of the lower wire will be
[Area of cross section of wire $= 0.005$ cm$^2$, $Y = 2 \times 10^{11}$ N m$^{-2}$ and $g = 10$ m s$^{-2}$]

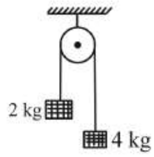
*01 Feb 2024 (E)*

**Q8.** The depth below the surface of sea to which a rubber ball be taken so as to decrease its volume by $0.02\%$ is _____ m.

(Take density of sea water $= 10^3\ \mathrm{kg\ m^{-3}}$, Bulk modulus of rubber $= 9 \times 10^8\ \mathrm{N\ m^{-2}}$, and $g = 10\ \mathrm{m\ s^{-2}}$)

***31 Jan 2024 (M)***

**Q9.** Two blocks of mass $2\ \mathrm{kg}$ and $4\ \mathrm{kg}$ are connected by a metal wire going over a smooth pulley as shown in figure. The radius of wire is $4.0 \times 10^{-5}\ \mathrm{m}$ and Young's modulus of the metal is $2.0 \times 10^{11}\ \mathrm{N\ m^{-2}}$. The longitudinal strain developed in the wire is $\frac{1}{\alpha\pi}$. The value of $\alpha$ is _____. [Use $g = 10\ \mathrm{m\ s^{-2}}$)

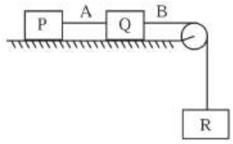



***31 Jan 2024 (E)***

**Q10.** Young's modules of material of a wire of length $L$ and cross-sectional area $A$ is $Y$. If the length of the wire is doubled and cross-sectional area is halved then Young's modules will be: ***30 Jan 2024 (M)***

(1) $\frac{Y}{4}$
(2) $4Y$
(3) $Y$
(4) $2Y$

**Q11.** Each of three blocks $P$, $Q$ and $R$ shown in figure has a mass of $3\ \mathrm{kg}$. Each of the wire $A$ and $B$ has cross-sectional area $0.005\ \mathrm{cm^2}$ and Young's modulus $2 \times 10^{11}\ \mathrm{N\ m^{-2}}$. Neglecting friction, the longitudinal strain on wire $B$ is _____ $\times 10^{-4}$. (Take $g = 10\ \mathrm{m\ s^{-2}}$)




***30 Jan 2024 (M)***

**Q12.** A wire of length $L$ and radius $r$ is clamped at one end. If its other end is pulled by a force $F$, its length increases by $l$. If the radius of the wire and the applied force both are reduced to half of their original values keeping original length constant, the increase in length will become: ***29 Jan 2024 (E)***

(1) 3 times
(2) $\frac{3}{2}$ times
(3) 4 times
(4) 2 times

**Q13.** Two metallic wires $P$ and $Q$ have same volume and are made up of same material. If their area of cross sections are in the ratio $4 : 1$ and force $F_1$ is applied to $P$, an extension of $\Delta l$ is produced. The force which is required to produce same extension in Q is $F_2$. The value of $\frac{F_1}{F_2}$ is ______. ***29 Jan 2024 (E)***

**Q14.** Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R)

**Assertion (A)** : The property of body, by virtue of which it tends to regain its original shape when the external force is removed, is Elasticity.

**Reason (R)** : The restoring force depends upon the bonded inter atomic and inter molecular force of solid.

In the light of the above statements, choose the correct answer from the options given below : ***27 Jan 2024 (E)***

(1) (A) is false but (R) is true
(2) (A) is true but (R) is false
(3) Both (A) and (R) are true and (R) is the correct explanation (A)
(4) Both (A) and (R) are true but (R) is not the correct explanation of (A)

**Q15.** If average depth of an ocean is $4000\ \mathrm{m}$ and the bulk modulus of water is $2 \times 10^9\ \mathrm{N\ m^{-2}}$, then fractional compression $\frac{\Delta V}{V}$ of water at the bottom of ocean is $\alpha \times 10^{-2}$. The value of $\alpha$ is _______, (Given, $\mathrm{g} = 10\ \mathrm{m\ s^{-2}}$, $\rho = 1000\ \mathrm{kg\ m^{-3}}$)

***27 Jan 2024 (M)***

**Q16.** A wire of length $L$ and radius $r$ is clamped rigidly at one end. When the other end of the wire is pulled by a force $f$, its length increases by $l$. Another wire of same material of length $2L$ and radius $2r$ is pulled by a force

$2f$. Then the increase in its length will be: ***15 Apr 2023 (M)***

(1) $4l$ (2) $\frac{l}{2}$

(3) $2l$ (4) $l$

**Q17.** The elastic potential energy stored in a steel wire of length $20$ m stretched through $2$ cm is $80$ J. The cross sectional area of the wire is _____ mm$^2$. (Given, $Y = 2.0 \times 10^{11}$ N m$^{-2}$)

***13 Apr 2023 (M)***

**Q18.** Under isothermal condition, the pressure of a gas is given by $P = aV^{-3}$, where $a$ is a constant and $V$ is the volume of the gas. The bulk modulus at constant temperature is equal to

***13 Apr 2023 (M)***

(1) $3P$ (2) $P$

(3) $2P$ (4) $\frac{P}{2}$

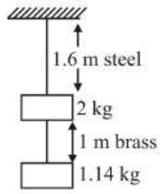
**Q19.** The length of a wire becomes $l_1$ and $l_2$ when 100 N and 120 N tension are applied respectively. If $10l_2 = 11l_1$, then the natural length of wire will be $\frac{1}{x}l_1$. Here the value of $x$ is ***11 Apr 2023 (M)***

**Q20.** Young's moduli of the material of wires $A$ and $B$ are in the ratio of $1 : 4$, while its area of cross sections are in the ratio of $1 : 3$. If the same amount of load is applied to both the wires, the amount of elongation produced in the wires A and B will be in the ratio of [Assume length of wires $A$ and $B$ are same] ***10 Apr 2023 (E)***

(1) $12 : 1$ (2) $1 : 36$

(3) $36 : 1$ (4) $1 : 12$

**Q21.** Two wires each of radius $0.2$ cm and negligible mass, one made of steel and the other made of brass are loaded as shown in the figure. The elongation of the steel wire is _____ $10^{-6}$ m. [Young's modulus for steel $= 2 \times 10^{11}$ N m$^{-2}$ and $g = 10$ m s$^{-2}$]




***10 Apr 2023 (M)***

**Q22.** An aluminium rod with Young's modulus $Y = 7.0 \times 10^{10}$ N m$^{-2}$ undergoes elastic strain of $0.04\%$. The energy per unit volume stored in the rod in SI unit ***08 Apr 2023 (M)***

(1) 2800 (2) 11200

(3) 5600 (4) 8400

**Q23.** A steel rod has a radius of $20$ mm and a length of $2.0$ m. A force of $62.8$ kN stretches it along its length. Young's modulus of steel is $2.0 \times 10^{11}$N m$^{-2}$. The longitudinal strain produced in the wire is _________ $\times 10^{-5}$.

***06 Apr 2023 (M)***

**Q24.** A metal block of mass $m$ is suspended from a rigid support through a metal wire of diameter 14 mm. The tensile stress developed in the wire under equilibrium state is $7 \times 10^5$ N m$^{-2}$. The value of mass $m$ is ______ kg. (Take $g = 9.8$ m s$^{-2}$ and $\pi = \frac{22}{7}$)

***06 Apr 2023 (E)***

**Q25.** The Young's modulus of a steel wire of length $6 \mathrm{~m}$ and cross-sectional area $3 \mathrm{~mm}^2$, is $2 \times 11^{11} \mathrm{~N/m}^2$. The wire is suspended from its support on a given planet. A block of mass $4 \mathrm{~kg}$ is attached to the free end of the wire. The acceleration due to gravity on the planet is $\frac{1}{4}$ of its value on the earth. The elongation of wire is (Take $g$ on the earth $= 10 \mathrm{~m/s}^2$ ): ***01 Feb 2023 (E)***

(1) $1\, cm$
(2) $1\, mm$
(3) $0.1\, mm$
(4) $0.1\, cm$

**Q26.** A certain pressure '$P$' is applied to 1 litre of water and 2 litre of a liquid separately. Water gets compressed to $0.01\%$ whereas the liquid gets compressed to $0.03\%$. The ratio of Bulk modulus of water to that of the liquid is $\frac{3}{x}$. The value of $x$ is ______. ***01 Feb 2023 (M)***

**Q27.** Under the same load, wire A having length $5.0 \mathrm{~m}$ and cross section $2.5 \times 10^{-5} \mathrm{~m}^2$ stretches uniformly by the same amount as another wire $B$ of length $6.0 \mathrm{~m}$ and a cross section of $3.0 \times 10^{-5} \mathrm{~m}^2$ stretches. The ratio of the Young's modulus of wire $A$ to that of wire $B$ will be: ***31 Jan 2023 (E)***

(1) 1 : 4
(2) 1 : 1
(3) 1 : 10
(4) 1 : 2

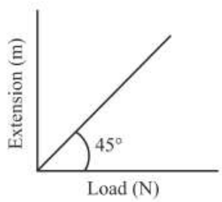
**Q28.** A force is applied to a steel wire $A$, rigidly clamped at one end. As a result elongation in the wire is $0.2 \mathrm{~mm}$. If same force is applied to another steel wire $B$ of double the length and a diameter $2.4$ times that of the wire $A$, the elongation in the wire $B$ will be (wires having uniform circular cross sections) ***30 Jan 2023 (E)***

(1) $6.06 \times 10^{-2} \mathrm{~mm}$
(2) $2.77 \times 10^{-2} \mathrm{~mm}$
(3) $3.0 \times 10^{-2} \mathrm{~mm}$
(4) $6.9 \times 10^{-2} \mathrm{~mm}$

**Q29.** Choose the correct relationship between Poisson ratio $(\sigma)$, bulk modulus $(K)$ and modulus of rigidity $(\eta)$ of a given solid object: ***30 Jan 2023 (M)***

(1) $\sigma = \frac{3K-2\eta}{6K+2\eta}$
(2) $\sigma = \frac{6K+2\eta}{3K-2\eta}$
(3) $\sigma = \frac{3K+2\eta}{6K+2\eta}$
(4) $\sigma = \frac{6K-2\eta}{3K-2\eta}$

**Q30.** As shown in the figure, in an experiment to determine Young's modulus of a wire, the extension-load curve is plotted. The curve is a straight line passing through the origin and makes an angle of $45^\circ$ with the load axis. The length of wire is $62.8 \mathrm{~cm}$ and its diameter is $4 \mathrm{~mm}$. The Young's modulus is found to be $\mathrm{x} \times 10^4 \mathrm{~N~m}^{-2}$. The value of $x$ is _______.




***25 Jan 2023 (M)***

**Q31.** Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**

**Assertion (A) :** Steel is used in the construction of buildings and bridges.

**Reason (R) :** Steel is more elastic and its elastic limit is high.

In the light of above statements, choose the most appropriate answer from the options given below ***24 Jan 2023 (E)***

(1) Both $A$ and $R$ are correct and $R$ is the correct explanation of $A$
(2) Both $A$ and $R$ are correct but $R$ is NOT the correct explanation of $A$
(3) $A$ is correct but $R$ is not correct
(4) $A$ is not correct but $R$ is correct

**Q32.** A 100 m long wire having cross-sectional area $6.25 \times 10^{-4}\ \mathrm{m}^2$ and Young's modulus is $10^{10}\ \mathrm{N\ m^{-2}}$ is subjected to a load of 250 N, then the elongation in the wire will be : ***24 Jan 2023 (M)***

(1) $6.25 \times 10^{-3}\ \mathrm{m}$ (2) $4 \times 10^{-4}\ \mathrm{m}$
(3) $6.25 \times 10^{-6}\ \mathrm{m}$ (4) $4 \times 10^{-3}\ \mathrm{m}$

**Q33.** If the length of a wire is made double and radius is halved of its respective values. Then, the Young's modulus of the material of the wire will : ***29 Jul 2022 (M)***

(1) Remain same (2) Become 8 times its initial value
(3) Become (1/4) th of its initial value (4) Become 4 times its initial value

**Q34.** A metal wire of length $0.5\ \mathrm{m}$ and cross-sectional area $10^{-4}\ \mathrm{m}^2$ has breaking stress $5 \times 10^8\ \mathrm{N\ m^{-2}}$. A block of $10\ \mathrm{kg}$ is attached at one end of the string and is rotating in a horizontal circle. The maximum linear velocity of block will be _____ $\mathrm{m\ s^{-1}}$. ***29 Jul 2022 (E)***

**Q35.** The force required to stretch a wire of cross-section $1\ \mathrm{cm}^2$ to double its length will be: (Given Yong's modulus of the wire $= 2 \times 10^{11}\ \mathrm{N\ m^{-2}}$) ***28 Jul 2022 (M)***

(1) $1 \times 10^7\ \mathrm{N}$ (2) $1.5 \times 10^7\ \mathrm{N}$
(3) $2 \times 10^7\ \mathrm{N}$ (4) $2.5 \times 10^7\ \mathrm{N}$

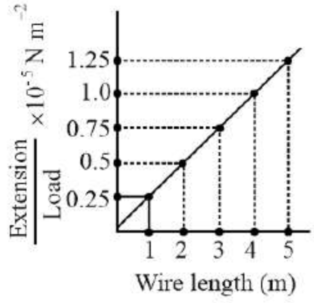
**Q36.** A string of area of cross-section $4\ \mathrm{mm}^2$ and length $0.5$ is connected with a rigid body of mass $2\ \mathrm{kg}$. The body is rotated in a vertical circular path of radius $0.5\ \mathrm{m}$. The body acquires a speed of $5\ \mathrm{m\ s^{-1}}$ at the bottom of the circular path. Strain produced in the string when the body is at the bottom of the circle is _____ $\times 10^{-5}$. (Use Young's modulus $10^{11}\ \mathrm{N\ m^{-2}}$ and $g = 10\ \mathrm{m\ s^{-2}}$) ***28 Jul 2022 (E)***

**Q37.** A square aluminium (shear modulus is $25 \times 10^9\ \mathrm{Nm^{-2}}$) slab of side $60\ \mathrm{cm}$ and thickness $15\ \mathrm{cm}$ is subjected to a shearing force (on its narrow face) of $18.0 \times 10^4\ \mathrm{N}$. The lower edge is riveted to the floor. The displacement of the upper edge is _____ $\mu\mathrm{m}$. ***27 Jul 2022 (M)***

**Q38.** A steel wire of length $3.2\ \mathrm{m}\left(Y_S = 2.0 \times 10^{11}\ \mathrm{N\ m^{-2}}\right)$ and a copper wire of length $4.4\ \mathrm{m}\ \left(Y_C = 1.1 \times 10^{11}\ \mathrm{N\ m^{-2}}\right)$, both of radius $1.4\ \mathrm{mm}$ are connected end to end. When stretched by a load, the net elongation is found to be $1.4\ \mathrm{mm}$. The load applied, in Newton, will be: (Given $\pi = \frac{22}{7}$) ***27 Jul 2022 (E)***

(1) 360 (2) 180
(3) 1080 (4) 154

**Q39.** In an experiment to determine the Young's modulus, steel wires of five different lengths $(1, 2, 3, 4$ and $5)$ but of same cross-section $\left(2\ \mathrm{mm}^2\right)$ were taken and curves between extension and load were obtained. The slope (extension/load) of the curves were plotted with the wire length and the following graph is obtained. If the Young's modulus of given steel wires is $\mathrm{x} \times 10^{11}\mathrm{N\ m^{-2}}$, then the value of $x$ is _____.




***27 Jul 2022 (E)***

**Q40.** The area of cross section of the rope used to lift a load by a crane is $2.5 \times 10^{-4}\ \mathrm{m}^2$. The maximum lifting capacity of the crane is 10 metric tons. To increase the lifting capacity of the crane to 25 metric tons, the required area of cross section of the rope should be (take $\mathrm{g} = 10\ \mathrm{ms}^{-2}$) ***26 Jul 2022 (E)***

(1) $6.25 \times 10^{-4}\ \mathrm{m}^2$ (2) $10 \times 10^{-4}\ \mathrm{m}^2$
(3) $1 \times 10^{-4}\ \mathrm{m}^2$ (4) $1.67 \times 10^{-4}\ \mathrm{m}^2$

**Q41.** A uniform heavy rod of mass $20\ \mathrm{kg}$. Cross sectional area $0.4\ \mathrm{m}^2$ and length $20\ \mathrm{m}$ is hanging from a fixed support. Neglecting the lateral contraction, the elongation in the rod due to its own weight is $x \times 10^{-9}\ \mathrm{m}$. The value of $x$ is _____ .
(Given. Young's modulus $Y = 2 \times 10^{11}\ \mathrm{Nm}^{-2}$ and $g = 10\ \mathrm{m\ s}^{-2}$ ) ***26 Jul 2022 (E)***

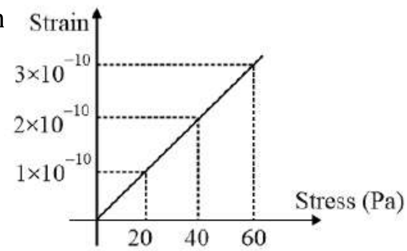
**Q42.** A wire of length $L$ and radius $r$ is clamped rigidly at one end. When the other end of the wire is pulled by a force $F$, its length increases by $5\ \mathrm{cm}$. Another wire of the same material of length 4 L and radius $4r$ is pulled by a force $4\ F$ under same conditions. The increase in length of this wire is _____ cm. ***25 Jul 2022 (M)***

**Q43.** A wire of length $L$ is hanging from a fixed support. The length changes to $L_1$ and $L_2$ when masses $1\ \mathrm{kg}$ and $2\ \mathrm{kg}$ are suspended respectively from its free end. Then the value of $L$ is equal to ***29 Jun 2022 (M)***

(1) $\sqrt{L_1 L_2}$ (2) $\frac{L_1+L_2}{2}$
(3) $2L_1 - L_2$ (4) $3L_1 - L_2$

**Q44.** The elongation of a wire on the surface of the earth is $10^{-4}\ \mathrm{m}$. The same wire of same dimensions is elongated by $6 \times 10^{-5}\ \mathrm{m}$ on another planet. The acceleration due to gravity on the planet will be ___ $\mathrm{m\ s}^{-2}$. (Take acceleration due to gravity on the surface of earth $= 10\ \mathrm{m\ s}^{-2}$) ***26 Jun 2022 (M)***

**Q45.** The elastic behaviour of material for linear stress and linear strain, is shown in the figure. The energy density for a linear strain of $5 \times 10^{-4}$ is _____ $\mathrm{kJ\ m}^{-3}$. Assume that material is elastic upto the linear strain of $5 \times 10^{-4}$,




***26 Jun 2022 (M)***

**Q46.** The bulk modulus of a liquid is $3 \times 10^{10}\ \mathrm{Nm}^{-2}$. The pressure required to reduce the volume of liquid by $2\%$ is : ***24 Jun 2022 (M)***

(1) $3 \times 10^8\ \mathrm{N\ m}^{-2}$ (2) $6 \times 10^8\ \mathrm{N\ m}^{-2}$
(3) $9 \times 10^8\ \mathrm{N\ m}^{-2}$ (4) $12 \times 10^8\ \mathrm{N\ m}^{-2}$

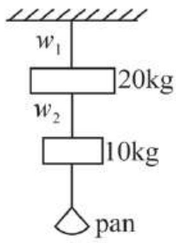
**Q47.** When a rubber ball is taken to a depth of _______ m in deep sea, its volume decreases by $0.5\%$
(The bulk modulus of rubber $= 9.8 \times 10^8\ \mathrm{N\ m}^{-2}$ Density of sea water $= 10^3\ \mathrm{kg\ m}^{-3}$, $\mathrm{g} = 9.8\ \mathrm{m\ s}^{-2}$) ***31 Aug 2021 (M)***

**Q48.** A uniform heavy rod of weight $10\ \mathrm{kg\ m\ s}^{-2}$, cross-sectional area $100\ \mathrm{cm}^2$ and length $20\ \mathrm{cm}$ is hanging from a fixed support. Young modulus of the material of the rod is $2 \times 10^{11}\ \mathrm{N\ m}^{-2}$. Neglecting the lateral contraction, find the elongation of rod due to its own weight: ***31 Aug 2021 (M)***

(1) $5 \times 10^{-10}$ m (2) $4 \times 10^{-8}$ m
(3) $5 \times 10^{-8}$ m (4) $2 \times 10^{-9}$ m

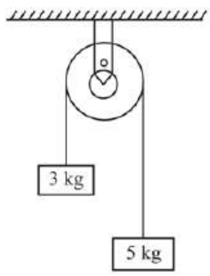
**Q49.** Four identical hollow cylindrical columns of mild steel support a big structure of mass $50 \times 10^3$ kg. The inner and outer radii of each column are $50$ cm and $100$ cm respectively. Assuming uniform local distribution, calculate the compression strain of each column.
[use $Y = 2.0 \times 10^{11}$ Pa, $g = 9.8 \mathrm{~m~s^{-2}}$] ***31 Aug 2021 (E)***
(1) $1.87 \times 10^{-3}$ (2) $2.60 \times 10^{-7}$
(3) $3.60 \times 10^{-8}$ (4) $7.07 \times 10^{-4}$

**Q50.** Wires $W_1$ and $W_2$ are made of same material having the breaking stress of $1.25 \times 10^9 \mathrm{~N~m^{-2}}$. $W_1$ and $W_2$ have cross-sectional area of $8 \times 10^{-7} \mathrm{~m^2}$ and $4 \times 10^{-7} \mathrm{~m^2}$, respectively. Masses of 20 kg and 10 kg hang from them as shown in the figure. The maximum mass that can be placed in the pan without breaking the wires is _____kg (Use $g = 10 \mathrm{~m~s^{-2}}$)




***27 Aug 2021 (E)***

**Q51.** Two blocks of masses 3 kg and 5 kg are connected by a metal wire going over a smooth pulley. The breaking stress of the metal is $\frac{24}{\pi} \times 10^2 \mathrm{~N~m^{-2}}$. What is the minimum radius of the wire ? (take $g = 10 \mathrm{~m~s^{-2}}$)




***26 Aug 2021 (E)***

(1) $1250$ cm (2) $1.25$ cm
(3) $125$ cm (4) $12.5$ cm

**Q52.** A stone of mass 20 g is projected from a rubber catapult of length $0.1$ m and area of cross section $10^{-6} \mathrm{~m^2}$ stretched by an amount $0.04$ m. The velocity of the projected stone is $\mathrm{m~s^{-1}}$. (Young's modulus of rubber $= 0.5 \times 10^9 \mathrm{~N~m^{-2}}$) ***27 Jul 2021 (M)***

**Q53.** Two wires of same length and radius are joined end to end and loaded. The Young's moduli of the materials of the two wires are $Y_1$ and $Y_2$. The combination behaves as a single wire then its Young's modulus is:
***25 Jul 2021 (M)***
(1) $Y = \frac{2Y_1Y_2}{3(Y_1+Y_2)}$ (2) $Y = \frac{2Y_1Y_2}{Y_1+Y_2}$
(3) $Y = \frac{Y_1Y_2}{2(Y_1+Y_2)}$ (4) $Y = \frac{Y_1Y_2}{Y_1+Y_2}$

**Q54.** The area of cross-section of a railway track is $0.01 \mathrm{~m^2}$. The temperature variation is $10\ ^\circ\mathrm{C}$. Coefficient of linear expansion of material of track is $10^{-5}\ ^\circ\mathrm{C}^{-1}$. The energy stored per meter in the track is $\mathrm{J~m^{-1}}$. (Young's modulus of material of track is $10^{11} \mathrm{~N~m^{-2}}$)
***22 Jul 2021 (M)***

**Q55.** The value of tension in a long thin metal wire has been changed from $T_1$ to $T_2$. The lengths of the metal wire at two different values of tension $T_1$ and $T_2$ are $\ell_1$ and $\ell_2$, respectively. The actual length of the metal wire is:

***20 Jul 2021 (M)***

(1) $\frac{T_1\ell_2-T_2\ell_1}{T_1-T_2}$
(2) $\frac{T_1\ell_1-T_2\ell_2}{T_1-T_2}$
(3) $\frac{\ell_1+\ell_2}{2}$
(4) $\sqrt{T_1 T_2\ell_1\ell_2}$

**Q56.** The length of a metal wire is $\ell_1$, when the tension in it is $T_1$ and is $\ell_2$ when the tension is $T_2$. The natural length of the wire is:

***20 Jul 2021 (E)***

(1) $\sqrt{\ell_1\ell_2}$
(2) $\frac{\ell_1 T_2-\ell_2 T_1}{T_2-T_1}$
(3) $\frac{\ell_1 T_2+\ell_2 T_1}{T_2+T_1}$
(4) $\frac{\ell_1+\ell_2}{2}$

**Q57.** Two separate wires $A$ and $B$ are stretched by $2\ \mathrm{mm}$ and $4\ \mathrm{mm}$ respectively, when they are subjected to a force of 2 N. Assume that both the wires are made up of same material and the radius of wire $B$ is 4 times that of the radius of wire $A$. The length of the wires $A$ and $B$ are in the ratio of $a:\ b$. Then $\frac{a}{b}$ can be expressed as $\frac{1}{x}$, where $x$ is _____. ***18 Mar 2021 (M)***

**Q58.** An object is located at $2\ \mathrm{km}$ beneath the surface of the water. If the fractional compression $\frac{\Delta V}{V}$ is $1.36\%$, the ratio of hydraulic stress to the corresponding hydraulic strain will be _____ [Given: density of water is $1000\ \mathrm{kg\ m^{-3}}$ and $g=9.8\ \mathrm{m\ s^{-2}}$.]

***17 Mar 2021 (E)***

(1) $1.96\times10^7\ \mathrm{N\ m^{-2}}$
(2) $1.44\times10^7\ \mathrm{N\ m^{-2}}$
(3) $2.26\times10^9\ \mathrm{N\ m^{-2}}$
(4) $1.44\times10^9\ \mathrm{N\ m^{-2}}$

**Q59.** The length of metallic wire is $l_1$ when tension in it is $T_1$. It is $l_2$ when the tension is $T_2$. The original length of the wire will be : ***26 Feb 2021 (E)***

(1) $\frac{T_2l_1+T_1l_2}{T_1+T_2}$
(2) $\frac{l_1+l_2}{2}$
(3) $\frac{T_2l_1-T_1l_2}{T_2-T_1}$
(4) $\frac{\mathrm{T}_1l_1-\mathrm{T}_2l_2}{\mathrm{T}_2-\mathrm{T}_1}$

**Q60.** The normal density of a material is $\rho$ and its bulk modulus of elasticity is $K$. The magnitude of increase in density of material, when a pressure $P$ is applied uniformly on all sides, will be : ***26 Feb 2021 (M)***

(1) $\frac{PK}{\rho}$
(2) $\frac{\rho P}{K}$
(3) $\frac{\rho K}{P}$
(4) $\frac{K}{\rho P}$

**Q61.** A uniform metallic wire is elongated by $0.04\ \mathrm{m}$ when subjected to a linear force $F$. The elongation, if its length and diameter is doubled and subjected to the same force will be _________ cm. ***24 Feb 2021 (E)***

**Q62.** If $Y,\ K$ and $\eta$ are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters. ***24 Feb 2021 (M)***

(1) $Y=\frac{9\,K\eta}{3\,K-\eta}\mathrm{N\ m^{-2}}$
(2) $\eta=\frac{3YK}{9K+Y}\mathrm{N\ m^{-2}}$
(3) $K=\frac{Y\eta}{9\eta-3Y}\ \mathrm{N\ m^{-2}}$
(4) $Y=\frac{9\,K\eta}{2\eta+3\,K}\ \mathrm{N\ m^{-2}}$

**Q63.** A cube of metal is subjected to a hydrostatic pressure 4 $GPa$. The percentage change in the length of the side of the cube is close to : (Given bulk modulus of metal, $B=8\times10^{10}\ Pa$) ***04 Sep 2020 (E)***

(1) 5 (2) $0.6$
(3) 20 (4) $1.67$

**Q64.** A wire of density $9 \times 10^{-3}$ kg $cm^{-3}$ is stretched between two clamps 1 m apart. The resulting strain in the wire is $4.9 \times 10^{-4}$. The lowest frequency of the transverse vibrations in the wire (Young's modulus of wire $Y = 9 \times 10^{10}$ $Nm^{-2}$), (to the nearest integer),_______ ***02 Sep 2020 (E)***

**Q65.** Two steel wires having same length are suspended from a ceiling under the same load. If the ratio of their energy stored per unit volume is 1 : 4, the ratio of their diameters is: ***09 Jan 2020 (E)***
(1) $\sqrt{2} : 1$ (2) $1 : 2$
(3) $2 : 1$ (4) $1 : \sqrt{2}$

**Q66.** A body of mass $m = 10$ kg is attached to one end of a wire of length 0.3 m. What is the maximum angular speed (in rad $s^{-1}$) with which it can be rotated about its other end in a space station without breaking the wire? [Breaking stress of wire ($\sigma$)$= 4.8 \times 10^7$ N $m^{-2}$ and area of cross-section of the wire$= 10^{-2}$ $cm^2$]
***09 Jan 2020 (M)***

**Q67.** Speed of a transverse wave on a straight wire (mass 6.0 g, length 60 cm and area of cross-section 1.0 $mm^2$ is 90 m $s^{-1}$. If the Young's modulus of wire is $16 \times 10^{11}$ N $m^{-2}$, the extension of wire over its natural length is:
***07 Jan 2020 (M)***
(1) 0.03 mm (2) 0.02 mm
(3) 0.04 mm (4) 0.01 mm

**Q68.** The elastic limit of brass is 379 MPa. The minimum diameter of a brass rod if it is to support a 400 N load without exceeding its elastic limit will be ***10 Apr 2019 (E)***
(1) 1.00 mm (2) 1.36 mm
(3) 1.16 mm (4) 0.90 mm

**Q69.** In an experiment, brass and steel wires of length 1 m each with areas of cross section 1 $mm^2$ are used. The wires are connected in series and one end of the combined wire is connected to a rigid support and other end is subjected to elongation. The stress required to produce a net elongation of 0.2 mm is, [Given, the Young's Modulus for steel and brass are, respectively, $120 \times 10^9$ $N/m^2$ and $60 \times 10^9$ $N/m^2$ ] ***10 Apr 2019 (E)***
(1) $8.0 \times 10^6$ $N/m^2$ (2) $1.2 \times 10^6$ $N/m^2$
(3) $0.2 \times 10^6$ $N/m^2$ (4) $1.8 \times 10^6$ $N/m^2$

**Q70.** A steel wire having a radius of 2.0 mm, carrying a load of 4 kg, is hanging from a ceiling. Given that $g = 3.1\pi$ m $s^{-2}$, what will be the tensile stress that would be developed in the wire? ***08 Apr 2019 (M)***
(1) $5.2 \times 10^6$ N $m^{-2}$ (2) $6.2 \times 10^6$ N $m^{-2}$
(3) $4.8 \times 10^6$ N $m^{-2}$ (4) $3.1 \times 10^6$ N $m^{-2}$

**Q71.** Young's moduli of two wires A and B are in the ratio 7 : 4. Wire A is 2 m long and has radius R. Wire B is 1.5 m long and has radius 2 mm. If the two wires stretch by the same length for a given load, the value of R is close to: ***08 Apr 2019 (E)***
(1) 1.3 mm (2) 1.9 mm
(3) 1.5 mm (4) 1.7 mm

**Q72.** A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross-section and of negligible mass. The boy keeps a stone weighing 0.02 kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of 20 $\mathrm{ms}^{-1}$ . Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closest to: ***08 Apr 2019 (M)***

(1) $10^6 \mathrm{N\ m}^{-2}$
(2) $10^4 \mathrm{N\ m}^{-2}$
(3) $10^8 \mathrm{N\ m}^{-2}$
(4) $10^3 \mathrm{N\ m}^{-2}$

**Q73.** A rod, of length $L$ at room temperature and uniform area of cross section $A$, is made of a metal having coefficient of linear expansion $\alpha\ /^{\circ}C$ It is observed that an external compressive force $F$ is applied on each of its ends, prevents any change in the length of the rod when its temperature rises by $\Delta T$ K Young's modulus, $Y$ for this metal is: ***09 Jan 2019 (M)***

(1) $\frac{F}{A\alpha(\Delta T-273)}$
(2) $\frac{2F}{A\alpha\Delta T}$
(3) $\frac{F}{A\alpha\Delta T}$
(4) $\frac{F}{2A\,\alpha\Delta T}$

## ANSWER KEYS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (20) | **2.** (1) | **3.** (2) | **4.** (600) | **5.** (5) | **6.** (2) | **7.** (3) | **8.** (18) |
| **9.** (12) | **10.** (3) | **11.** (2) | **12.** (4) | **13.** (16) | **14.** (3) | **15.** (2) | **16.** (4) |
| **17.** (40) | **18.** (1) | **19.** (2) | **20.** (1) | **21.** (20) | **22.** (3) | **23.** (25) | **24.** (11) |
| **25.** (3) | **26.** (1) | **27.** (2) | **28.** (4) | **29.** (1) | **30.** (5) | **31.** (1) | **32.** (4) |
| **33.** (1) | **34.** (50) | **35.** (3) | **36.** (30) | **37.** (48) | **38.** (4) | **39.** (2) | **40.** (1) |
| **41.** (25) | **42.** (5) | **43.** (3) | **44.** (6) | **45.** (25) | **46.** (2) | **47.** (500) | **48.** (1) |
| **49.** (2) | **50.** (40) | **51.** (4) | **52.** (20) | **53.** (2) | **54.** (5) | **55.** (1) | **56.** (2) |
| **57.** (32) | **58.** (4) | **59.** (3) | **60.** (2) | **61.** (2) | **62.** (3) | **63.** (4) | **64.** (35) |
| **65.** (1) | **66.** (4) | **67.** (1) | **68.** (3) | **69.** (1) | **70.** (4) | **71.** (4) | **72.** (1) |
| **73.** (3) | | | | | | | |