Additional Problems For Self Practice (APSP)

PART- I : PRACTICE TEST PAPER

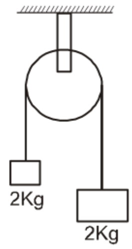
Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

1. The force required to stretch a steel wire of 1 cm^2 cross-section to 1.1 times of its length will be : ($Y = 2 \times 10^{11}\ Nm^{-2}$)
(1) 2×10^6 N (2) 2×10^3 N (3) 2×10^{-6} N (4) 2×10^{-7} N

2. Two blocks each of mass 2kg are connected as shown in figure. The breaking stress of the material of the wire is $\frac{2}{\pi} \times 10^9$ N/m^2. Find the minimum radius of the wire used if it not to break.



(1) 10^{-3} m (2) 10^{-4} m
(3) 10^{-5} m (4) 10^{-6} m

3. Four wires of the same material are stretched by the same load. The dimension of the wires are as given below. The one which has the maximum elongation is of
(1) diameter 1 mm and length 1 m (2) diameter 2 mm and length 2 m
(3) diameter 0.5 mm and length 0.5 m (4) diameter 3 mm and length 3 m

4. An elevator cable can have a maximum stress of 7×10^7 N/m^2 for appropriate safety factors. Its maximum upward acceleration is 1.5 m/s^2. If the cable has to support the total weight of 2000 kg of a loaded elevator, the minimum area of cross-section of the cable should be (g = 10 m/s^2)
(1) 3.28 cm^2 (2) 2.38 cm^2 (3) 0.328 cm^2 (4) 8.23 cm^2

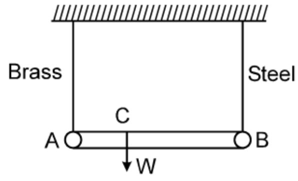
5. A wire of cross-sectional area A is stretched horizontal between two clamps located at a distance 2ℓ meters from each other. A weight W N is suspended from the mid point of the wire. The strain produced in the wire, (if the vertical distance through which the mid point of the wire moves down $x << \ell$) will be
(1) x^2/ℓ^2 (2) $2x^2 / \ell^2$ (3) $x^2/2\ell^2$ (4) $x/2\ell$

6. A cube is subjected to a uniform volume compression. If the side of the cube decreases by 2%, the bulk strain is -
(1) 0.02 (2) 0.03 (3) 0.04 (4) 0.06

7. The mean density of sea water is ρ, and bulk modulus is B. The change in density of sea water in going from the surface of water to a depth h is :
(1) $\frac{\rho gh}{B}$ (2) Bρgh (3) $\frac{\rho^2 gh}{B}$ (4) $\frac{B\rho^2}{gh}$

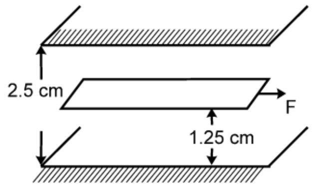
8. A rain drop of radius 1.5 mm, experiences a drag force $F = (2 \times 10^{-5}\ v)$ N, while falling through air from a height 2 km, with a velocity v. The terminal velocity of the rain drop will be nearly (use g = 10 m/s^2) :
(1) 200 m/s (2)60 m/s (3) 7 m/s (4) 3 m/s

9. A 2m long light metal rod AB is suspended from the ceiling horizontally by means of two vertical wires of equal length tied to its ends. One wire is of brass and has cross-sectional area of 0.2×10^{-4} m^2 and the other is of steel with 0.1×10^{-4} m^2 cross-sectional area. in order to have equal stresses in the two wires, a weight W is hung from the rod. The position of the weight along the rod from end A should be



(1) 66.6 cm (2) 133 cm (3) 44.4 cm (4) 155.6 cm

10. A space 2.5 cm wide between two large plane surfaces is filled with oil. Force required to drag a very thin plate of area 0.5 m^2 just midway the surfaces at a speed of 0.5 m/sec is 1N. The coefficient of viscosity in kg–sec/m^2 is :



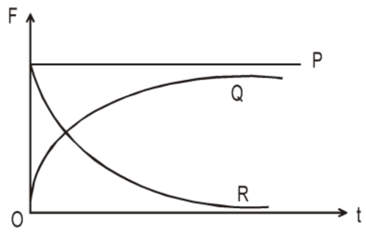
(1) 5×10^{-2} (2) 2.5×10^{-2}
(3) 1×10^{-2} (4) 7.5×10^{-2}

11. A sample of a liquid has an initial volume of 1.5 L. The volume is reduced by 0.2 mL, when the pressure increases by 140 kPa. What is the bulk modulus of the liquid.
(1) 3.05×10^9 Pa. (2) 1.05×10^9 Pa. (3) 1.05×10^7 Pa. (4) 1.05×10^{11} Pa.

12. A 50 kg motor rests on four cylindrical rubber blocks. Each block has a height of 4 cm and a cross-sectional area of 16 cm^2. The shear modulus of rubber is 2×10^6 N/m^2. A sideways force of 500 N is applied to the motor. The distance that the motor moves sideways is
(1) 0.156 cm (2) 1.56 cm (3) 0.312 cm (4) 0.204 cm

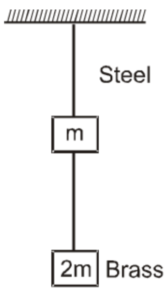
13. A brass rod of length 2 m and cross-sectional area 2.0 cm^2 is attached end to end to a steel rod of length L and cross-sectional area 1.0 cm^2 . The compound rod is subjected to equal and opposite pulls of magnitude 5×10^4 N at its ends. If the elongations of the two rods are equal, then length of the steel rod (L) is ($Y_{Brass} = 1.0 \times 10^{11}$ N/m^2 and $Y_{Steel} = 2.0 \times 10^{11}$ N/m^2)
(1) 1.5 m (2) 1.8 m (3) 1 m (4) 2 m

14. A spherical ball is dropped in a long column of viscous liquid. Which of the following graphs represent the variation of
(i) Gravitational force with time
(ii) Viscous force with time
(iii) Net force acting on the ball with time



(1) Q, R, P (2) R, Q, P
(3) P, Q, R (4) P, R, Q

15. If the ratio of lengths, radii and Young's modulii of steel and brass wires in the figure are a, b, c respectively. Then the corresponding ratio of increase in their lengths would be :



(1) $\frac{2ac}{b^2}$ (2) $\frac{3a}{2b^2c}$
(3) $\frac{3c}{2ab^2}$ (4) $\frac{2a^2c}{b}$

16. Two identical rods in geometry but of different materials having co-efficients of thermal expansion α_1 and α_2 and Young's modulli 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 the rods. If $\alpha_1 : \alpha_2 = 2 : 6$ the thermal stresses developed in the two rods are equal provided $Y_1 : Y_2$ is equal to :
(1) 2 : 3 (2) 1 : 1 (3) 3 : 1 (4) 4 : 9

17. According to Newton, viscous force is given by

$F = -\eta A \frac{dv}{dx}$, where η = coefficient of viscosity, so dimensions of η will be :
(1) $[ML^{-1}T^{-2}]$ (2) $[MLT^{-2}]$ (3) $[ML^{-1}T^{-1}]$ (4) $[M^{-1}L^2T^{-2}]$

18. A 5m 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 be in mm.
(1) 1.75 (2) 2.0 (3) 2.3 (4) 5.0

19. 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 ?
(1) 0.2 J (2) 10J (3) 20J (4) 0.1 J

20. The following four wires are made of same material and same tension is applied on them. Which one will have maximum increase in length?
(1) Length = 100 cm, Diameter = 1mm
(2) Length = 50 cm, Diameter = 0.5 mm
(3) Length = 200 cm, Diameter = 2mm
(4) Length = 300 cm, Diameter = 3 mm

21. A catapult's string made of rubber having cross section area 25 mm^2 and length 10 cm. To throw a 5 gm pabble it is stretched up to 5 cm and released. Velocity of projected pabble is (Young coefficient of elasticity of rubber is 5×10^8 N/m^2) :
(1) 20 m/s (2) 100 m/s (3) 250 m/s (4) 200 m/s

22. Diameter of a brass rod is 4 mm and Young coefficient of elasticity is 9×10^{10} N/m^2. Force required to increase the length of rod by 0.10% will be :
(1) 360π Newton (2) 36 Newton (3) $144\pi \times 10^3$ Newton (4) $36\pi \times 10^5$ Newton

23. A rubber ball is brought into 200 m deep water, its volume is decreased by 0.1% then volume elasticity coefficient of material of ball will be :
(1) 19.6×10^8 N/m^2 (2) 19.6×10^{-10} N/m^2 (3) 19.6×10^{10} N/m^2 (4) 19.6×10^{-8} N/m^2

24. If one end of a wire is tied at rigid support and at other end 10 Newton weight is suspended by which 0.5 mm is increased in length of wire. Then the ratio of energy of wire and workdone to displace the wire by 1.5 mm will be :
(1) $\frac{1}{30}$ (2) $\frac{1}{4}$ (3) $\frac{1}{15}$ (4) $\frac{1}{3}$

25. If poission ratio is 0.4 and after increasing the length of wire by 0.05% then decrease in its diameter will be :
(1) 0.02% (2) 0.1% (3) 0.01% (4) 0.4%

26. A tensile force F is applied on all six surfaces of a cube of side unity then increase in length of each side will be (Y = young modulii] σ = Poission's ratio½
(1) $\frac{F}{Y(1-\sigma)}$ (2) $\frac{F}{Y(1+\sigma)}$ (3) $\frac{F(1-2\sigma)}{Y}$ (4) $\frac{F}{Y(1+2\sigma)}$

27. If tension is removed from wire (one time) then :
(1) It will break
(2) It's temperature will be decreased
(3) There be no change in its temperature
(4) It's temperature will increase

28. A steel wire of 1 m long and 1 mm^2 cross section area is hang from rigid end. When weight of 1 kg is hung from it then change in length will be (given $Y = 2 \times 10^{11}$ N / m^2)
(1) 0.5 mm (2) 0.25 mm (3) 0.05 mm (4) 5 mm

29. The mean distance between the atoms of iron is 3×10^{-10} m and interatomic force constant for iron is 7 N / m The Young's modulus of elasticity for iron is
(1) 2.33×10^5 N / m^2 (2) 23.3×10^{10} N / m^2 (3) 233×10^{10} N / m^2 (4) 2.33×10^{10} N / m^2

30. 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°. The angle of shear is
(1) 12° (2) 0.12° (3) 1.2° (4) 0.012°

Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART- II : PRACTICE QUESTIONS

1. When a force is applied on a wire of uniform cross-sectional area 3×10^{-6} m^2 and length 4m, the increase in length is 1 mm. Energy stored in it will be ($Y = 2 \times 10^{11}$ N / m^2)

(1) 6250 J (2) 0.177 J (3) 0.075 J (4) 0.150 J

2. The elastic energy stored in a wire of Young's modulus Y is

(1) $Y \times \frac{\text{Strain}^2}{\text{Volume}}$ (2) Stress × Strain × Volume

(3) $\frac{\text{Stress}^2 \times \text{Volume}}{2Y}$ (4) $\frac{1}{2}$ Y × stress × Strain × Volume

3. A wire of length 50 cm and cross sectional area of 1 sq. mm is extended by 1 mm. The required work will be ($Y = 2 \times 10^{10}$ Nm^{-2})

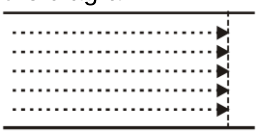
(1) 6×10^{-2} J (2) 4×10^{-2} J (3) 2×10^{-2} J (4) 1×10^{-2} J

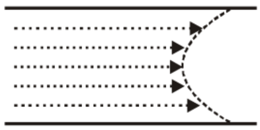
4. In Poiseuilli's method of determination of coefficient of viscosity. the physical quantity that requires greater accuracy in measurement is

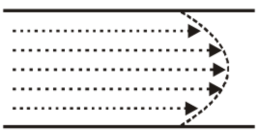
(1) Pressure difference (2) Volume of the liquid collected

(3) Length of the capillary tube (4) Inner radius of the capillary tube

5. A viscous fluid is flowing through a cylindrical tube. The velocity distribution of the fluid is best represented by the diagram.

(1) 

(2) 

(3) 

(4) None of these

6. What is the velocity υ of a metallic ball of radius r falling in a tank of liquid at the instant when its acceleration is one-half that of a freely falling body ? (The densities of metal and of liquid are ρ and σ respectively, and the viscosity of the liquid is η).

(1) $\frac{r^2 g}{9\eta}(\rho - 2\sigma)$ (2) $\frac{r^2 g}{9\eta}(2\rho - \sigma)$ (3) $\frac{r^2 g}{9\eta}(\rho - \sigma)$ (4) $\frac{2r^2 g}{9\eta}(\rho - \sigma)$

7. Two springs of equal lengths and equal cross-sectional areas are made of materials whose Young's moduli are in the ratio of 2 : 3. They are suspended and loaded with the same mass. When stretched and released, they will oscillate with time periods in the ratio of :

(1) 9 : 4 (2) 3 : 2 (3) $3\sqrt{3} : 2\sqrt{2}$ (4) $\sqrt{3} : \sqrt{2}$

8. A stress of 10^6 N/m^2 is required for breaking a material. If the density of the material is 3×10^3 kg/m^3, then the maximum length of the uniform wire that will not breaks under its own weight is : (Take g = 10 m/s^2)

(1) 10 m (2) 33.3 m (3) 5 m (4) 64 m

9. A steel rod of length 1m is heated from 25ºC to 75ºC keeping its length constant. The longitudinal strain developed in the rod is (Given : Coefficient of linear expansion of steel = 12×10^{-6}/ºC)
(1) 6×10^{-6} (2) -6×10^{-5} (3) -6×10^{-4} (4) zero

10. The elastic limit of elevator cable is 2×10^9 N/m^2. The maximum upward acceleration that an elevator of mass 2×10^3 kg can have when supported by a cable whose cross–section area is 10^{-4} m^2, provided that the stress in cable sould not exceed half of the elastic limit would be (g = 10 m/s^2) :
(1) 10 m/s^2 (2) 50 m/s^2 (3) 40 m/s^2 (4) Not possible to move up

11. 32 g of O_2 is contained in a cubical container of side 1m and maintained at a temperature of 127°C. The isothermal bulk modulus of elasticity of the gas in terms of universal gas constant R is
(1) 127 R (2) 400 R (3) 200 R (4) 560 R

12. Rigidity modulus of steel is η and its young's modulus is Y. A piece of steel of cross–sectional area 'A' is changed into a wire of length L and area A/10 then
(1) Y increases and η decrease (2) Y and η remains the same
(3) both Y and η increase (4) both Y and η decrease

13. Two drops of same radius are falling through air with steady speed v. If the two drops coalesce, what would be the terminal speed.
(1) v (2) 2v (3) 3v (4) none of these

14. If η represents the coefficient of viscosity and T the surface tension, then the dimension of $\frac{T}{\eta}$ is same as that of :
(1) length (2) mass (3) time (4) speed

Comprehension # 1

When a tensile or compressive load 'P' is applied to rod or cable, its length changes. The change in length x which, for an elastic material is proportional to the force (Hook's law).
$P \alpha x$ or $P = kx$
The above equation is similar to the equation of spring. For a rod of length L, area A and young modulus Y, the extension x can be expressed as -

$$x = \frac{PL}{AY} \quad \text{or} \quad P = \frac{AY}{L}x, \quad \text{hence } K = \frac{AY}{L}$$

Thus rods or cables attached to lift can be treated as springs. The energy stored in rod is called strain energy & equal to $\frac{1}{2}$Px. The loads placed or dropped on the floor of lift cause stresses in the cables and can be evaluated by spring analogy. If the cable of lift is previously stressed and load is placed or dropped, then maximum extension in cable can be calculated by energy conservation.

15. If rod of length 4 m, area 4cm^2 and young modules 2×10^{10} N/m^2 is attached with mass 200 kg, then angular frequency of SHM (rad/sec.) of mass is equal to -
(1) 1000 (2) 10 (3) 100 (4) 10 π

16. In above problem if mass of 10 kg falls on the massless collar attached to rod from the height of 99cm then maximum extension in the rod is equal (g = 10 m/sec^2) -
(1) 9.9 cm (2) 10 cm (3) 0.99 cm (4) 1 cm

17. In the above problem, the maximum stress developed in the rod is equal to - (N/m^2)
(1) 5×10^7 (2) 5×10^8 (3) 4×10^7 (4) 4×10^8

18. If two rods of same length (4m) and cross section areas 2 cm^2 and 4 cm^2 with same young modulus 2×10^{10} N/m^2 are attached one after the other with mass 600 kg then angular frequency is

(1) $\frac{1000}{3}$ (2) $\frac{10}{3}$ (3) $\frac{100}{3}$ (4) $\frac{10\pi}{3}$

19. Four identical rods of geometry as described in problem (2) are attached with lift. If weight of the lift cage is 1000 N, and elastic limit of each rod is taken as 9×10^6 N/m^2 then the number of persons it can carry safely is equal to. (g = 10m/sec^2 , assume average mass of a person as 50 kg and lift moves with constant speed)

(1) 7 (2) 26 (3) 24 (4) 25

APSP Answers

PART- I

1.	(1)	**2.**	(2)	**3.**	(3)	**4.**	(1)	**5.**	(3)	**6.**	(4)	**7.**	(3)
8.	(3)	**9.**	(1)	**10.**	(2)	**11.**	(2)	**12.**	(1)	**13.**	(4)	**14.**	(3)
15.	(2)	**16.**	(3)	**17.**	(3)	**18.**	(3)	**19.**	(4)	**20.**	(2)	**21.**	(3)
22.	(1)	**23.**	(1)	**24.**	(3)	**25.**	(1)	**26.**	(3)	**27.**	(4)	**28.**	(3)
29.	(4)	**30.**	(2)										

PART- II

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(4)	**5.**	(3)	**6.**	(3)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(3)	**11.**	(2)	**12.**	(2)	**13.**	(4)	**14.**	(4)
15.	(3)	**16.**	(4)	**17.**	(1)	**18.**	(3)	**19.**	(2)				