BALJINDER KAUR CLASSES

(IISER PROFESSOR)

CLASS 11 - PHYSICS

Physics

Time Allowed: 2 hours **Maximum Marks: 200**

1. A solid brass sphere is initially surrounded by air, and the air pressure exerted on it is 1.0×10^5 N/ m^2 (normal atmospheric pressure). The sphere is lowered into the ocean to a depth at which the pressure is 2.0×10^7 N/ m^2. The volume of the sphere in air is 0.50 m^3. By how much does this volume change once the sphere is submerged? modulus of brass as 61 GPa **[4]**

   a) -1.7 $\times 10^{-4}$ m^3 b) -1.4 $\times 10^{-4}$ m^3

   c) -1.5 $\times 10^{-4}$ m^3 d) -1.6 $\times 10^{-4}$ m^3

2. If the shear stress exceeds about 4.00×10^8 N/ m^2, steel ruptures. Determine the shearing force necessary to shear a steel bolt 1.00 cm in diameter **[4]**

   a) 3.44×10^4 N b) 3.34×10^4 N

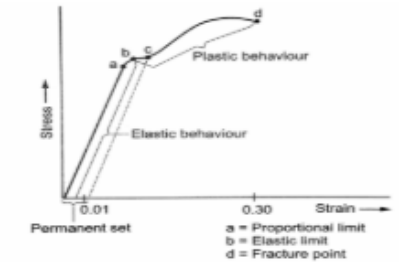
   c) 3.14×10^4 N d) 3.24×10^4 N

3. A 12.0-kg mass, fastened to the end of an aluminum wire with an un-stretched length of 0.50 m, is whirled in a vertical circle with a constant angular speed of 120 rev/min. The cross-sectional area of the wire is 0.014 cm^2. Calculate the elongation of the wire when the mass is at the lowest point of the path (young modulus of steel = 0.70 X 10^{11} N/m^2) **[4]**

   a) 0.56 cm b) 0.50 cm

   c) 0.54 cm d) 0.52 cm

4. With reference to figure the plastic zone is **[4]**



   a) bc b) oa

   c) cd d) ab

5. A lead cube measures 6.00 cm on each side. The bottom face is held in place by very strong glue to a flat horizontal surface, while a horizontal force F is applied to the upper face parallel to one of the edges. How large must F be to cause the cube to deform by 0.250 mm? (Shear modulus of lead = 0.6 $\times 10^{10}$ Pa) **[4]**

   a) 0.9×10^5 N b) 1.4×10^5 N

   c) 2.0×10^5 N d) 1.6×10^5 N

6. When water freezes, it expands by about 9.00%. What would be the pressure increase inside your automobile's engine block if the water in it froze? (The bulk modulus of ice is 2.00×10^9 N/ m^2.) **[4]**

a) 2.4×10^8 N/m^2 b) 1.1×10^8 N/m^2

c) 4.16×10^8 N/m^2 d) 1.8×10^8 N/ m^2

7. If the elastic limit of copper is 1.50×10^8 N/ m^2, determine the minimum diameter a copper wire can have under a load of 10.0 kg if its elastic limit is not to be exceeded. **[4]**

a) 0.812 mm b) 0.912 mm

c) 0.712 mm d) 1.012 mm

8. You hang a flood lamp from the end of a vertical steel wire. The flood lamp stretches the wire 0.18 mm and the stress is proportional to the strain. How much would it have stretched for a copper wire of the original length and diameter? (young modulus of steel=2.0 X 10^{11} N/m^2 and young modulus of copper=1.1 X 10^{11} N/m^2) **[4]**

a) 0.33 mm b) 0.39 mm

c) 0.18 mm d) 0.37 mm

9. Four identical hollow cylindrical columns of mild steel support a big structure of mass 50,000 kg. The inner and outer radii of each column are 30 and 60 cm respectively. Assuming the load distribution to be uniform, calculate the compression strain of each column. . Take Young's modulus of steel as 20×10^{10} Pa **[4]**

a) 2.95×10^{-6} b) 3.1×10^{-6}

c) 3.0×10^{-6} d) 2.18×10^{-6}

10. A perfectly rigid body is one **[4]**

a) which does not move on application of force b) whose shape and size do not change on application of force

c) which starts flowing like water on application of force d) whose shape and size change on application of force

11. The importance of the elastic behavior of materials is **[4]**

a) that it gives methods for understanding materials b) that it is useful in building sling shots

c) that it is useful in making springs d) that it enables a safe and sound design of bridges, buildings, machinery parts.

12. A copper cube measures 6.00 cm on each side. The bottom face is held in place by very strong glue to a flat horizontal surface, while a horizontal force F is applied to the upper face parallel to one of the edges. How large must F be to cause the cube to deform by 0.250 mm? (shear modulus of copper = 4.4×10^{10} Pa) **[4]**

a) 6.4×10^5 N b) 6.5×10^5 N

c) 6.3×10^5 N

d) 6.6×10^5 N

13. A 14.5 kg mass, fastened to the end of a steel wire of unstretched length 1.0 m, is whirled in a vertical circle with an angular velocity of 2 rev/s at the bottom of the circle. The cross-sectional area of the wire is 0.065 cm^2. Calculate the elongation of the wire when the mass is at the lowest point of its path. **[4]**

a) 1.9 mm

b) 1.4 mm

c) 1.1 mm

d) 0.8 mm

14. Stress is **[4]**

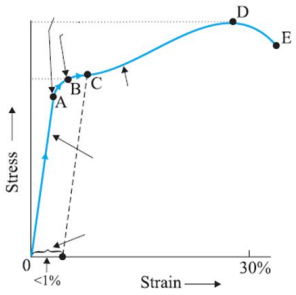
a) total applied force

b) force per unit length

c) restoring force per unit area

d) three point average of forces

15. With reference to figure the yield strength point corresponds to **[4]**



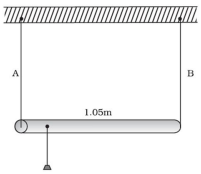
a) D

b) A

c) C

d) B

16. A rod of length 1.05 m having negligible mass is supported at its ends by two wires of steel (wire A) and aluminum (wire B) of equal lengths as shown in Figure. The cross-sectional areas of wires A and B are 1.0 mm^2 and 2.0 mm^2, respectively. At what point along the rod should a mass m be suspended in order to produce equal strains in both steel and aluminum wires. Take Young's modulus of steel as 200 GPa, for aluminum 70 GPa **[4]**



a) 0.42 m from steel wire

b) 0.40 m from steel wire

c) 0.43 m from steel wire

d) 0.44 m from steel wire

17. What diameter should a 10-m-long steel wire have if we do not want it to stretch more than 0.5 cm under a tension of 940 N? Take Young's modulus of steel as 20×10^{10} Pa **[4]**

a) 3.6 mm

b) 3.4 mm

c) 3.0 mm

d) 3.2 mm

18. In a materials testing laboratory, a metal wire made from a new alloy is found to break when a tensile force of 90.8 N is applied perpendicular to each end. If the diameter of the wire is 1.84 mm, what is the breaking stress of the alloy? **[4]**

a) 3.41×10^7 Pa

b) 3.61×10^7 Pa

c) 3.31×10^7 Pa

d) 3.51×10^7 Pa

19. According to Hooke's law **[4]**

a) For small deformations the stress and strain are proportional to each other

b) For small deformations the stress is proportional to square of strain

c) For small deformations the stress and strain are inversely proportional to each other

d) For large deformations the stress and strain are proportional to each other

20. volumetric strain is defined **[4]**

a) as the change in volume ΔV

b) as the ratio of change in volume (ΔV) to thrice the original volume V

c) as the ratio of change in volume (ΔV) to twice the original volume V

d) as the ratio of change in volume (ΔV) to the original volume V

21. You hang a flood lamp from the end of a vertical steel wire. The flood lamp stretches the wire 0.18 mm and the stress is proportional to the strain. How much would it have stretched if the wire had the same length but twice the diameter? **[4]**

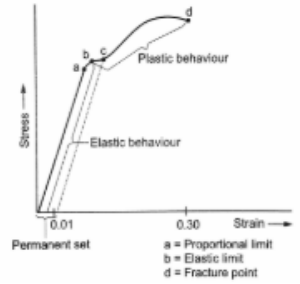
a) 0.075 mm

b) 0.045 mm

c) 0.055 mm

d) 0.065 mm

22. With reference to figure the yield point corresponds to **[4]**



a) a

b) c

c) d

d) b

23. Elasticity is the property of a body, by virtue of which **[4]**

a) it is distorted or stretches without the application of force

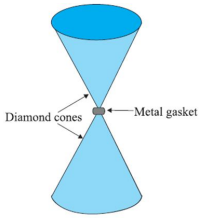
b) it changes size and shape when the force is applied and stays in that shape when applied force is removed

c) it remains in original size and shape when the force is applied

d) it tends to regain its original size and shape when the applied force is removed

24. Anvils made of single crystals of diamond, with the shape as shown in Figure, are used to investigate behaviour of materials under very high pressures. Flat faces at the narrow end of the anvil have a diameter of 0.50 mm, and the wide ends are subjected to a compression force **[4]**

of 50,000 N. What is the pressure at the tip of the anvil?



a) 2.1×10^{11} Pa

b) 2.5×10^{11} Pa

c) 2.9×10^{11} Pa

d) 3.2×10^{11} Pa

25. You hang a flood lamp from the end of a vertical steel wire. The flood lamp stretches the wire 0.18 mm and the stress is proportional to the strain. How much would it have stretched if the wire were twice as long? **[4]**

a) 0.36 mm

b) 0.34 mm

c) 0.40 mm

d) 0.38 mm

26. A rigid bar of mass 15 kg is supported symmetrically by three wires each 2.0 m long. Those at each end are of copper and the middle one is of iron. Determine the ratios of their diameters if each is to have the same tension. **[4]**

a) D_{copper}/D_{iron} = 1.55

b) D_{copper}/D_{iron} = 1.25

c) D_{copper}/D_{iron} = 1.35

d) D_{copper}/D_{iron} = 1.45

27. Determine the volume contraction of a solid copper cube, 10 cm on an edge, when subjected to a hydraulic pressure of 7.0×10^6Pa. Bulk modulus of copper 140 GPa. **[4]**

a) 0.05 cm^3

b) 0.12 cm^3

c) 0.26 cm^3

d) 0.08 cm^3

28. A specimen of oil having an initial volume of 600 cm^3 is subjected to a pressure increase of 3.6 $\times 10^6$Pa and the volume is found to decrease by 0.45 cm^3 what is the bulk modulus of the material? **[4]**

a) 4.4×10^9 Pa

b) 5.0×10^9 Pa

c) 4.8×10^9 Pa

d) 4.6×10^9 Pa

29. Compute the bulk modulus of water from the following data: Initial volume = 100.0 litre, Pressure increase = 100.0 atm (1 atm = 1.013×10^5 Pa), Final volume = 100.5 litre **[4]**

a) 2.226×10^9 Pa

b) 2.126×10^9 Pa

c) 2.326×10^9 Pa

d) 2.026×10^9 Pa

30. A child slides across a floor in a pair of rubber-soled shoes. The frictional force acting on each foot is 20.0 N. The footprint area of each shoe's sole is 14.0 cm^2, and the thickness of each sole is 5.00 mm. Find the horizontal distance by which the upper and lower surfaces of each sole are offset. The shear modulus of the rubber is 3.00×10^6 N/ m^2. **[4]**

a) 2.38 mm

b) 2.68 mm

c) 2.58 mm

d) 2.48 mm

31. If a wire has an initial length L and becomes L + ΔL on application of force, the longitudinal **[4]**

strain is given by

a) $\frac{\triangle L}{2L}$ b) $\Delta \mathrm{L}$

c) $\frac{\triangle L}{L}$ d) $\frac{\triangle L}{3L}$

32. 12.0-kg mass, fastened to the end of an aluminum wire with an un-stretched length of 0.50 m, is whirled in a vertical circle with a constant angular speed of 120 rev/min. The cross-sectional area of the wire is 0.014 cm^2. Calculate the elongation of the wire when the mass is at the highest point of its path.(young modulus of aluminium 0.70 X 10^{11} N/m^2) **[4]**

a) 0.42 cm b) 0.38 cm

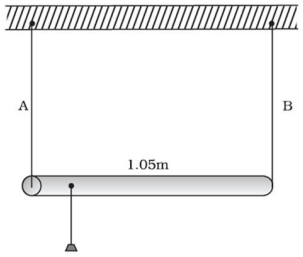
c) 0.36 cm d) 0.40 cm

33. The Marina trench is located in the Pacific Ocean, and at one place it is nearly eleven km beneath the surface of water. The water pressure at the bottom of the trench is about 1.1 $\times$ 10^8 Pa. A steel ball of initial volume 0.32 m^3 is dropped into the ocean and falls to the bottom of the trench. What is the change in the volume of the ball when it reaches to the bottom? Bulk modulus of steel = 160 GPa **[4]**

a) 2.6 $\times$ 10^{-4} m^3 b) 2.9 $\times$ 10^{-4} m^3

c) 2.2 $\times$ 10^{-4} m^3 d) 2.5 $\times$ 10^{-4} m^3

34. A rod of length 1.05 m having negligible mass is supported at its ends by two wires of steel (wire A) and aluminum (wire B) of equal lengths as shown in Figure. The cross-sectional areas of wires A and B are 1.0 mm^2 and 2.0 mm^2, respectively. At what point along the rod should a mass m be suspended in order to produce equal stresses? Take Young's modulus of steel as 200 GPa, for aluminum 70 GPa **[4]**



a) 0.8 m from steel wire b) 0.7 m from steel wire

c) 0.6 m from steel wire d) 0.9 m from steel wire

35. If the shear stress exceeds about 4.00 $\times$ 10^8 N/ m^2, steel ruptures. Determine the shearing force necessary to punch a 1.00-cm-diameter hole in a steel plate 0.500 cm thick **[4]**

a) 6.28 $\times$ 10^4N b) 6.18 $\times$ 10^4 N

c) 5.98 $\times$ 10^4 N d) 6.08 $\times$ 10^4 N

36. A steel cable with a radius of 1.5 centimeter supports a chairlift at a ski area. If the maximum stress is not to exceed 10^8 N m^{-2} , what is the maximum load the cable can support? **[4]**

a) 6.87$\times$ 10^4 N b) 7.17$\times$ 10^4 N

c) 7.07$\times$ 10^4 N d) 6.97$\times$ 10^4 N

37. A mild steel wire of length 1.0 m and cross-sectional area 0.50 $\times$ 10^{-2} cm^2 is stretched, well within its elastic limit, horizontally between two pillars. A mass of 100 g is suspended from the **[4]**

mid-point of the wire. Calculate the depression at the midpoint.

a) 0.90 m
b) 1.5 m
c) 0.40 m
d) 0.51 m

38. What is the density of water at a depth where pressure is 80.0 atm, given that its density at the surface is 1.03×10^3 kg m^{-3}? **[4]**

a) 1.054×10^3 kg/ m^3
b) 1.074×10^3 kg/ m^3
c) 1.094×10^3 kg/ m^3
d) 1.034×10^3 kg/ m^3

39. How much should the pressure on a litre of water be changed to compress it by 0.10 percent? Bulk modulus of water 2.2 GPa **[4]**

a) 2.4×10^6 N/ m^2
b) 2.2×10^6 N/ m^2
c) 2.6×10^6 N/ m^2
d) 2.0×10^6 N/ m^2

40. A steel cable with cross-sectional area 3.00 cm^2 has an elastic limit of 2.40×10^8 Pa. Find the maximum upward acceleration that can be given a 1200-kg elevator supported by the cable if the stress is not to exceed one-third of the elastic limit. **[4]**

a) 9.2 m/ s^2
b) 10.2 m/ s^2
c) 8.2 m/ s^2
d) 11.2 m/ s^2

41. Plasticity is the property of a body, by virtue of which **[4]**

a) it is distorted or stretches without the application of force
b) it gets permanently deformed on application of force i.e. shape and size do not change on removal of force
c) it tends to regain its original size and shape when the applied force is removed
d) it remains in original size and shape when the force is applied

42. A specimen of oil having an initial volume of 600 cm^3 is subjected to a pressure increase of 3.6×10^6 Pa and the volume is found to decrease by 0.45 cm3 what is the compressibility of the material? **[4]**

a) 2.3×10^{-10} Pa^{-1}
b) 2.1×10^{-10} Pa^{-1}
c) 1.7×10^{-10} Pa^{-1}
d) 1.9×10^{-10} Pa^{-1}

43. A piece of copper having a rectangular cross-section of 15.2 mm $\times$ 19.1 mm is pulled in tension with 44,500 N force, producing only elastic deformation. Calculate the resulting strain? Take Young's modulus of copper as 11×10^{10}Pa **[4]**

a) 0.06×10^{-2}
b) 0.11×10^{-2}
c) 0.04×10^{-2}
d) 0.14×10^{-2}

44. Two strips of metal are riveted together at their ends by four rivets, each of diameter 6.0 mm. What is the maximum tension that can be exerted by the riveted strip if the shearing stress on the rivet is not to exceed 6.9×10^7Pa? Assume that each rivet is to carry one quarter of the load. **[4]**

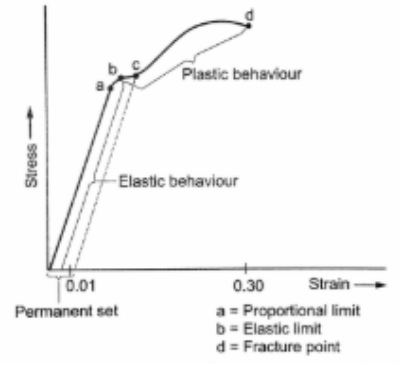
a) 7.2 N

b) 7.0 N

c) 7.8 N

d) 6.5 N

45. With reference to figure the elastic zone is **[4]**



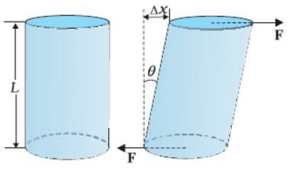
a) bc

b) oa

c) ab

d) cd

46. Referring to figure shearing strain is defined as. **[4]**



a) $\cot\theta$

b) $cos\theta$

c) $\tan\ \theta$

d) $\sin\theta$

47. A 200-kg load is hung on a wire with a length of 4.00 m, a cross-sectional area of 0.200 $\times\ 10^{-4}$ m^2, and a Young's modulus of 8.00 $\times\ 10^{10}$N/ m^2. What is its increase in length? **[4]**

a) 4.70 mm

b) 4.90 mm

c) 5.00 mm

d) 4.80 mm

48. When a solid is deformed, **[4]**

a) only the atoms or molecules of the surface move from their equilibrium position

b) only the atoms or molecules at some points move from their equilibrium position

c) the atoms or molecules do not move from their equilibrium position

d) all the atoms or molecules are displaced from their equilibrium positions causing a change in inter atomic (or intermolecular) distances.

49. The S.I. unit of stress is **[4]**

a) Newton

b) Joule

c) Watt

d) Pascal

50. Compute the fractional change in volume of a glass slab, when subjected to a hydraulic pressure of 10 atm. Bulk modulus of glass 37 GPa. **[4]**

a) 0.473×10^{-4}

b) 0.373×10^{-4}

c) 0.573×10^{-4}

d) 0.273×10^{-4}