

1. How large a force is necessary to stretch a 2.0-mm-diameter steel wire ($E = 2.0 \times 10^{11}$ N/m²) by 1.0%?

Ans. 6.3×10^3 N

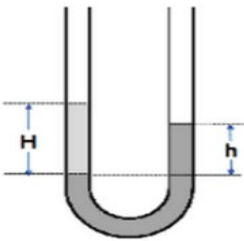
2. A 2-m long wire of diameter 0.20 mm stretches by 4 mm when a 6.28-N force is applied to it. What is modulus of elasticity for this wire?

Ans. 1×10^{11} Pa

3. Crew members attempt to escape from a damaged submarine 80 m below the surface. What force must they apply to a pop-out hatch of radius of 18 cm to push it out? Assume the density of ocean water 1025 kg/m³.

Ans 82 kN

4. A simple open U-tube contains water. When $H = 8$ cm of oil, of unknown density, is poured into the left arm of the tube, the water level in the right arm is $h = 5$ cm above the interface. What is the density of the oil? (The density of water is 1000 kg/m^3)

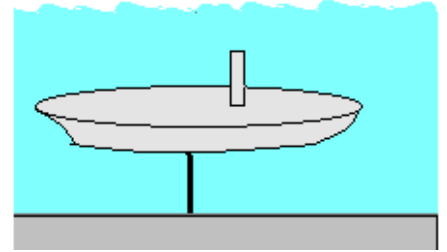


Ans. 625 kg/m^3

5. A cylindrical submarine with mass 20×10^5 kg, radius of 2.75 m and length of 100 m is

anchored to the bottom of a channel as shown schematically in the figure. What is the tension in the cable assuming the submarine is totally submerged?

Ans $3.7 \times 10^6 \text{ N}$



6. A 1500 g block of wood floats in a container of oil (the oil's density is 750 kg/m^3). What volume of oil does the wood displace?

ans 0.002 m³

7. A sample of unknown material appears to weigh 300 N in air and 200 N when immersed in water. What is the density of the material? (the density of water is 1000 kg/m³)

ans 3000 kg/m³

8. A water hose of radius of 1.2 cm is used to fill a bucket of volume of 75 L. If it takes 2.2 min to fill the bucket, what is the speed at which the water leaves the hose? (1L = 10⁻³m³)

ans 1.3 m/s

9. A hydraulic press is designed to lift maximum weight of 24000 N when 120 N force is applied to the smaller piston The radius of the smaller piston is 2.5 cm. What is the radius of the larger piston?

Ans. 35 cm

10. An air condition system uses a cylindrical air duct to replenish the air in a room of volume 280 m^3 every 8 min. The air flows in the duct at 5 m/s . What is the cross-section area of the air duct?

Ans. 0.12 m^2

11. If wind (density of air $=1.29 \text{ kg/m}^3$) blows at 30 m/s parallel to a flat roof having an area of 475 m^2 , what is the force exerted on the roof?

ans $2.76 \times 10^5 \text{ N}$, up

12. An airplane has a mass of $1.7 \times 10^6 \text{ kg}$ and the air flows past the lower surface of the wing at 342 km/h . If the wings have a surface area 1200 m^2 , how fast must the air flow over the upper surface of the wing if the plane is to stay in the air? Density of air = 1.24 kg/m^3

Ans. 177 m/s

13. Water pressurized to $3.5 \times 10^5 \text{ Pa}$ is flowing at 5.0 m/s in a horizontal pipe of a diameter of 12 cm . If it contracts to the diameter of 7 cm , what are the velocity and pressure of the water after the contraction?

ans 2.5×10^5 Pa, 15 m/s

14. The temperature of the iron cube, 5 cm on edge, should be changed by what amount for the volume of the cube to increase by 0.35 cm^3 . (The coefficient of linear expansion of iron is 1.2×10^{-5} per $^{\circ}\text{C}$)

ans 77°C

15. For mercury to expand its volume by 2 % , what change in temperature is necessary? ($\beta = 180 \times 10^{-6} / ^\circ\text{C}$).

ans 111°C

16. Suppose the ends of a 20-m-long steel beam are rigidly clamped at 0°C to prevent expansion. The rail has a cross-sectional area of 30 cm^2 . What force does the beam exert when it is heated to 40°C ? ($\alpha_{\text{steel}} = 1.1 \times 10^{-5} / \text{C}^\circ$, $Y_{\text{steel}} = 2.0 \times 10^{11} \text{ N/m}^2$).

ans $2.6 \times 10^5 \text{ N}$

17. What is the temperature of 3 moles of gas at a pressure of 250 kPa held in a volume of 0.015 m^3 ?

ans - $123 \text{ }^\circ\text{C}$

18. A sealed cylinder fitted with a movable piston contains ideal gas at 27°C , pressure 0.500 atm , and volume 1.25 m^3 . What will be the final temperature if the gas is compressed to 0.800 m^3 and the pressure rises to 0.820 atm ?

Ans. 42⁰C

Problems 19, 20, and 21

19. Approximately how many moles of argon (atomic mass is 40g/mol) are needed to fill the space between two panes of glass in a window, if the absolute gas pressure is 2 atm., the volume of the space is 0.2 m³, and the temperature is 30⁰C? (1atm=1.013x10⁵Pa)

ans 16 moles

20. What is the mass of the argon inside?

ans 640 g

21. How many argon atoms are inside the space between two panes of glass?

Ans. 9.6×10^{24} atoms

22. A scuba diver has his lungs filled to half capacity (3 liters) when 10 m below the surface. If the diver holds his breath while quietly rising to the surface, what will the volume of the lungs be (in liters) at the surface? Assume the temperature is the same at all depths. (The density of water is 1.0×10^3 kg/m³.)

ans 5.9 L

23. An aluminum electric tea kettle has a 1500-W heating coil. How long will it take to heat up 1 kg of water from 18°C to 98°C in this kettle? (specific heat of water is 4186 J/kg·°C)

Ans. 4 minutes

24. A 320-g piece of metal alloy at 130° is dropped into the light calorimeter containing 178 g of water at 15°C. The final temperature

of the system is 30°C . What is the specific heat of the metal?

$$C=349 \text{ J/kg}^{\circ}\text{C}$$

25. A 120 grams of ice at temperature 0°C added to water was able to decrease the temperature of water from 26°C to 11°C . What was the mass of the water? (latent heat of fusion for water is 335000 J/kg ; specific heat of water is $4186 \text{ J/kg}^{\circ}\text{C}$) .

Ans $m=0.73 \text{ kg}$

