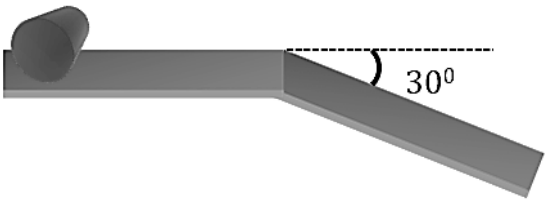
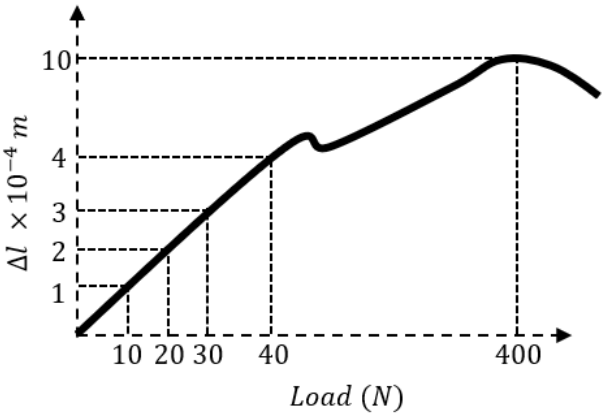
WORK SHEET

Q.1 A uniform solid cylinder of radius R = 15 cm rolls over a horizontal plane passing into an inclined plane forming an angle α = 30° with the horizontal. Find the maximum value of the velocity v_0 which still permits the cylinder to roll onto the inclined plane section without a jump. Assume there is no sliding between the cylinder and surfaces.



(A) 1 m/s **(B)** 2 m/s **(C)** 4 m/s **(D)** 0.5 m/s

Q.2 A wire of length 2 m is suspended from the top of a roof at one end and a load of W is attached at the other end. Cross-sectional area of the wire is $5 \times 10^{-7}\ m^2$ and elongation (Δl) is shown in the graph. Find the Young's modulus of elasticity of the wire material.

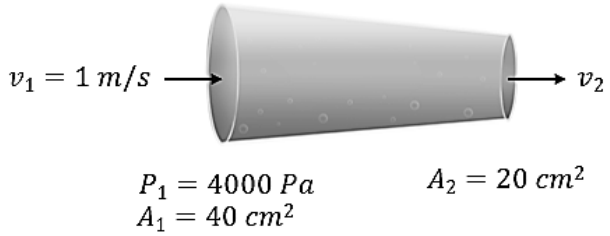


(A) 1×10^{11} N/m² **(B)** 1.6×10^{12} N/m² **(C)** 2×10^{11}N/m² **(D)** 4×10^{11}N/m²

Q.3 A steel rod is having a radius of 10 mm and length 1.0 m. A force of 100 kN is used to stretch it along its length. If the Young's modulus of steel is $2 \times 10^{11}\ Nm^{-2}$, then the strain in the rod will be

(A) 0.002 **(B)** 0.003 **(C)** 0.008 **(D)** 0.0016

Q.4 A horizontal pipeline carries water in a streamline flow. The inlet area of the pipeline is 40 cm^2& water velocity at inlet is $1 m/s$. Find the pressure at the outlet of pipeline if the inlet pressure is 4000 Pa and outlet cross-section is 20 cm^2. Will the result for outlet pressure be same, if we place a heater inside the pipeline assuming the walls of the pipeline to be insulated. Take $\rho_{H_2O} = 1000$ kg/ m³.



(A) 2000 Pa, no pressure will not be same **(B)** 3500 Pa, yes pressure will be same
(C) 2500 Pa, no pressure will not be same **(D)** 2000 Pa, yes pressure will be same

Q.5 In a car lift, compressed air exerts a force F_1 on a small piston having a radius of 5.0 cm. This pressure is transmitted to the second piston of radius 10.0 cm. If the mass of the car to be lifted by the second piston is 1350 kg, calculate F_1 (Take $g = 10\ m/s^2$)

(A) 1800 N **(B)** 2400 N **(C)** 3375 N **(D)** 5625 N

Q.6 The excess pressure inside a spherical drop of water is 4 times that of another drop. Then their respective mass ratio is

(A) 1: 4 **(B)** 1: 64 **(C)** 1: 16 **(D)** 64 : 1

Q.7 When a tube of length 10 cm is dipped in water, the water rises up to 6 cm. If the entire arrangement is put in a freely falling elevator, the length of water column in the capillary tube will be

(A) 2 cm **(B)** 6 cm **(C)** 10 cm **(D)** 4 cm

Q.8 Temperature of an object increases by 40 degrees on the Celsius scale. What are corresponding changes on the Fahrenheit scale and absolute scale?

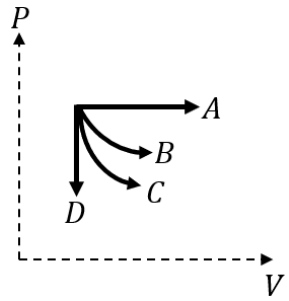
(A) 40°F, 72 K **(B)** 72°F, 40 K **(C)** 22.2°F, 40 K **(D)** 40°F, -22.2 K

Q.9 Volume of a cylinder increases by 6% upon heating. The area of its curved surface will increase by

(A) 1 % **(B)** 6 % **(C)** 3 % **(D)** 4 %

Q.10 Consider the four processes A, B, C, D shown in the graph given below. List I show process & List II gives value of index 'n' for the equation $PV^n = \text{const.}$
Match List I with List II.

List I	List II
A. A	1. 0
B. B	2. 1
C. C	3. 1.4
D. D	4. ∞



(A) A − 4, B − 2, C − 3, D – 1 **(B)** A − 1, B − 2, C − 3, D − 4

(C) A − 1, B − 3, C − 2, D – 4 **(D)** A − 4, B − 3, C − 2, D − 1

Q.11 Helium in a piston/cylinder at 27°C, 100 kPa is brought to 400 K in a reversible polytropic process with exponent $n = 1.25$. Helium can be assumed to be an ideal gas with constant specific heat capacity. Find the work done per unit mass of gas. . Assume R for helium = 2.07 kJ/kg K

(A) −587.7 kJ/kg **(B)** −687.7 kJ/kg **(C)** −787.7 kJ/kg **(D)** −828 kJ/kg

Q.12 A cylinder fixed with a piston contains saturated vapour of a refrigerant at 10°C, the volume and pressure are 10 L and 0.681 MPa respectively. The refrigerant is compressed to 3.5 L and 2 MPa. If the saturated vapour is undergoing polytropic process as PV^n = constant, where n = 1.025, then calculate the work done during the process.

(A) −7.60 kJ **(B)** −5.76 kJ **(C)** −3.12 kJ **(D)** −2.9 kJ

Q.13 P − V diagram of a diatomic gas is a straight line passing through origin. What is the molar heat capacity of the gas during the process?

(A) R **(B)** 2R **(C)** 3.33R **(D)** 3R

Q.14 An ideal CO_2 gas obeys the law PV^x = constant. The range of x for which the gas has non-positive molar specific heat at normal temperature is

(A) $x \geq -0.5$ **(B)** $x \leq 1.7$ **(C)** $1 < x \leq -1.4$ **(D)** $x \leq -1.4$

Q.15 Air (ideal gas with $\gamma = 1.4$) at 1 bar and 300 K is compressed till the final volume is one- sixteenth of the original volume, following a polytropic process $PV^{1.25}$ = constant. Calculate the (a) work done and (b) the energy transferred as heat per mole of the air.

(A) -9.977 kJ/mol, -3.742 kJ/mol **(B)** -6.97 kJ/mol, -8.24 kJ/mol

(C) -6397 kJ/mol, -2.64 kJ/mol **(D)** -3.742 kJ/mol, -2.64 kJ/mol

Q.16 3 moles of an ideal monoatomic gas performs a cycle shown in the figure. The gas temperature at A, B, C, D are TA = 400 K, TB = 800 K, $T_C = 2400$ K, $T_D = 1200$ K. Find the work done by the gas.

(A) 12 KJ **(B)** 20 KJ **(C)** 120 KJ **(D)** 24 KJ

Q.17 An ideal gas is taken along the process AB as shown in the P– V diagram. Find the volume of the gas where the temperature becomes maximum.

(A) $\frac{3}{2}V_0$ **(B)** $\frac{4}{5}V_0$ **(C)** $\frac{5}{3}V_0$ **(D)** $\frac{3}{5}V_0$

Q.18 An ideal gas at pressure 1 bar and temperature 300 K is compressed till the final volume is $\frac{1}{16}^{\text{th}}$ of the original volume following a polytropic process $PV^{1.25}$ = constant. If the final pressure of the gas is $x \times 10^3$ kPa, the x is

Q.19 A particle of mass m is projected with a velocity v making an angle of 45° with the horizontal. The magnitude of the angular momentum of the projectile about the point of projection when the particle is at its maximum height h is given by which of the following relation(s)?

(A) zero **(B)** $\frac{mv^3}{4\sqrt{2}g}$ **(C)** $\frac{mv^3}{\sqrt{2}g}$ **(D)** $m\sqrt{2gh^3}$

Q.20 A gas is compressed from some initial volume V_1 to find volume V_f along two different paths as shown in figure. If W_1, W_2 corresponds to work done during polytropic process of exponents n_1, n_2 respectively, then which of the following statements is/are correct?

(A) $W_1 > W_2$ **(B)** $n_1 > n_2$ **(C)** $W_1 < W_2$ **(D)** $n_1 < n_2$

Q.21 One mole of a monoatomic ideal gas is taken along two cyclic processes E → F → G → E *and* E → F → H → E as shown on given P– V diagram. The processes involved are purely isochoric, isobaric, isothermal or adiabatic. Which of the following is/are correct?

(A) $W_{EFHE} >$ WEFGE **(B)** $W_{EF} = 0$ **(C)** $W_{EFHE} <$ WEFGE **(D)** $W_{EF} <$ WFG

WORK SHEET

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(D)	(D)	(C)	(C)	(B)	(C)	(B)	(D)	(B)
Q.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Sol.	(D)	(B)	(D)	(C)	(A)	(B)	(A)		(B), (D)	(A), (B)
Q.	21									

ANSWER KEY

Sol.	(B), (C), (D)								