WORK SHEET

Q.1 A stone dropped from a certain height reaches ground in 5 sec. If it is dropped and stopped for infinitesimal time interval at $t = 3$ s, then time taken by the stone to reach the ground is

(A) 6 s **(B)** 6.5 s **(C)** 7 s **(D)** 7.5 s

Q.2 An aero plane has to go along straight line from A to B and back along. The relative speed w.r.t. wind is V. The wind blows perpendicular to line AB with speed V_0. The distance between A&B is l. The total time for the round trip is

(A) $\frac{2l}{\sqrt{V^2-V_0^2}}$ **(B)** $\frac{2Vl}{\sqrt{V^2-V_0^2}}$ **(C)** $\frac{2V_0l}{\sqrt{V^2-V_0^2}}$ **(D)** $\frac{2l}{\sqrt{V^2+V_0^2}}$

Q.3 A motorbike is being chased by a car. The motorbike moves with the speed of 10 m/s and has acceleration of $5\ m/s^2$. Where as, the car has speed of 20 m/s and accelerates with $3\ m/s^2$. If the initial separation between motorbike and car is 60 m, find the distance by which car will miss the motorbike.

(A) 25 m **(B)** 30 m **(C)** 35 m **(D)** 40 m

Q.4 In the figure shown, find the value of frictional force between A and B&B and the surface respectively. Take $g = 10\ m/s^2$.

(A) 4N,6N **(B)** 6N.4N **(C)** 2N.4N **(D)** 2N.6N

Q.5 Two blocks of masses 4 kg and 2 kg are placed on a frictionless surface and connected by a spring. An external kick gives a velocity of 12 m/s to the heavier block in the direction towards the lighter one. The magnitude of the velocities of two blocks in the center of mass frame, after the kick, are respectively

(A) 6 m/s, 10 m/s **(B)** 4 m/s, 8 m/s **(C)** 8 m/s, 6 m/s **(D)** 4 m/s, 10 m/s

Q.6 What will be the total resistance offered to the flow of water by the system ofpipe 1, pipe 2, pipe 3and pipe 4 ignoring the joints? If all the pipes are of length 3 m and radius 2 m and η is viscosity of water. (Assume $\pi = 3$)

(A) 1.25η **(B)** 3η **(C)** 4.5η **(D)** 9η

Q.7 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.8 A right circular cone of density ρ, floats just immersed with its vertex downwards, in a vessel containing two liquids of densities σ_1 and σ_2 respectively. The plane of separation of the two liquids cuts off from the axis of the cone at a fraction z (taken from vertex) of its length. Find z.

(A) $h\left(\frac{\rho+\sigma_2}{\sigma_1+\sigma_2}\right)^{1/3}$ **(B)** $h\left(\frac{\rho-\sigma_2}{\sigma_1-\sigma_2}\right)^{1/3}$ **(C)** $h\left(\frac{\rho-\sigma_2}{\sigma_1+\sigma_2}\right)^{1/2}$ **(D)** $h\left(\frac{\rho-\sigma_2}{\sigma_1-\sigma_2}\right)$

Q.9 A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is $250\ m^2$. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be ($\rho_{air} = 1.2\ kg/m^3$).

(A) 4.8×10^5 N, downwards

(B) 4.8×10^5 N, upwards

(C) 2.4×10^5 N, upwards **(D)** 2.4×10^5 N, downwards

Q.10 A rod is measured using a scale. The reading is 60 cm at 12°C. If thermal coefficient of linear expansion of the rod is $3 \times 10^{-5}/°C$, the reading of the rod at 42°C is:
(Assume the scale does not expand)

(A)60.025cm **(B)**60.054cm **(C)**60.065cm **(D)** 59.985cm

Q.11 The area enclosed by a PV graph for one thermodynamic cycle of a heat engine is 610 J. The total thermal energy absorbed by the gas in one cycle is 1300 J. Determine the efficiency of the cycle.

(A)47% **(B)**23% **(C)** 9.4% **(D)** 363.8%

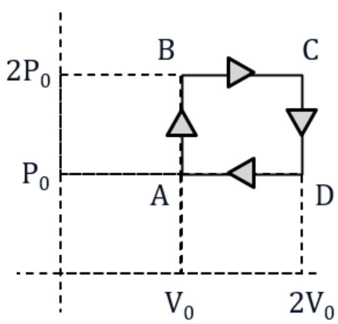
Q.12 A real heat engine has an efficiency of 40%. The work output of the engine is 100 kJ per cycle. How much energy is extracted from the high temperature reservoir per cycle?

(A)40 kJ
(B)250 kJ
(C) 400 kJ
(D) Can be calculated only if the engine is a Carnot engine.

Q.13 30 people gather in a 10 m × 5 m × 3 m room for a confidential meeting. The room is completely sealed off and insulated. Calculate the rise in temperature of the room in half an hour. Assume that the average energy thrown off by the body of a person is 2500 kcal/day, density of air is 1.2 kg/m^3 and specific heat capacity of air at constant volume is 0.24 kcal kg^{-1}°C^{-1}.
[Neglect volume occupied by the people].

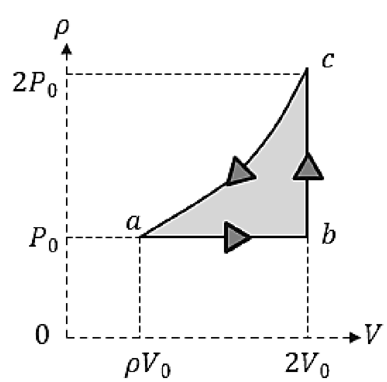
(A)18^0C **(B)**36^0C **(C)**54^0C **(D)** 68^0C

Q.14 Helium gas goes through a cycle $ABCDA$ (consisting of two isochoric and two isobaric lines) as shown in figure. Efficiency of this cycle is nearly:[Assume the gas to be an ideal gas]



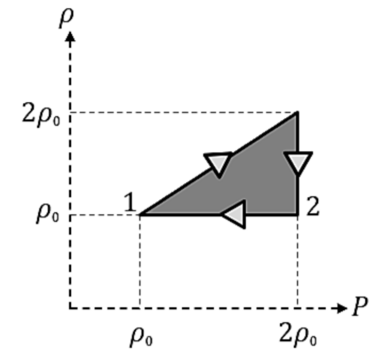
(A)15.4% **(B)** 9.1% **(C)** 10.5% **(D)** 12.4%

Q.15 One mole of an ideal monoatomic gas is taken through a cycle a → b → c → aas shown in the figure. Find the difference between maximum and minimum values of internal energy of the gas during the cycle.



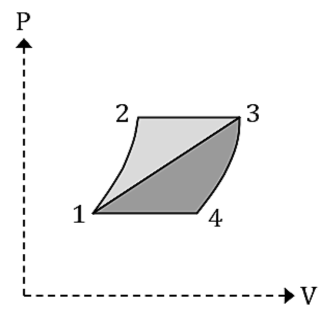
(A)$9P_0V_0$ **(B)**$6P_0V_0$ **(C)** $\frac{9}{2}P_0V_0$ **(D)**$3P_0V_0$

Q.16 One mole of a monoatomic gas of molar mass M undergoes a cyclic process as shown in the figure. Here, **ρ** is the density and P is the pressure of the gas. Find the efficiency of the cycle.



(A) $\frac{3}{5}(1-\ln 2)$ **(B)** $\frac{2}{5}(1-\ln 2)$ **(C)** $\frac{3}{5}\ln 2$ **(D)** $\frac{2\ln 2}{5}$

Q.17 An ideal gas is taken through a cycle 1231 (see figure) and the efficiency of the cycle was found to be 25%. When the same gas goes through the cycle 1341, the efficiency is 10%. Find the efficiency of the cycle 12341.



(A) 18.6 % **(B)** 23.2 % **(C)** 32.5 % **(D)** 44 %

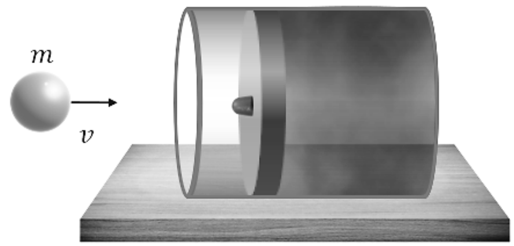
Q.18 An ideal gas has a molar heat capacity C_v at constant volume. It undergoes a process given by $T = T_0 e^{\frac{\alpha}{V}}$, where T_0 and α are constants. Find the molar heat capacity of the gas as a function of V.

(A) $C_v - \frac{VR}{\alpha}$ **(B)** $C_v + VR$ **(C)** $C_v - \frac{Ra}{v}$ **(D)** $C_v - \frac{V^2R}{\alpha}$

Q.19 For the case of an ideal gas, find the equation of the process in which the molar heat capacity varies as $C = C_v + \alpha T^2$, where α is constant. Take V_0 to be the initial volume of the gas.

(A) $V = V_0 e^{\frac{\alpha T^2}{2R}}$ **(B)** $V = V_0 e^{\frac{2\alpha T}{R}}$ **(C)** $V = V_0 e^{\frac{\alpha T^2}{R}}$ **(D)** $V = V_0 e^{\frac{T^2}{\alpha R}}$

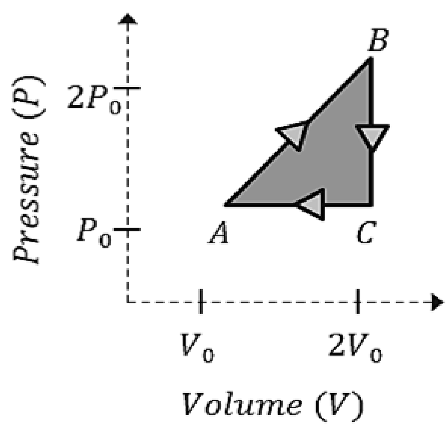
Q.20 An adiabatic cylindrical chamber with a frictionless movable piston has been placed on a smooth horizontal surface as shown. One mole of an ideal monoatomic gas is enclosed inside the chamber. Mass of the piston is M and mass of the remaining chamber including the gas is 4M. The gas is at atmospheric pressure and temperature. A particle of mass M moving horizontally with speed v, strikes the piston elastically.Find the change in temperature of the gas when the compression is maximum. [R is the ideal gas constant]



(A) $\Delta T = \frac{2MV^2}{3R}$ (B) $\Delta T = \frac{2MV^2}{15R}$ (C) $\Delta T = \frac{3MV^2}{7R}$ (D) $\Delta T = \frac{4MV^2}{15R}$

Q.21 The efficiency of the thermodynamic cycle shown in figure for an ideal diatomic gas is given by the fraction $\frac{1}{n}$. Then, find n.

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



ANSWER KEY

Sol.	(A)	(B)	(B)	(A)	(C)	(B)	(C)	(A)	(A)	(D)
Q.	21									
Sol.										