M. Prakash Academy **Daily Workout**
Science Set – II 22-29 April

PART -1

Dear Students,

This is a set of mixed problems which are extremely elementary. Ideally, you should be able to do more than 80% of these problems without any paper-work. Do a time test for yourself and record the total time required to solve all the problems (of course with correct solutions.) We will be interested to find out the minimum time required to solve such a problem set.

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1. Water drips from the nozzle of a shower onto the floor 200 cm below. The drops fall at regular (equal) intervals of time, the first drop striking the floor at the instant the fourth drop begins to fall. Find the locations of the second and third drops when the first strikes the floor.

2. A parachutist bails out and freely falls 50 m. Then the parachute opens and thereafter she decelerates at 2.0 m/s^2. She reaches the ground with a speed of 3.0 m/s. How long is the parachutist in the air? At what height does the fall begin?

3. A rock is dropped (from rest) from the top of a 60 m tall building. How far above the ground is the rock 1.2 s before it reaches the ground?

4. A mother racing her son has half the kinetic energy of the son, who has half the mass as the mother. Mother speeds up by 1.0 m/s and then has the same kinetic energy as that of the son. What are the original speeds of the mother and the son?

5. The force (not the power) required to tow a boat at constant velocity is proportional to the speed. If a speed of 4.0 km/h requires 7.5 kW power, how much power does a speed of 12 km/h require?

6. A block of wood floats in freshwater with two-thirds of its volume submerged. In oil the block floats with 0.90 of its volume submerged. Find the density of the wood and the oil.

7. An iron anchor of density 7870 kg/m^3 appears 200 N lighter in water than in air. What is the volume of the anchor? How much does it weigh in air?

8. A water filled cone of height 50 cm and base area 20 sq cm is placed on a table with the base on the table. What is the thrust offered by the water on the table?

9. What is the resultant temperature when 100 g of steam at 100° C is passed through 500 g of ice at -20° C. the specific heat of water is 0.5 cal g^{-1}° C^{-1}.

10. Two substances A and B have their densities, specific heats and volumes in the same ratio of 2:3. Find the ratio of the thermal capacities.

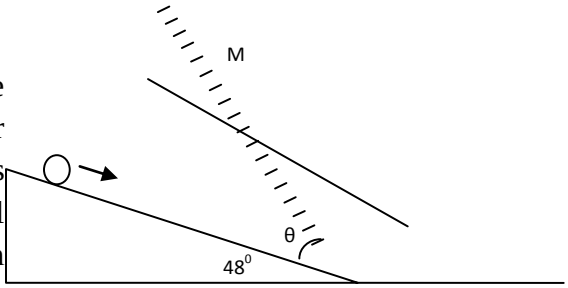
11. A stone is dropped from the top of a tall building. Two second later another stone is dropped from the same point. Calculate the distance between the stones, 2.5 second after the 2nd stone was dropped. Ignore air resistance. Express your answer in meter.

12. The speed of a motor boat with respect to water is v = 14 m/s. The speed of water with respect to the banks is 6 m/s. When the boat began travelling upstream, a buoy was dropped from it. A buoy is a body that can float in water. The boat travelled 6.3 km upstream (with respect to banks), turned about and caught up with the buoy. Find the time T lapsed between dropping the buoy and catching up with it again.

13. A person performs the following experiment to measure the acceleration of an elevator. He takes a weighing machine, keeps it on the floor of an elevator. He records his mass as 50 kg when the elevator is at rest. He continues to stand on the machine and then starts the elevator, which begins to move down. He records his mass to be 48 kg during the downward acceleration of the elevator. From this observation, calculate the acceleration of the elevator.

14. Two clay balls are moving toward each other along a common straight line. The one on the left has mass 3 kg and velocity 4 m/s. The one on the left has mass 2 kg and velocity 9 m/s. The balls collide and form a single ball of mass 5 kg and keep moving. Some kinetic energy is lost as heat in this process. Calculate this lost energy. Express your answer in Joule.

15. A ball is set rolling down an inclined plane of angle 48^0 as shown. A mirror M is to be placed at the lower edge of the incline such that the image of the ball is seen to be moving downward in exactly vertical direction. Calculate the angle θ which is made between the incline and the mirror. Express your answer in degree.



PART -2

GAS LAWS

1. A gas is expanded at constant temperature from an initial volume of 300 ml to a final volume of 1 litre where its pressure is 0.15 atm. What was the original pressure?

2. 12.0 litres of helium gas at 1.5 atmosphere is squeezed into a metereological balloon of 1.2 litres. How much pressure needs to be applied if the temperature does not change?

3. A balloon containing 3 litres of hydrogen gas at 750 mm Hg pressure. After 4 hours, the pressure of the gas was found to be 720 mm Hg. How much is the expansion in the volume of the balloon? Assume temperature constant.

4. A given quantity of a gas at 760 mm Hg pressure and a temperature of 25^0C occupies a volume of 3.5 litres. What is the volume of the same amount of the gas at 35^0C and 760 mm Hg pressure?

5. A gas with a volume of 200 litres is under a pressure of 2 atmosphere at 20^0C. What temperature in ^{0}C would be required to triple the pressure without changing the volume?

6. A gas with a volume of 2 litres is cooled at a constant pressure from 1000^0C to 0^0C. What volume in ml will it occupy now?

7. What is the volume at STP of a gas that occupies 100 ml at 23^0C and 800 mm Hg pressure?

8. A sealed iron container containing 0.4 dm^3 of the nitrogen gas at 25^0C and 0.99 atm pressure is thrown into a fire where the temperature is 1100^0C. What will be the new pressure of the gas in the container? Assume constant volume and ideal behaviour.

9. 700 ml of a gas at 20^0C and 755 torr is pumped into a vessel of 400 ml at 25^0C. What is the pressure of the gas in the vessel?

10. What is the temperature of a sample of 4.0 moles of a gas occupying a volume of 8.0 litres at 740 mm Hg pressure?

11. Calculate the pressure of 4.4 g CO_2 in a 5 litre container at 0^0C.

12. What is the volume occupied by 3.5 g of oxygen gas at 30^0C and 750 torr?

13. Hydrogen is filled in 224 ml container at 0^0C and one atmosphere. Calculate the number of molecules of hydrogen in the container.

14. 10 moles of oxygen are confined in a vessel with a capacity of 224 litres. If the temperature is 0^0C, what is the pressure?

15. Nitrous oxide gas is present in a 5.0 litre rigid container at a pressure of 7.6×10^{-5} torr. Calculate the number of nitrous oxide molecules in the container at -10^0C?

16. An open vessel containing 15 moles of air at 25^0C is cooled until the total number of moles becomes 25. Assuming that the volume of the vessel remains constant, find the temperature to which the vessel has been cooled.

17. 50.0 g of a gas at 30^0C occupied the same volume as 25 g of oxygen at 20^0C and at the same pressure. What is the molecular mass of the gas?

18. The volume occupied by the vapour when 12.4 g of white phosphorus is vaporized at 280.3^0C at 715 mm Hg pressure is 4.82 litres. What is the molecular formula of phosphorus vapour under these conditions?

19. The mass of 400 ml of a ……..gas at 20^0C and 0.611 atm pressure is 0.48 g. Calculate the mass in g of one atom.

20. The total pressure of a sample of nitrous oxide gas over water is 745 mm Hg at 35^0C. The aqueous tension of water at 35^0C is 42.2 mm Hg. What is the pressure exerted by the nitrous oxide gas?

21. 34 ml of a sample of acetylene is collected over water at 15^0C and 755 mm pressure. What is the volume of acetylene at STP? The vapour pressure of water at 15^0C is 12.8 mm.

22. Ammonium nitrate decomposes on heating to give nitrous oxide gas(N_2O) and H_2O gas. What is the total pressure developed in a 2 litre steel vessel by decomposing 32 g of ammonium nitrate at 250^0C?

23. What is the volume at STP of a mixture of 3.2 g O_2 and 4.4 g CO_2 ?

24. 325 ml of a gas weighs 0.043 g at 55^0C and 0.95 atm. The mass of 325 ml of hydrogen gas at 55^0C and 0.95 atm is 0.023 g. What is the vapour density of the gas?

25. What is the vapour density of a 0.356 g sample of a gas occupying 336 ml at STP ? Calculate its molecular mass.

ANSWERS GAS LAWS

1. 0.5 atm	**2. 15 atm**	**3. 0.125 litre**	**4. 3.62 litres**
5. 606^0C	**6. 429 ml**	**7. 97 ml**	**8. 4.56 atm**
9. 1343.8 mm	**10. –249.2^0C**	**11. 0.448 atm**	**12. 2.76 litres**
13. 6.023×10^{21}	**14. 1 atm**	**15. 1.396×10^{16}**	**16. –94.2^0C**
17.66.2 g mol^{-1}	**18. P_4**	**19.$2.656x10^{-23}$**	**20. 702.8 mm**
21. 31.47ml	**22. 25.73 atm**	**23. 448 ml**	**24. 1.87**
25. 11.87, 23.74			

Documentary of the Week:

Visit the following link to watch an interesting account of ‘perpetual’ motion. Can we have energy without supplying any energy? Check this out at:

http://www.youtube.com/watch?v=c6UgV3gVmd0
