Part A : FROM TEXT BOOK (Basic Physics, Page 1-34)

Question Type	Page	Question No.	Total Questions	Remarks
Example	3-16	Example 1.1 to 1.7, 1.9	8	Practice yourself in loose sheets!
Test Yourself Problems	3-16	TY 1.01 to 1.10, 1.12,1.13	12	Practice yourself in Register Notebook! (Submission required)
Conceptual Problems	17-19	1 to 8	8	Practice yourself in loose sheets!
Solved Numerical Problems	19-26	1-13	13	Practice yourself in loose sheets!
MCQ	27-29	1.1 to 1.25	25	Solve and write hints of each questions in Register Notebook! (Submission required)
Further Exercise	30-34	1.39,1.44,1.46-1.58, 1.61-1.67	23	Practice in Register Notebook with your friends & consult your teacher. (Submission required)

Part B: Additional Problems: Practice in Register notebook (Submission required)

1. The angular speed is inversely proportional to the moment of inertia, that is given by the principle of conservation of energy. a) In a flywheel, most of the mass is concentrated at the rim? Explain why? b) The angular velocity of the earth around the sun increases, when it comes closer to the sun. Why? c) If the earth were to shrink suddenly, what would happen to the length of the day? d) If the ice on the polar caps of the earth melts, how will it affect the duration of the day? Explain.
2. Can you distinguish a raw egg and a hardboiled egg by spinning each one on the table? Explain.
3. Both "the work done by a force" and "the torque produced by a force" are the produce of force and the position vector. How can one make the difference between the two? Explain.
4. If earth shrinks, how will be the duration of a day affected?
5. Does the angular momentum of a body moving in a circular path change? Give explanation to your answer.
6. The cap of a bottle can be easily opened with the help of two fingers than with one finger. Why?
7. A fan with blades takes longer time to come to rest than without blades. Why?
8. A solid sphere and a hollow cylinder of same mass and same size is rolling down on an inclined plane from rest. Which one reaches the bottom first? Why?
9. A dancer girl is rotating over a turntable with her arms outstretched. If she lowers her arms how does this effect her motion?
10. Explain why spokes are fitted in the cycle wheel.
11. Suppose that only two external forces act on a rigid body and the two forces are equal in magnitude but opposite in direction. Under what conditions will the body rotate?
12. If the earth is struck by meteorites, the earth will slow down slightly. Why?
13. Why is it easier to hold down a 10 kg. body in your hand at your side than to hold it with your arm extended horizontally?
14. Define moment of inertia. Show that K.E. of a rotating body is $\frac{1}{2} I\omega^2$.
15. What is moment of inertia? Show that in rotational motion, power is the product of torque and angular velocity.
16. Define moment of inertia. Derive an expression for the moment of inertia of thin uniform rod about an axis through its centre and perpendicular to its length.
17. What is the physical meaning moment of inertia of a rigid body? Also derive its expression in the case if a thin and uniform rod about an axis passing through one end and perpendicular to its length.
18. What is meant by moment of inertia? How is it related with the rotational kinetic energy of a body?
19. Explain the concept of torque and angular acceleration in the case of a rigid body. Derive a relation between them.
20. Define torque and couple din rotational motion. Also derive an expression for the work done by couple.
21. Define moment of inertia. Obtain an expression for the moment of inertia of a thin and uniform rod about an axis passing through the either end and perpendicular to its length.
22. A wheel starts from rest and accelerates with constant angular acceleration to an angular velocity of 15 revolutions per second in 10 seconds. Calculate the angular acceleration and angle which the wheel has rotated at the end of 2 second.
Ans: 9.42 rad/sec², 188.4 radian

23. A ballet dancer spins with 2.4 rev/s with her arms outstretched when the moment of inertia about the axis of rotation is 1. With her arms folded, the moment of inertia about same axis becomes 0.6I. Calculate the new rate of spin. **Ans: 4 rev/sec**

24. A constant torque of 500 Nm turns a wheel about its center. The moment of inertia about this axis is 100 kgm^2. Find the angular velocity gained in 4 seconds and kinetic energy gained after 20 revolutions. **Ans: 20 rad/sec, 62800 J**

25. A computer disk drive is turned on starting from the rest and has constant angular acceleration, (a) how long did it take to make the first complete rotation, and (b) what is its angular acceleration? Given that the disk took 0.750 sec for the drive to make its second complete revolution. **Ans: 1.81 sec, 3.83 rad/sec**

26. A constant torque of 200 Nm turns a wheel about its centre. The moment of inertia about the axis in 100 kg m^2. Find the angular velocity gained in 4 seconds and the kinetic energy gained after 10 revolutions. **Ans: 8 rad/sec, 12566.4 J**

28. A constant torque of 200N turns a wheel about its center. The moment of inertia of it about the axis is 100 kg m^2. Find the K.E. gained after 20 revolutions when it starts from rest. **Ans: 25132.7 J**

29. A ballet dancer spins about a vertical axis at 1 revolution per second with her arms stretched. With her arms folded, her moment of inertia about the axis decreases by 40%, calculate the new rate of revolution. **Ans: 1.67 rps**

30. An electric fan is turned off, and its angular velocity decreases uniformly from 500 rev/min in 4.00s (a) Find the angular acceleration and the number of revolutions made by the motor in 4.00s interval. (b) How many more seconds are required for the fan to come to rest if the angular acceleration remains constant? **Ans: −7.85 rad s^{-2}, 23.3, 2.68 sec**

31. Speed of a body spinning about an axis increase from rest to 100 rev. min^{-1} in 5 sec, if a constant torque of 20 Nm is applied. The external torque is then removed at the body comes to rest in 100 sec. due to friction. Calculate the frictional torque. **Ans: 1 Nm**

32. A heavy flywheel of moment of inertia 0.3 kgm^2 is mounted on a horizontal axle of radius 0.01m and negligible mass compared with the flywheel. Neglecting friction find (a) the angular acceleration if a force of 40N is applied tangentially to the axle.(b) the angular velocity of the fly wheel after 10 sec from rest. **Ans:1.3rad/s^2, 13.3rad/s**

33. The angular velocity of a flywheel decreases uniformly from 12000 rev/min to 3000 rev/min in 8sec. Find the angular acceleration and the no. of revolutions made by the wheel in the 8 sec interval. How many more seconds are required for the wheel to come of rest? **Ans: 117.8rad/s^2, 1000, 2.67sec**

34. A fly wheel of moment of inertia 0.32kgm^2 is rotated steadily at 120 rad/s by a 50W electric motor. (a) Find the K.E. and angular momentum of the flywheel (b) calculate the value of the frictional couple opposing the rotation (c) Find the time taken for the wheel to come to rest after the motor has been switched off. **Ans: 2304J, 38.4kgm^{2}s^{-1}, 0.42Nm, 92.3 sec**

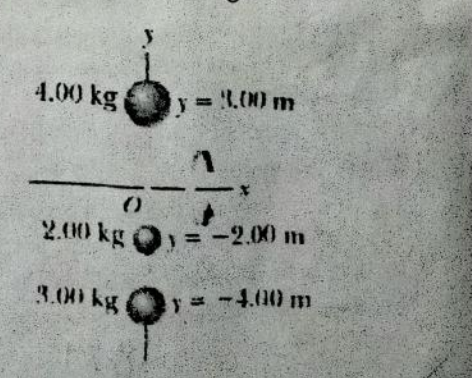
35. The speed of a motor engine decreases from 900 rev/min. to 600 rev/min. in 10 seconds.(i) The angular acceleration.(ii) Number of revolutions made by the motor during this interval.(iii) How many additional seconds are required for motor to come to rest in the same rate.

36. A physics teacher stands on a freely rotating platform. He holds a dumbbell in each hand of his outstretched arms while a student gives him a push until his angular velocity reaches 1.5 rad/s. When the freely spinning teacher pulls his hands in close to his body, his angular velocity increases to 5.0 rad/s. What is the ratio of his final kinetic energy to initial kinetic energy?

37. A helicopter has two blades each of which has a mass of 240 kg and can be approximated as a thin rod of length 6.7m. The blades are rotating at an angular speed of 44 rad/s . (a) What is the total moment of inertia of the two blades about the axis of rotation? (b) Determine the rotational kinetic energy of the spinning blades. **Ans: 7.18 × 10^3 kg · m^2, 6.95 × 10^{-6} J**

38. During a certain time interval, the angular position of a swinging door is described by $\theta = 4.95 + 9.4t + 2.05t^2$, where θ is in radians and t is in seconds. Determine the angular position, angular speed, and angular acceleration of the door at the following times. a) t=0 b) t=2.99 s **Ans: (a) 4.95 rad, 9.4 rad/s, 4.1 rad/s^2 (b) 51.38 rad, 21.66 rad/s, 4.1 rad/s^2**

39. A wheel 1.65 m in diameter lies in a vertical plane and rotates about its central axis with a constant angular acceleration of 3.70 rad/s^2. The wheel starts at rest at t = 0, and the radius vector of a certain point P on the rim makes an angle of 57.3° with the horizontal at this time. At t = 2.00 s, find the following: a) the angular speed of the wheel. b) the tangential speed of the point P. c) the total acceleration of the point P. d) the angular position of the point P. **Ans: a) 7.40 rad/s (b)6.11 m/s (c) a_t = 3.05 m/s^2, a_r = 45.18 m/s^2, a= 45.28 m/s (d) 28.40 rad**



40. Rigid rods of negligible mass lying along the y axis connect three particles. The system rotates about the x axis with an angular speed of 2.10 rad/s. a) Find the moment of inertia about the x axis. b) Find the total rotational kinetic energy evaluated from $^1/_2 I\omega^2$. c) Find the tangential speed of each particle. d) Find the total kinetic energy evaluated from $\Sigma\ ^1/_2 m_i v_i^2$ **Ans: (a) 92 kg.m^2 (b) 202.86 J (c) 6.30 m/s, 4.20 m/s, 8.40 m/s (d) 202.86 J**

The following questions should be on your respective teachers' note copy. These questions are necessary but not sufficient. For further practice, please take the reference of your text book. We may ask you these questions for your internal evaluation at any time.

1. If specific resistance of a potentiometer wire is 10^{-7} Ωm, current flowing through it is 0.1A and cross sectional area of wire is 10^{-6} m^2, then potential gradient will be, **(a)** 10^{-2} V/m (b)10^{-4} V/m (c) 10^{-6} V/m (d) 10^{-8} V/m
2. Indicate the 'wrong statement from the following. For accurate measurements, a potentiometer wire
   a) Must have a uniform cross section **b)** Must have a high temperature coefficient of resistance
   c) High specific resistance d) Homogeneity
3. A potentiometer is properly set the balancing length (L) for a cell is obtained. If the current through the potentiometer wire is decreased, then the balancing length a) is decreased **b)** is increased c)is not charged d) becomes half
4. A cell of e.m.f. of 1.08 V is balanced by a 216 cm length of a potentiometer. Find the length of the wire that would balance a cell of e.m.f. 1.5 V a) 250 cm b) 290 cm **c)** 300 cm d) 310 cm
5. A cell of e.m.f. of 1.08 V is balanced by a 216 cm length of a potentiometer. Find the length of the wire that would balance a cell of e.m.f. 1.5 V a) 250 cm b) 290 cm **c)** 300 cm d) 310 cm
6. What is the principle of potentiometer? Why is the potentiometer preferred to a voltmeter to measure the emf of a cell?
7. State the principle of potentiometer and write down its one application.
8. If the current flowing in the wire of the potentiometer be decreased, what will be the effect on the position of zero deflection in potentiometer? Explain.
9. Why do we prefer a potentiometer with longer wire?
10. Draw a circuit diagram of meter bridge to determine the resistance of a wire. Write the formula used.
11. How can a galvanometer be converted into voltmeter? Explain.
12. If the length of the wire be doubled, what will be the effect on the position of zero deflection in a potentiometer?
13. A voltmeter has high resistance. Explain why?
14. State and explain Kirchhoff's slaws of electric circuits.
15. How would you convince that the principle of measurement of resistance of wire by meter bridge is based on Wheatstone bridge principle? Explain.
16. An ammeter is always connected in series. Why?
17. The resistance of an ammeter must essentially be very small. Why?
18. Why is a voltmeter always connected in parallel with the load resistance?
19. Kirchhoff's laws in electricity are very useful in solving the complicated circuit connections. a) What is the significance of first law? b) State and explain second law with circuit diagram. c) Apply these laws to calculate unknown value of resistance. d) What is meter bridge? Write name of material used to construct meter bridge.
20. What are Kirchhoff's laws of current and voltage? State Wheatstone bridge principle and obtain balanced condition of it using Kirchhoff's laws.
21. What do you mean by shunt? Describe its use in converting a galvanometer into an ammeter.
22. State the principle of potentiometer. Discuss the application of potentiometer to determine the internal resistance of a cell.
23. What is a galvanometer? How can you convert it into a voltmeter? Why should the resistance of a voltmeter be high?
24. State principle of meter bridge. Describe how it is used to determine the resistance of a wire.
25. What is the principle of a potentiometer? Explain with necessary theory how you would determine the internal resistance of a cell using this principle.
26. What is internal resistance of a cell? How can you measure the internal resistance of a cell by using potentiometer?
27. What is a Wheatstone bridge? Obtain the balanced condition for the bridge. Explain how resistance can be measured by a meter bridge.

Numerical Problems

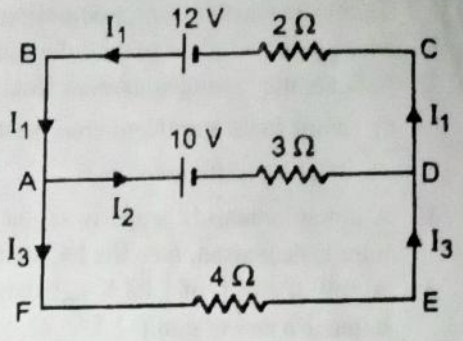
28. The emf of a battery is balanced by a length 75 cm on a potentiometer wire and emf of a standard cell of 1.02 volt is balanced by a length 50 cm of it. Calculate the emf of the battery. **Ans: 1.53 V**
29. A moving coil meter has a resistance of 25Ω and indicates full scale deflection when a current of 4.0 mA flows through it. How could this meter be converted top a milliammeter having a full scale deflection for a current of 50mA? **Ans: 2.14Ω**
30. The resistance of the coil of a galvanometer is 9.36Ω and a current of 0.0224 A causes it to deflect full scale. The only shunt available has a resistance 0.02Ω. What resistance must be connected in series with the coil to make it an ammeter of range 0-20A? **Ans: 12.49Ω**

31. A potentiometer is 10 m long. It has a resistance of 20 Ω. It is connected in series with a battery of 3V and a resistance of 10 Ω. What is the potential gradient along with wire? **Ans: 0.2 V/m**

32. The resistance of a galvanometer coil is 9.36Ω, and the current required for full scale deflection is 0.0224A. We want to convert this galvanometer to an ammeter reading 20A full scale. The only shunt available has a resistance of 0.025Ω What resistance must be connected in series with the coil. **Ans: 12.94Ω**

33. A battery of 6V and internal resistance 0.5Ω is joined in parallel with another of 10V and internal resistance 1Ω. The combination sends a current through an external resistance of 12Ω. Find the current through each battery. **Ans: I_2 = 2.27A, I_2 = 2.86A**

34. Using Kirchhoff's law, find I_1,I_2 , I_3 and V_{ae} in the given figure.



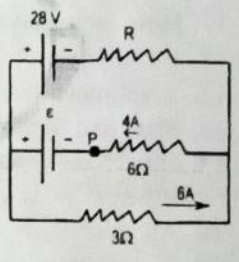
35. The driver cell of a potentiometer has an emf 2V and negligible internal resistance. The potentiometer wire has a resistance of 3Ω. Calculate the resistance needed in series with the wire if a p.d. of 5mV is required across the whole wire. **Ans: (i) 1197Ω**

36. The total length of the wire of a potentiometer is 10m. A potential gradient of0.0015 V/cm is obtained when a steady current is passed through this wire. Calculate, (i) the distance of null point on connecting standard dell of 1.018V.(ii) the unknown p.d. if the null point is obtained at a distance of 940 cm, and (iii) the maximum p.d. which can be measured by this instrument. **Ans: (i) 6.8 m (ii) 1.41 V (iii) 1.5 V**

37. The driver cell of a potentiometer has an emf of 2V and negligible internal resistance. The potentiometer wire has a resistance of 3 ohm. Calculate the resistance needed in series with the wire if a p.d. 5.0 mV is required across the whole wire. The wire is 100.0 cm long and a balanced length of 60 cm is obtained for a thermocouple of emf E. What is the value of E? **Ans: 1197.2 Ω, 3 mV**

38. The emf of a battery A is balanced by a length 75.0 cm on a potentiometer wire. The emf of a standard cell 1.02 volt is balanced by a length of 50.0 cm. What is the emf of A? **Ans: 1.53V**

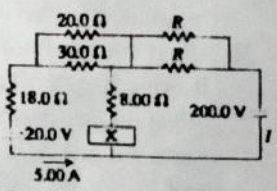
39. The driving cell of a potentiometer has an emf of 2V and negligible internal resistance. The potentiometer wirer has a resistance of 3Ω. Calculate the resistance needed in series with the wire of a p.d. of 1.5m V is required across the whole wire. **Ans: 3997 Ω**



40. In the adjacent circuit find: (a) the current in resistor R. (b) resistance R, (c) the unknown emf ε, (d) if the circuit is broken at P, what is the current in resistor R ?

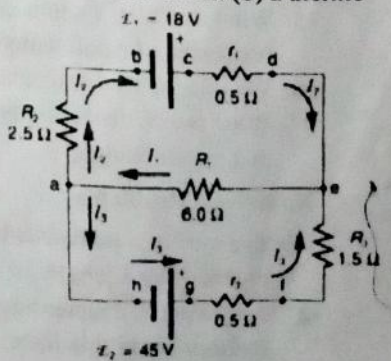
41. In the meter bridge, the null deflection is shown on the galvanometer which is at a distance of 30 cm from one point. When a known resistance of 10 Ω is connected in parallel with another unknown resistance S the null deflection shows at 50 cm from the same point. Find the unknown resistance of R and S. Ans: 5.71Ω & 13.33 Ω

42. In figure, the current in the 20V battery is 5A in the direction shown and the voltage across 8Ω resistor is 16V, with the lower end of the resistor at higher potential. Find (a) the emf (including it's polarity) of the battery X, (b) the current I through the 200V battery, (c) the resistance R. **Ans: (a) X =186.0 V with the upper terminal positive (b) I = 3.00 A (c) R= 20.0 Ω**



43. A potentiometer consists of a fixed resistance 2030Ω in series with a slide wire of resistance 4Ωm^{-1}. When a constant current flows in the potentiometer circuit a balance is obtained when (a) a Weston cell of emf of 1.010V is connected across the fixed resistance and 150cm of the slide wire and also when. (b) a thermo-couple is connected across 125 cm of the slide wire only. Find the current in the potentiometer circuit and the emf of the thermo couple.

44. Find I_1,I_2 , I_3 and V_{ae} in the adjacent figure. **Ans: I_1= 4.75 A, I_2=-3.5A (The assumed direction is opposite to the actual direction), I_3= 08.25A, Vae = 28.5V**



45. A potentiometer has a wire of length 8 m and the resistance of the wire is 20 Ω. It is connected in series with a cell of emf 2 V and an internal resistance 2 Ω and a rheostat. Find the value of the resistance in rheostat when the potential drop along the wire is 20 μv/mm. **Ans: 228 Ω**

46. The resistivity of a potentiometer wire is given as 5 ×10^{-6} Ωm. The area of cross section of the wire is given as 6×10^{-4} m^2. Find the potential gradient if a current of 1 A is flowing through the wire. **Ans: 0.83× 10^{-2} v/m**

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1. A particle undergoes SHM having time period T. What is the time taken by it to move from mean position to half of amplitude? a) $\frac{T}{2}$ b) $\frac{T}{3}$ c) $\frac{T}{6}$ d) $\frac{T}{12}$

2. The time period of a simple pendulum is a) $T = 2\pi\sqrt{\frac{l}{g}}$ b) $T = \frac{1}{4\pi}\sqrt{\frac{l}{g}}$ c) $T = 4\pi\sqrt{\frac{g}{l}}$ d) $T = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$

3. In S.H.M., particle velocity is minimum at a) extreme positions b) mean position c) half of the amplitude d) one fourth of the amplitude

4. Starting from mean position, a particle in simple harmonic motion takes time T_1 and T_2 to cover first half and next half displacement in moving from mean to extreme position, then a) $T_1 = T_2$ b) $T_2 = 2T_1$ c) $T_1 = 2T_2$ d) $T_1 < T_2$

5. Which one of the following is a necessary and sufficient condition for S.H.M.?
   a) constant acceleration b) constant period c) proportionality between acceleration and displacement from equilibrium position d) proportionality between restoring force and displacement from equilibrium position

6. The period of a simple pendulum will be doubled if a) Its length is increased to four times b) The acceleration due to gravity is doubled c) The mass of the bob is doubled d) The length of the pendulum and mass of the bob are doubled

7. The potential energy of a particle executing a linear S.H.M., at a distance x from the equilibrium position is directly proportional to a) x b) x^2 c) x^3 d) None

8. Define S.H.M. and write its equation.

9. a) What is meant by Simple Harmonic Motion? b) Show that motion of a simple pendulum is simple harmonic and hence calculate its time period. c) On what factors does the time period of simple pendulum depend? (e) What do you understand by a second's pendulum? If it is taken to moon, will it gain or lose time? Why? (f) A pendulum clock is taken to moon. Will it gain or lose time? (g) If length of a simple pendulum increased by 4 times its original length, will its time period change? If yes, by how much? (h) If a pendulum clock is taken to a mountain top, does it gain or lose time?

10. A simple harmonic motion is represented in usual notation, by $y = a \sin(\omega t + \phi)$. Find its acceleration.

11. A pendulum clock is in an elevator that descends at constant velocity. Does it keep correct time? It the some clock is in an elevator in free fall, does it keep correct time?

12. What is simple harmonic motion? Calculate the total energy of a particle executing simple harmonic motion. Calculate the total energy of a particle executing simple harmonic motion.

13. Show that the small oscillations of a mass loaded spring suspended vertically are simple harmonic. Deduce expression for its time period.

14. Obtain an expression for the time period of a mass 'm' attached with a spring placed horizontally on a smooth table.

15. A particle of mass 0.25 kg oscillates with a period of 2sec. If its greatest displacement is 0.4 m, what is its maximum kinetic energy?

16. Calculate the period of oscillation of a simple pendulum of length 1.8m with a bob of mass 2.2kg. If the bob of this pendulum is pulled aside a horizontal distance of 20cm and released, what will be the K.E. of the bob at the lowest point of swing.

17. Simple harmonic motion is defined from periodic functions like sine or cosine functions.(a) State the basic equation of motion for a body executing simple harmonic motion.(b) Find expression for velocity and acceleration of a particle describing SHM.(c) The tip of tunning fork goes through 550 complete vibrations in 1 sec. Find the angular frequency and time period of the motion.

18. The position of a certain object in S.H.M. is given as $x = 0.05 \cos(290t + 2.5)$ where x is in meter and t is in sec. What are the amplitude, period and initial phase angle for this motion?

19. A particle of mass 0.3 kg vibrates with a period of 2 seconds. If its amplitude is 0.5m, what is its maximum kinetic energy?

20. A simple pendulum 4m long swings with an amplitude 0.2m. Compute i) velocity of the pendulum at its lowest point ii) its acceleration at the end of its path.

21. The velocity of a particle executing simple harmonic motion is 16 cms^{-1} at a distance of 8 cm from the mean position and 8 cms^{-1} at a distance of 12 cm from the mean position. Calculate the amplitude of the motion.

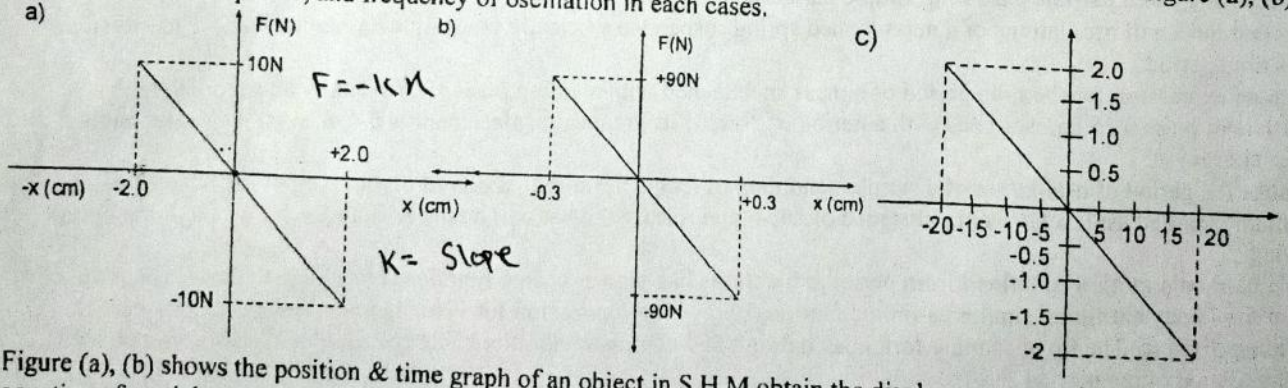
22. A simple pendulum 4m long swings with an amplitude of 0.2m. Compute the velocity of the pendulum at its lowest point and its acceleration at extreme ends.

23. A body of mass 0.1 kg is undergoing simple harmonic motion of amplitude 1 m and period 0.2 second. It the oscillation is produced by a spring what will be the maximum value of the force and the force constant of the spring?

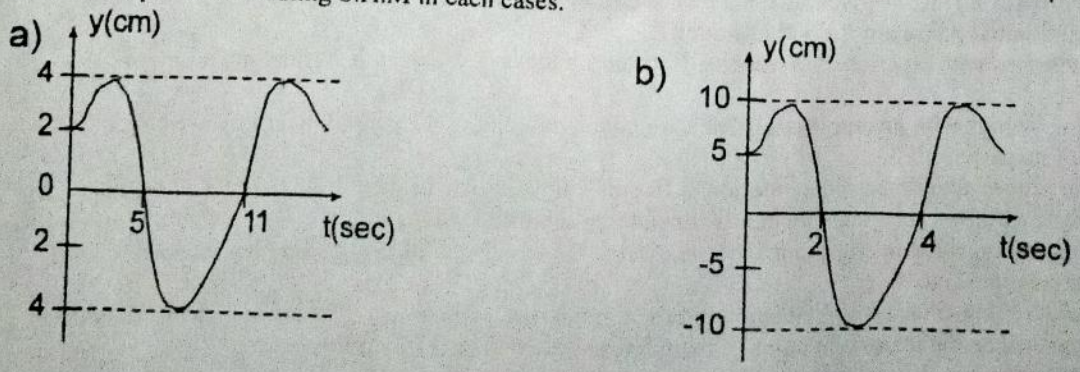
24. A body of mass 200 g is executing simple harmonic motion with amplitude of 20 mm. The maximum force which acts upon it is 0.8N. Calculate its maximum velocity and its period of oscillation.

25. A body of mass 2kg is suspended from a spring of negligible mass and is found to stretch the spring 0.1 m. What is its force constant and the time period?
26. A glider with mass m = 2.00 kg sits on a frictionless horizontal air track, connected to a spring with force constant k = 5.00 N/m. You pull the glider, stretching the spring 0.100 m and then releases it with no initial velocity. The glider begins to move back toward its equilibrium position (x = 0). What is its velocity when x = 0.080m?
27. A simple pendulum 5 m long swings with an amplitude 25 cm. Find the velocity of the pendulum at its lowest point and the acceleration at the end of its path.
28. A body is vibrating with simple harmonic motion of amplitude 15 cm and frequency 4 Hz. Calculate the maximum value of acceleration and velocity.
29. A small mass of 0.2 kg is attached to one end of helical spring and produce an extension of 15mm. The mass is now set into vertical oscillation of amplitude 10 mm. What is: i) the period of oscillation? ii) the maximum kinetic energy of the mass? iii)the potential energy of the spring when the mass is 5mm below the below centre of oscillation?
30. A simple pendulum has a period of 4.2 second, when the pendulum is shortened by 1m the period is 3.7 second. From these measurements, calculate the acceleration of free fall and the original length of the pendulum.
31. Calculate the period of oscillation of a simple pendulum of length 1.8m with a bob of mass 2.2 kg. If the bob of this pendulum is pulled aside a horizontal distance of 20 cm and released. What will be the values of (i) the K.E. and (ii) the velocity of the bob at the lowest point of the swing?
32. A simple pendulum 4m, long swings with an amplitude of 0.2 m. i) Compute the velocity of the pendulum at its lowest point. ii) Compute its acceleration at the end of its path.
33. Check whether the given motion of particle are oscillatory, simple harmonic or none.
    a) $F = -2(x-2)^3 \longrightarrow$ oscillatory
    b) $F = -2(x-2) \longrightarrow$ non oscillatory/ non S.H.M
    c) $F = -2(x-2)^2 \longrightarrow$ simple harmonic motion
    d) $F = -4(x-4)^2 \longrightarrow$

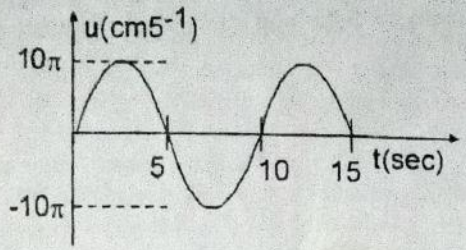
    oscillatory motion $F = -k(x-a)^n$
    n=odd number, x = a is the mean position
34. Which of the following function represent S.H.M
    a) $y = \sin(2\omega t) \longrightarrow a = -4\omega^2 y$ b) $y = \sin(\omega t) + 2\cos(\omega t) \longrightarrow a = -\omega^2 y$
    c) $y = \sin(\omega t) + \cos(2\omega t)$ $a \neq -\omega^2 y$ (not S.H.M) d) $y = a\sin(\omega t - \phi)$
    e) $y = a\cos(\omega t + \phi)$ f) $y = Ae^{i\omega t}$
35. 3. A S.H.M is represented by given notation
    a) $y = a\cos(\omega t + \phi)$ b) $y = a\sin(\omega t + \phi)$ c) $y = Ae^{i\omega t}$
    Find (i) velocity & acceleration for given displacement.
36. A body of mass 10 g executes S.H.M about mean position under the influence of a force shown below in figure (a), (b) & (c). Find the time period, and frequency of oscillation in each cases.



37. Figure (a), (b) shows the position & time graph of an object in S.H.M obtain the displacement equation and velocity equation of particle executing S.H.M in each cases.

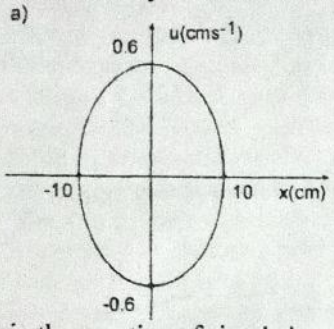


gure shows the velocity-time graph of on object executing S.H.M. Find the equation of (i) displacement (ii) velocity (iii) acceleration of particle representing S.H.M.

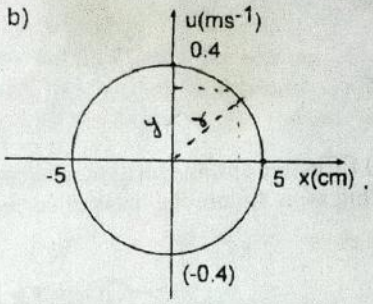


39. From given figure, of a particle executing S.H.M, find the period of oscillation and frequency of the particle also find maximum velocity & maximum acceleration.

a)

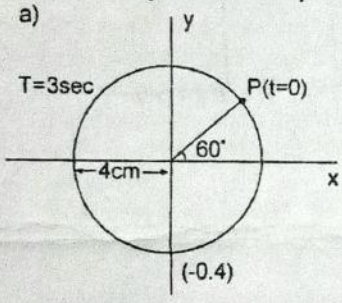


b)

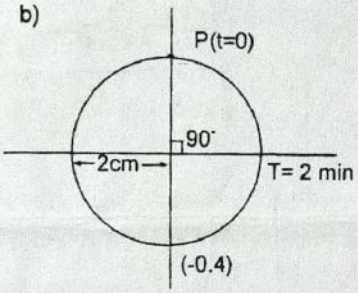


40. Obtain the equation of simple harmonic motion of the y-projection of the revolving particle from each figure.

a)

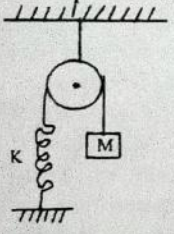


b)

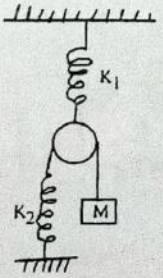


41. Find time period and oscillation of given system

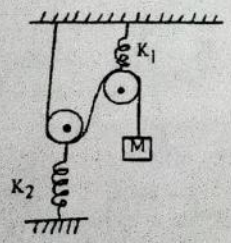
a)



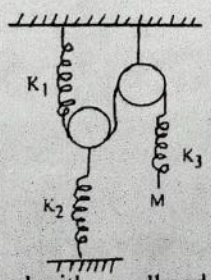
b)



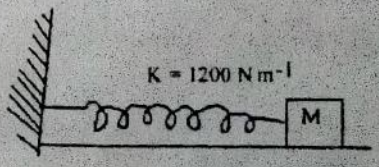
c)



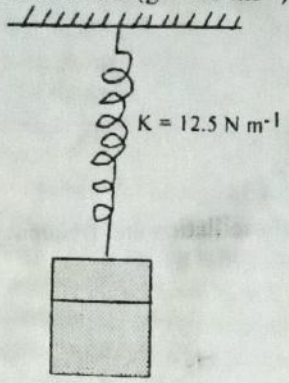
d)



42. One end of the spring is rigidly fixed with a wall and a mass of 2.0 kg is attached to the other end. The system is placed on a table as shown in figure. The mass is pulled through a distance of 1cm and then released find.
    a) Frequency of oscillation of the mass
    b) The maximum acceleration of the mass &
    c) The maximum velocity of the mass

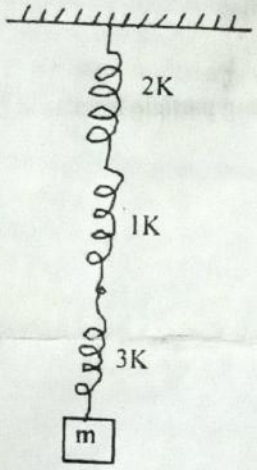


43. Two masses $m_1 = 2.0$ kg and $m_2 = 1.5$ kg are suspended together by a mass less spring of spring constant 'k' as show figure (a). When masses are equilibrium, m_1 is removed without disturbing the system. Calculate the angular frequen and the amplitude of oscillation ($g = 9.8\ ms^{-2}$)

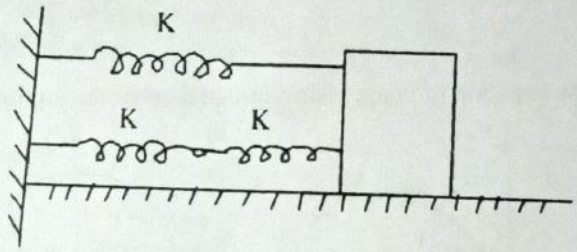


44. From given mass-spring system. Find. i) Effective spring constant. ii) Time period of mass-spring system. iii) Frequency of oscillation of mass spring syste Ignore the mass of spring.

a)



b)



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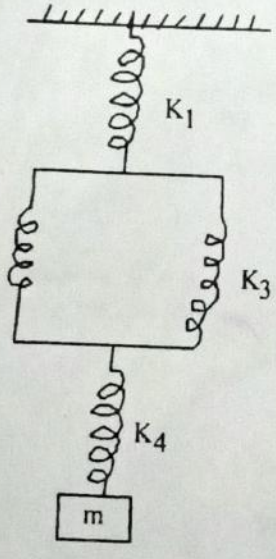

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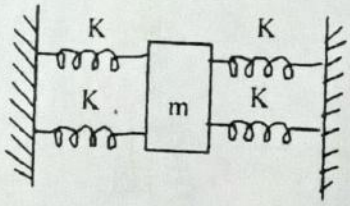

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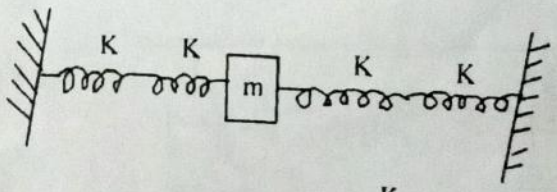

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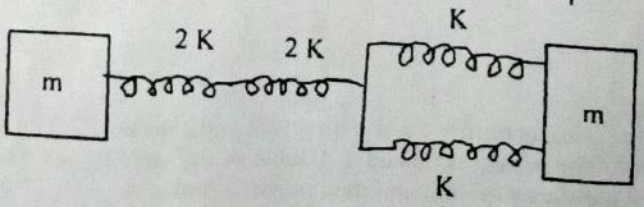
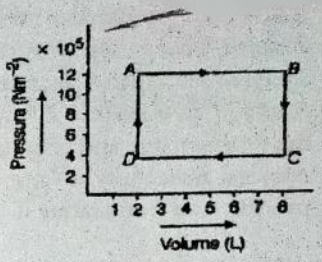
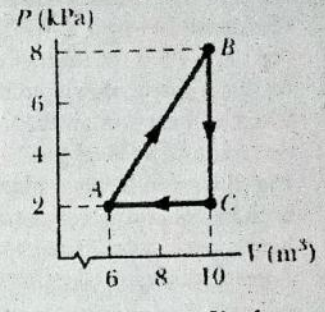
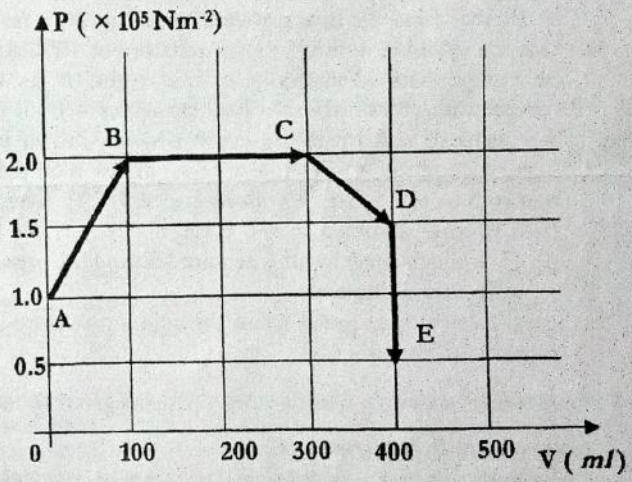




1. a) What do you mean by internal energy?
   b) Does internal energy of a gas depend on temperature only? Explain.
   c) The given figure represents p-V diagram of different stages of a thermodynamic process. Calculate the net work done in the complete cyclic process.
2. Draw the P-V,V-T and P-T curves in (a) isothermal (b) adiabatic (c) isochoric (d) isobaric processes.
3. a) Why do gases have two specific heat capacities?
   b) Take n moles of an ideal gas in a cylinder and derive the relation $C_p = C_v + R$, where C_p, C_v and R molar specific heat capacity at constant pressure, molar specific heat capacity at constant volume and universal gas constant respectively.
4. a) What do you mean by cyclic process?
   b) Does net work done become zero in this process?
   c) The given figure represents p-V diagram of different stages of a thermodynamic process. Calculate the work done in each stage and also net work done in the complete cyclic process.



5. For hydrogen, the molar heat capacities at constant volume and constant pressure be 20.5 J/mole K and 28.8 J/mole K respectively. Calculate (i) heat needed to raise the temperature of 8 gm of hydrogen from 10° C to 15° C at constant pressure (ii) the increase in internal energy of the gas. (molar mass of H_2 = 2 gm)
6. In an Isochoric process if $T_1 = 27°C$ and $T_2 = 127°C$, then calculate the value of P_1/P_2
7. Air is expanded from 50 litre to 150 litre at 2 atmospheric pressure (1 atm pressure = 10^5 Nm^{-2}). Find the external work done.
8. If one mole of helium gas is mixed with one gram of oxygen gas at 0°C. Calculate the amount of heat energy supplied to increase the temperature of gaseous mixture to 100°C at-(a) const. volume (b) const pressure
9. The thermodynamic process ABCDE of an ideal gas is shown in P-V diagram.
   (a) Find the work done by or on the gas from- (i) A to B (ii) B to C (iii) C to D (iv) D to E (v) A to E
   (b) Identify the intervals (processes) which are isobaric and isochoric.



10. Derive the expression for workdone in (a) isothermal process (b) isobaric process (c) adiabatic process (d) isochoric process
11. A certain volume of dry air at NTP is allowed to expand five times of its original volume under adiabatic condition. Calculate the final pressure and temperature. **Ans: 1.06×10^4 N/m², 196 K**
12. A certain volume of dry air at NTP is allowed to expand four times of its original volume under (i) isothermal conditions (ii) adiabatic conditions. Calculate the final pressure and temperature in each case. (γ= 1.4). **Ans: 25250 Nm^{-2}, 1092 K, 14502.3 N/m^{-2}, 157K**
13. A gas in a cylinder initially at a temperature of 10°C and one atmospheric pressure is to be compressed adiabatically to 1/8 of its volume. Find the final temperature. (Take γ = 1.4) **Ans: 650 K**
14. A gas in a cylinder is initially at a temperature of 17°C and pressure 1.01×10^5 Nm^{-2}. If it is compressed adiabatically to one-eighth of its original volume, what would be the final temperature and pressure of the gas?
15. For hydrogen the molar heat capacities at constant value and constant pressure are 20.5 $Jmol^{-1}K^{-1}$ and 28.8$Jmol^{-1}K^{-1}$ calculate (i) the heat needed to raise the temperature of 8g of hydrogen from 10°C to 15°C at constant pressure, (ii) the increase in internal energy of the gas. [molar mass of H_2 = 2gm] **Ans: 576 J, 410 J**
16. Five moles of an ideal gas are kept at constant temperature of 53°C while the pressure of the gas is increased from 1.00 atm to 3.00 atm. Calculate work done by the gas. **Ans: −14881 J**
17. Air is compressed adiabatically to half its volume. Calculate the change in its temperature. **Ans: 32%**
18. A monoatomic ideal gas that in initially at a pressure of 1.50×10^5 pa and has a volume of 0.08m³ compressed adiabatically to a volume of 0.04m³. (a) What is the final pressure? (b) How much work is done by the gas? (c) What is the ratio of the final temperature of the gas to its initial temperature? **Ans: 476220 pa; 10573 J, 1.58**
19. If the ratio of specific heat capacities of a gas is 1.4 and its density at S.T.P. is 0.09 kg/m³. Calculate the values of specific heat capacities at constant pressure and at constant volume. **Ans: 1.03×10^4 Jkg^{-1}, 1.44×10^4 $Jkg^{-1}k^{-1}$**

20. Gas in a cylinder initial at a temperature of 17°C and pressure of 1.01×0^5 Nm^{-2} is to be compressed adiabatically to one eight of its volume. Find the temperature and pressure of the gas. **Ans: 1.85×10^6 Nm^{-2}, 666.24K**

21. A liter of air, initially air initially at 20°C and at 760 mm of Hg pressure, is heated at constant pressure until its volume is doubled. Find (i) the temperature, (ii) external work done by the air in expanding, and (iii) the quantity of heat supplied. Specific heat capacity at constant volume = 714 J/kgK. **Ans: 586 K, 101.3 J, 352.8 J**

22. A litre of air initially at 20°C and at 760mm of Hg pressure is heated at constant pressure until its volume is doubled. Find the final pressure and temperature and the external work done by the gas in expanding. **Ans: 586 K, 101.3J**

23. An ideal gas initially at 4 atmosphere and 300 K is permitted to expand adiabatically twice its initially volume. Find the final pressure and temperature if the as is (i) monatomic and (ii) diatomic with $C_V = 5/2$ R

Ans: (a) 1.257 atm; 189k (b) 1. 1.52 atm; 227.35 k

24. The density of an ideal gas is 1.6 kgm^{-3} at 27°C and 10^5Nm^{-2} pressure. Its specific heat capacity at constant volume is 312 $JKg^{-1}K^{-1}$. Find the ratio of the specific heat at constant pressure to that at constant volume. **Ans: 1.67**

25. The density of a gas is 1.775 Kg m^{-3} at 27°C and 10^5 Nm^{-2} pressure. If the specific heat capacity at constant pressure is 846 Jkg^{-1} K^{-1}. Find the ratio of specific heat capacity at constant pressure to that at constant volume. **Ans: 1.29**

26. An ideal gas in slowly compressed at constant temperature of 50°C to one half of its original volume. In this process, 80 cal of heat was given. How much work was done and what was the change in the internal energy of the gas? Assume one mole of an ideal gas. **Ans: 807.03 J; 1143.03 J**

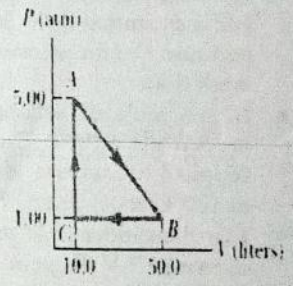
27. 16g of oxygen having volume $0.02m^3$ at a temperature of 27°C and pressure of 2×10^5 Nm^{-2} is heated at constant pressure until its volume increases to $0.03m^3$. Calculate the external work done and increase in internal energy of the gas if its Molar heat capacity at constant volume is 0.8 J $mol^{-1}k^{-1}$ and Molar mass of oxygen is 32. **Ans: 2×10^3 J, 60 J**

28. A gasoline engine takes in air at 25°C and one atmospheric pressure and compresses adiabatically to one-tenth of its original volume. Find the final temperature and pressure. ($\gamma = 1.4$). **Ans: 748.5 K, 25.11 atmosphere**

29. A mass of air occupying initially a volume $2\times10^{-3}m^{-3}$ at a pressure of 760 mm of mercury and a temperature of 20°C is expanded adiabatically and reversible to twice its volume, and then compressed isothermally and reversibly to a volume of 3×10^{-3} m^3. Find the final pressure assuming the ratio of the specific het capacities of air to be 1.4. **Ans: 384 mm of Hg**

30. Gas is a cylinder, initially at a temperature of 10°C and pressure of 1.01×10^6 Nm^{-2} is to be compressed adiabatically to one eight of its volume. Find final pressure and temperature. (Ratio of molar heat capacities = 1.40) **Ans: 18.5×10^5 Nm–2, 560.16K**

31. A substance undergoes the cyclic process shown in the figure below. Work output occurs along path AB while work input is required along path BC, and no work is involved in the constant volume process CA. Energy transfers by heat occur during each process involved in the cycle. a) What is the work output during process AB? (b) How much work input is required during the process BC? (c) What is the net energy input Q during this cycle?

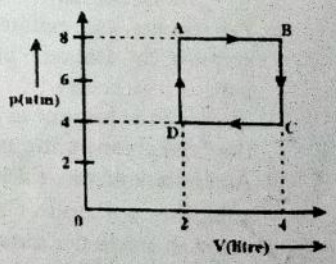


32. Ideal monoatomic gas is taken through a process dQ = 2 dU. What is the molar heat capacity for the process?

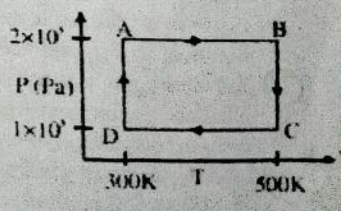
33. A certain mass of gas undergoes a process given by $dU = \frac{dW}{2}$. If the molar heat capacity of the gas for this process is $\frac{15\ R}{2}$ then identify the type of gas.

34. 10 gram of water is converted into steam at atmospheric pressure and 100° C. Calculate the increase in internal energy. Sp. latent heat of vaporization of water = 540 cal/gm and volume of 1 gram of water and steam are 1 cm^3 and 1671 cm^3.

35. 2 mole of a gas is heated to get a cyclic process. Do the following questions:(a) Find the net work done in the given system. (b) find the amount of energy supplied to the system to perform this process. (d) In the thermodynamic process AB, 2000 J heat energy is supplied to expand the gas, what should be the value of the increase in internal energy? (e) Find the values of molar specific heat capacities.



36. Two moles of Helium gas are taken over the cycle ABCDA as shown a) Calculate the work done along each cycle AB, BC, CD and DA. (b) Also, find the net work done in this cyclic process. (c) What is the value of molar specific heat capacity at constant volume?



37. A family enters a winter vacation cabin that has been unheated for such a long time that the interior temperature is the same as the outside temperature (0°C). The cabin consists of a single room of floor area 6 m by 4 m and height 3 m. The room contains one 2 kW electric heater. Assuming that the room is perfectly airtight and that all the heat from the electric heater is absorbed by the air, none escaping through the walls or being absorbed by the furnishings, how long after the heater is turned on will the air temperature reach the comfort level of 21°C ? $C_V = 20.8$ J/mol K

38. A balloon contains 5 moles of diatomic gas. Its temperature is kept constant at 25° C, while the balloon contracts to 40% of its initial volume. Find the work done by the gas in expanding the balloon.

SHORT ANSWER QUESTIONS

1. A proton and the photon have got the same de -Broglie wavelength. Which one has greater kinetic energy? Explain.
2. An electron and proton have same kinetic energy. Which has longer wavelength?
3. Compare the de-Broglie wavelength of a proton with that of an electron if they have same kinetic energies.
4. The accelerating voltage of the proton is increased to twice. How will its wavelengths be changed? Explain.
5. The wave nature of the particle is not observed in our daily life, why?
6. What do you mean by matter wave? How is it differ from the electromagnetic wave?
7. Explain the Heisenberg's uncertainty principle. Write its application.
8. The temperature is increased by four times of the certain particle showing dual nature. How many times will be its wavelengths changed?
9. Differentiate between ionization potential and excitation potential.
10. Explain the differences between stimulated emission and spontaneous emission.
11. How are Paschen and Balmer series originated in Hydrogen spectra?
12. Draw energy level diagram of the hydrogen atom to show different spectral lines.
13. What are the limitations of the Bohr's atomic model?
14. The ionization energy of the hydrogen atom is 13.6 eV. What does it mean?
15. What is the significance of the negative energy in the orbit of the hydrogen atom?
16. An electron is in third excited state. How many different photon-wavelength are possible?
17. The energy of hydrogen atom is – 0.85 eV. Find the corresponding quantum number and angular momentum of that state.
18. How many photons per second are emitted by a 7.5 m W CO_2 laser a wavelength of 10.6 μm?

LONG ANSWER QUESTIONS

19. Stating the Bohr's postulates, deduce an expression for the radius, velocity and energy of an electron in n^{th} orbit of hydrogen atom.
20. What is the angular momentum of an electron in Bohr's hydrogen atom whose energy is -3.4 eV?
21. Show that the velocity of the electron in the first Bohr orbit is (1/137) c where c is the velocity of light.
22. Determine the minimum wavelength of a photon that can cause ionization of He^+ ion. [Ans: 22.8 nm]
23. A doubly ionized lithium atom is hydrogen-like with atomic number 3. Find the wavelength of the radiation requiredto excite the electron in Li^{+2} from the first to third Bohr orbit. The ionization energy of the hydrogen atom is 13.6 eV.[Ans: 3.744 Å]
24. Calculate (a) the wavelength and (b) the frequency of the H_β line of the Balmer series for hydrogen.[Ans: $4.9 \times 10^{-7} m$, $6.12 \times 10^{14} Hz$]
25. A single. electron orbits a stationary nucleus of charge +Ze, where Z is a constant and e is the magnitude of electronic charge. It requires 47.2 eV to excite the electron from the second orbit to the third Bohr orbit. Find: (a) the value of Z.[Ans: 5] (b) the energy required to excite the electron from the third to the fourth Bohr orbit.[Ans: 16.53 eV] (c) the wavelength of electromagnetic radiation required to remove the electron from the first Bohr orbit to infinity.[Ans:36.5 Å] (d) find the K.E, P.E and angular momentum of an electron in the 1st Bohr orbit.[Ans: $5.4.4 \times 10^{-17} J$, $10.88 \times 10^{-17} J$, $1.05 \times 10^{-13} Js$] (e) the radius of the first Bohr orbit.[Ans: 0.106 Å]
26. Using the known values for the hydrogen atoms, calculate (a) the radius of the third orbit for Li^{+2}. [Ans: 1.587 Å] (b)speed of an electron in the fourth orbit for He^+. [Ans:$1.0695 \times 10^6 m/s$] (c) angular momentum of an electron in 3rd orbit of He^+.
27. The Balmer series for the hydrogen atom corresponds to electron transitions that terminate in the state of quantum number n = 2.(a) Find the longest wavelength photon emitted and determine its energy.[Ans: 656.3 nm, 3.03×10^{-19}J] (b) and the shortest wavelength photon emitted in the Balmer series.[Ans: 364.6 nm]
28. What is the maximum number of spectral lines emitted by a hydrogen atom when it is in the third excited state?[Ans: 3]
29. A microscope, using photons, is employed to locate an electron in an atom to within a distance of 0.2 Å. What is the uncertainty in the momentum of the electron located in this way?[Ans: $5.27 \times 10^{-24} kgm/s$]
30. The lifetime of an excited state of an atom is about 10^{-8} sec. Calculate the minimum uncertainty in the determinationof the energy of the excited state.[Ans:$6.5 \times 10^{-8} eV$]
31. A proton is fired from very far away towards a nucleus with charge Q = 120 e, where e is the electronic charge. It makes the closest approach of 10 fm to the nucleus.
32. The de-Broglie wavelength (in units of fm) of the proton at itsstart is [mp = $1.67 \times 10^{-27} kg$][Ans: 7 fm]
33. Find the de-Broglie wavelength of single electron in 2 nd orbit of hydrogen atom.[Ans: 6.64 Å]
34. A Hydrogen atom is in ground state. What is the quantum number to which it will be excited absorbing a photon of energy 12.75 eV?
35. Determine the wavelength of a proton that has been accelerated through a potential difference of 20 kV. Mass of proton is 1.67×10^{-27} kg and Planck constant is 6.62×10^{-34}Js.
36. The first member of Balmer series of hydrogen atom has a wavelength of 6563 A°. Calculate the wavelength of its second member.
37. Calculate the de Broglie wavelength of electron having kinetic energy of 400eV.
38. Calculate the wave length of electromagnetic radiation emitted by a hydrogen atom which undergoes a transition between energy levels of -1.36×10^{-19} J and -5.45×10^{-19} J. (Given Planck constant is 6.6×10^{-34}Js)
39. Determine the energy that must be given to a hydrogen atom so that it can emit second line of Balmer series. ($R=1.097 \times 10^7 m^{-1}$)
40. A cricket ball is moving with a speed of 120 km/hr. What would be its de-Broglie wavelength if its mass is 400 gms.
41. Find the wavelength of the radiation emitted from a hydrogen atom when an electron jumps from third orbit to second orbit. ($\varepsilon_o=8.854 \times 10^{-12} N^{-1} m^{-2}$, $h=6.62 \times 10^{-34}$Js, $m_e=9.1 \times 10^{-31}$ kg)
42. If an electron position can be measured to an accuracy of 10^{-9} m. How accurately can its velocity be measured? ($m_e=9.1 \times 10^{-31}$ kg)
43. Calculate energy in eV of a quantum of radiation of wavelength 0.15nm. Take $e=1.6 \times 10^{-19}$ C, $h=6.62 \times 10^{-34}$Js, $C=3 \times 10^8 ms^{-1}$

44. An electron of energy 20 eV comes into collision with the hydrogen atom in its ground state. The atom is excited into a higher state and the electron is scattered with reduced velocity. The atom subsequently returns to its ground state with the emission of photon of wavelength 1.216×10^{-7} m. Determine the velocity of scattered electron. ($m_e=9.1\times10^{-31}$ kg)

(X-RAYS)

SHORT ANSWER QUESTIONS

45. Can X-ray diffraction experiment performed by an ordinary grating? Why?
46. Production of X-ray is the inverse phenomenon of photoelectric effect. Justify it.
47. Can X-rays be produced from gases? Explain.
48. Can Bragg's law of x-ray diffraction be verified with yellow light of wavelength 600 nm? Explain.
49. What are the differences between X-rays and the ordinary ray of light?
50. Can aluminum be used as a target in X-ray tube?

LONG ANSWER QUESTIONS

51. Describe Coolidge tube for the production of X-rays. How do you control (i). the intensity and (ii)The penetrating power of the emitted X-rays?
52. Derive Bragg's equation and explain how this equation is used to determine the crystal plane spacing.

NUMERICAL PROBLEMS

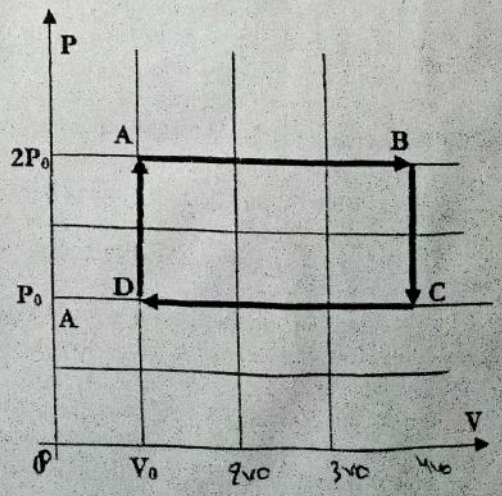
53. An X-ray tube works at a dc potential difference of 50 kV. Only 0.4% of the energy of the cathode rays is converted into x-rays and heat is generated in the target at the rate of 600 watt. Estimate the current passed into the tube, no. of electrons striking per second on the target and the velocity of the electrons striking the target.
54. An X-ray spectrometer has a crystal of rock salt for which atomic spacing is 2.82 A° set at an angle of 14° to the beam coming from a tube operated at a constantly increasing voltage. An intense first line appears when the voltage across the tube is 9045 V. Calculate the value of Planck constant.
55. X-ray beam of wavelength 2.9 A° is diffracted from the plane of cubic crystal. The first order diffraction is obtained at an angle of 35°. Calculate the spacing between the planes.
56. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. What series of wavelengths will be emitted?
57. Find the cut-off wavelength for the continuous X-rays coming from an X-ray tube operating at 40 kV.[Ans:0.31 Å]
58. For what kinetic energy of a neutron will the associated de-Broglie wavelength be 1.40 × 10–10 m? Also find the de-Broglie wavelength of a neutron, in thermal equilibrium with matter, having an average kinetic energy of (3/2) k T at 300 K.

MCQS

59. According to Einstein's photoelectric equation, the plot of the maximum kinetic energy of the emitted photoelectrons from a metal *versus* frequency of the incident radiation gives a straight line whose slope (a) depends on the nature of metal used (b) depends on the intensity of radiation (c) depends on both intensity of radiation and the nature of metal used (d) is the same for all metals and independent of the intensity of radiation
60. The velocity of the electron in the first Bohr orbit as compared to that of light is about(a) 1/300 (b) 1/500 (c) 1/137 (d) 1/187
61. An X-ray tube is operated at 20 kV. The cut off wavelength is (a) 0.89 Å (b) 0.75 Å (c) 0.62 Å (d) None of these
62. What is the ratio of de-Broglie wavelength of electron in the second and third Bohr orbits in the hydrogen atoms? (a) 2/3 (b)3/2 (c)4/3 (d) 3/4
63. The energy of a hydrogen like atom (or ion) in its ground state is – 122.4 eV. It may be (a) hydrogen atom (b) He^+ (c)Li^{2+} (d) Be^+
64. The operating potential in an X-ray tube is increased by 2%. The percentage change in the cut off wavelength is
    (a) 1% increase (b) 2% increase (c)2% decrease (d) 1% decrease
65. The energy of an atom or ion in the first excited state is –13.6 eV. It may be (a) He+ (b) Li+ + (c)hydrogen (d) deuterium
66. In order that the short wavelength limit of the continuous X-ray spectrum be 1 Å, the potential difference through which an electron must be accelerated is (a) 124 kV (b) 1.24 kV(c)12.4 kV (d) 1240 kV
67. The momentum of an X-ray photon with l = 0.5 Å is (a) 13.26×10^{-26} kg-m/s (b)1.326×10^{-26}kg-m/s(c)13.26×10^{-24}kg-m/s (d)$13\ 26\times10^{-22}$ kg-m/s
68. The work-function of a substance is 1.6 eV. The longest wavelength of light that can produce photoemission from the substance is
    (b) 7750 Å (b) 3875 Å (c)5800 Å (d) 2900 Å
69. Let the potential energy of hydrogen atom in the ground state be zero. Then, its energy in the first excited state will be
    (c) 10.2 eV (b) 13.6 eV (c)23.8 eV (d) 27.2 eV
70. Find the binding energy of an electron in the ground state of a hydrogen like atom in whose spectrum the third Balmer line is equal to 108.5 nm. (a) 54.4 eV (b) 13.6 eV (c)112.4 eV (d) None of these
71. Light of wavelength 330 nm falling on a piece of metal ejects electrons with sufficient energy with required voltage V_0 to prevent them from reaching a collector. In the same set up, light of wavelength 220 nm ejects electrons which require twice the voltage $V0$ to stop them in reaching a collector. The numerical value of voltage V_0 is (a) 16//15V (b)15/16V (c)15/8V (d)8/15V
72. If the electron in hydrogen orbit jumps from third orbit to second orbit, the wavelength of the emitted radiation is given by
    (a)$\lambda = R/6$ (b) $\lambda = 5/R$ (c) $\lambda = 36/5R$ (d) $\lambda = 5/36R$
73. A potential of 10000 V is applied across an X-ray tube. Find the ratio of de-Broglie wavelength associated with incident electrons to the minimum wavelength associated with X-rays. (Given, $e/m = 1.8\times10^{11}$ C/kg for electrons) (a) 10 (b) 20 (c)1/10 (d) 1/20
74. The frequency of the first line in Lyman series in the hydrogen spectrum is ν. What is the frequency of the corresponding line in the spectrum of doubly ionized Lithium? (a) ν (b) 3 ν (c)9 ν (d) 2 ν
75. Which energy state of doubly ionized lithium (Li^{++}) has the same energy as that of the ground state of hydrogen?
    (a) n = 1 (b) n = 2 (c)n = 3 (d) n = 4
76. The longest wavelength of the Lyman series for hydrogen atom is the same as the wavelength of a certain line in the spectrum of He+ when the electron makes a transition from $n = 2$. The value of n is (a)3 (b) 4 (c) 5 (d) 6
77. A 1000 W transmitter works at a frequency of 880 kHz. The number of photons emitted per second is
    (a)1.7×10^{28} (b) 1.7×10^{30} (c)1.7×10^{23} (d) 1.7×10^{25}

1. Identify the wrong statement a) for isothermal process, $\Delta T = 0$ b) for isochoric process, $\Delta V = 0$ c) for isobaric process, $\Delta P = 0$ **d)** for cyclic process, $\Delta W = 0$
2. An ideal gas ratio of heat capacities = 5/3 at 72°C is expanded adiabatically to eight times to its original volume. Approximate rise in temperature of the gas is **a)** 86 K b) 186 K c) 259 K d) 273 K
3. Which of the following is correct expression of the first law of thermodynamics? a) $q = \Delta H - W$ **b)** $\Delta H = q + W$ c) $\Delta U = q + W$ d) $\Delta U = \Delta H + P\Delta K$
4. The first law of thermodynamics is also known as, a) law of mass action b) law of conservation of mass **c)** law of conservation of energy d) law of conservation of mass and energy
5. What are the conditions for an adiabatic pressure? a) transfer of heat but no change in temp. b) no transfer of heat and no change in temp. **c)** no transfer of heat but change in temp d) none of the above
6. What is the process during the working stroke of heat engine? a) isothermal **b)** Adiabatic c) Isobaric d) Isochoric
7. When a gas undergoes adiabatic expansion, its internal energy: a) Increases **b)** Decreases c) Remains same d) None
8. In an adiabatic process on a gas with $\gamma = 1.4$, the pressure is increased by 0.5%. The volume of the gas decreases by **a)** 0.36% b) 0.7% c) 0.5% d) 1%
9. If a gas is allowed to expand adiabatically against external pressure. a) Its temperature remains constant b) pressure remains constant c) there is increase in internal energy **d)** There is decrease in internal energy
10. The maximum efficiency of an engine operating between 30°C and 300°C is, a) 4.71% **b)** 47% c) 90% d) 9 %
11. A Carnot cycle includes **a)** Two isothermal and Two adiabatic processes. b) Two isothermal and Two isobaric processes. c) Two isothermal processes. d) Two adiabatic processes.
12. The refrigerator and heat pump is work on which principle. a) First law of thermodynamics b) Second law of thermodynamics c) Third law of thermodynamics **d)** Zeroth law of thermodynamics
13. The law of Kelvin Planck statement about the a) Conservation of energy b) Conservation of heat c) Conservation of work **d)** Conversion of heat into work
14. According to Kelvin Planck statement of 2nd law of thermodynamics. **a)** It is impossible to construct an engine working on a cyclic process whose main purpose is to covert heat energy into the work. b) It is possible to construct an engine working on a cyclic process whose sole purpose is to convert heat into work.c) Both of the above d) None of the above
15. A Carnot engine takes 2000 J of heat from a reservoir at 500 K, does some work and discards some heat to the reservoir at 273 K. The work done by the engine is a) 980 J **b)** 908 J c)2000 J d) 1000 J
16. The efficiency of a Carnot engine is $\frac{1}{5}$. On reducing the temperature of sink by 45°C, efficiency becomes $\frac{1}{3}$. The initial temperature of the sink was **a)** 270 Kb) 310 K c) 337 K d) 540 K
17. The efficiency of a carnot engine is 20%. On reducing te temperature of sink by 45°C, efficiency becomes 33.3%. The initial temperature of the sink was **a)** 270 K b) 310 K c) 337 K d) 540 K
18. In a Carnot's engine, the temperature of the het sink is 27°C and that of the source is 327°C. The efficiency of the engine is a) 50% b) 70% c) 91% d) 95%
19. Efficiency of Carnot engine working between 27°C and 127°C is a) 50% b) 100% c) 25% d) 75%
20. A Carnot engine takes in 3000 kcal of heat from a reservoir at 627°C and gives it to a sink at 27°C. The work done by the engine is a) 4.2×10^6 J **b)** 8.4×10^6 J c) 16.8×10^6 J d) 0
21. What happens to the energy added to an ideal gas when it is heated at? i) constant volume ii) constant pressure
22. A certain quantity of ideal gas is compressed to half of its initial volume. The process may be adiabatic or isothermal. For which process greater amount of mechanical work is required?
23. What are the limitations of first law of thermodynamics?
24. The initial energy of a compressed gas is less than that of a rarefied gas at the same temperature. Why?
25. Why does the temperature of a gas drop during an adiabatic expansion?
26. Why does a gas have two specific heat capacities? Is C_p always greater than C_v?
27. Explain the significance of the first law of thermodynamics. Hence write its expression in terms of the change in entropy of the system.
28. Why specific heat capacity of gas at constant pressure is greater than its specific heat capacity at constant volume?
29. When a gas expands adiabatically, it does work on its surroundings. But, if there is no heat input to the gas where does the energy come from?
30. Can heat be considered as a form of potential energy?
31. When we blow on the block of our hand with our mouth wide open, we feel warm. But if we partially close out mouth to form an 'O' and then blow on our hand, our breath feels cool. Why?
32. Air escaping from a tiny hole of a tube is felt cool, why? Air escaping from an air hose at a gas station always feels cold. Why?
33. Explain why temperature of gas drops in adiabatic expansion.
34. Milk is poured into a cup of tea and is mixed with spoon. Is this an example of reversible process? Explain.
35. Why is the molar heat capacity of a gas at constant pressure always greater than at constant volume?

36. What happens to the internal energy of a gas during (1) isothermal expansion (ii) adiabatic expansion?
37. Why does a refrigerator consume more power in summer than in winter to cool the same quantity of food by same degree?
38. Entropy is defined is defined in the second law of thermodynamics. Can the first law be expressed in terms of entropy? How?
39. Explain the significant difference between the first and the second laws of thermodynamics.
40. Spark plug is not necessary in a diesel engine, why?
41. Write down the statements of second law of thermodynamics.
42. Why do diesel engines need no spark plugs?
43. Petrol engine is less efficient than diesel engine. Explain why?
44. Describe the working principle of diesel engine with the help of PV diagram.
45. State and explain second law of thermodynamics. Define the efficiency of a heat engine and explain qualitatively why the efficiency of such an engine is always less than 100%?
46. Describe the working principle of petrol engine with the help of its PV diagram.
47. Describe the workings of a diesel engine with a P-V diagram What are its merits and demerits?
48. Describe the workings of refrigerator.
49. What is entropy? Write the mathematical expression of entropy.
50. A Carnot engine working between 300 K and 600 K has a work output of 800 J per cycle. What is the amount of heat energy supplied to the engine from source per cycle? **Ans: 1600 J/ cycle**
51. A Carnot engine takes 10^3 calories of heat from a reservoir at 227°C and rejects heat to a reservoir at 27°C. How much work is done by it **Ans: 1680 J**
52. A diesel engine performs 2500J of mechanical work and discards 4000 J of heat each cycle. (i). How much heat must be supplied to the engine each cycle? (ii) What is the thermal efficiency of the engine? **Ans: 6500 J, 38.46%**
53. The efficiency of a Carnot cycle is 15%. If on reducing the temperature of sink by 65°C, the efficiency becomes double, find the temperature of source and sink. **Ans: 433.33 K, 368.33 K**
54. A Carnot engine has 50% efficiency with a sink at 9°C. By how many degrees should temperature of source be increased in order to raise the efficiency to 70%? **Ans: 376 K**
55. An ideal heat engine operates between two reservoirs at two temperatures in order to achieve 30% efficiency when the temperature of the sink to 50°C, what should be the temperature of the source? **Ans: 461.43 K**
56. The source reservoir of a Carnot engine is at a temperature of 400 K and takes 400 K and takes 400 J of heat and rejects 20 J of heat to the sink reservoir in each cycle. What is the efficiency of engine and the temperature of the sink? **Ans: 20 K**
57. A Carnot's engine has 25% efficiency with a sink at 9°c. By how many degrees should the temperature of the source be increased in order to raise the efficiency to 70%? **Ans: 564 K**
58. A diesel engine performs 2200 J of mechanical work and discards 4300 J of heat each cycle. (i) How much heat must be supplied to the engine in each cycle? (ii) What is the thermal efficiency of the engine? **Ans: 6500 J, 33.85%**
59. What will be the thermal efficiency of an engine if it takes 8 kJ heat from the source and rejects 6 kJ the sink in one cycle. **Ans:25%**
60. A Carnot engine works between the source and the sink with efficiency 40%. How much temperature of the sink be lowered keeping the source temperate constant so that its efficiency increases by 10%? **Ans: 30 K**
61. A Carnot engine works between the source and the sink with 25% efficiency. How much temperature of the sink be raised keeping the sink at the same constant temperature at 27°C so that the efficiency is increased by 15°C?**Ans: 100 K**
62. The efficiency of Carnot cycle is 15%. If on reducing temperature of the sink by 65°C, the efficiency becomes 30%, find the initial and final temperatures between which the cycle is working. **Ans: 433.33 k, 368.33 k**
63. A petrol engine consumes 25kg of petrol per hour. The calorific value of petrol is 11.4×10^6 cal/kg. The power of the engine is 99.75kw. Calculate the efficiency of the engine. **Ans: 30%**
64. A Carnot Engine works between 800° and 400°C. If it is possible either to increase the source temperature by 50°C or to decrease the sink temperature by 50°C, which of these actions will be causing more increase in the efficiency? Justify your answer. **Ans: To decrease the sink by 50°C because efficiency is more, η on increasing temperature of source is 40% while decreasing is 42%.**
65. A Carnot engine absorbs heat from a reservoir at the temperature 127°c. If the engine absorbs 1000 calories of heat form the high temperature reservoir, find the work done and the efficiency. **Ans: 1333.5 J**
66. A petrol engine consumes 10 kg of petrol in one hour. The calorific value of petrol is 11.4×10^3 cal.gm. The power of the engine is 20 kwatts. Calculate the efficiency of the engine. **Ans: 15%**
67. A Carnot engine whose low temperature reservoir is at 27°C has an efficiency of 25%. In order to increase the efficiency to 50%, how much the temperature of the high temperature reservoir be increased, if the temperature of ther low temperature reservoir remains constant. **Ans: 200 K**
68. A petrol engine consumes 5 kg of petrol per hour. If the power of engine is 20 KW and the calorific value of petrol is 11×10^3 K cal per kg. Calculate the efficiency of the engine. **Ans: 31.15%**
69. The given P-V diagram represents the thermodynamic cycle of an engine, operating with an ideal monatomic gas. Calculate the amount of heat extracted from the source in a single cycle. **Ans : 6.5 P_0V_0**



1. Why is titration between ammonium hydroxide and carbonic acid uncommon?
2. What volume of water should be added to 50 mL of semi normal NaOH solution to make it exactly deci-normal.
3. Distinguish between titrant and titrand.
4. Oxalic acid is taken as primary standard substance, why?
5. Distinguish between decinormal and decimolar solution.
6. Distinguish between titration error and normality factor.
7. Differentiate between end point and equivalence point of a reaction.
8. Differentiate between normality and molarity.
9. Distinguish between primary standard solution and secondary standard solution.
10. Define the terms: i) Primary standard solution ii) Acidimetry
11. Define the terms: i) Normality ii) Secondary standard solution
12. How is end point differed from equivalence point?
13. What is the importance of calculating normality factor of solutions during titration?
14. Define the terms: i) Normality factor ii) Secondary standard solution
15. Why is crystal oxalic acid regarded as a good substance for the preparation of primary standard solution?
16. How would you convert 500 cc of 2 M H_2SO_4 into: i) Gram/liter ii) Normality
17. Distinguish between end point and equivalence poimt of reaction.
18. Which one has higher concentration and why? a. 80 g/litre NaOH solution and 3 M NaOH solution. b. 5.3 g/litre Na_2CO_3 and $\frac{N}{10}$ Na_2CO_3 solution.
19. A sample of Na_2CO_3 weighting 0.53 g is added to 101 m^2 of 0.1N H_2SO_4 solution. Will the resulting solution be acidic, basic or netural?
20. Define the term: i) Semi normal solution ii) Alkalimerty
21. Define secondary standard solution with a suitable example.
22. Write an example of redox titration. Why is it called so?
23. What is the normality of 20 cc of 2 M phosphoric acid (H_3PO_4)?
24. What is normality? How is it related with molarity?
25. What do you mean by equivalent weight of an element?
26. What are the requisites for a substance to be a primary standard?
27. Define decinormal solution.
28. Define the acidity of base 0.4 gm of a divalent metal was dissolved in 50 cc of 0.64 N Hcl and the solution was diluted to 100 cc. Then 25 cc of this solution required 27.3 cc of 0.11 N NaOH for neutralization. Find atomic mass of the metal.
29. Define molality of solution. Calculate molality of one liter of 93% H_2SO_4 solution (weight by volume). The density of the solution is 1.84 g mL^{-1}.
30. "All standard solution are not primary standard solution." Comment the statement. How many ml of a 0.1 MHCl are required to react completely 1gm mixture of Na2CO3 and NaHCO3 containing equimol???? Amount of the two.
31. Define normality factor. 0.18 g????? divalent metal was completely dissolved in 250 cc or ????? solution containing 4.9 g H_2SO_4 per liter 50 cc of ??? residual acid solution required 20 cc of N/10 alkali ????? complete neutralizion. Calculate the atomic weight of metal.
32. Are all standard solutions, primary standard solutions or not? Give reason. 1 g of a Divalent metal was dissolved in 25 mL of 2N H_2SO_4 (f = 1.01). The Excess acid required 15.1 mL of 1N NaOH (f = 0.8) for complete neutralization. Find the atomic weight of the metal.
33. It is better to express concentration in molality rather than molarity, why? x g of a metal (equivalent weight = 12) was completely dissolved in 100 cc of $\frac{N}{2}$ HCL solution. The volume was then made upto 500cc. It is found that 25cc of the diluted acid solution required 17.5 cc of $\frac{N}{10}$ NaOH for complete neutralization. Find the value of X.
34. Define deci- normal solution. 12 g of commercial zinc is made to react with excess dil. H_2SO_4. The total volume of H_2 gas was found to be 4.2 liters at 570 mmHg pressure and 279 K temperturte. Determine the percentage purity of the zinc.
35. Define end point. 12 g of commercial zinc is made to react with excess dilute H_2SO_4. The total volume of H_2 gas liberated was found to be 4.2 liters at 570 mmHg pressure and 279 K. Determine the percentage purity of the zinc. (Atomic mass of Zn = 65)
36. What is meant by normality factor? How many mL of conc. HNO_3 of specific gravity 1.41 containing 69% by mass are required to prepare 500mL of 0.5 N HNO_3?
37. Define the terms: i) Titration error ii) Unknown solution

What volume of 10 M HCl and 3 M HCl should be mixed to obtain one liter of 6 M HCl solution?

38. Define titration error. 0.012 g of a divalent metal is completely dissolved in 40 cc of $\frac{N}{10}$ HCl. The excess of acid required 15 cc of $\frac{N}{5}$ NaOH for neutralization. Find the atomic weight of the metal.
39. Define the terms: i) titration error ii) Standrad solution
calculate the volume of 1M NaOH required to neutralize 200 cc of 2M HCl. What mass of sodium chloride are produced from the neutralization reaction?
40. What is meant by acidity of base? 500 cc of 2 N. Na2CO3 are mixed with 400 cc of 3 N H_2SO_4 and volume was diluted to one liter. Will the resulting solution acidic, basic or natural? Also calculate the molarity of the dilute solution.
41. Define redox titration. 10 g of NaOH was added to 200 cc of $\frac{N}{2}$ (f = 1.5) H_2SO_4. The volume was diluted to two liters. Predict whether the dilute solution is acidic, basic or natural and also calculate the resulting molarity of the dilute solution.
42. What is meant by acidimetry? A solution of conc. HCl contain 38% HCl by mass: i) What is the molarity of this solution if the density of the solution is 1.19 g/cc? ii) What volume of the conc. HCl is required to neutralize one liter of 0.1 M NaOH solution?
43. What is meant by normality factor? What volume of 95% sulphuric acid (denisity = 1.85g/cc) and what mass of water must be taken to prepare 100 cc of 15% solution of sulphuric acid (density = 1.1g/cc)?
44. What are primary and secondary standard solution? Calculate the resulting normality of a solution prepared by mixing 20 mL o f0.8 M NaOH with 25 mL of 0.4 M H_2SO_4 solution.
45. During litration the concentration of $KMnO_4$ solution can be determined by using standard oxalic acid solution. i) What is meant by standard solution? ii) Calculate the equivalent weight of $KMnO_4$ in acidic medium. (Molar mass of $KMnO_4$ = 158) iii) Why isd above titration called redox titration? Iv) Name the indictor used in this titration.
46. 1 gram of a divalent metal was dissolved in 25 mL of 1 M H_2SO_4. The unreacted acid future required 15 c.c. of NaOH (f = 0.8) for complete neutralization. i) Calculate the gram equivalent of unreacted acid. ii) Find the atomic weight of metal.
47. Define acidity of a base giving an example. 0.8 g of a divalent metal was dissolved in 100 cc of 1.28 N HCl and the solution was diluted to 200 cc. 50 cc of this dilute solution required 54.6 cc of 0.22 N NaOH for neutralization: Calculate the atomic mass of the metal.
48. Why volume of 5% NaOH are required to neutralize 2 liter of decinormal H_2SO_4?
49. Define the terms: i) Primary standard solution ii) Normality Solution iii) Acidic of a base iv) Alkalimetry.
What is meant by redox? Write an example of it. 4 g of NaOH was added to 20 cc of 2 N H_2SO_4 solution and the volume was diluted to one liter. Predict whether the dilute solution as acidic, basic or netural and also calculate the resulting normality of the dilute solution in term of g/liter.
50. Define normality and molarity of a solution. Find their relationship for a given solution. 1 g of NaOH is added to 2 liter of x M H_2SO_4 solution, so that the pH of the resulting solution is 7. Find the value of x.
51. Define molar solution, end point and indictor. Calculate the molarity of 5% H_2SO_4 Solution.
52. 7.5 g of a dibasic acid dissolved in water and the solution made up to 250 cc. 25 cc of this acid requires 16.3 cc (1 N) NaOH for co,plete neutralization. Calculate the molecular weight of the acid.
53. Normality and motarity are the terminologies of volumetric analysis used to express the concentration of solution.
    i) Distinguish between molarity and normality.
    ii) Deduce the normality equation $S_1V_1 = S_2V_2$.
    iii) Why is this equation not always used to calculate molarity?
    iv) Your chemistry teacher added 4 g of sodium hydroxide in a bottle containing 20 cc of 2N H_2SO_4 and he diluted sit up to 1 litre by adding water. Then, he gave you a blue and a red litmus paper.
        a) Which litmus paper would you used to test the solution and why?
        b) Calculate the normality of the dilute solution.
54. Normality and Molarity are the ways of expressing concentration of solution
    i) Establish the relationship between normality with molarity.
    ii) Calculate the resulting normality of a solution prepared by mixing 20 mL of 0.8 M NaOH with 25 mL 0.4 M H_2SO_4 solution.

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