Gujarat Secondary and Higher Secondary Education Board, Gandhinagar
Standard 12　　　Diagnostic Test

Subject : Physics (054)	**Marks : 80**
Medium : English	**Time : 3 hours**

Section – A

1.　　Do as directed. [Each carries 1 mark]　　　　　　　　　　　　24

- **i.** The range of weak nuclear force is ....
  (A) 10^{-15} m　　　　(B) 10^{-16} m　　　　(C) 10^{-13} m　　　　(D) 10^2 cm

- **ii.** From given fundamental forces, ... is strongest force and .... is weakest force.
  (A) Electromagnetic force, Gravitational force　　(B) Strong nuclear force, Weak nuclear force
  (C) Strong nuclear force, Gravitational force　　(D) Strong nuclear force, Electromagnetic force

- **iii.** Which pair does not have equal dimensions ?
  (A) Torque and Energy　　　　　　　　(B) Force and impulse
  (C) Angular momentum and planck's constant　　(D) Elastic modulus and pressure

- **iv.** The surface area of a solid sphere of radius 3 cm is .... mm²

- **v.** A ball is thrown in vertically upwards direction with velocity 50 m/s. Maximum height covered by the ball will be .... (g = 10 m/s²)

- **vi.** If resultant vector of two vectors of equal magnitude has magnitude equal to one of those vectors, than what should be the angle between two vectors ?

- **vii.** Periodic time of a simple pendulum suspended in stationary lift is T. Now when lift moves in upward direction with acceleration $\dfrac{g}{3}$. New periodic time will be ....

  (A) $\sqrt{3}\ T$　　　　　(B) $\dfrac{\sqrt{3}}{2}T$　　　　　(C) $\dfrac{T}{\sqrt{3}}$　　　　　(D) $\dfrac{T}{3}$

- **viii.** 1 kWh = ... Ev

- **ix.** Does potential energy of a spring decrease/increase when it is compressed or stretched ?

- **x.** Which quantity have unit rpm. Show it in rad/s.

- **xi.** What is value of g and G at the centre of earth ?

- **xii.** A satellite has potential energy -8×10^9 J, then what is its binding energy (escape energy) ?

- **xiii.** Which one is more elastic – water or air ?

- **xiv.** Water rises to a height of 20 mm in a capillary. If the radius of the capillary is made $\dfrac{1}{3}$ r of its previous value, to what height will the water now rise in the capillary ?

- **xv.** An ideal fluid flows through a pipe of circular cross-section made of two sections with diameters 2.5 cm and 3.75 cm. The ratio of the velocities of fluid through these two respective sections is ....
  (A) $9:4$　　　　　(B) $3:2$　　　　　(C) $\sqrt{3}:\sqrt{2}$　　　　　(D) $\sqrt{2}:\sqrt{3}$

- **xvi.** What will be the difference in volume of water when it is heated from 0° C to 10° C ?

- **xvii.** True or False : Equation to convert Celsius temperature in Fahrenheit is $t\,°\mathrm{F} = \dfrac{5}{9}t\,°\mathrm{C} + 32$.

- **xviii.** Fill in the blank : The change of internal energy in cyclic process is ....

- **xix.** An ideal gas undergoes cyclic process ABCDA as shown in given P - V diagram. The amount of work done by the gas is ......
  (A) $6P_0V_0$　　　　　(B) $-2P_0V_0$
  (C) $+2P_0V_0$　　　　　(D) $+4P_0V_0$
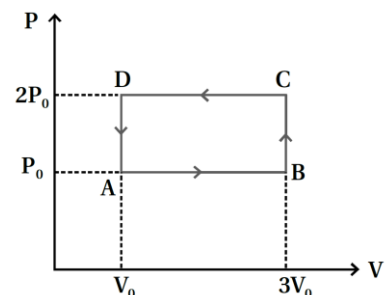
xx. Find kinetic energy of 1 gram nitrogen at 77° C. (R = 8.31 J mol⁻¹ k⁻¹)

xxi. What is ratio of universal gas constant and Avogadro number ?

xxii. The initial phase of body executing SHM is $\frac{\pi}{4}$ then what will be its phase at the end of 10 oscillations ?

xxiii. What is the ratio of maximum acceleration to the maximum velocity of a simple harmonic oscillator ?

xxiv. Match Column-A with Column-B.

	Column-A		Column-B
(a)	Light waves	(i)	Mechanical and transverse
(b)	Sound waves	(ii)	Mechanical and longitudinal
(c)	Earthquake waves	(iii)	Non - mechanical and transverse
(d)	Waves on a tense string	(iv)	Mechanical, transverse and longitudinal

Section – B

❖ **Anaswers any 11 questions from following questions. [Each carries 2 marks]** **22**

2. A jet airplane travelling at the speed of 400 km h⁻¹ ejects its products of combustion at the speed of 1200 km h⁻¹ relative to the jet plane. What is the speed of the latter with respect to an observer on the ground ?

3. Derive the formula for Range of a projectile.

4. Explain conservation of linear momentum by suitable example.

5. Derive the work energy theorem for a variable force exerted on a body in one dimension.

6. Explain the torque acting on a particle.

7. Find the scalar and vector products of two vectors. $A = \left(3\hat{i} - 4\hat{j} + 5\hat{k} \right)$ and $B = \left(2\hat{i} + \hat{j} - 3\hat{k} \right)$

8. Write Newton's universal law of gravitation and represent it in mathematical expression.

9. A steel wire of length 6 m and cross-sectional area 3.0×10^{-5} m² stretches by the same amount as a copper wire of length 4 m and cross-sectional area of 5.0×10^{-5} m² under a given load. What is the ratio of the Young's modulus of steel to that of copper ?

10. In a car lift compressed air exerts a force F_1 on a small piston having a radius of 4.0 cm. This pressure is transmitted to a second piston of radius 12 cm. (See figure). If the mass of the car to be lifted is 1200 kg. Calculate F_1. What is the pressure necessary to accomplish this task ? ($g = 9.8$ ms⁻²)

11. What is specific heat capacity ? on which factors does it depend ?

12. Obtain an expression for work done by an ideal gas during isothermal expansion.

13. An air bubble of volume 1.0 cm³ rises from the bottom of a lake 40 m deep at a temperature of 10° C. To what volume does it grow when it reaches the surface, which is at a temperature of 30° C ?

14. Obtain the expressions of kinetic energy potential energy and total energy in simple harmonic motion.

15. What is the length of a simple pendulum which ticks seconds ?

16. Write the equation of speed of sound wave. According to Newton's explanation and explain Laplace correction for it.

17. A steel wire 0.92 m long has a mass of 5.0×10^{-3} kg. If the wire is under a tension of 80 N, what is the speed of transverse waves on the wire ?

Section – C

❖ **Anaswers any 8 questions from following questions. [Each carries 3 marks]** **24**

18. We measure the period of oscillation of a simple pendulum. In successive measurements, the readings turn out to be 2.63 s, 2.56 s, 2.42 s and 2.71 s. Calculate the absolute errors, relative error or percentage error.

19. Derive the equations of uniformly accelerated motion by graphical method.

20. Find the magnitude and direction of the resultant of two vectors A and B in terms of their magnitudes and angle θ between them.

21. Obtain the formula for the maximum safe speed (v_{max}) for a vehicle moving on a banked curved road.

22. Two masses 6 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses and the tension in the string when the masses are released.

23. A pump on the ground floor of a building can pump up water to fill a tank of volume 30 m³ in 12 min. If the tank is 40 m above the ground, and the efficiency of the pump is 40%, how much electric power is consumed by the pump ?

24. In the HC1 molecule, the separation between the nuclei of the two atoms is about 1.27 Å (1 Å = 10^{-10} m). Find the approximate location of the CM of the molecule, given that a chlorine atom is about 35.5 times as massive as a hydrogen atom and nearly all the mass of an atom is concentrated in its nucleus.

25. Find the potential energy of a system of four identical particles placed at the vertices of a square of side *l*. Also obtain the potential at the centre of the square.

26. Derive an expression for excess of pressure (pressure difference) inside the drop and bubble of a fluid.

27. What amount of heat must be supplied to 2.0×10^{-2} kg of nitrogen (at room temperature) to raise its temperature by 40° C at constant pressure ?
(Molecular mass of N_2 = 28; R = 8.3 J mol^{-1}K^{-1}.)

28. Derive differential equation for damping oscillations and writes its solution.

29. A stone dropped from top of a tower of height 280 m high, splashes into the water of a pond near the base of the tower. When is the splash heard at the top given that the speed of sound in air is 340 ms^{-1} ? (g = 9.8 ms^{-2})

Section – D

❖ Answers any 2 questions from following questions. [Each carries 5 marks]   10

30. What is uniform circular motion ? By using proper figure, obtain equation of acceleration for uniform circular motion. Show that its direction is towards centre.

31. A cord of negligible mass is wound round the rim of a fly wheel of mass 24 kg and radius 24 cm. A steady pull of 30 N is applied on the cord. The flywheel is mounted on a horizontal axle with frictionless bearings.

    (a) Compute the angular acceleration of the wheel.

    (b) Find the work done by the pull, when 2m of the cord is unwound.

    (c) Find also the kinetic energy of the wheel at this point. Assume that the wheel starts from rest.

    (d) Compare answers to parts (b) and (c).

32. A transverse harmonic wave on a string is described by y(x, t) = 2.0 sin (36t + 0.018x + π/4) where x and y are in cm and t in s. The positive direction of x is from left to right :
(a) Is this a travelling wave or a stationary wave ? If it is travelling, what are the speed and direction of its propagation ?
(b) What are its amplitude and frequency ?
(c) What is the initial phase at the origin ?
(d) What is the least distance between two successive crests in the wave ?

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