

**KENDRIYA VIDYALAYA SANGATHAN NEW DELHI**  
**IN SERVICE COURSE 2<sup>nd</sup> SPELL,**  
**KV NO. 1 ROORKEE**  
**SESSION ENDING EXAMINATION**  
**XI – PHYSICS (THEORY)**  
**SET 1**

**Time: Three Hours**

**Max. Marks: 70**

**General Instructions -**

- (a) All questions are compulsory. There are 27 questions in all.
- (b) This question paper has 4 sections: Section A, Section B, Section C, and Section D.
- (c) Section A contains five questions of one mark each, Section B contains seven questions of two marks each, Section C contains twelve questions of three marks each, Section D contains three questions of five marks each.
- (d) There is no overall choice. However, an internal choice has been provided in two questions of one marks, two questions of two marks , four questions of three marks and all three questions of five marks each. You have to attempt only one of the given choices in such questions.
- (e) Use of calculators is not permitted.
- (f) You may use the following physical constants wherever necessary:  
 $c = 3 \times 10^8 \text{ms}^{-1}$        $h = 6.6 \times 10^{-34} \text{Js}$       Boltzmann constant  $k = 1.38 \times 10^{23} \text{JK}^{-1}$   
Avogadro's number  $N_A = 6.023 \times 10^{23} / \text{mole}$

**Section A**

1. A particle is inside a uniform spherical shell. What is the gravitational force acting on the particle due to shell?

OR

How acceleration due to gravity changes when a person walks from pole to equator?

2. Calculate the work done by a car against gravity in moving along a straight horizontal road. The mass of the car is 400 kg and the distance moved is 2m.
3. How much force of static friction is acting on the block of mass 2 kg shown in figure below if the coefficient of static friction between the block and the surface is 0.2?



OR

Arrange coefficient of static friction  $\mu_s$ , coefficient of kinetic friction  $\mu_k$ , and coefficient of rolling friction  $\mu_r$  in ascending order.

4. How is the gravitational force between two point masses affected when they are dipped in water keeping the separation between them the same?
5. State the law of equipartition of energy.

**Section B**

6. A physical quantity  $X$  is related to four measurable quantities  $a$ ,  $b$ ,  $c$  and  $d$  as follows:  
 $X = a^2 b^3 c^{5/2} d^{-2}$  The percentage error in the measurement of  $a$ ,  $b$ ,  $c$  and  $d$  are 1%, 2%, 3% and 4%, respectively. What is the percentage error in quantity  $X$ ?

OR

Distinguish between accuracy and precision by giving example?

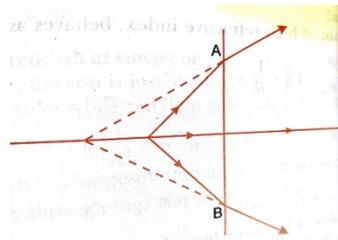
- The frequency of vibration ( $\nu$ ) of a string may depend upon length ( $l$ ) of the string, tension ( $T$ ) in the string and mass per unit length ( $m$ ) of the string. Using the method of dimensions, derive the formula for  $\nu$  ?
- Two sitar strings A and B playing the note 'Ga' are slightly out of tune and produce beats of frequency 6 Hz. The tension in the string A is slightly reduced and the beat frequency is found to reduce to 3 Hz. If the original frequency of A is 324 Hz, what is the frequency of B?

**OR**

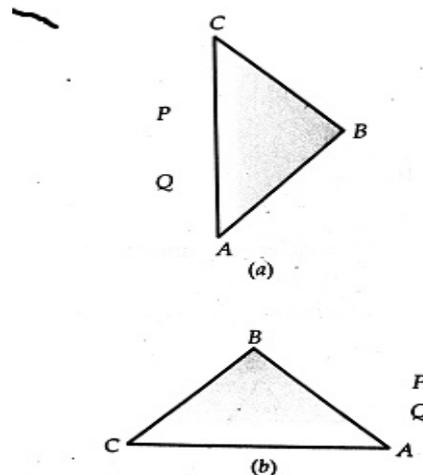
A steel wire 0.72 m long has a mass of  $5.0 \times 10^{-3}$  kg. If the wire is under a tension of 60 N, what is the speed of transverse waves on the wire ?

- Why is the molar specific heat capacity at constant pressure greater than the molar specific heat capacity at constant volume?
- If kinetic energy of a body is increased by 300%, by what percentage will linear momentum of the body increase?
- The line AB in the ray diagram represents a lens. Whether the lens is convex or concave?

Justify.



- A right angle prism is placed before an object in the two positions shown in fig. The prism is made of crown glass with critical angle equal to  $41^\circ$ . Trace the paths of two rays from P and Q normal to the hypotenuse in fig. (a) and parallel to the hypotenuse in fig.(b)



### Section C

- If the magnitude of sum of two equal vectors is equal to the magnitude of each vector, then find the angle between the two vectors.
  - Two straight lines drawn on the same x-t curve make angles  $30^\circ$  and  $60^\circ$  with time axis. Which line represents greater velocity? What is the ratio of the two velocities?

**OR**

Two projectiles are thrown with different velocities and at different angles so as to cover the same maximum height. Show that the sum of the times taken by each to reach the highest points is equal to the total time taken by either of the projectiles.

14. Derive an expression for the centripetal acceleration of a particle moving with uniform speed  $v$  along a circular path of radius  $r$ . Discuss the direction of this acceleration.
15. A point object is projected at an angle  $\theta$  with the horizontal with velocity  $\vec{u}$  from the ground and the object strikes the ground on the same level as that of projection after some time. Prove that -
  - (i) The trajectory of the object is parabolic.
  - (ii) If the horizontal range and maximum height of the object are equal, the angle of projection is  $\tan^{-1} 4$ .
16. Differentiate between elastic and inelastic collisions. Prove that in a two dimensional elastic collision of a moving ball with another identical stationary ball, the two balls moves perpendicular to each other after collision.

OR

State work energy theorem. What is the relation between a conservative force and potential energy? Using this relation obtain the expression for elastic force of spring if elastic potential energy of stretched spring is  $\frac{1}{2} kx^2$ , where  $x$  is displacement.

17. Define angular momentum. Prove that the time rate of change of the angular momentum of a particle is equal to the torque acting on it.
18. Discuss the variation of acceleration due to gravity with depth. Hence find the value of the acceleration due to gravity at the center of the earth.

OR

Discuss the variation of acceleration due to gravity with height. What is relation between height 'h' and depth 'd' for the same change in 'g'.

19. Define radius of gyration. Derive necessary expression for it. On What factors it depends?
20. A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in (i) a medium of refractive index 1.65, (ii) a medium of refractive index 1.33.
  - (a) Will it behave as a converging or diverging lens in two cases?
  - (b) How will its focal length change in two media?
21. Eight spherical rain drops of the same mass and radii are falling down with a terminal speed of 10 m/s. If they collapse to form one big drop then what will be its terminal speed?

OR

A liquid drop of diameter  $D$  breaks up into 27 tiny drops. Find the change in surface energy. Take surface tension of the liquid 'T'

22. What is mean free path? Write the expression for it. Give the dependence of mean free path of molecules of a gas on pressure and temperature of gas.
23. The transverse displacement of a string (clamped at its both ends) is given by

$$y(x, t) = 0.06 \sin\left(\frac{2\pi}{3}x\right) \cos(120\pi t)$$

Where  $x$  and  $y$  are in m and  $t$  in s. The length of the string is 1.5 m and its mass is  $3.0 \times 10^{-2}$  kg.

Answer the following:

- (a) Does the function represent a travelling wave or a stationary wave?
- (b) Determine the tension in the string.

24. A Carnot engine is working between source temperature  $227^{\circ}\text{C}$  and sink temperature  $27^{\circ}\text{C}$ . Calculate the efficiency of the Carnot engine.

**Section D**

25. (a) What is the necessity of banking of roads at turns? Obtain an expression for maximum speed with which a vehicle can safely negotiate a curved road banked at an angle  $\theta$  with frictional coefficient  $\mu$ .  
(b) Determine the angle of banking so as to minimize the wear and tear of tyres of a vehicle negotiating a banked curve road.

**OR**

A rectangular box lies on a rough inclined surface. The co-efficient of friction between the surface and the box is  $\mu$ . Let the mass of the box be  $m$ .

- (a) Determine the angle of inclination  $\theta$  of the plane to the horizontal at which the box just start to slide down the plane?  
(b) What is the force acting on the box down the plane, if the angle of inclination of the plane is increased to  $\alpha > \theta$ ?  
(c) What is the force needed to be applied upwards along the plane to make the box either remain stationary or just move up with uniform speed?

26. State and prove Bernoulli's theorem.

**OR**

Define capillarity. Derive an expression for the rise of liquid in a capillary tube of uniform bore. Discuss the case of rise of a liquid in a tube of insufficient length.

27. (a) What is Doppler Effect? Derive an expression for the apparent frequency of sound due to Doppler Effect when the listener moves towards the stationary source.  
(b) A rocket is moving at a speed of  $200 \text{ m s}^{-1}$  towards a stationary target. While moving, it emits a wave of frequency  $1000 \text{ Hz}$ . Calculate the frequency of the sound as detected by the target. The speed of sound in air is  $330 \text{ m s}^{-1}$ .

**OR**

- (a) Find the total energy of the particle executing S.H.M. and show graphically the variation of P.E. and K.E. with time and displacement.  
(b) What is the frequency of these energies with respect to the frequency of the particle executing S.H.M.?
-