ANNUAL EXAMINATION

PH XI-M2

Class 11 - Physics

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. There are 35 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

Section A

1. Let $[\mu_0]$ denote the dimensional formula of the permeability of free space. If M = mass, L = length, T = time and A = electric current, then **[1]**

   a) $[\mu_0] = [M^{-1} L^2 T^{-1} A^{-2}]$ b) $[\mu_0] = [M^{-1} L^{-3} T^2 A]$

   c) $[\mu_0] = [M^1 L^1 T^{-2} A^{-2}]$ d) $[\mu_0] = [M^{-1} L^{-3} T^4 A^2]$

2. At a metro station, a girl walks up a stationary escalator in time t_1 If she remains stationary on the escalator, then the escalator takes her up in time t_2. The time taken by her to walk upon the moving escalator will be: **[1]**

   a) $\frac{t_1 t_2}{t_2 - t_1}$ b) $\frac{t_1 + t_2}{2}$

   c) $t_2 - t_1$ d) $\frac{t_1 t_2}{t_2 + t_1}$

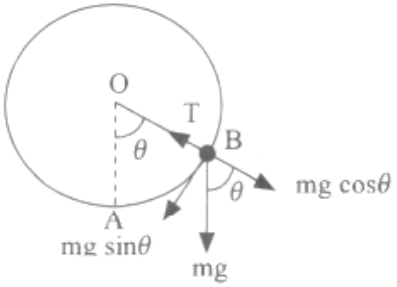
3. Resultant of two vectors $\vec{A}$ and $\vec{B}$ is inclined at 45^o to either of them. What is the magnitude of resultant? **[1]**

   a) $\sqrt{A^2 - B^2}$ b) A + B

   c) A - B d) $\sqrt{A^2 + B^2}$

4. A heavy particle hanging from a fixed point by a light inextensible string of length l is projected horizontally with speed $\sqrt{(gl)}$. Find the speed of the particle and the inclination of the string to the vertical at the instant of **[1]**

the motion when the tension in the string is equal to the weight of the particle.



a) None of these

b) v = $2\sqrt{\frac{gl}{3}}$

c) v = $\sqrt{gl}$

d) v = $\sqrt{\frac{gl}{3}}$

5. A particle moves from a point $(-2\hat{i}+5\hat{j})$ to $(4\hat{j}+3\hat{k})$ when a force of $(4\hat{i}+3\hat{j})$N is applied. How much work has been done by the force? **[1]**

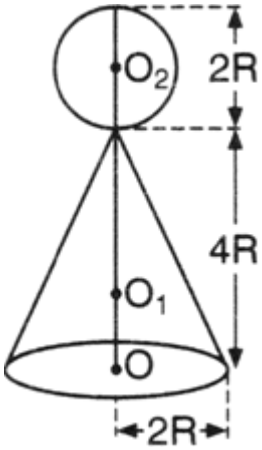
a) 2 J

b) 5 J

c) 11 J

d) 8 J

6. A carpenter has constructed a toy as shown in the adjoining figure. If the density of the material of the sphere is 12 times that of cone, the position of the centre of mass of the toy is given by: **[1]**



a) at a distance of 3R from O

b) at a distance of 5R from O

c) at a distance of 2R from O

d) at a distance of 4R from O

7. Two-point objects of masses 1.5 g and 2.5 g respectively are at a distance of 16 cm apart, the centre of gravity is at a distance x from the object of mass 1.5 g where x is: **[1]**

a) 3 cm

b) 13 cm

c) 6 cm

d) 10 cm

8. How can the sag in a beam be prevented? **[1]**

a) Using a material having Poisson's ratio one

b) Using a material having small Young's modulus

c) Using a material having zero Young's modulus

d) Using a material having large value of Young's modulus

9. With increase in temperature the viscosity of: **[1]**

i. both gases and liquids increases

ii. both gases and liquids decreases

iii. gases increases and liquids decreases

iv. gases decreases and liquids increases

a) ii and iii

b) i and ii

c) iv and i

d) only iii

10. A soap bubble A of radius 0.03 and another bubble B of radius 0.04 m are brought together so that the combined bubble has a common interface of radius r, then the value of r is: **[1]**

a) 0.12 m

b) 0.48 m

c) None of these

d) 0.24 m

11. The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by 100^{o}C is (For steel, Young's modulus is 2×10^{11}Nm^{-2} and coefficient of thermal expansion is $1.1 \times 10^{-5}\mathrm{K}^{-1}$) **[1]**

a) 2.2×10^{7} Pa

b) 2.2×10^{9} Pa

c) 2.2×10^{8} Pa

d) 2.2×10^{6} Pa

12. The temperature of a wire is doubled. The Young's modulus of elasticity will: **[1]**

a) Remain same

b) Also double

c) Become four times

d) Decrease

13. One mole of an ideal monoatomic gas is heated at a constant pressure from 0^{o}C to 110^{o}C. Then the change in the internal energy of the gas is (Given: R = 8.32 Jmol^{-1} K^{-1}) **[1]**

a) 4.6×10^{3} J

b) 1.15×10^{3} J

c) 1.37×10^{3} J

d) 0.83×10^{3} J

14. The study of physical phenomenon at low temperatures (below liquid nitrogen temperature) is called: **[1]**

a) Refrigeration

b) Radiation

c) Cryogenics

d) Pyrometry

15. **Assertion:** Internal energy of real gas is always negative at absolute zero temperature. **[1]**
Reason: Potential energy of a bounded system is negative.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

16. **Assertion:** In S.H.M., the motion is to and fro and periodic. **[1]**
Reason: Velocity of the particle, $v = \omega\sqrt{a^2 - x^2}$ where x is displacement.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is

d) Assertion is wrong statement but reason is

wrong statement. correct statement.

17. **Assertion (A):** Explosions on other planets are not heard on earth. **[1]**

Reason (R): To hear distinct beats, difference in frequencies of two sources should be less than 10 Hz.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

18. In the case of stationary waves all the particles of the medium between two nodes vibrate: **[1]**

i. in phase but with different amplitudes and time periods

ii. in phase and with same amplitude and time period

iii. in phase with the same time period but different amplitudes

iv. with the same time period but in different phases and with different amplitudes

a) ii and iii

b) iv and i

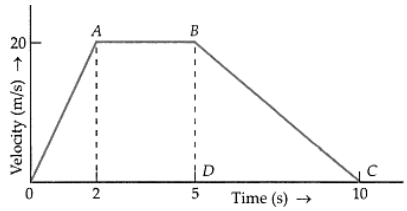
c) i and ii

d) only iii

Section B

19. The wavelength λ associated with a moving particle depends upon its mass m, its velocity v and Planck's constant h. Show dimensional relation between them. **[2]**

20. The velocity-time graph of an object moving along a straight line is as shown below: **[2]**



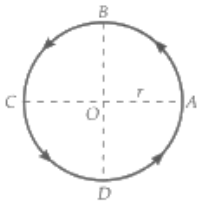
Calculate the distance covered by the object between:

i. t = 0 to t = 5 s

ii. t = 0 to t = 10 s

OR

In Figure, a particle moves along a circular path of radius r. It starts from point A and moves anticlockwise. Find the distance travelled by the particle as it



i. moves from A to B

ii. moves from A to C

iii. moves A to D

iv. completes one revolution. Also, find the magnitude of displacement in each case.

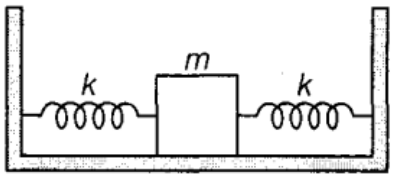
21. The speed of driving a car safely depends upon the range of headlight. Explain. **[2]**

22. Calculate the power of a motor which is capable of raising 2000 liters of water in 5 min from a well 120 m deep. **[2]**

23. i. Among the known types of forces in nature, the gravitational force is the weakest. Why then does it play a dominant role for motion of bodies on the terrestrial, astronomical and cosmological scale? **[2]**

ii. Do the forces of friction and other contact forces arise due to gravitational attraction? If not, what is the origin of these forces?

24. Two identical springs of spring constant k are attached to a block of mass m and to fixed supports as shown in figure. Show that when the mass is displaced from its equilibrium position on either side, it executes a simple harmonic motion. Find the period of oscillations. **[2]**



25. Define wavelength. How is it defined in a transverse wave and in a longitudinal wave **[2]**

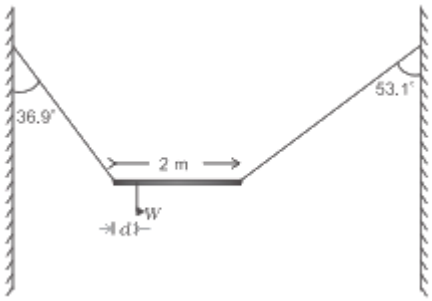
OR

State few important uses of the phenomenon of beats.

Section C

26. A driver of a car travelling at 52 km h^{-1} applies the brakes and decelerates uniformly. The car stops in 5 seconds. Another driver going at 34 km h^{-1} applies his brakes slower and stops after 10 seconds. On the same graph paper, plot the speed versus time graph for two cars. Which of the two cars travelled farther after the brakes were applied? **[3]**

27. A non-uniform bar of weight W is suspended at rest by two strings of negligible weight as shown in fig. The angles made by the strings with the vertical are 36.9^o and 53.1^o respectively. The bar is 2 m long. Calculate the distance d of the centre of gravity of the bar from its left end. **[3]**



28. How far away from the surface of earth does the value of g is reduced to 4% of its value on the surface of the earth? Given radius of earth = 6400km. **[3]**

29. A metallic sphere of radius 1.0×10^{-3}m and density 1.0×10^{4}kg m^{-3} enters a tank of water, after a free fall through a distance of h in the earth's gravitational field. If its velocity remains unchanged after entering water, determine the value of h. Given coefficient of viscosity of water = 1.0×10^{-3} Nsm^{-2}, g = 10 ms^{-2} and density of water = $1.0 \times 10^{3}$$kgm^{-3}$. **[3]**

30. A body of mass m is situated in a potential field $U(x) = U_0(1 - \cos \alpha x)$, where U_0 and α are constants. Find the time period of small oscillations. **[3]**

OR

A particle is moving with SHM in a straight line. When the distance of the particle from mean position has values x_1 and x_2 the corresponding values of velocities are v_1 and v_2. Show that the time period of oscillation is given by:

$T = 2\pi \left[\frac{x_2^2 - x_1^2}{u_1^2 - u_2^2}\right]^{1/2}$

Section D

31. i. Pick out only the vector quantities from the following: Temperature, pressure, impulse, time, power, charge. **[5]**

ii. Show by drawing a neat diagram that the flight of a bird is an example of composition of vectors.

iii. A man is travelling at 10.8 km h^{-1} in a topless car on a rainy day. He holds his umbrella at an angle 37° to the vertical to protect himself from the rain which is falling vertically downwards. What is the velocity of the rain?

[Given cos 37°= $\frac{4}{5}$]

32. The displacement vector of a particle of mass *m* is given by $\vec{r}(t) = \hat{i}A\cos\omega t + \hat{j}B\sin\omega t$ **[5]**

a. Show that the trajectory is an ellipse.

b. Show that $\vec{F} = -m\omega^2\vec{r}$

OR

A box of mass 4 kg rests upon an inclined plane. The inclination of the plane to the horizontal is gradually increased. It is found that when the slope of the plane is 1 in 3, the box starts sliding down the plane. Given g = 9.8 ms^{-2}.

i. Find the coefficient of friction between the box and the plane.

ii. What force applied to the box parallel to the plane will just make it move up the plane?

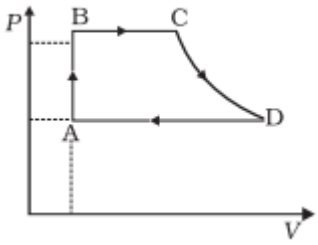
33. A cycle followed by an engine (made of one mole of an ideal gas in a cylinder with a piston) is shown in Fig. Find heat exchanged by the engine, with the surroundings for each section of the cycle. (C_V = ($\frac{3}{2}$) R) **[5]**

AB : constant volume

BC : constant pressure

CD : adiabatic

DA : constant pressure



Section E

34. **Read the case study given below and answer any four subparts:** **[4]**

In everyday life, the term work is used to refer to any form of activity that requires the exertion of mental or muscular efforts. In physics, work is said to be done by a force or against the direction of the force, when the point of application of the force moves towards or against the direction of the force. If no displacement takes place, no work is said to be done.

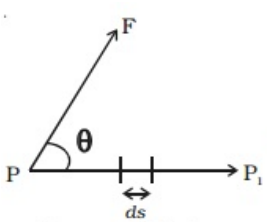


Fig. Work done by a force

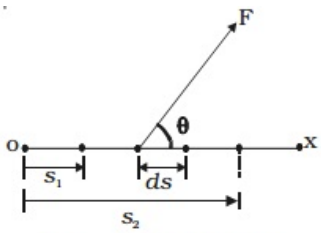


Fig. Work done by a constant force

i. A box is pushed through 4.0 m across a floor offering 100 N resistance. How much work is done by the applied force?

ii. What is work done in holding a 15 kg suitcase while waiting for 15 minutes?

iii. Frictional forces are:

a. conservative forces

b. non- conservative forces

c. buoyant force

d. none of these

iv. When the body moves in circular motion, net 'work' done is:

a. positive

b. negative

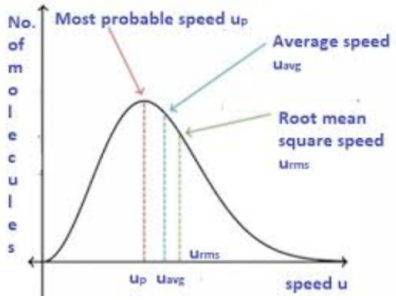
c. zero

d. none of these

v. Force of 4N is applied on a body of mass 20 kg. Find the work done in 3rd second .

35. **Read the case study given below and answer any four subparts:** **[4]**

Root mean square velocity (RMS value)is the square root of the mean of squares of the velocity of individual gas molecules and the Average velocity is the arithmetic mean of the velocities of different molecules of a gas at a given temperature.



i. Moon has no atmosphere because:-

ii. For an ideal gas, $\frac{C_P}{C_V}$ is

a. >1

b. <1

c. ≤ 1

d. none of these

iii. The root mean square velocity of hydrogen is $\sqrt{5}$ times than that of nitrogen. If T is the temperature of the gas then:

a. $T(H_2) = T(N_2)$

b. $T(H_2) < T(N_2)$

c. $T(H_2) > T(N_2)$

d. none of these

iv. Suppose the temperature of the gas is tripled and N_2 molecules dissociate into an atom. Then what will be the rms speed of atom:

v. The velocities of the molecules are v, 2v, 3v, 4v & 5v. Find the rms speed.