ARMY PUBLIC SCHOOL SHILLONG

ANNUAL EXAMINATION 2022-23

CLASS- XI
SUBJECT – PHYSICS

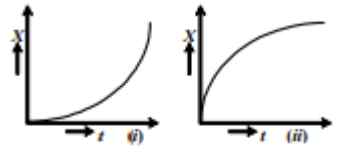
TIME: 3 Hours. **MAX.MARKS:70**

General Instructions:

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

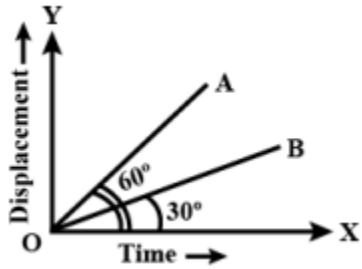
SECTION A

Q.1 Figures (i) and (ii) below show the displacement-time graphs of two particles moving along the x-axis. **1**



We can say that
(a) both the particles are having a uniformly accelerated motion
(b) both the particles are having a uniformly retarded motion
(c) particle (i) is having a uniformly accelerated motion while particle (ii) is having a uniformly retarded motion
(d) particle (i) is having a uniformly retarded motion while particle (ii) is having a uniformly accelerated motion

Q.2 The displacement – time graph of the two particles A and B are shown in the figure. The ratio of their velocities Va : Vb is **1**



(a) 3:1 (b) 1: √3 (c) 1:3 (d) √3 :1

Q.3 A block of mass 100 g is lying on an inclined plane of angle 30°. The frictional force on this block..... N. ($g = 9.8\ m/s^2$) **1**
(a) 4.9×10^{-2} (b) 4.9×10^{-1} (c) 4.9×10^{0} (d) 4.9×10^{1}

Q.4 110 J of heat is added to a gaseous system, whose internal energy increases by 40 J. Then, the amount of external work done is **1**
(a) 150 J (b) 70 J (c) 110 J (d) 40 J

Q.5 Moon has no atmosphere because **1**

(a) rms velocity of all gases is more than the escape velocity of moon's surface
(b) its surface is not smooth
(c) it is quite far away from the surface of the earth
(d) it does not have population

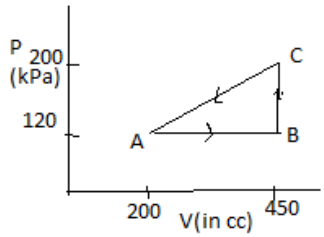
Q.6 Which of the following is a non-conservative force? **1**
(a) Electrostatic force (b) Gravitational force (c) Viscous force (d) Interatomic force

Q.7 If W is the amount of work done in forming a soap bubble of volume V, then the amount of work done in forming a bubble of volume 8V from the same solution will be **1**
(a) 2W (b) 4W (c) 8W (d) W/8

Q.8 For an adiabatic process, **1**
(a) $\Delta U = 0$ (b) $\Delta Q = 0$ (c) $\Delta V = 0$ (d) $W = 0$

Q.9 Mass is distributed uniformly over a thin square plate. If two end points of a diagonal are (-2,0) and (2,2), what are the co- ordinates of the centre of mass of plate? **1**
(a) (2,2) (b) (1, 10) (c) (2,1) (d) (0,1)

Q.10 P-V diagram of a cyclic process is shown in the figure. Work done by the gas during ABCA as shown in the figure. **1**



(a) 10J (b) -10J (c) 20J (d) -20J

Q.11 The pressure at a depth of h in a fluid of density ρ at a place where the acceleration due to gravity is g and the pressure at h = 0 is P_o, is given by **1**
(a) $P = P_o + \rho gh$ (b) $P = P_o + 2\rho gh$ $P = \rho gh$ $P = P_o + 3\rho gh$

Q.12 A spring of constant 5 x 10^5 N/m is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is **1**
(a) 12.50 Nm (b) 6.25 Nm (c) 25.00 Nm (d) 18.75 Nm

Q.13 A body of moment of inertia of 3 Kg m^2 rotating with an angular speed of 2 rad/sec has the same kinetic energy as a mass of 12 kg moving with a speed of **1**
(a) 2m/s (b) 1m/s (c) 4m/s (d) 8 m/s

Q.14 The gravitational force between the two objects is F. If masses of both the objects are halved without altering the distance between them, the gravitational force would become **1**
(A) F/4 (B) F/2 (C) F (D) 2F

Q.15 For a fluid in a steady flow, the increase in flow speed at a constriction follows **1**
(a) Pascal's law (b) Bernoulli's principle (c) Torricelli's law (d) conservation of mass

For question number 16,17,18 two statements are given, One labelled Assertion (A) and other labelled Reason (R). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.
(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 and R is also false.

Q.16 **Assertion:** It is harder to open and shut the door if we apply force near the hinge. **1**
Reason: At the hinges the applied force to produce the required torque is maximum.

Q.17 **Assertion:** Work done by the force of friction in a round trip is zero. **1**
Reason: The force of friction is a conservative force.

Q.18 **Assertion:** The rate of change of momentum is zero in uniform circular motion. **1**
Reason: Speed is constant in uniform circular motion.

SECTION B

Q.19 A body is vertically thrown upwards after sometime it returns to the ground draw the graph between displacement vs time and velocity versus time for the projected body. **2**

Or

A body changes its speed from 20 m/sec to 30 m/sec in two seconds. Find the distance travelled in two seconds.

Q.20 Using dimensional analysis check the correctness of the equation **2**

$$v = \frac{\sqrt{p}}{\sqrt{\rho}}$$

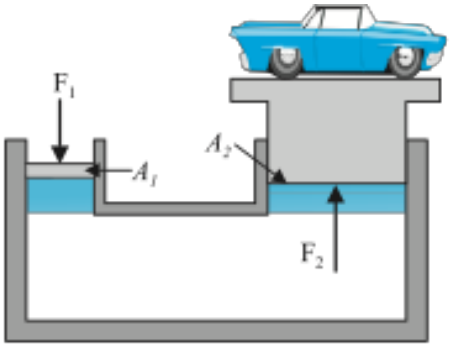
where v – velocity of sound , P – pressure and ρ – density.

Q.21 A body of mass 10 kg revolves in a circle of diameter 0.40m making 1000 revolutions per minute. Calculate its angular and linear velocity. **2**

Q.22 Explain why **2**

(a) To keep a piece of paper horizontal, you should blow over, not under it.
(b) The angle of contact of mercury with glass is obtuse, while that of water with glass is acute.

Q.23 In a car lift compressed air exerts a force F_1 on a small piston having a radius of 5.0 cm. This pressure is transmitted to a second piston of radius 15 cm. If the mass of the car to be lifted is 1350 kg, calculate F_1. What is the pressure necessary to accomplish this task? ($g = 9.8\ ms^{-2}$). **2**



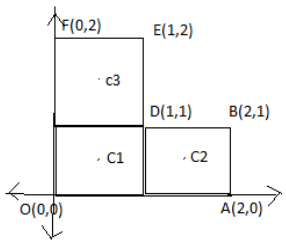
Q.24 A cricket ball of mass 150 g is moving with a velocity of 12 m/s, and is hit by a bat, so that the ball is turned back with a velocity of 20 m/s. The force of the blow acts for 0.01 second on the ball. Find the average force exerted by the bat on the ball. **2**

Q.25 A wire of length 150 cm and area of cross section $1mm^2$ is stretched by a weight of 3kg. Determine the increase in length. Young's modulus of material of the wire is $2x10^{11}\ Nm^{-2}$ $g = 9.8\ m/s^2$. **2**

SECTION C

Q.26 Define terminal velocity. Derive expression of terminal velocity of sphere having radius 'r' and falling in liquid of density 'ρ'. **3**

Q.27 Find the centre of mass of a uniform L- shaped lamina (a thin flat plate) with the dimensions as shown in fig. The mass of the lamina is 3 kg. **3**



Q.28 A transverse harmonic wave on a string is described by $y(x,t)=3.0\sin(36\,t+0.018x+\pi/4)$ where x and y are in cm and t in s. The positive direction of x is from left to right. **3**

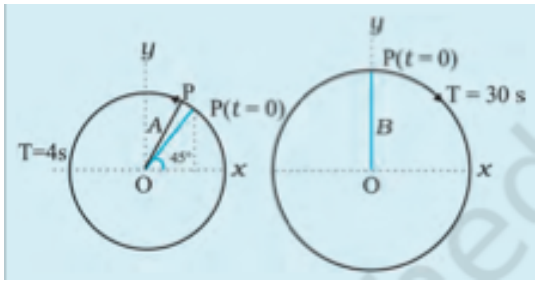
(a) Is this a travelling wave or a stationary wave ?
If it is travelling, what are the speed and direction of its propagation ?

(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 ?

Q.29 The figure given below depicts two circular motions. The radius of the circle, the period of revolution, the initial position and the sense of revolution are indicated in the figures. Obtain the simple harmonic motions of the x-projection of the radius vector of the rotating particle P in each case. **3**



Q.30 A block whose mass is 1kg fastened to a spring .The spring constant of a spring is 50N/m. The block is pulled to a distance of x = 10cm from its equilibrium position x= 0 cm on a frictionless surface from rest at t = 0 s. calculate the kinetic and potential energy of the block. **3**

SECTION D

Q.31 (a) What do you mean by capillarity. Write one application of capillarity. **5**

(b) Derive an expression for the height to which the liquid rises in a capillary tube of radius r.

(c) Why does mercury drop its level in a capillary tube?

Or

(a) Derive an expression for the excess pressure inside a liquid drop.

(b) Calculate the work done in blowing a soap bubble from a radius of 2 cm to 3 cm.
(The surface tension of the soap solution is 30 dynes per cm)

Q.32 (a) Obtain an expression for the acceleration due to gravity on the surface of the earth in terms of mass of the earth and its radius(R). **5**

(b) Discuss the variation of acceleration due to gravity with altitude and depth.

(c) If a body is taken to a height equal to R/ 4 from the surface of the earth then find percentage decrease in the weight of the body. R is radius of the earth.

Or

(a) Define escape velocity. Obtain an expression for the escape velocity of the body from the surface of the earth.

(b) If the mass of a planet is 3 times of the mass of the earth and radius 3 times the of the earth's radius ,then calculate the escape velocity from this planet.

Q.33 (a) What do you mean by an angular projectile? Give one example from daily life and Derive the expression for the range, height and time of flight with the help of labelled diagram? **5**

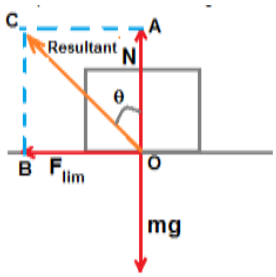
OR

(b) Derive three equation of motion using graphical method. Which physical quantity is Obtained by the 1. Slope of velocity- time graph 2. Area under the velocity- time graph?

SECTION E

Q.34 Friction between any two surfaces in contact is the force that opposes the relative motion between them. The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction R between them i.e. $F \alpha R$ or $F = \mu R$, where μ is coefficient of limiting friction. If θ is angle of friction then $\mu = \tan\theta$. **4**

With the help of passage given above, choose the appropriate alternative for each of following questions:



(i)The force of 49 N is just able to move a block of wood weighing 10 kg on a rough horizontal surface. The coefficient of friction is (g= 10m/s^2)

(a) 0.49 (b) 4.9 (c) 10/49 (d) 49/9.8

(ii)What would be coefficient of friction if angle of friction is 30^o

(a) √3 (b) 5.77 (c)1.577 (d)0.577

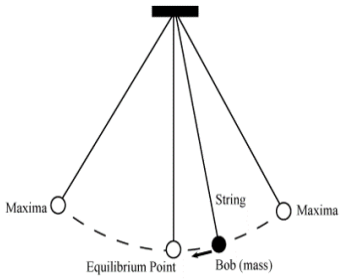
(iii) A horizontal force of 1.2 kgf is applied on a 1.5 kg block which rests on a horizontal surface. If the coefficient of friction is 0.3, force of friction is

(a) 0.45 kgf (b)1.2 kgf (c)1.5 kgf (d) 0.3 kgf

(iv)The acceleration produced in a block in the above question is

(a) 9.8 m/s^2. (b)0.3 m/s^2 (c)1.5 m/s^2 (d)4.9 m/s^2

Q.35



Simple Harmonic Motion

Consider a particle oscillating back and forth about x-axis between the limits +A and -A. This oscillatory motion is said to be simple harmonic if the displacement x of the particle from the origin varies with time as: $x(t) = A\cos(\omega t + \phi)$
where A, ω and Ø are constants.
Thus, simple harmonic motion (SHM) is not any periodic motion but one in which displacement is a sinusoidal function of time. While the amplitude A is fixed for a given SHM, the state of motion (position and velocity) of the particle at any time t is determined by the argument (ωt + Ø) in the cosine function. This time-dependent quantity, (ωt + Ø) is called the phase of the motion. The value of phase at t = 0
is Ø and is called the phase constant (or phase angle)

Answer the following questions: **4**

(a) How energy of particle executing SHM will vary?

(b) Find the expression of the velocity of particle in SHM.

(c) A body oscillates with SHM according to the equation $x= 5.0\cos(2\pi t + \pi/4)$
Calculate its acceleration at t=1.5 s,

Or

(d) Calculate the time period and amplitude of the motion $y = \sin\omega t + \cos\omega t$

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