INDIAN SCHOOL SOHAR
FINAL EXAMINATION 2019-20
PHYSICS

No. of printed pages: 4

CLASS: XI
DATE: 09/02/2020

Max Marks: 70
Duration: 3 Hours

General Instructions:

(i) All questions are compulsory. There are 37 questions in all.
(ii) This question paper has four sections: Section A, Section B, Section C and Section D.
(iii) Section A contains 20 questions of one mark each, Section B contains seven questions of two marks each; Section C contains seven questions of three marks each and Section D contains three questions of five marks each.
(iv) There is no overall choice. However, internal choice have been provided in two questions of one mark each , two questions of two marks, one question of three marks, and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.

Section A

1. Which of the following pairs of physical quantities does not have same dimensional formula?
   (a) Work and torque.
   (b) Angular momentum and Planck's constant.
   (c) Tension and surface tension.
   (d) Impulse and linear momentum.
2. The angle between $a = \hat{i} + \hat{j}$ and $b = \hat{i} - \hat{j}$ is
   (a) 45° (b) 90° (c) –45° (d) 180°
3. A body of mass 2kg travels according to the law $x(t) = p\,t + q\,t^2 + r\,t^3$ where p= 3ms^{-1} , q = 4ms^{-2} and r = 5ms^{-3} . The force acting on the body at t = 2 seconds is
   (a) 136 N (b) 134 N
   (c) 158 N (d) 68 N
4. A bicyclist comes to a skidding stop in 10 m. During this process, the force on the bicycle due to the road is 200N and is directly opposed to the motion. The work done by the cycle on the road is
   (a) + 2000J (b) – 200J
   (c) Zero (d) – 20,000J
5. A couple produces a
   (a) pure linear motion (b) pure rotational motion
   (c) both linear and rotational motion (d) no motion
6. The time period of second's pendulum in a satellite is
   (a) zero (b) 2 s
   (c) infinity (d) depends on mass of the body
7. 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 in the two pipes is
   (a) 9:4 (b) 3:2
   (c) √3 :√ 2 (d) √2 : √3

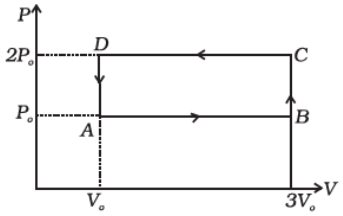
   OR

   Along a streamline
   (a) The velocity of a fluid particle remains constant.

(b) The velocity of all fluid particles crossing a given position is constant.
(c) The velocity of all fluid particles at a given instant is constant.
(d) The speed of a fluid particle remains constant

8. An ideal gas undergoes cyclic process ABCDA as shown in given *P-V* diagram. The amount of work done by the gas is

(a) 6 P_oV_0
(b) –2 P_oV_0
(c) + 2 P_oV_0
(d) + 4 P_oV_0



9. A particle executing S.H.M. has a maximum speed of 30 cm/s and a maximum acceleration of 60 cm/s^2. The period of oscillation is

(a) π s. (b) 2 π s.
(c) $\frac{\pi}{2}$ s (d) $\frac{\pi}{t}$ s

10. With propagation of longitudinal waves through a medium, the quantity transmitted is
(a) Matter. (b) Energy.
(c) Energy and matter. (d) Energy, matter and momentum.
11. In uniform accelerated motion , position – time graph is----------
12. Reciprocal of bulk modulus of a material is called its----------
13. ----------neither reflects nor transmits but absorbs whole of the heat radiation incident on it.
14. Total number of independent ways in which the particles of the system can absorb energy is known as------
15. ---------waves do not transfer any energy and momentum in the material medium.
16. A ballet dancer stretches her hand out for slowing down from spinning. Name the principle of conservation involved.
17. How escape velocity is related to orbital velocity for orbits close to the surface of the earth.
18. What will be the angle of contact of a water drop on a lotus leaf?

OR

What is the cause of excess pressure inside a soap bubble ?

19. Air pressure in a car tyre increases during driving. Why?
20. When will the motion of a simple pendulum be simple harmonic?

Section B

21. A ball is thrown vertically up with a velocity of 20 m/s. construct displacement-time graph.
22. A body is moved along a closed loop. Is the work done in moving the body necessarily zero? If not, state the condition under which work done over a closed path is always zero.
23. Why does a solid sphere have smaller moment of inertia than a hollow cylinder of same mass and radius, about an axis passing through their axes of symmetry?
24. The length of a metal is l_1 when the tension in it is T_1 and l_2 when the tension is T_2. Find the original length of the wire.

OR

Prove that elastic energy density of a stretched wire is equal to $\frac{1}{2} stress \times strain$

25. (i) Why cooking is difficult on hills?
(ii) The earth without its atmosphere would be inhospitably cold, why?

OR

Two stars radiate maximum energy at wavelength 3.6×10^{-7} m and 4.8×10^{-8} m respectively. What is the ratio of their surface temperature?

26. Draw a schematic representation working of a refrigerator. Coefficient of performance of the refrigerator cannot be infinity, why?
27. A cylinder of fixed capacity 44.8 liters contains Helium gas at standard temperature and pressure. What is the amount of heat needed to rise the temperature of the gas in the cylinder by 15^0 C. (R=8.314 J mol^{-1} K^{-1})

Section C

28. (i) A new system of units is proposed in which unit of mass is α kg, unit of length β m and unit of time γ s. How much will 5 J measure in this new system?

    (ii) Check the consistency of the equation $E = mgh + \frac{1}{2}kx^2$ where k is the spring constant all others have the usual meaning.
29. (i) State parallelogram law of vector addition.

    (ii) A boy throws a ball in air at 60° to the horizontal along a road with a speed of 10 m/s (36km/h). Another boy sitting in a passing by car observes the ball. Sketch the motion of the ball as observed by the boy in the car, if car has a speed of (18km/h). Give explanation to support your diagram.
30. (i) A body is being raised to a height *h* from the surface of earth. What is the sign of work done by
    (a) applied force
    (b) Gravitational force?

    (ii) A raindrop of mass 1.00 g falling from a height of 1 km hits the ground with a speed of 50 m s^{-1}. Calculate
    (a) The loss of P.E. of the drop.
    (b) The gain in K.E. of the drop.
    (c) Is the gain in K.E. equal to loss of P.E.? If not why. Take g = 10 m s^{-2}
31. Two discs of moments of inertia I_1 and I_2 about their respective axes (normal to the disc and passing through the centre), and rotating with angular speed ω_1 *and* ω_2 are brought into contact face to face with their axes of rotation coincident.
    (a) Does the law of conservation of angular momentum apply to the situation? Why?
    (b) Find the angular speed of the two-disc system.
    (c) Calculate the loss in kinetic energy of the system in the process.

    OR

    (i) Define centre of gravity.

    (ii) Find the torque of a force $7\hat{i} + 3\hat{j} - 5\hat{k}$ about the origin. The force acts on a particle whose positon vector is $\hat{i} - \hat{j} + \hat{k}$
32. A satellite is to be placed in equatorial geostationary orbit around earth for communication.
    (a) Calculate height of such a satellite.
    (b) Find out the minimum number of satellites that are needed to cover entire earth so that at least one satellite is visible from any point on the equator. [M = 6 × 10^{24} kg, R = 6400 km, T = 24h, G = 6.67 × 10^{-11} in SI units]
33. State and explain three different modes of transfer of heat.
34. (a) Show that the motion of a particle represented by y = sin ωt – cos ωt is simple harmonic with a period of 2π/ω.

    (b) Find the displacement of a simple harmonic oscillator at which its P.E. is half of the maximum energy of the oscillator.

    (c) A spring of force constant k is cut into two pieces, such that one of the pieces doubles the length of the other. What is the force constant of the longer piece of the spring ?

Section D

35. (i) Derive expression for velocity of a car on a banked circular road having coefficient of friction μ.

Hence write the expression for optimum velocity.

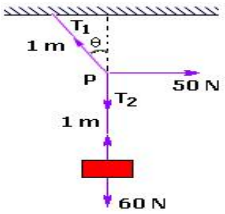
(ii) A circular race track of radius 300m is banked at an angle of 15^0. If the coefficient of friction between the wheels of a race car and the road is 0.2, what is the (a) optimum speed of the car to avoid wear and tear on its tyres, and (b) maximum permissible speed to avoid slipping? ($\tan 15^0 = 0.268$)

OR

(i) What are concurrent forces ? Obtain a condition for the equilibrium of three concurrent forces.

(ii) Explain the term impulse. Show that impulse is equal to the change in momentum.

(iii) A mass of 6 kg is suspended by a rope of length 2m from the ceiling. A force of 50 N in the horizontal direction is applied at the mid point of the rope, as shown: what is the angle the rope makes with the vertical in equilibrium? (take g = 10 ms^{-2}). Neglect the mass of the rope.



36. (a) State Stoke's law. Define terminal velocity. Establish an expression for it for a spherical body falling through a viscous medium.

(b) In Millikan's oil drop experiment, what is the terminal speed of an uncharged drop of radius 2.0×10^{-5} m and density 1.2×10^3 kg m^{-3}. Take viscosity of air at the temperature of the experiment to be 1.8×10^{-5} Pa s . How much is the viscous force on the drop at that speed. Neglect buoyancy of the drop due to air. (Take g = 9.8 ms^{-2}).

OR

(i) What is the phenomenon of capillarity? Derive an expression for the rise of liquid in a capillary tube. Give its one application.

(ii) What will happen if the length of the capillary tube is smaller than the height to which the liquid rise?

(iii) A liquid drop of diameter 4 mm breaks into 1000 droplets of equal size. Calculate the resultant change in surface energy, the surface tension of the liquid is 0.07 Nm^{-1}.

37. (A) Given below are some functions of x and t to represent the displacement of an elastic wave.

(a) $y = 5 \cos (4x) \sin (20t)$

(b) $y = 4 \sin (5x - t/2) + 3 \cos (5x - t/2)$

(c) $y = 10 \cos [(252 - 250) \pi t] \cos [(252+250)\pi t]$

(d) $y = 100 \cos (100\pi t + 0.5x)$

State which of these represent (i) a travelling wave along $-x$ direction,(ii) a stationary wave, (iii) beats (also find the beat frequency) and (iv) a travelling wave along $+x$ direction. Give reasons for your answers.

(B) Show that when a string fixed at its two ends vibrates in 1 loop, 2 loops, 3 loops and 4 loops, the frequencies are in the ratio1:2:3:4.

OR

(a) What is Doppler Effect? Derive an expression for the apparent frequency of sound as heard by a stationary observer in a still medium, when the source is moving towards the observer with a uniform velocity. Hence write the expression for the apparent frequency when the source moves away from the stationary observer.

(b) A SONAR system fixed in a submarine operates at a frequency 40.0 kHz. An enemy submarine moves towards the SONAR with a speed of 360 km h^{-1}. What is the frequency of sound reflected by the submarine? Take the speed of sound in water to be 1450 m s^{-1}.