ANANDALAYA
ANNUAL EXAMINATION
Class : XI

Subject: Physics
Date : 17/02/2020

M.M : 70
Time: 3 Hours

General Instructions:
1. All questions are compulsory. There are 37 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains twenty 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.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark each, one question of two marks, two questions of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants where ever necessary.

$c = 3 \times 10^8$ m/s
$h = 6.63 \times 10^{-34}$Js
$e = 1.6 \times 10^{-19}$ C
$G = 6.67 \times 10^{-11}$ Nm^{2}kg^{-2}
$g = 10$ ms^{-2}

$m_e = 9.1 \times 10^{-31}$ kg
mass of neutron $= 1.675 \times 10^{-27}$ kg
mass of proton $= 1.673 \times 10^{-27}$ kg
Avogadro's number $= 6.023 \times 10^{23}$ per gram mole
Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}
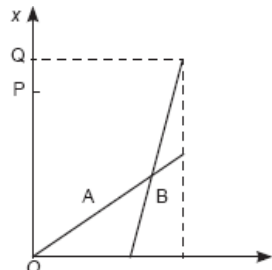
SECTION A

Direction (Q1 – Q 10): Choose the correct option.

1. The dimensional formula of acceleration is (1)
   (a) $[M^0L^0T^1]$ (b) $[M^1L^0T^{-2}]$ (c) $[M^0L^1T^{-2}]$ (d) $[M^0L^1T^0]$

2. Determine π^2 with due regard for significant figures. [Given $\pi = 3.14$] (1)
   (a) 9.8596   (b) 9.860   (c) 9.86   (d) 9.9

3. The slope of a v-t graph is equal to (1)
   (a) magnitude of acceleration   (b) magnitude of displacement
   (c) speed   (d) magnitude of velocity

4. The position-time (x-t) graphs for two children A and B returning from their school O to their homes P and Q respectively are shown in figure. Out of the following options which is correct option. (1)


   (a) B lives closer to the school than A   (b) B starts from the school earlier than A
   (c) B walks faster than A   (d) A walks faster than B

5. A body of mass 5 kg is acted upon by two perpendicular forces 8 N and 6 N. The magnitude of the acceleration is (1)
   (a) 2 m/s^2 (b) 10 m/s^2 (c) 20 m/s^2 (d) none of the above

6. Which of the potential energy curves in figure possibly describes the elastic collision of two billiard balls? Here *r* is the distance between centres of the balls. (1)

(a)   (b)   (c)   (d)

(OR)
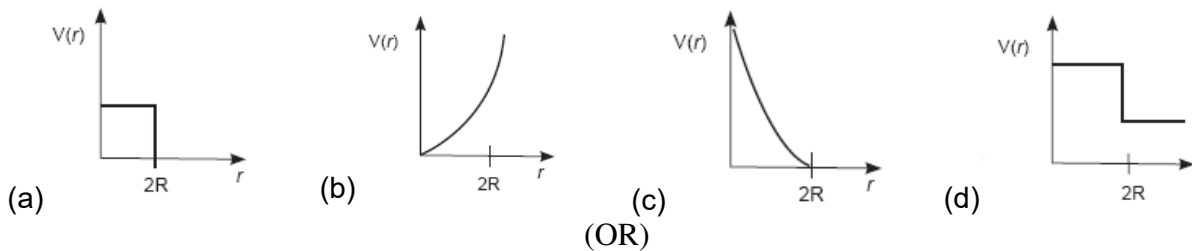
Which of the following statements are/is true in the case of conservative force?

(i) Work done against conservative force is dependent of path.

(ii) Work done in a closed path is zero.

(a) (i) & (ii) both are true.   (b) (i) & (ii) both are not true

(c) Only (i) is true   (d) Only (ii) is true

7. A sphere, ring, disc and a spherical shell, all with equal mass and same radius, are coming down an inclined plane, rolling without slipping. Which one will reach the ground first?   (1)

(a) Sphere   (b) ring   (c) disc   (d) spherical shell

8. A 20 cm long capillary tube stands vertically with lower end just in water. Water rises up to 5 cm. If the entire system is now kept on a freely falling platform, the length of the water column in the capillary tube will be   (1)

(a) 5 cm   (b) 10 cm   (c) zero   (d) 20 cm
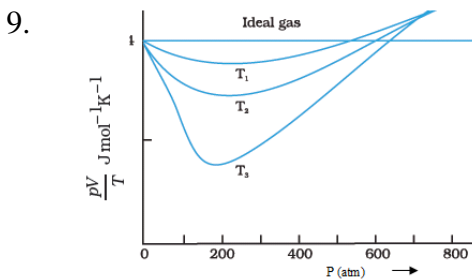
9.

Write the temperatures T_1, T_2 and T_3 in decreasing order of magnitude.   (1)

(a) $T_1 < T_2 < T_3$

(b) $T_3 < T_2 < T_1$

(c) $T_1 > T_2 < T_3$

(d) $T_1 < T_2 > T_3$

10. A Carnot engine works between the temperature 40 °C and 200 °C. What is its efficiency?   (1)

(a) 80 %   (b) 20%   (c) 28%   (d) 100%

(OR)

Identify the thermodynamic processes shown in the diagram as 1 and 2?

(a) 1 – isochoric and 2 – isothermal

(b) 1 – isochoric and 2 – isobaric

(c) 1 – isobaric and 2 – adiabatic

(d) 1 – isothermal and 2 – adiabatic
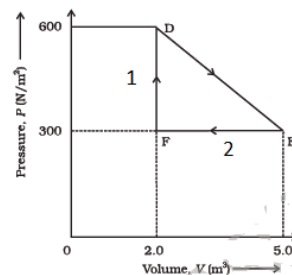
Directions (Q11 –Q15) Fill in the blanks.

11. The angle of contact between a liquid and a solid surface is 102°. Will the liquid wet the solid surface? _____ (yes or no)   (1)

12. The number of degrees of freedom of a rigid diatomic molecule is _____.   (1)

13. The frequency of oscillation of a simple pendulum mounted in a cabin that is freely falling under gravity is _____   (1)

14. Is the function of time $e^{-\omega t}$ periodic? _____ (yes or no)   (1)

15. The value of gravitational constant is _____.   (1)

(OR)

The gravitational potential energy of a mass 'm' due to another mass 'M' at infinite distance from the mass M is _____.

Directions (Q16 –Q20): Answer the following.

16. Under what condition will the distance and displacement of a moving object have the same (1) magnitude?

17. The equation of motion of an object is given by $y = 3t^3$. Is the acceleration of the object (1) uniform?

18. What will be the change in coefficient of friction when the mass of the object is doubled? (1)

19. A mass 1 kg rotates in a circular path of radius 5 cm with an angular velocity of 60 rpm. What (1) is its kinetic energy?

20. Calculate the coefficient of volume expansion of an ideal gas at $0°C$. (1)

SECTION B

21. Show that the direction of centripetal acceleration is towards the centre. Draw the necessary (2) diagram.

22. A body goes from A to B with a velocity of 40 m/s and comes back from B to A with a (2) velocity of 60 m/s. What is the (i) average velocity during the whole journey and (ii) average speed during the whole journey?

23. Draw (x-t) graphs for (a) positive and (b) zero accelerations. (2)

24. State: (a) parallel axis theorem and (b) perpendicular axes theorem with respect to moment of (2) inertia.

25. Derive the expression for the orbital velocity of a satellite revolving around the Earth in a (2) circular orbit of radius 'r'.

(OR)

Derive the expression for the escape velocity near the Earth surface.

26. 1 kg of water at 90 °C is added to 5 Kg of water at 18 °C. What is the final temperature of the (2) mixture?

27. What is mean free path? What are the factors it depends on? (2)

SECTION C

28. In an experiment, refractive index of glass was observed to be 1.45, 1.56, 1.54, 1.44, 1.54 and (3) 1.53. Calculate (i) Mean value of refractive index, (ii) Mean absolute error, (iii) Fractional error and (iv) Percentage error. Express the result in terms of absolute error and percentage error.

(OR)

Rule out or accept the following formulae (where the notations have usual meaning) for kinetic energy on the basis of dimensional arguments.

(i) $K = \frac{3}{16}mv^2$ (ii) $K = \frac{1}{2}mv^2 + ma$ (iii) $K = \frac{1}{2}mv^2 + max$

29. State parallelogram law of vector addition. Show that resultant of two vectors A and B (3) inclined at an angle θ is R $= \sqrt{A^2 + B^2 + 2AB\cos\theta}$.

(OR)

Prove that the path of a projectile is a parabola.

30. A mass 10 kg hanging from a ceiling in a string is pulled sidewise with a force F. The angle (3) made by the string with the vertical is 30°. What is the magnitude of the force F? What is the tension in the string? Take 'g' as 10 m/s^2.

31. Define the term 'coefficient of friction' between two surfaces. A body of mass 10 kg is placed (3) on an inclined surface of angle 30°. If the coefficient of limiting friction is $\frac{1}{\sqrt{3}}$, find the force required to just push the body up the inclined surface. The force is being applied parallel to the inclined surface.

32. (a) Two masses M_1 and M_2 separated by distance r start moving towards each other due to (3) their own force of attraction. What will be the change in centre of mass?
    (b) What is the average angular velocity of the hour hand of clock?
    (c) A spherical body of mass M and radius R is rotated about an axis passing tangential to it. What is its moment of inertia? Given that the moment of inertia of the spherical body about an axis passing through its centre is $\frac{2}{5}MR^2$.

33. Give reason for: (3)
    (a) 'I' shaped beams or columns
    (b) usage of braided steel wires in bridges
    (c) the maximum height of a mountain on earth is approximately 10 km.

34. A particle executes S.H.M. with a time period of 10 s. The displacement of particle at any (3) instant is given by: $x = 10\ sin\omega t\ (in\ cm)$. Find the velocity and acceleration of a body at 5 s after it passes through mean position.

SECTION D

35. (a) What do you mean by perfectly inelastic collision? (5)
    (b) Two equal masses collide inelastically. If the velocity of the second mass is zero and that of first mass is u, find the loss of kinetic energy. Assume the collision is perfectly inelastic.

(OR)

    (a) Show that for a freely falling object the total mechanical energy is conserved.
    (b) A spring (spring constant = 50 N/m) attached with a mass of 0.5 kg is stretched to a distance of 2 cm. When left free, what would be the kinetic energy of the mass when it crosses the mean position?

36. (a) Using Bernoulli's principle, derive an expression for the velocity of efflux flowing out of (5) an orifice.
    (b) Water flows through a horizontal pipe of radius 1 cm at a speed of 2 m/s. What should be the diameter of its nozzle if the water is to come out at a speed 10 m/s?

(OR)

    (a) State and prove Pascal's law and (b) How does a hydraulic lift work? Explain.

37. The wave equation of a transverse wave is given as $y = 0.05\ \sin(2\pi x - 4\pi t)$ meter where x (5) is in meter and t is in second. Find;
    (a) the direction of propagation
    (b) the amplitude of the wave
    (c) the wavelength
    (d) the frequency of the wave
    (e) the speed of the wave

(OR)

    (a) What is Doppler effect?
    (b) A stationary observer O listens to the sound of frequency ν generated by a source S. The source is moving away from the observer with a speed V_S. Derive the expression for the frequency of the sound as listened by the observer. Assume that the speed of the sound is much greater than the speed of the source.