

(Fifteen minutes extra will be given for reading the question paper.)

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

Q1. The unit of Planck's constant h is the same as that of:

- | | |
|---------------------|----------------------|
| (a) Linear momentum | (b) Angular momentum |
| (c) Work | (d) Energy |

Q2. What type of energy does a stretched spring possess?

- | | |
|--------------------------|------------------------------|
| (a) Potential energy | (b) Kinetic energy |
| (c) Gravitational energy | (d) Elastic potential energy |

Q3. Which of the following unit is not a derived unit?

- | | |
|-----------|--------------|
| (a) joule | (b) kilogram |
| (c) watt | (d) newton |

Q4. Two wires of equal lengths are made of the same material. Wire A has a diameter that is twice as that of wire B. If identical weights are suspended from the ends of these wires, the increase in length is:

- | | |
|---|---|
| (a) one-fourth for wire A as for wire B | (b) four times for wire A as for wire B |
| (c) twice for wire A as for wire B | (d) half for wire A as for wire B |

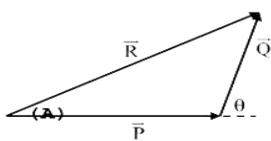
Q5. The radius and mass of earth are increased by 0.5%. Which of the following statements are true at the surface of the earth?

- | | |
|--|-----------------------|
| (a) Potential energy will remain unchanged | (b) g will decrease |
| (c) Escape velocity will remain unchanged | (d) g will increase |

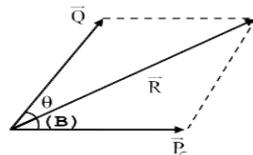
Q6. Dimensional formula of G is

- | | |
|-------------------------|-------------------------|
| (a) $[M^{-1}L^3T^{-2}]$ | (b) $[M^{-2}L^3T^{-2}]$ |
| (c) $[M^{-1}L^3T^{-1}]$ | (d) $[M^{-1}L^2T^{-2}]$ |

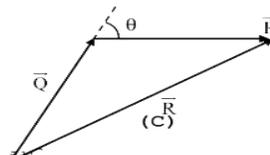
- Q7. The amplitude of SHM is a and time period is T . The maximum instantaneous velocity will be
 (a) $4a/T$ (b) $2a/T$
 (c) $2\pi a/T$ (d) None of these
- Q8. If we go downward from the earth's surface, the value of acceleration due to gravity (g)
 (a) decreases (b) remains constant
 (c) increases (d) None of these
- Q9. Two soap bubbles have radii in the ratio 2:1. The ratio of excess pressures inside them is:
 (a) 1:2 (b) 2:1
 (c) 4:1 (d) 1:4
- Q10. A tuning fork of frequency 580 Hz is employed to produce transverse waves on a long rope. The distance between the nearest crests is found to be 20 cm. The velocity of the wave is
 (a) 58 ms^{-1} (b) 20 ms^{-1}
 (c) 580 ms^{-1} (d) 116 ms^{-1}
- Q11. A body starts from rest and travels on straight path for t second with uniform acceleration of 2 m/s^2 . If the displacement made by it is 25 m, the time of travel t is
 (a) 4 s (b) 3 s
 (c) 6 s (d) 5 s
- Q12. According to work energy theorem the work done by the net force on a particle is equal to the change in its
 (a) Kinetic energy (b) Angular momentum
 (c) Linear momentum (d) Potential energy
- Q13. When a satellite revolves close to the surface of the earth, orbital velocity becomes
 (a) $(gR)^{1/2}$ (b) $(gR)^{3/2}$
 (c) $(gR)^{5/2}$ (d) $(gR)^{7/2}$
- Q14. Which of the following representation is incorrect for vector equation $\vec{R} = \vec{P} + \vec{Q}$?



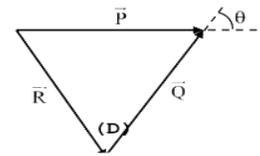
(a)



(b)



(c)



(d)

- Q15. A particle performs circular motion with an angular momentum J . If the frequency of the particle's motion is doubled and its kinetic energy is halved, the angular momentum becomes
 (a) $2J$ (b) $4J$
 (c) $J/2$ (d) $J/4$

Note:Q16-18 are Assertion Reason type questions.Choose the correct option from the following options:

- (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.

Q16.Assertion (A): The perpendicular vector of $(\hat{i} + \hat{j} + \hat{k})$ is $(\hat{i} - 2\hat{j} + \hat{k})$.

Reason (R): Two vectors are perpendicular if their dot product is equal to zero.

Q17. Assertion(A): On a banked curved track, vertical component of normal reaction provides the necessary centripetal force.

Reason(R): Centripetal force is not always required for turning.

Q18.Assertion (A): Specific heat capacity is the cause of formation of land and sea breeze.

Reason(R) : The specific heat of water is more than land.

SECTION :-B

Q19.A body covers a measured distance of (13.8 ± 0.2) m in a measured time interval (4 ± 0.3) s.

Calculate its speed with error limits.

Q20.The change in the value of g at a height h above the earth is the same as at a deep d below it. If h and d are compared to the radius of the earth, what is the ratio (h/d) ?

OR

State Newton's law of gravitation and explain how force of gravitation between two objects of masses m each change if distance between them is halved?

Q21.An object moves from A to B with the speed 40 ms^{-2} and returns from B to A with the speed 60 m^{-2}
Calculate average speed and average velocity of the body.?

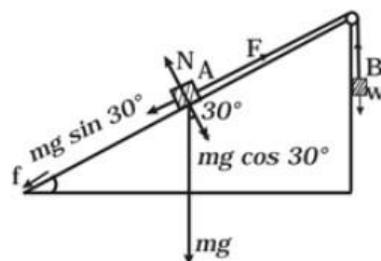
Q22.What is degree of freedom? Calculate the number of degrees of freedom of diatomic gas.

OR

What are the assumptions of kinetic theory of gases (4 points)

Q23.Explain why the temperature less than absolute zero (0 K) is not possible.

Q24.Block A of weight 100 N rests on a frictionless inclined plane of slope angle 30° (Fig.). A flexible cord attached to A passes over a frictionless pulley and is connected to block B of weight W . Find the weight W for which the system is in equilibrium.



SECTION :-D

Q31.(i)For an ideal fluid explain

- (a)Kinetic energy (b) Potential energy (c) Pressure energy

(ii)An steel sphere of radius 2×10^{-3} m is falling through glycerin. Determine the terminal velocity of the sphere. Relative densities of steel and glycerine are 8 and 1.3 respectively. The coefficient of viscosity of glycerine is 0.83 in SI units.

OR

- (i)When a spherical body falls in a viscous fluid, how many forces act on it?
(ii)What is terminal velocity of the body during motion.
(iii)How the terminal velocity of a body during motion in viscous fluid depends upon the size of body?

Q32.(i)A cubical body is heated to a certain temperature. Explain and derive the relation among coefficients of linear, superficial and cubical expansion.

(ii)A copper rod is 1.50 m long at 20° C. What is the increase in length when it is heated to 40° C? The Coefficient of linear expansion is 1.7×10^{-6} per $^{\circ}$ C.

Q33.An ideal gas is kept in a cubical container. Gas molecules exerts pressure on the walls of container.

Calculate (i) Pressure exerted by gas

(ii)Show that average kinetic energy of one mole of gas is directly proportional to absolute temperature.

OR

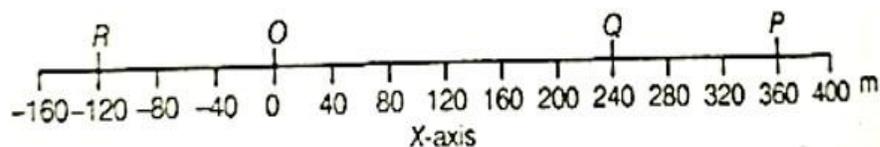
(i)Explain Kinetic interpretation of temperature and hence explain why temperature below absolute zero is not possible.

(ii)Show that root mean square velocity of gases is directly proportional to square root of absolute temperature and inversely proportional to square root of molecular weight.

SECTION :-E

Q34.Read the text carefully and answer the questions:

If the position of an object is continuously changing w.r.t. its surrounding, then it is said to be in the state of motion. Thus, motion can be defined as a change in position of an object with time. It is common to everything in the universe. In the given figure, let P, Q and R represent the position of a car at different instants of time.



- (i) With reference to the given figure, What are the position coordinates of points P and R?
- (ii) Give any 2 differences between distance and displacement.
- (iii) From the given figure, find the displacement of a car in moving from O to P and then to Q?
- (iv) If the car goes from O to P and returns back O, what will be the displacement of the car for whole journey?

Q35. Read the text carefully and answer the questions:

There are many types of spring. Important among these are helical and spiral springs as shown in the figure. Usually, we assume that the springs are massless. Therefore, work done is stored in the spring in the form of the elastic potential energy of the spring. Thus, the potential energy of a spring is the energy associated with the state of compression or expansion of an elastic spring.

- (i) When the potential energy of a spring may be considered as zero?
 - (ii) The ratio of spring constants of two springs is 2 : 3. What is the ratio of their potential energy, if they are stretched by the same force?
 - (iii) The potential energy of a spring increases by 15 J when stretched by 3 cm. If it is stretched by 4 cm. What will be the increase in potential energy.
 - (iv) The potential energy of a spring when stretched through a distance x is 10 J. What is the amount of work done on the same spring to stretch it through an additional distance x ?
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