No. of Printed Pages/Questions: 8/ 33

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Annual Examination - (2025 – 2026)

Class: XI **Subject: Physics (042)**

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

General Instructions:

(1) There are 33 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.

(3) All the sections are compulsory.

(4) **Section A** contains **sixteen questions, twelve MCQ and four assertion reasoning based of 1 mark each**, **Section B** contains **five questions of two marks each**, **Section C** contains seven questions of three marks each, **Section D** contains **two case study-based questions of four marks each** and **Section E** contains **three long answer questions of five marks each**.

(5) There is no overall choice. However, an internal choice has been provided in two question in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

(i)$G=6.674 \times 10^{-11}$ N.m^2/kg^2

(ii)k=1.38 × 10–23 J/K

(iii) h=6.626 × 10–34 J.s

(iv)R=8.314 J/(mol. K)

(v)Latent heat of vaporisation= 2256KJ/Kg = 540 cal/g

(vi) Latent heat of fusion= 334KJ/Kg= 80 cal/g

SECTION A

Q1. A force F is given by $F = at + bt^2$, where t is time. What are the dimensions of a and b?

(a)MLT^{-1} and MLT^0 (b) MLT^{-3} and ML^2T^4

(c) MLT^{-4} and MLT^1 (d) MLT^{-3} and MLT^{-4}

Q2. A particle is moving with uniform acceleration in x-direction, the displacement x of particle varies with time t as $x = 4t^2-15t+25$ m . Acceleration of particle at t = 2 s

(a)0 ms^{-2} (b) 8 ms^{-2}

(c) 10 ms^{-2} (d) 20 ms^{-2}

Q3. Calculate the angle between two vectors i–2j+ 3k and 3i–2j+k .

(a) $\cos^{-1}\frac{1}{5}$ (b) $\cos^{-1}\frac{5}{7}$

(c)$\cos^{-1}\frac{2}{7}$ (d) $\cos^{-1}\frac{2}{5}$

Q4. A simple pendulum is suspended from the ceiling of a lift, when the lift is at rest, its time period is T. with what acceleration should lift be accelerated upwards in order to reduce its time period to $\frac{T}{2}$?

(a)2g (b)3g

(c)4g (d)5g

Q5. A particle performs simple harmonic motion along the x-axis with amplitude A. At which displacement from the mean position is its speed maximum?

(a) At $x = \pm A$
(b) At $x = \pm \frac{\pm A}{2}$
(c) At $x = 0$
(d) At every point, the speed is the same

Q6. Two waves of wavelengths 50 cm and 51 cm produced 12 beats per second. The velocity of sound is

(a) 340 m/s
(b) 331 m/s
(c)306 m/s
(d) 360 m/s

Q7. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in m /s) after collision will be

(a)0,1
(b)1,1
(c)1, 0.5
(d)0, 2

Q8. A wheel of mass 10 kg has moment of inertia of 160 kgm^2 about its own axis. The radius of gyration about same axis is :

(a)10m
(b)4m
(c)5m
(d)6m

Q9. One gram mole of an ideal gas at N.T.P. is first expanded isothermally to twice the original volume. It is then compressed at constant volume, till its pressure is raised to the original value. Calculate the total amount of work done. (Given R = 8.3 J $mole^{-1}$ K^{-1}) (ln2 = 0.693)

(a) 5.4×10^3 J
(b) 1.57×10^3 J
(c) 9.2×10^3 J
(d) 12.5×10^3J

Q10. A diatomic ideal gas undergoes an adiabatic process at room temperature. The relation between temperature and volume for this process is $T V^x$ = constant, then x

(a) $\frac{2}{5}$
(b) $\frac{2}{3}$
(c) $\frac{5}{3}$
(d) $\frac{3}{5}$

Q11. The fundamental frequency of closed organ pipe is equal to the first overtone frequency of an organ pipe. If the length of the open pipe organ is 60cm .What is length of the closed pipe?

(a)10cm
(b)15 cm
(c)20 cm
(d)25 cm

Q12. The escape velocity of a body from earth's surface is V_e. The escape velocity of the same body from a height equal to 7R from the earth's surface will be?

(a) $\frac{V_e}{2\sqrt{2}}$
(b) $\frac{V_e}{2}$
(c) $\frac{V_e}{3}$
(d) $\frac{V_e}{3\sqrt{2}}$

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

A. If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
C. If Assertion is true but Reason is false.
D. If both Assertion and Reason are false.

Q13. Assertion: In adiabatic compression, the internal energy and temperature of the system get decreased.
Reason: The adiabatic compression is a slow process .

Q14. Assertion: The shape of a liquid drop is spherical.
Reason : The pressure inside the drop is greater than that of outside.

Q15. Assertion: Burns from steam is more serious than water at same temperature.
Reason : Water has higher Latent heat of fusion as compared to latent heat of vaporisation.

Q16. Assertion: On a banked curved track, horizontal component of normal reaction provides the necessary centripetal force.
Reason : centripetal force is not always required for turning.

SECTION B

Q17. A body travels a distance of 20 m is 7th second and 24 m in 9th second. How much distance shall it travel in 15th second?

OR

The motion of an object is given by the equation $\frac{dv}{dt} = 4-2v$, where v is the speed of the object in ms^{-1} and t is in second .The object is at rest at t = 0 then prove that speed varies with time as , $v = 2(1-e^{-2t})$ ms^{-1}.

Q18. A thin rod of mass 96 g and of length 1 m is made to rotate about an axis perpendicular to the length of rod passing through a point at a distance 25 cm from one end of rod. Find the moment of inertia of that rod?

Q19. (i)A force F=20+10y acts on a particle in y-direction where F is in newton and y in meter. Calculate work done by this force to move the particle from $y=0$ to $y=1$ m.
(ii)State Kepler's second law of gravitation. Also draw diagram supporting this law.

Q20. Write 5 postulates of kinetic theory of gas.

Q21. A composite wire consists of a steel wire of length 1.5m and a copper wire of length 2.0m with a uniform cross-sectional area of $2.5 \times 10^{-5} m^2$. It is loaded with a mass of 200kg. Find the extension produced. Young's modulus of copper is 1.0×10^{11} Nm^{-2} and that of steel is 2.0×10^{11} Nm^{-2}. (Take g = $9.8 ms^{-2}$)

SECTION C

Q22. Attempt either **(A)** or **(B):**

(A):

Prove speed of sound in air is given by $V=\sqrt{\frac{\gamma P}{\rho}}$ where γ is possion ratio , P is pressure in sound and ρ is density of air .

OR

(B):

(i) A wire stretched between two rigid supports vibrates in its fundamental mode with a frequency of 45 Hz .The mass of wire is 3.5×10^{-2} kg and its linear density is 4×10^{-2} kg/m .What is the speed of transverse wave on string and tension in the wire.

(ii)Write two differences between Progressive and standing waves.

Q23. (i)An ice cube of density of 900 kg/m^3 is floating in water of density 1000 kg/m^3. Calculate percentage of volume of ice outside the water ?

(ii) A sphere contracts in volume by 0.01%, when taken to the bottom of sea 1 km deep. Find the bulk modulus of the material of the sphere. Density of sea water may be taken as 1×10^3 kg m^{-3}. (Take g= 9.8ms^{-2})

(iii) 10gm of steam at100 ^{0}C is mixed with 50gm of ice at 0^{0}C then calculate its final temperature?

Q24. (i) Derive an expression for pressure due to an ideal gas.

(ii) If root mean square velocity of the molecules of hydrogen at NTP is 1.84 kms^{-1}, Calculate the rms velocity of oxygen molecules at NTP.

Q25. A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1 m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. Find the minimum angular velocity needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis. (g=10 m/s^2)

Q26. (i)Calculate the area enclosed by a circle of diameter 1.06 m with correct number of significant figures?

(ii) If E ,m ,L and G denote energy, mass, angular momentum and gravitational constant respectively, then find the dimension of a quantity $\frac{EL^2}{m^5G^2}$?

Q27. Attempt either **(A)** or **(B):**

(A):

A rod of mass 15 kg and length 50 cm is hinged at its one end and suspended with a massless string from other end. The string is cut at t=0 , then find (take g= 10ms^{-2})

(i)angular acceleration

(ii)acceleration of centre of mass

(iii)hinged forces

OR

(B):

A system consisting of two objects and has a total momentum 18 kg m/s $\hat{\imath}$, and its centre of mass has the velocity 3 m/s $\hat{\imath}$. One of the object has the mass 4 kg. and velocity 1.5 m/s $\hat{\imath}$. Then find the mass and velocity of other object.

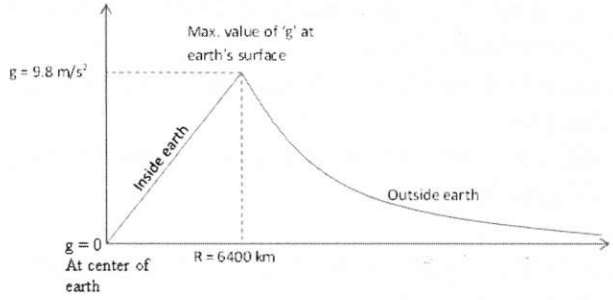
Q28. (i)The horizontal range of a projectile is $2\sqrt{3}$ times its maximum height. Find the angle of projection.

(ii)If a vector $2i + 4j + 6k$ is perpendicular to the vector $5i + 6j - ak$ .Find the value of a

SECTION D

Q29. Variation of graph with altitude

The following graph shows how the gravitational acceleration g varies with altitude h from the surface of the earth.



(i). From the graph, what happens to 'g' as altitude increases?

(a) It increases exponentially.
(b) It decreases linearly.
(c) It decreases non linearly.
(d) It remains constant

(ii). If the altitude is 1000km, what is the approximate value of g ?

(a) 9.8 m/s^2 (b) 8.5 m/s^2
(c) 7.3 m/s^2 (d) 6.5 m/s^2

(iii). At what altitude does the gravitational acceleration become half of its surface value?

(a) 2650 km (b) 1600km
(c) 4000km (d) 5000km

(iv).Which physical law explains the variation in g with altitude?

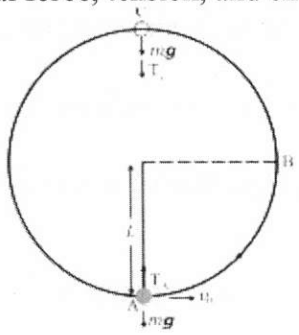
(a) Hooke's law (b) Newton's law of universal gravitation
(c) Coulomb's law (d) Archimedes' principle.

OR

(v). If the altitude increases beyond 5000 km, what will happen to the gravitational acceleration?

(a) It will increase after a certain point.
(b) It will decrease and eventually become zero.
(c) It will remain constant after 5000 km.
(d) It will fluctuate based on the mass of the object.

Q30. A mass m is attached to a string of length r and is swung in a vertical circle. The mass is released from the top of the circle. The study focuses on the forces acting on the mass and the concepts of centripetal force, tension, and energy transformations.



(i)At the highest point of the vertical circle, which forces are acting on the mass, and how do they contribute to the centripetal force?

(a) Only gravitational force acts downward, providing all the centripetal force.
(b) Tension acts upward and gravitational force acts downward, and they together provide the centripetal force.
(c) Only tension acts upward, which is greater than the gravitational force, providing the centripetal force.
(d) Gravitational force acts downward, and tension is zero at the highest point, providing no centripetal force.

(ii)What happens to the tension in the string as the mass moves from the top to the bottom of the vertical circle?

(a) Tension remains constant throughout the motion.
(b) Tension increases as the mass moves downward.
(c) Tension decreases as the mass moves downward.
(d) Tension becomes zero at the bottom of the circle.

(iii) What is the minimum speed required at the lowest point to maintain circular motion?

(a)$\sqrt{(5rg)}$ (b) $2\sqrt{(rg)}$
(c) $\sqrt{(2rg)}$ (d) $3\sqrt{(rg)}$

(iv) Which statement best describes the energy transformations that occur as the mass moves from the top to the bottom of the vertical circle?

(a) Kinetic energy is converted into potential energy.
(b) Potential energy is converted into kinetic energy.
(c) Total mechanical energy decreases.
(d) Kinetic energy remains constant throughout the motion.

OR

When the mass reaches the lowest point of the vertical circle, what is true about the forces acting on it?

(a) Only gravitational force acts, and the mass experiences no net force.
(b) Tension in the string is zero, and gravitational force provides centripetal force.
(c) The net force is directed upward, and tension is greater than gravitational force.
(d) Both tension and gravitational force act downward, resulting in no centripetal force

SECTION E

Q31. Attempt either **(A)** or **(B):**

(A):

(i)A sample of hydrogen of mass 5 g is allowed to expand isothermally at 27°C till its volume is doubled. Calculate work done during expansion?

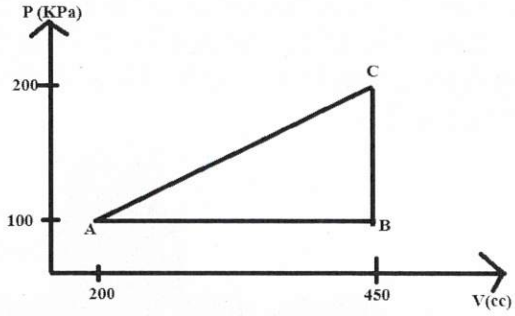
(ii)What is the relation between temperature and volume for adiabatic change in a thermodynamics system?

(iii) A gas at 2×10^5 Pa pressure and 300K temperature is compressed adiabatically to $\frac{1}{6}$ th of its initial volume. The final temp. of the gas becomes 750K, then find the value of γ for the gas? (ln 6= 1.8 and ln 15= 2.72)

OR

(B):

(i) Find the work done by the gas in the state diagram.



(ii) One mole of an ideal gas is compressed adiabatically at 27°C. Its temperature becomes 102°C then finds the work done in this process?

Q32. Attempt either **(A)** or **(B):**

(A):

(i) An 8 kg body performs SHM of amplitude 30 cm. The restoring force is 60 N, when the displacement is 30 cm.

Find (a) time period

(b) the acceleration when displacement is 5 cm.

(c) Potential and Kinetic energy when displacement is 12 cm.

(ii)A spring of force constant K is cut into lengths of ratio 1:2:3. They are connected in series and the new force constant is K_1. Then they are connected in parallel and force constant is K_2. Then find the ratio of K_1 and K_2.

OR

(B):

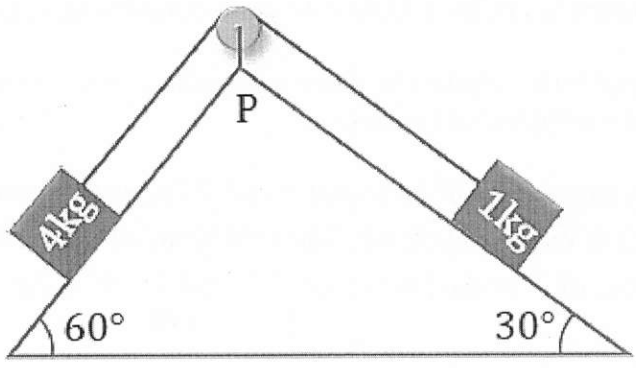
(i) If the length of second's pendulum is increased by 1 % , how many seconds will it loss or gain in a day?

(ii)A particle is performing simple harmonic motion and initially starts from $\frac{-A}{\sqrt{2}}$ moving in positive x -direction . write its equation of x and t.

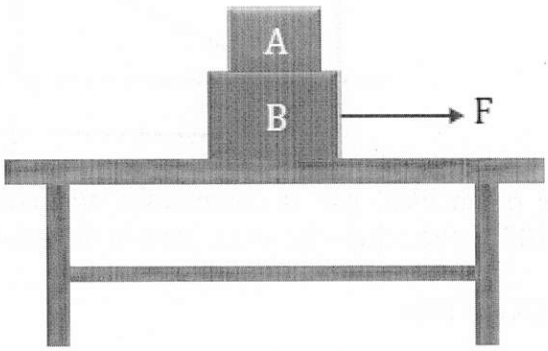
Q33. Attempt either **(A)** or **(B):**

(A):

(i)As per given figure, a weightless pulley *P* is attached on a double inclined frictionless surface. Find the tension in the string and acceleration of blocks . (Take, $g = 10 m/s^2$).



(ii) Two blocks A and B of masses $m_A = 1$ kg and $m_B = 3$ kg are kept on the table as shown in figure. The coefficient of friction between A and B is 0.2 and between B and the surface of the table is also 0.2.Calculate the maximum force F that can be applied on B horizontally, so that the block A does not slide over the block B i ? (Take $g = 10 m/s^2$)



OR

(B):

(i) A particle moves in a circle of radius 20 cm. Its linear speed at any time is given by $v = 2t$ where v is in m/s and t is in seconds. Find the centripetal and tangential acceleration at $t = 3$ seconds and hence calculate the total acceleration at this time.

(ii) A disc revolves with a speed $26\frac{1}{2}$ rev/min, and has a radius of 30 cm. Two coins *A* and *B* are placed at 4 cm and 28 cm away from the centre of the disc. If the coefficient of friction between the coins and the disc is 0.2 which of the coins will revolve with the disc? Give reason.

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