UNIT TEST 2 ,2025-26

CLASS XI

PHYSICS

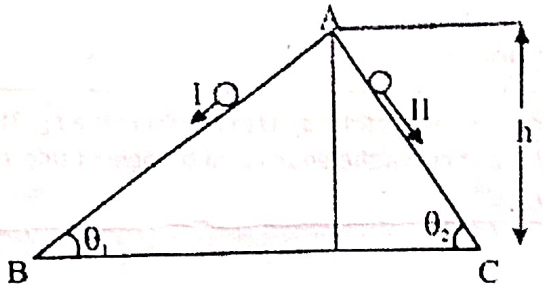
Time: 1 Hr 30 min. M.M.: 40

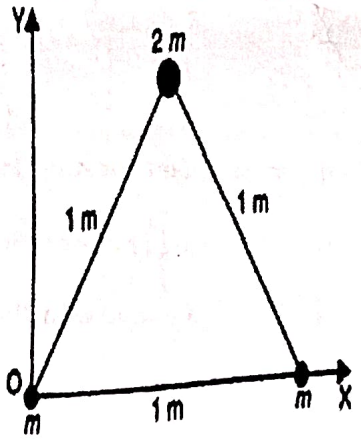
General Instructions:

(i) There are 17 questions in all. All questions are compulsory.

(ii) Section A contains 3 MCQs and 2 assertion-reasoning questions of 1 mark each, Section B contains four questions of two marks each, Section C contains six questions of three marks each, Section D contains one question of four marks and Section E contains one question of 5 marks.

(iii) Use of smart watch is not allowed.

	SECTION A	
1.	Two inclined frictionless tracks ,one gradual and other steep meet at A from where the two stones are allowed to slide down from rest ,one on each track as shown:  Which of the following statements is correct: (a) Both the stones reach the bottom at the same time but with different speeds (b) Both the stones reach the bottom with the same speed but stone I reaches the bottom earlier than stone II. (c) Both the stones reach the bottom with the same speed but stone II reaches the bottom earlier than stone I. (d) Both the stones reach the bottom with different times and with different speeds.	1
2	When the load of the wire is increased slowly from 2kg to 4kg ,the elongation increases from 0.6mm to 1.0mm. Taking g = 10m/s^2 , the work done during the extension is : a) 14 J b) 14 mJ c) 28 J d) 28 mJ	1
3	A boy is standing on a disc rotating about the vertical axis passing through its center .He pulls his arms towards himself, reducing his moment of inertia by a factor of *m*. The new angular speed of the disc becomes double its initial value. If the moment of inertia of the boy is I_0 , then the moment of inertia of the disc will be:	1

	a) $2I_0/m$ b) $I_0(1-\frac{2}{m})$ c) $I_0(1-\frac{1}{m})$ d) $I_0/2m$	
	ASSERTION & REASON : **The following questions consists of two statements each, printed as Assertion and Reason. While answering these questions you are to choose any one of the following four responses.** **(A) If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion.** **(B) If both Assertion and Reason are true but Reason is not an explanation of the Assertion.** **(C) If Assertion is true but the Reason is false.** **(D) If Assertion is false but Reason is true.** **(E) If both Assertion and Reason are false.**	
4	**Assertion:** Modulus of rigidity for an ideal fluid is infinite. **Reason** : A liquid at rest begins to move under the effect of tangential force.	1
5	**Assertion** : Torque on a body can be zero even if there is no net force on it. **Reason** : Torque and force are always perpendicular .	1
	SECTION B	
6	Determine the x and y - coordinates of the center of mass of the system shown in the fig .The system consists of masses m,m,2m placed at the vertices of the equilateral triangle of side 1m.  	2
7	The masses and the co-ordinates of three spheres are : 20kg, x=0.50m,y=1.0m ; 40kg x= -1.0 m y= -1.0 m; 60 kg, x=0,y= -0.50 m. What is the magnitude of the gravitational force on a 20kg sphere located at the origin due to the other spheres	2
8	A cube of aluminum of each side 4 cm is subjected to a tangential force . The top face of the cube is sheared through 0.12 cm w.r.t. to the bottom face . Find the shearing strain , shearing stress and the shearing force . Given the modulus of rigidity is $2.08 * 10^{11}$ dynes cm^{-2}.	2
9	Derive the expression for gravitational potential energy.	2

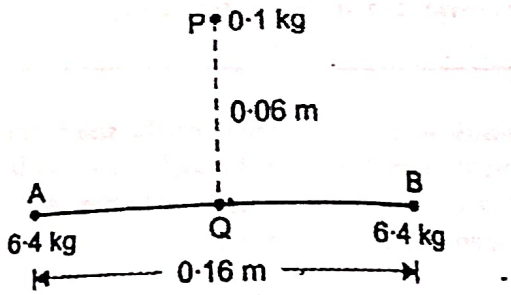
	SECTION C	
10	(a) Define coefficient of restitution. Mention its SI units. (b) A block of mass m moving with a speed v collides with another block of mass 2m at rest. The lighter block comes to rest after the collision. Find the coefficient of restitution.	3
11	State and prove Kepler's Law of Area.	3
12	Read each of the statement carefully and state with reason if it is true or false: a) When a material is under the tensile stress ,the restoring forces are caused by interatomic attraction, while under the compressional stress the restoring forces are due to interatomic repulsions. b) A piece of rubber under an ordinary stress can display 1000% strain, yet when unloaded it returns to it's original length. This shows that the elastic restoring forces in a rubber piece are strictly conservative. c) Elastic restoring forces are strictly conservative when Hooke's law is obeyed.	3
13	Derive the expression for the rotational kinetic energy of the body and hence define Moment of Inertia.	3
14	Two equal masses of 6.40 kg are separated by a distance of 0.16m. A small body is released from a point P equidistant from the two masses and at a perpendicular distance of 0.06m from the line joining them. i) Calculate the velocity of the body when it passes through Q. ii) Calculate the acceleration of this body at P and Q if it's mass is 0.1kg 	3
15	A stone of 0.5 kg mass is attached to one end of a 0.8m long aluminum wire of 0.7mm diameter and suspended vertically . The stone is now rotated in a horizontal plane at a rate such that wire makes an angle of 60^0 with the vertical. Find the increase in the length of the wire . The young's modulus of aluminum is $7*10^{10}$ N/m^2.	3
	SECTION D	
16	**CASE BASED QUESTION**	

Table below shows the major differences between linear and rotational motion:

TABLE 7.2 Analogy between linear motion and rotational motion

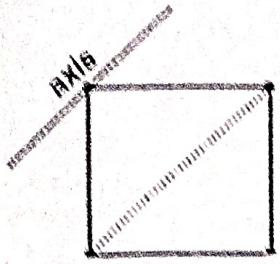
	Linear Motion		Rotational Motion
1.	Distance/displacement (s)	1.	Angle or angular displacement (θ)
2.	Linear velocity $v = \frac{ds}{dt}$	2.	Angular velocity $\omega = \frac{d\theta}{dt}$
3.	Linear acceleration $a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$	3.	Angular acceleration $\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$
4.	Mass (m)	4.	Moment of inertia (I)
5.	Linear momentum $P = mv$	5.	Angular momentum $L = I\omega$
6.	Force $F = ma$	6.	Torque $\tau = I\alpha$
7.	Also, force $F = \frac{dp}{dt}$	7.	Also, torque $\tau = \frac{dL}{dt}$
8.	Translational K.E $= \frac{1}{2}mv^2 = \frac{p^2}{2m}$	8.	Rotational K.E $= \frac{1}{2}I\omega^2 = \frac{L^2}{2I}$
9.	Work done, $W = Fs$	9.	Work done, $W = \tau\theta$
10.	Power $P = Fv$	10.	Power $= \tau\omega$
11.	Linear momentum of a system is conserved when no external force acts on the system. (Principle of conservation of linear momentum)	11.	Angular momentum of a system is conserved when no external torque acts on the system. (Principle of conservation of angular momentum)
12.	Equations of Translational motion (i) $v = u + at$ (ii) $s = ut + \frac{1}{2}at^2$ (iii) $v^2 - u^2 = 2as$, where the symbols have their usual meaning.	12.	Equations of Rotational motion (i) $\omega_2 = \omega_1 + \alpha t$ (ii) $\theta = \omega_1 t + \frac{1}{2}\alpha t^2$ (iii) $\omega_2^2 - \omega_1^2 = 2\alpha\theta$, where the symbols have their usual meaning.
13.	Distance travelled in nth second $S_{nth} = u + \frac{a}{2}(2n-1)$	13.	Angle traced in nth second $\theta_{nth} = \varphi_1 + \frac{\alpha}{2}(2n-1)$

In view of the above table answer the following questions:

(i) A wheel is rotating freely with an angular speed ω on the shaft. The moment of the inertia of the wheel is I and the moment of the inertia of the shaft is negligible. Another wheel of the moment of inertia 3I initially at rest is suddenly coupled to the same shaft. The resultant fractional loss in the Kinetic energy of the system is :

a) 6/5 b)1/4 c) 3/4 d) 0

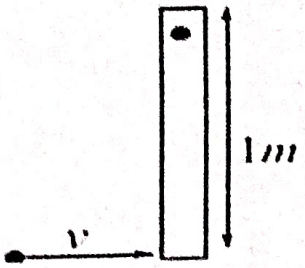
ii) Four point masses each of mass m are fixed at the corners of the square of side l. The square is rotating with an angular frequency ω ,about an axis passing through one of the corners of the square and parallel to one of it's diagonal as shown in the fig.



The angular momentum of the square about the axis is:

a) $ml^2\omega$ b) $2ml^2\omega$ c) $3ml^2\omega$ d) $4ml^2\omega$

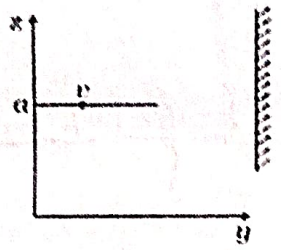
iii) A thin rod of mass 0.9 kg and length 1m is suspended at rest from one end so that it can freely oscillate in a vertical plane. A particle of mass 0.1 kg is moving in a straight line with a velocity 80m/s hits the rod at its bottommost point and sticks to it .



The angular speed of the rod immediately after collision will be

a) 10 rad/s b) 15 rad/s c) 20 rad/s d) 25 rad/s

iv) A particle of mass m is moving in yz-plane with a uniform velocity v with its trajectory running parallel to +ve y-axis and intersecting z-axis at z = a

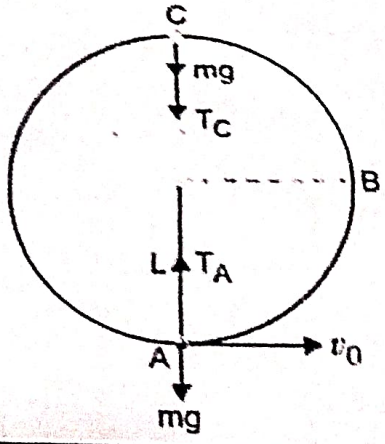


The change in its angular momentum about the origin as it bounces elastically from a wall at y = constant is:

(a) $mva\,\hat{e}_x$ (b) $2mva\,\hat{e}_x$ (c) $ymv\,\hat{e}_x$ (d) $2ymv\,\hat{e}_x$

SECTION E

17 A bob of mass m is suspended by a light string of length L. It is imparted a horizontal velocity v_0 at lowest point A such that it completes a semi-circular trajectory in the vertical plane with the string becoming slack only on reaching the top most point C . This is shown in the fig. 5



(a) Obtain the expression v_0.
(b) Speed at the points B and C.
(c) Ratio of the Kinetic energies at B and C
(d) Comment on the nature of the trajectory of the bob after it reaches C

HALF-YEARLY EXAMINATION (2025-26)

Subject: PHYSICS (042)

Class: XI

Time: 3 Hours **M.M.: 70**

General Instructions:

(i) There are 33 questions in all. All questions are compulsory.

(ii) The question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(iii) All the sections are compulsory.

(iv) Section A contains sixteen questions, twelve MCQs and 4 assertion-reasoning questions 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 question of four marks and Section E contains three questions of five marks each.

(v) There is no overall choice. However, an internal choice has been provided in one question in section B, one question in section C, one question in each CBQ in section D and in all three of section E. you have to attempt only one of the choices in such questions.

(vi) Use of calculator is not allowed.

Section: A

Q1. The dimension of light year is **(1)**

(a) [T] (b) [LT^{-1}] (c) [L] (d) [T^{-1}]

Q2. The atmospheric pressure is 10^6 dyne/cm^2 in CGS system. What is its value in SI unit? **(1)**

(a) 10^4 N/m^2 (b) 10^5 N/m^2 (c) 10^6N/m^2 (d) 10^{-5}N/m^2

Q3. When the distance travelled by the body is proportional to the time taken. Its speed

(a). Remains same (c). increases

(b). Becomes zero (d). decreases **(1)**

Q4. Which physical quantity we will get under the area of position-time graph **(1)**

(a). Velocity (c). Time

(b). Acceleration (d). No physical quantity

Q5. A body is dropped from the top of the tower of height H meters. It takes 't' time to reach the ground. Where is the body, t/2 times after the release **(1)**

(a). At H/2 from the ground (c). At 3H/4 from the ground

(b). At H/4 from the ground (d). At H/6 from the ground

Q6. In one dimensional motion, instantaneous speed v satisfies $0 \leq v \geq v_0$ then **(1)**

(a) Displacement in time t must always be non-negative

(b) Displacement x in the time t satisfies $-v_0t < x > v_0t$

(c) Acceleration is always a non-negative number.

(d) Motion has no turning point

Q7. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to vector $\vec{A}$ and its magnitude is equal to half of the magnitude of vector $\vec{B}$. The angle between $\vec{A}$ and $\vec{B}$ is **(1)**

(a) 120° (b) 150° (c) 135° (d) 45°

Q8. A man of mass **80 kg** is standing in an elevator which is moving with an acceleration of **2 ms^{-2}** in upward direction. The **apparent weight** of the man will be ($g = 10\ ms^{-2}$) **(1)**

(a). 1920 N (b). 1600 N (c). 640 N (d). 960 N

Q9. An athlete throws a javelin with velocity of **20 m/s** at an angle of **15°** with the horizontal. How far javelin would hit the ground from the point of projection **(1)**

(a) 20.4 m (b) 20.2 m (c) 20 m (d) 40.8 m

Q10. A body of mass **2 kg** slides down with an acceleration of **3 m/s^2** on a rough inclined plane having a slope of **30°**. The external force required to take the same body up the inclined plane with same acceleration will be ($g = 10\ m/s^2$) **(1)**

(a). 6 N (b). 14 N (c). 4 N (d). 20 N

Q11. When forces F_1, F_2, and F_3 are acting on a particle of mass m such that F_2 and F_3 are mutually perpendicular then particle remains stationary. If the force F_1 is now removed then the acceleration of particle is **(1)**

(a). F_1/m (b). F_2F_3/mF_1 (c). $(F_2-F_3)/m$ (d). F_2/m

Q12. If A body of mass **m** dropped from a height **h** reaches the ground with a speed of $0.8\sqrt{gh}$. The value of work done by the air friction is **(1)**

(a) -0.68 mgh (b) mgh (c) 0.64 mgh (d) 1.64 mgh

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 Assertion is false but Reason is true
(e). If both Assertion and Reason are false.

Q13. Assertion: The work done in moving a body over a closed loop is zero for every force in nature.
Reason: Gravitational force is conservative in nature. **(1)**

Q14. Assertion: If dot product of **A** and **B** are zero, it implies that one of the vector **A** and **B** must be a null vector.
Reason: Null vector is a vector with zero magnitude. **(1)**

Q15. Assertion: On a rainy day, it is difficult to drive a car or bus at high speed.
Reason: The value of coefficient of friction is lowered due to wetting of the surface. **(1)**

Q16. Assertion: In projectile motion, the angle between the instantaneous velocity and acceleration at the highest point is 180°.
Reason: At the highest point, velocity of projectile will be in horizontal direction only. **(1)**

Section: B

Q17. When **1m, 1 kg** and **1 min** are taken as the fundamental units, the magnitude of the force is **36 units**. What will be the value of this force in CGS system? **(2)**

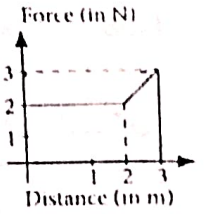
OR

The relation between time **t** and distance ***x*** is, $t=\alpha x^2+\beta x$ where α and β are constants. Show that retardation is $2\alpha v^3$, where v is the instantaneous velocity. **(2)**

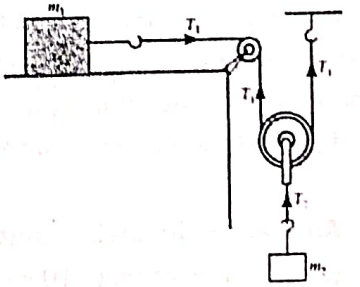
Q18. The length of a rectangular block is **2.5 m,** breadth is **1.75 m**. Calculate its **perimeter and area** taking into account the significant figures. **(2)**

Q19. **ABCDEF** is a regular hexagon with point **O** as centre. Calculate the value of $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}$ **(2)**

Q20. A particle moves in one dimension from rest under the influence of a force that varies with the distance travelled by the particle as shown in the figure. Tell its kinetic energy when it covers 3 m. **(2)**



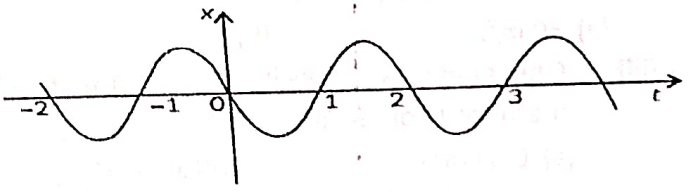
Q21. In terms of masses m_1,m_2 and **g**, find the acceleration of both the blocks shown in fig. neglect all friction and masses of the pulley. **(2)**



Section: C

Q22. If A gas bubble from an explosion under water oscillates with time period T, this time period depends upon static pressure P, density of the water d and total energy E. Using dimensions find the expression of time period T. **(3)**

Q23. In the given figure x-t plot of a particle executing one dimensional simple harmonic motion. Give the signs of **position, velocity and acceleration** variables of the particle at **t= 0.3 s, 1.2 s, -1.2 s.** **(3)**



OR

A man is standing on the top of a building **100 m** high. He throws two balls vertically, one at **t = 0** and other after a time interval (less than **2 seconds**). The later ball is thrown at a velocity of **half the first.** The vertical gap between first and second ball is **+15** m at **t = 2s**. The gap is found to remain constant. Calculate the velocity with which the balls were thrown and the exact time interval between their thrown. **(3)**

Q24. The frequency of the vibration of a string depends on **(i)** tension in the string **(ii)** mass per unit length of the string, **(iii)** length of the string. Find dimensionally the relation for frequency. **(3)**

Q25. A For an object projected upward with a velocity **u**, which comes back to same point after some time, draw:

(a) Acceleration-time graph

(b) Velocity-time graph

(c) Position-time graph (3)

Q26. A river 800 m wide flows at the rate of **5 kmh^{-1}**. A swimmer who can swim at **10 kmh^{-1}** in still water, wishes to cross the river straight. (i) Along what direction must he strike? (ii) What should be his resultant velocity? (iii) How much time he would take? (3)

Q27. A box of mass **4 kg** rests upon an inclined plane. The inclination of the horizontal is gradually increased. It is found that when the slop of the plane is **1 in 3**, the box starts sliding down the plane. Given g = 9.8 ms^{-2}. (3)

(i) Find the coefficient of friction between the box and the plane.

(ii) What force applied to the box parallel to the plane, just make it move up the plane?

Q28. State work-energy theorem. Derive its expression for variable force. (3)

Section: D

Q29. Case Study Based Question: Conservation of Momentum

This principle is a consequence of Newton's second and third laws of motion.

In an isolated system (i.e., a system having no external force), mutual forces (called internal forces) between pairs of particles in the system causes momentum change in individual particles.

Let a bomb be at rest, then its momentum will be zero. If the bomb explodes into two equal parts, then the parts fly off in exactly opposite directions with same speed, so that the total momentum is still zero. Here, no external force is applied on the system of particles (bomb).

Answer the following questions (1×4 =4)

(i) A shell of mass 10 kg is moving with a velocity of 10 ms^{-1} when it blasts and forms two parts of mass 9 kg and 1 kg respectively. If the first mass is stationary, the velocity of the second is

(a) 1 m/s **(b)** 10 m/s **(c)** 100 m/s **(d)** 1000 m/s

(ii) A bullet of mass 10 g is fired from a gun of mass 1 kg with recoil velocity of gun 5 m/s. The muzzle velocity will be

(a) 30 m/s **(b)** 500 m/s **(c)** 30 km/min **(d)** 60 km/min

(iii) A bullet of mass 0.1 kg is fired with a speed of 100 m/s. The mass of gun being 50 kg, then the velocity of recoil becomes

(a) 0.05 m/s **(b)** 0.5 m/s **(c)** 0.1 m/s **(d)** 0.2 m/s

(iv) Two masses of M and 4M are moving with equal kinetic energy. The ratio of their linear momenta is

(a) 1:8 (b) 1:2 (c) 1:4 (d) 1:4

OR

(iv) A bullet hits and gets embedded in a solid block resting on a frictionless surface. In this process which one of the following is correct?

(a) Only momentum is conserved

(b) Only kinetic energy is conserved

(c) Neither momentum nor kinetic energy is conserved

(d) Both momentum and kinetic energy is conserved

Q30. Case Study Based Question: Motion under gravity

We saw the case of an apple falling from a tree. The gravitational pull exerted by the earth acts downwards, and the acceleration due to it is called **acceleration due to gravity**(g). g carries a value of 9.8 m/s^2 near the surface of the earth. Although its value changes on different points of the earth. The value of g does not depend upon the mass of the object undergoing freefall; but air resistance offered by air molecules plays an important role in accelerating a body. This is the reason a feather falls much slower in comparison to a coin. Air resistance makes the feather slow as compared to the coin, since air resistance on the feather is more. But if the coin and feather are released in vacuum where there is no air resistance, both would reach the ground at the same time.

Answer the following questions (1×4 =4)

(i) A particle is thrown vertically upwards with a velocity of 20 m/s. from the top of a tower. It reaches the ground in 6 s. Find the velocity with which it reaches the ground?

(a) Zero **(b)** 40 m/s **(c)** 60 m/s **(d)** 20 m/s

(ii) If two blocks of 1 kg and 10 kg are dropped from the same height then which will experience more gravity

(a) 1 kg block
(b) 10 kg block
(c) Both will experience same gravity
(d) 9.8 N

(iii) A particle is projected vertically upwards with a velocity of 196 m/sec. What will the time of rise?

(a) 10 s **(b)** 20 s **(c)** 30 s **(d)** 40 s

(iv) If we throw an object vertically upwards then its velocity becomes zero at the highest point. At that point where velocity is zero, acceleration will be equal to

(a) 0 (b) g (c) more than g (d) less than g

OR

(iv) Motion under gravity is a type of

(a) Uniform motion
(b) Accelerating motion
(c) Decelerating motion
(d) Both (b) and (c)

Section: E

Q31. **(a)**Find the relation between velocity and displacement using graph for uniformly accelerating object. **(2)**

(b) A body of mass **0.4 kg** moving with a constant speed of **10 m/s** to the North is subjected to a constat force of **8 N** directed towards south for **30 s**. Take the instant the force is applied to be **t = 0**, the position of the body at that time to be **x = 0** and predict its position at **t= -5 s, 25 s and 100 s.** **(3)**

OR

(a) A An object is moving along +ve x-axis with a uniform acceleration of **4 ms^{-2}**. At time t =0, **x = 5 m** and **v = 3 ms^{-1}**.

(i) What will be the velocity and position of the object at time **t = 2 s**?

(ii) What will be the position of the object when it has a velocity of 5 ms^{-1}? (2)

(b) A parachutist bails out from an aeroplane and after dropping through a distance of 40 m, he opens the parachute and decelerates at 2 ms^{-2}. If he reaches the ground with a speed of 2 ms^{-1}, how long is he in the air? At what height did he bail out from the plane? (3)

Q32. (a) If R is the horizontal range for θ inclination and h is the maximum height reached by the projectile, show that the maximum range is given by $\frac{R^2}{8h} + 2h$. (3)

(b) a stone is dropped from the top of a tower of height h. After 1 second another stone is dropped from the balcony 20 m below the top of the tower. Both reach the bottom simultaneously. What is the value of h? (2)

OR

(a) Find the relation between linear velocity and angular velocity of an object having uniform circular motion. (2)

(b) The greatest height to which a boy throws a ball is 50 m. What will be the greatest distance along the horizontal, up to which the boy can throw the ball with the same speed? (3)

Q33. (a) What is centrifugal force? Derive expression for centripetal acceleration. (3)

(b) A girl riding a bicycle along the straight road with a speed of 5 m/s throws a stone of 0.5 kg which has a speed of 15 m/s with respect to the ground along her direction of motion. The mass of girls and bicycle is 50 kg. Does the speed of bicycle change after the stone is thrown? What is the change is speed, if so? (2)

OR

(a) Why shockers are provided in a vehicle? (1)

(b) A table in placed in a room. Tell the direction in which frictional force will act. (1)

(c) Why we cannot walk in space? (1)

(d) Why pulling a lawn roller is easier? (2)

SET-B

ARMY PUBLIC SCHOOL, DHAULA KUAN

Examination: UT II(2025-26)

CLASS: XI SUBJECT: Physics (042)

M.M:40

TIME: 1.5 h

General Instructions:

All questions are compulsory.

Marks are indicated against each question.

Q1.	Two bodies of masses 10kg and 15kg are located in the Cartesian plane at (2,0) and (0,2). What is the location of their center of mass?	
Q2.	A constant torque is acting on a wheel. If starting from rest, the wheel makes 'n' rotations in 't' seconds. Find the angular acceleration.	
Q3.	What is the moment of inertia of a thin rod of mass 'M' and length 'L' about an axis passing along its length?	
Q4.	The mass and diameter of a planet are twice those of the earth. What will be the time period of that pendulum on this planet, which is second's pendulum on the earth?	
Q5.	What is the bulk modulus of a perfectly rigid body?	1
Q6.	Find the volume strain on a cube when it is subjected to a uniform volume compression and its side decreases by 2 %	1
	Given below are two statements labelled as Assertion (A) and Reason (R) Select the most appropriate answer from the options 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. If both A and R are false.	
Q7.	**Assertion:** The blood pressure in humans is greater at the feet than at the brain **Reason:** Pressure of liquid at any point is proportional to height, density of liquid and acceleration due to gravity.	
Q8.	**Assertion:** Ductile metals are used to prepare thin wires. **Reason:** In the stress - strain curve of ductile metals, the length between the points representing elastic limit and breaking point is very small.	
Q9.	What will be the duration of the day, if earth suddenly shrinks to 1/64 of its original volume, mass remaining the same?	2
Q10.	(a) How will you distinguish between a hard boiled egg and a raw egg by spinning it on a table top? (b) Why are the doors provided with handles near the outer edges far away from the hinges.	2
Q11.	A stress of 1 kg mm^{-2} is applied to a wire of which Young's modulus is 10^{11} Nm^{-2}. Find the percentage increase in length.	2
Q12.	The velocity of water in a river is 18 Km/h near the surface. If the river is 5 m deep, find the shearing stress between horizontal layers of water. Coefficient of viscosity of water = 10^{-2} poise.	2
Q13.	(a) Derive a relation to show the variation of acceleration due to gravity with altitude 'h' from the surface of earth. (b) What is the relation between height h and depth d for the same change in g? (Consider h << R).	3

Q14.	A metal bar 70 cm long and 4 kg in mass supported on the two knife edges placed 20 cm from each end. A 6 kg load is suspended at 30 cm from on end. Find the normal reaction at the knife-edge. (Assume it to be of uniform cross section and homogeneous).	3
Q15.	(a) Derive an expression for elastic energy density of a stretched wire which is equal to ½ stress x strain . (b)What is compressibility? Write its dimensions.	3
Q16.	A particle is projected upward from the surface of the earth (radius R) with a K.E. equal to half the minimum value needed for it to escape. To which height does it rise above the surface of the earth?	3
Q17.	(a) The linear speed of a planet is not constant in its orbit. Explain using Kepler's law. (b) The distances of two planets from the sun are 10^{13} m and 10^{12} m respectively. Find the ratio of time periods and speeds of the two planets.	3
Q18.	The property due to which the free surface of liquid tends to have minimum surface area and behaves like a stretched membrane is called surface tension. It is a force per unit length acting in the plane of interface between the liquid and the bounding surface *i.e.*, $S = F/L$, where F = force acting on either side of imaginary line on surface and L = length of imaginary line. Surface tension decreases with rise in temperature. Highly soluble impurities increase surface tension and sparingly soluble impurities decreases surface tension. (a) The excess pressure inside a soap bubble is three times than excess pressure inside a second soap bubble, find the ratio of their surface area (b) A liquid does not wet the solid surface. What is the range of its angle of contact? (c) Write two practical applications of surface tension	4
Q19.	(a) State and prove Bernoulli's Principle. (b) An ideal fluid flows (laminar flow) through a pipe of non-uniform diameter. The maximum and minimum diameters of the pipes are 6.4cm and 4.8cm, respectively. Find the ratio of the minimum and the maximum velocity of fluid in this pipe.	5

Sonam Sahoo
XI 'A'

Half Yearly Examination-2025-26
Class- XI
Subject: Mathematics (041)

Time: 3 Hours **Maximum Marks: 80**

General Instructions:

Read the following instructions very carefully and strictly follow them:

(i) This Question paper contains 38 questions. All questions are compulsory.

(ii) This Question paper is divided into five Sections - A, B, C, D and E.

(iii) In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.

(iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.

(v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.

(vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.

(vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.

(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.

(ix) Use of calculators is not allowed.

SECTION-A [1x 20= 20]

(This section comprises of multiple-choice questions (MCQs) of 1 mark each) **Select the correct option.**

(Question 1 - Question 18):

	QUESTION
1.	For $z=1-2i$, $\|z\|$ equals **A.** $\sqrt{5}$ **B.** $\pm\sqrt{5}$ **C. 5** **D.** $-\sqrt{5}$

2. Number of words from the letters of the words **BHARAT** in which B and H will never come together is:
A. 210 B. 422
C. 240 D. 400

3. The value of i^{-999} is
A. 1 B. -1
C. i D. -i

4. If 7 points out of 12 are in the same straight line, then what is the number of triangles formed?
A. 84 B. 175
C. 201 D. 185

5. Additive inverse of 4+3i is
A. 4-3i B. -4+3i
C. (4+3i)/25 D. -4-3i

6. If $f(x) = x$ and $g(x) = |x|$, then $(f+g)(x)$ is equal to
A. 0 for all $x \in R$ B. 2x for all $x \in R$
C. $\begin{cases} 2x, & for\ x \geq 0 \\ 0, & for\ x < 0 \end{cases}$ D. $\begin{cases} 0, & for\ x \geq 0 \\ 2x, & for\ x < 0 \end{cases}$

7. If $A = \{0\}$, then A is
A. Null set B. Singleton set
C. Disjoint set D. None of these

8. If set A has 3 elements and set B has 6 elements then
A. $6 \leq n(A \cap B) \leq 9$ B. $6 \leq n(A \cup B) \leq 8$
C. $0 \leq n(A \cap B) \leq 3$ D. $3 \leq n(A \cap B) \leq 6$

9. Number of subsets of a null set is
A. 0 B. 1
C. 2 D. None of these

10. If $f(x) = -|x|$. Choose the correct option from the following:
A. Domain is set of negative real numbers
B. Range is set of real numbers
C. Range is set of all negative integers
D. Range is $(-\infty, 0]$

11. The diameter of a circle is 60 cm. The length of an arc of this circle whose chord is 30 cm, is

A. $15\pi\ cm$ B. $20\pi\ cm$

C. $10\pi\ cm$ D. $5\pi\ cm$

12. The value of $\sin\left(-\frac{31\pi}{3}\right)$ is

A. $-\frac{\sqrt{3}}{2}$ B. $\frac{\sqrt{3}}{2}$

C. $\frac{1}{2}$ D. $-\frac{1}{2}$

13. **Fill in the blanks:** If $a < b$ and $c < 0$, then $\left(\frac{a}{c}\right)$ _____ $\left(\frac{b}{c}\right)$.

A. $<$ B. $\leq$

C. $>$ D. $\geq$

14. Fifth term of the series $a_1 = a_2 = 1$ and $a_n = a_{n-1} + a_{n-2}$, $n > 2$. Is

A. 2 B. 3

C. 5 D. 8

15. Solution of the given inequality : $-8 \leq 5x - 3 < 7$ is

A. $1 \leq x < 2$ B. $-1 \leq x < 2$

C. $x > -1$ & $x > 3$ D. **None** of these

16. If $a_n = (-1)^{n-1}.(5)^{n+1}$, then second and third terms are :

A. 125, -625 **B. -125, 625**

C. -25, 25 D. 25, -25

17. If $n_{C_{12}} = n_{C_8}$, then n is equal to

A. 12 B. 04

C. 06 D. 20

18. For the function $f(x) = [x]$, where [.] is greatest integer function, the range of $f(x)$ is

A. Z^+ B. Z^-

C. $[0, \infty)$ D. Z

ASSERTION-REASON BASED QUESTIONS

Question numbers 19 and 20 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as 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 but (R) is true.

Q.19. Assertion (A): An angle of $\frac{11}{7}$ radian is nearly equal to 90^0.

Reason (R): Angle in radian = Angle in degree $\times \frac{\pi}{180}$.

Q.20. Assertion (A): Number of terms in the expansion of $[(3x+y)^8 - (3x-y)^8]$ is 4.
Reason (R): If n is even, then $[(x+a)^n-(x-a)^n]$ has n/2 terms.

SECTION-B [2x 5= 10]

(This section comprises of 5 very short answer (VSA) type questions of 2 marks each.)
(Question 21 - Question 25):

	QUESTION
21.	Evaluate : $\cot\left(\frac{\pi}{8}\right)$.
22.	A wheel makes 360 revolutions in one minute. Through how many radians does it turn in six seconds?
23.	Let A= {x: x is a solution of x^2 -7x+10=0} and B = {x: x is an even prime number}. Find (i) A-B (ii) B-A **OR** Let U = {1, 2, 3, 4, 5, 6}, A = {2, 3} and B = {3, 4, 5}. Find A′, B′, A′ ∩ B′, A ∪B and hence show that (A∪B) ′ = A′∩ B′
24.	If A is the set of even natural numbers less than 8 and B is the set of prime numbers less than 7, then find the number of relations from A to B .
25.	A solution is to be kept between 68^0F and 77^0F. What is the range of temperature in degree Celsius (C), if conversion formula is given by F = 9/5 C + 32 **OR** Solve the inequality 3(1-x) < 2(x+4) and show the graph of solution on number line.

SECTION-C [3x 6= 18]

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)
(Question 26 - Question 31):

	QUESTION
26.	If $\alpha + \beta = \pi/4$, then find the value of $(1 + \tan \alpha)(1 + \tan \beta)$.
27.	A group consists of 4 girls and 7 boys. In how many ways can a team of 5 members be selected if the team has: (i) no girl (ii) at least 3 girls **OR** Find the number of words with or without meaning which can be made using all the letters of the word "***AGAIN***". If these words are written as in a dictionary, what will be the 49th word and 50th word?
28.	If U = {1,2,3,4,5,6,7,8,9} , A = {1,2,3,4} and B = {3,4,8,9}. Find A - B , B - A , AUB and A∩B , verify that: (i) A – B = A ∩ B' (ii) (A – B) U (B – A) = (AUB) – (A ∩ B)
29.	Find the modulus and conjugate of a complex number $\frac{(3-2i)(2+3i)}{(1+2i)(2-i)}$ **OR** If $(x + iy)^3 = u + iv$, then show that $\frac{u}{x} + \frac{v}{y} = 4(x^2 - y^2)$
30.	Evaluate $(\sqrt{2}+1)^6 + (\sqrt{2}-1)^6$ by using Binomial theorem
31.	Let $f = \{(1,1), (2,3), (-1,-3)\}$ be a function from Z to Z defined by $f(x) = ax + b$ for some integers a and b. Find the values of a and b. **OR** Draw the graph of real function $f(x) = \|x - 3\|$, and find its domain and range

SECTION-D [5x4= 20]

(This section comprises of 4 long answer (LA) type questions of 5 marks each.)

(Question 32 - Question 35):

	QUESTION
32.	If $\sin x = -\frac{1}{2}$ and x lies in the IV quadrant, find the values of $\cos\frac{x}{2}$, $\sin\frac{x}{2}$ and $\tan\frac{x}{2}$. **OR** Prove that: $\cos^2 x + \cos^2(x+\frac{\pi}{3}) + \cos^2(x-\frac{\pi}{3}) = \frac{3}{2}$
33.	Using properties of sets prove the followings. i) $(A \cap B) \cup (A - B) = A$ [2] ii) Let A, B and C are sets such that $A \cup B = A \cup C$ and $A \cap B = A \cap C$. Show that B=C. (3)
34.	A man wants to cut three lengths from a single piece of board of length 91 cm. The second length is to be 3 cm longer than the shortest and the third length is to be twice as long as the shortest. What are the possible lengths of the shortest piece, if the third piece is to be at least 5 cm longer than the second is?
35.	Using binomial theorem, prove that $6^n - 5n$ always leaves remainder 1 when divided by 25. **OR** Using Binomial Theorem Show that $3^{2n+2} - 8n - 9$ is divisible by 64.

SECTION-E [4x3= 12]

(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)

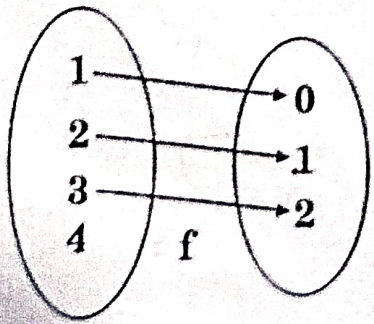
(Question 36 - Question 38):

Case Study-1

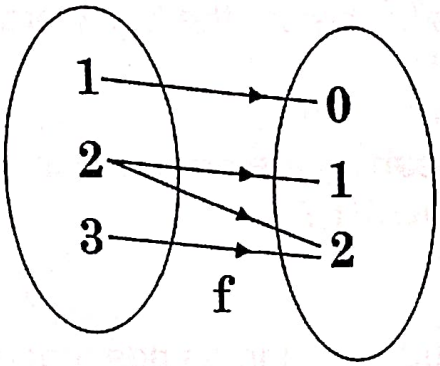
Q.36. Given a relation in x and y, we say 'y is a function of x' if for every element x in the domain, there corresponds exactly one element y in the range.

Based on the above information, attempt the following questions.

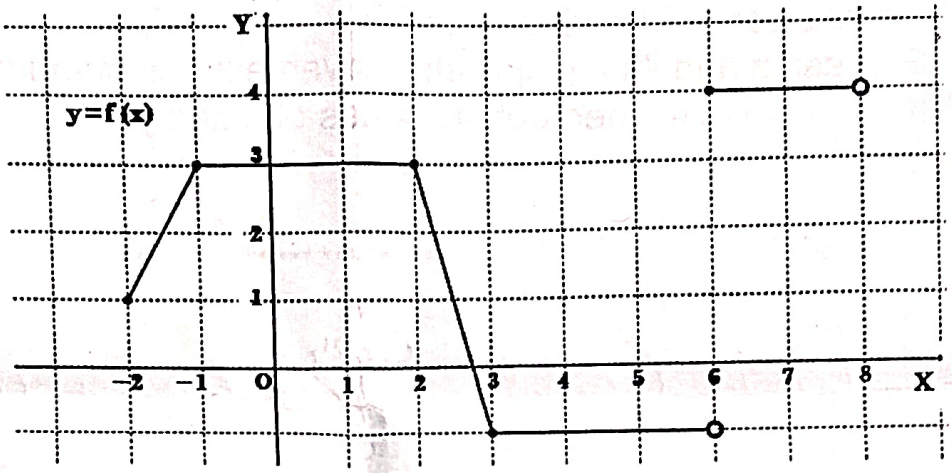
(i) Determine whether the following is a function or not.



(ii) Determine whether the following is a function or not.



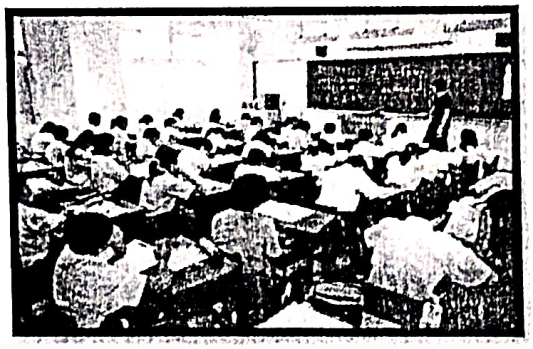
(iii) Examine the graph shown below for the function $y=f(x)$. Mention the **integral value (s)** of x at which $f(x)=3$.



OR

(iii) Check if $f=\{(a,u),(b,v),(b,w),(b,x),(c,y)\}$ is a function or not. Justify your answer.

Case Study-2



Q.37. During the mathematics class, a teacher clears the concept of permutation and combination to the 11th standard students. After the class, he asked the students some questions as follows.

Letters of the word "***OUGHT***" are arranged in all possible orders forming words with or without meaning . Answer the following questions on the basis of the above activity.

(i) How many words with or without meaning can be formed so that the vowels occupy even places ?

(ii) How many words with or without meaning can be formed so that the vowels occupy first and last places ?

(iii) If all the words with or without meaning are arranged in dictionary how many words are there in this list before the first word starting with **T** ?

OR

If all the words with or without meaning are arranged in dictionary then find the rank of the word **TOUGH ?**

Case Study-3

Q.38 While solving a typical equation a student Garima finds that one of the roots of the equation is a complex number $z=\frac{1+2i}{1-3i}$. Help her to find the answer of following questions.

(i) Express z and its multiplicative inverse in the standard form a+ib.

(ii) If $z=2x+(4-y)i$, then obtain values of x and y.

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