# Indian School Al Wadi Al Kabir

## Assessment II (2024-2025)

Class: XI | Sub: Physics | Max. Marks: 70

Date: 24/11/2024 | Set - II | Time: 3 Hours

**General Instructions:**

i. There are 33 questions in all. All questions are compulsory.
ii. This 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 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.
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 all three questions in Section E. You have to attempt only one of the choices in such questions.
vi. Use of calculators is not allowed.

**[SECTION – A]** **(16x1=16 marks)**

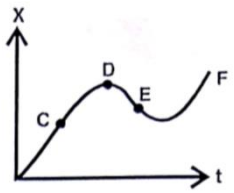
1. Which two of the following four physical parameters have the same dimensions?
   (i) Energy density
   (ii) Work
   (iii) Speed of light
   (iv) Young's modulus

(a) (i) and (ii)
(b) (i) and (iv)
(c) (ii) and (iv)
(d) (ii) and (iii)

2. If $x = at + bt^2$, where 'x' is the distance travelled by the body in kilometer while 't' is the time in second, then the unit of 'b' is:

(a) $kms^{-1}$
(b) km-s
(c) $kms^{-2}$
(d) $km\text{-}s^2$

3. The displacement-time graph of moving particle is shown below.



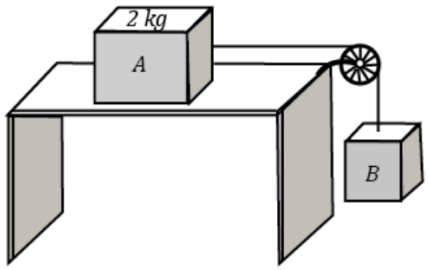

The instantaneous velocity of the particle is negative at the point:

(a) D
(b) C
(c) E
(d) F

4. If $\vec{A} = 3\hat{\imath} + 4\hat{\jmath} + 5\hat{k}$ and $\vec{B} = 3\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$, then the angle between $\vec{A}$ and $\vec{B}$ will be:
(a) 0°
(b) 45°
(c) 180°
(d) 90°

5. A coastguard ship locates a pirate ship at a distance of 320 m. It fires a cannon ball with an initial speed of 80 $ms^{-1}$. At what angle from horizontal, must the ball be fired so that it hits the pirate ship?
(a) 15°
(b) 30°
(c) 45°
(d) 90°

6. The coefficient of static friction ($\mu_s$), between block A of mass 2 kg and the table (as shown in the figure) is 0.2. What would be the maximum mass value of block B, so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless (g = 10 $m/s^2$).




(a) 4 kg
(b) 0.4 kg
(c) 2 kg
(d) 0.2 kg

7. Match the column - I with column – II:

| COLUMN – I | COLUMN - II |
|---|---|
| (1) When a body does work against friction | (P) Force must be conservative |
| (2) When work done over a closed path is zero | (Q) Potential energy increases |
| (3) When a body is dropped from a height | (R) Kinetic energy decreases |
| (4) A body is accelerating up on a smooth inclined surface | (S) Kinetic energy increases |

(a) (1) - (R), (2) – (S), (3) – (Q), (4) – (P)
(b) (1) - (R), (2) – (P), (3) – (S), (4) – (Q)
(c) (1) - (S), (2) – (R), (3) – (Q), (4) – (P)
(d) (1) - (R), (2) – (P), (3) – (Q), (4) – (S)

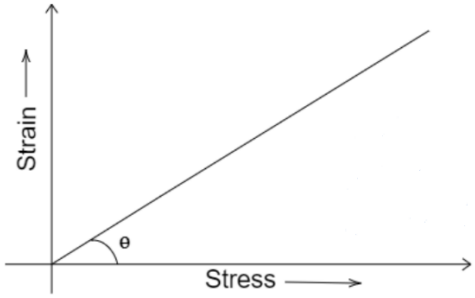
8. A wheel with moment of inertia 2 $kgm^2$ about its axis, rotates at 50 rpm. The magnitude of the torque that can stop the wheel in one minute is

(a) $\pi/9$ Nm
(b) $\pi/18$ Nm
(c) $\pi/36$ Nm
(d) $\pi$ Nm

9. Two bodies with moments of inertia $I_1$ and $I_2$ ($I_1 > I_2$) have equal angular momenta. If $E_1$ and $E_2$ are their rotational kinetic energies respectively, then
(a) $E_1 > E_2$
(b) $E_1 = E_2$
(c) $E_1 < E_2$
(d) The one which has larger mass has the larger kinetic energy.

10. A solid cylinder of mass 20 kg rotates about its axis with an angular speed of 100 $rads^{-1}$. The radius of the cylinder is 0.25 m. The kinetic energy associated with the rotation of the cylinder is:
(a) 6250 J
(b) 3100 J
(c) 3125 J
(d) 312.5 J

11. The value of tan (90° – θ ) in the graph gives:




(a) Young's modulus of elasticity
(b) Compressibility
(c) Strain
(d) Tensile strength

12. The following four wires are made up of same material. Which of these will have the largest extension when the same tension is applied?
(a) Length =50 cm, diameter =0.5 mm
(b) Length =100 cm, diameter =1 mm
(c) Length =200 cm, diameter =2 mm
(d) Length = 300 cm, diameter = 3 mm

**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 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.**

13. **Assertion(A):** A body having zero acceleration has constant velocity.
**Reason(R):** Acceleration is the rate of change of velocity.

14. **Assertion(A):** The apparent weight of a body in an elevator moving with some downward acceleration is less than the actual weight of a body.
    **Reason(R):** A person feels weightless in a moving lift when the lift moves downward with an acceleration of 9.8 $ms^{-2}$.
15. **Assertion(A):** The time period of revolution of a satellite close to surface of earth is smaller than that revolving away from surface of earth.
    **Reason(R):** The square of time period of revolution of a satellite is directly proportional to cube of its orbital radius.
16. **Assertion(A):** Stress is the force per unit area of a body.
    **Reason(R):** Rubber is more elastic than steel.

**[SECTION – B]** **(05x2=10 marks)**

17. (i) Draw the variation of potential energy and kinetic energy of a block attached to a spring, which obeys Hooke's law.
    (ii) Define spring constant and write its SI unit.

18. State the law of conservation of angular momentum. Give an illustration to explain the same.

19. Derive an expression for the orbital velocity of a satellite.

20. The limiting stress for a typical human bone is $0.9 \times 10^8$ $Nm^{-2}$ while Young's modulus is $1.4 \times 10^{10}$ $Nm^{-2}$. How much energy can be absorbed by the two legs (without breaking) if each has a typical length of 50 cm and an average cross-sectional area of 5 $cm^2$?

21. How far from earth must a body be along a line towards the sun so than the sun's gravitational pull on it balances that of the earth? Distance between sun and earth's centre is $1.5 \times 10^{10}$ km. Mass of sun is $3.24 \times 10^5$ times of earth.

**OR**

Compare the weights of a body when it is (i) 100 km above the surface of the earth and (ii) 100 km below the surface of the earth. Radius of the earth is 6400 km.

**[SECTION – C]** **(07x3=21 marks)**

22. A gas bubble, from an explosion under water, oscillates with a period 'T' proportional to $P^a$, $d^b$ and $E^c$, where 'P' is the static pressure, 'd' is the density of water and 'E' is the total energy of the explosion. Find the values of a, b and c.

23. Using v-t graph, derive $s = ut + 1/2\ at^2$, where all the terms have their usual meanings.

24. (i) A cyclist needs to bend inward while going on a circular track. Justify this statement.
    (ii) Show that impulse is equal to change in momentum.
    (iii) State the law of inertia.

25. Derive an expression for the potential energy of an elastic stretched spring.

26. What will be the duration of the day, if earth suddenly shrinks to 1/64 of its original volume, mass remaining the same? (Moment of inertia of earth = $2/5\ MR^2$)

**OR**

A ring of diameter 0.4 m and of mass 10 kg is rotating about its axis at the rate of 2100 rpm. Find (i) moment of inertia (ii) angular momentum and (iii) rotational kinetic energy of the ring.

27. a) Define moment of inertia.
    b) A particle performs uniform circular motion with an angular momentum L. If the angular frequency of particle's motion is doubled and its kinetic energy halved, then what is its angular momentum?

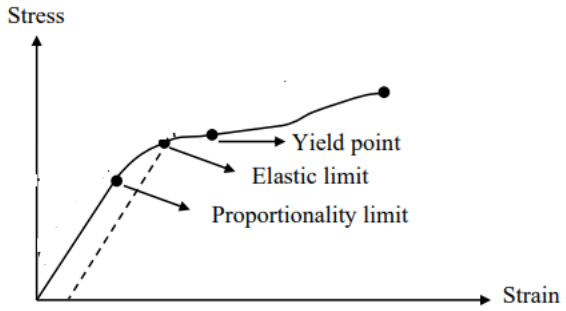
28. Derive an expression for the acceleration due to gravity above the surface of the earth.

**[SECTION D]** **(02x4=08 marks)**

29. **Case Study Based Question:**

The **stress-strain curve** is a graphical representation of the relationship between the **stress** (force per unit area) applied to a material and the **strain** (deformation) produced in the material. It helps to understand the mechanical properties of materials, including their elasticity, plasticity, and strength. The yield strength is the stress at which the material first begins to exhibit permanent deformation. Beyond this point, the material starts to deform plastically.

The stress-strain curve is an essential tool for understanding the mechanical properties of materials. By analyzing the curve, engineers can determine the material's **strength**, **elasticity**, **ductility**, **toughness**, and **brittleness**, which are crucial for selecting the right material for different applications in engineering and design.




i. Which of the following materials is most likely to show a stress-strain curve with a very long plastic region?
   (a) Brittle material.
   (b) Ductile material.
   (c) Concrete.
   (d) Glass.

ii. What does the slope of the stress-strain curve in the elastic region represent?
   (a) The toughness of a material.
   (b) The yield strength of the material.
   (c) The Young's modulus of the material.
   (d) The ultimate tensile strength of the material.

iii. If the ratio of radii of two wires of same material is 2 : 1 and ratio of their lengths is 4 : 1, then the ratio of the normal forces that will produce the same extension in the length of two wires is
   (a) 2:1
   (b) 1:4
   (c) 4:1
   (d) 1:1

iv. What does a material with a high Young's modulus indicate?

(a) The material is very flexible and can easily stretch.
(b) The material will undergo a lot of plastic deformation before breaking.
(c) The material is stiff and resists deformation under stress.
(d) The material has low tensile strength.

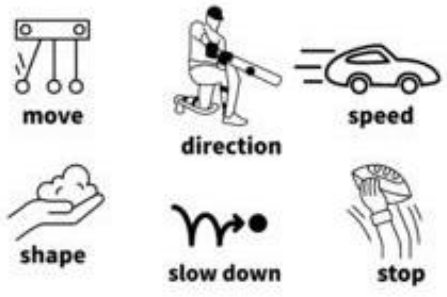
**OR**

Which of the following is the correct sequence of events on the stress-strain curve for a ductile material?

(a) Elastic region → Plastic region → Necking → Breaking point
(b) Plastic region → Elastic region → Breaking point → Necking
(c) Elastic region → Plastic region → Breaking point → Necking
(d) Necking → Elastic region → Breaking point → Plastic region

30. **Case Study Based Question:**

Force is an external effort in the form of push or pull which (i) produces or tries to produce motion in a body at rest (ii) stops or tries to stop a moving body (iii) changes or tries to change the direction of motion of a body.

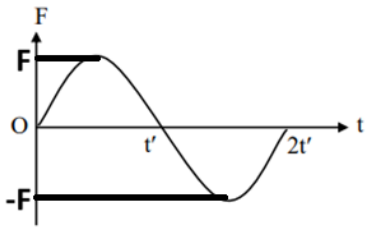



According to Aristotle, an external force is always required to keep a body in uniform motion along a straight line. Later on, Galileo established that state of rest and the state of motion with constant velocity are equivalent. In both cases, no net force is acting on the body.
According to Galileo's law of inertia, if net force is zero, a body at rest continues to be at rest, and a body in uniform motion continues to move uniformly along a straight line. Linear momentum (p) of a body is defined as the product of mass (m) of the body and its velocity (v).

i. Two billiard balls A and B of mass 50 g each and moving in opposite directions with speed of 5 $ms^{-1}$ each, collide and rebound with the same speed. If the collision lasts for $10^{-3}$ s, which of the following statements are true?

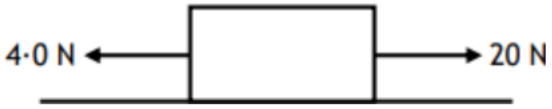
(a) The change in momentum of each ball is 0.25 kg $ms^{-1}$ and the force on each ball is 250 N.
(b) The impulse imparted to each ball is 0.25 kg $ms^{-1}$ and the force on each ball is 25 x $10^{-5}$ N.
(c) The impulse imparted to each ball is 0.5 Ns.
(d) Impulse and change in momentum are equal and opposite.

ii. A time varying force 'F' acts on a body of mass 'm' for a short time 2t′ as shown in the figure. The body was initially at rest. What is the velocity acquired by the body?




(a) Zero
(b) πFT/4m
(c) πFT/2m
(d) FT/4m

iii. The diagram shows the horizontal forces acting on a box.




The box accelerates at 1.6 $ms^{-2}$. The mass of the box is:
(a) 0.10 kg
(b) 1.0 kg
(c) 10.0 kg
(d) 100.0 kg

iv. An object of mass 20 kg moves at a constant speed of 5 $ms^{-1}$. A constant force, that acts for 2 s on the object, gives it a speed of 3 $ms^{-1}$ in opposite direction. The force acting on the object is
(a) 8 N
(b) -8 N
(c) 80 N
(d) -80 N

**OR**

A block of mass 5 kg is moving horizontally at a speed of 1.5 $ms^{-1}$. A vertically upward force 5 N acts on it for 4 seconds. What will be the distance of the block from the point where the force starts acting?
(a) 2 m
(b) 6 m
(c) 8 m
(d) 10 m

**[SECTION E]** **(03X5=15)**

31. I. (a) Derive an expression for time of flight and maximum height of a projectile, in terms of initial velocity and angle of projection.
(b) A girl stands at 39.2 m from a building and throws a ball which just passes through a window 19.6 m above the ground. Calculate the velocity of the projection of the ball.

**OR**

II. (a) $\vec{A}$ and $\vec{B}$ are two co-initial vectors with an angle Θ between them. Derive an expression for the magnitude and direction of the resultant of these two vectors in terms of the angle Θ between them.
(b) The sum of the magnitude of the two forces acting at a point is 18 N and the magnitude of their resultant is 12 N. If the resultant makes an angle 90° with the force of smaller magnitude, what are the magnitudes of the two forces?

32. I. (a) Define escape velocity? Obtain an expression for the escape velocity of an object on earth.

(b) An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the earth. Determine the height of the satellite above the earth's surface. Take g = 9.8 $ms^{-2}$, radius of the earth is 6400 km.

**OR**

II. (a) State Newton's universal law of gravitation. Derive an expression for gravitational potential energy.

(b) At what height from the surface of earth, the gravitational potential and the value of 'g' are $-5.4\times10^{7}$ $Jkg^{-1}$ and 6 $ms^{-2}$ respectively? Take the radius of the earth as 6400 km.

33. I. (a) Derive the expressions for final velocities of two bodies undergoing one dimensional elastic collision.

(b) A ball of mass 0.1 kg makes an elastic head on collision with a ball of unknown mass that is initially at rest. If the 0.1 kg ball rebounds at one-third of its original speed, what is the mass of the other ball?

**OR**

II. (a) What is elastic collision? Prove that bodies of identical masses exchange their velocities after head on elastic collision.

(b) A railway carriage of mass 9000 kg moving with a speed of 36 $kmh^{-1}$ collides with a stationary carriage of the same mass. After the collision, the carriages get coupled and move together. What is their common speed after collision? What type of collision is this?