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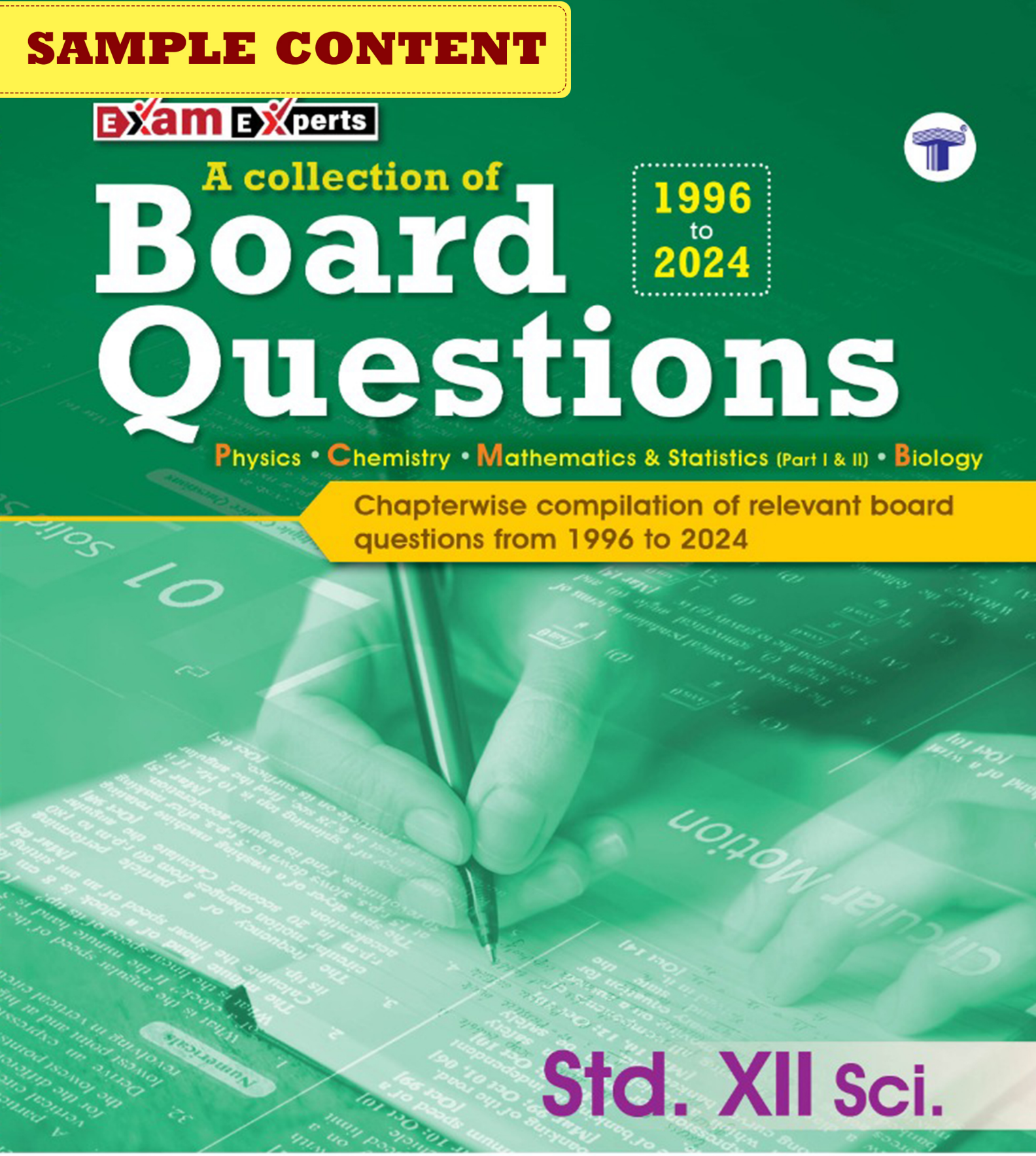
A collection of

Board Questions

1996 to 2024

Physics • Chemistry • Mathematics & Statistics (Part I & II) • Biology

Chapterwise compilation of relevant board questions from 1996 to 2024



Std. XII Sci.

Target Publications® Pvt. Ltd.

Written as per the latest HSC syllabus prescribed by the Maharashtra State Board of Secondary and Higher Secondary Education, Pune.

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PREFACE

The journey to academic excellence in the Higher Secondary Certificate (HSC) examinations is both challenging and rewarding. **Target's 'Board Questions: Std. XII Sci.'** is a compilation of all the relevant questions (MCQs + Theory Questions + Numericals) that have been asked in the previous years' HSC Maharashtra Board Papers of science stream for Physics, Chemistry, Mathematics & Statistics (Part I & II) and Biology. The objective of this book is to provide students with quick access to relevant questions from previous years to aid their preparation for the HSC board examinations.

The chapter wise and subtopic wise (for Theory Questions & Numericals) segregation of questions enable students gauge the weightage given and type of questions preferred for a chapter. Flow of questions is set year wise with questions from the most recent examination placed last in a subtopic. Special care has been taken to include only those questions from previous years which fall under the latest syllabus prescribed by Maharashtra State Board of Secondary and Higher Secondary Education. Additionally, to aid students in understanding the different ways questions can be framed, each one is listed with its alternate versions, marked with an 'OR'.

Publisher

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A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

CONTENT

01 Rotational Dynamics

Multiple Choice Questions

1. A car is moving along a horizontal curve of radius 20 m and coefficient of friction between the road and wheels of the car is 0.25. If acceleration due to gravity is 9.8 m/s^2, then its maximum speed is **[Mar 08]**
(A) 3 m/s (B) 5 m/s (C) 7 m/s (D) 9 m/s

2. A body is acted upon by a constant torque. In 4 seconds its angular momentum changes from L to 4L. The magnitude of the torque is _____. **[Oct 08]**
(A) $\frac{L}{4}$ (B) $\frac{3L}{4}$ (C) 3L (D) 12L

3. Radius of gyration of a ring about a transverse axis passing through its centre is _____. **[Mar 09]**
(A) 0.5 × diameter of ring
(B) diameter of ring
(C) 2 × diameter of ring
(D) (diameter of ring)^2

4. A stone is tied to a string and rotated in a horizontal circle with constant angular velocity. If the string is released, the stone flies _____. **[Oct 09, Mar 10]**
(A) radially inward
(B) radially outward
(C) tangentially forward
(D) tangentially backward

5. The radius of gyration of a solid sphere of mass M and radius R rotating about an axis with its diameter N is **[Mar 10]**
(A) $\sqrt{\frac{1}{5}}\cdot R$ (B) $\sqrt{\frac{2}{5}}\cdot R$
(C) $\sqrt{\frac{3}{5}}\cdot R$ (D) $\sqrt{\frac{7}{5}}\cdot R$

6. The moment of inertia of a thin uniform rod of mass M and length L, about an axis passing through a point, midway between the centre and one end, perpendicular to its length is **[Mar 13]**
(A) $\frac{48}{7}ML^2$ (B) $\frac{7}{48}ML^2$
(C) $\frac{1}{48}ML^2$ (D) $\frac{1}{16}ML^2$

7. If 'L' is the angular momentum and 'I' is the moment of inertia of a rotating body, then $\frac{L^2}{2I}$ represents its **[Oct 13]**
(A) rotational P.E. (B) total energy
(C) rotational K.E. (D) translational K.E.

8. A thin wire of length L and uniform linear mass density ρ is bent into a circular coil. Moment of inertia of the coil about tangential axis in its plane is _____. **[Oct 14]**
(A) $\frac{3\rho L^2}{8\pi^2}$ (B) $\frac{8\pi^2}{3\rho L^3}$ (C) $\frac{3\rho L^3}{8\pi^2}$ (D) $\frac{8\pi}{3\rho L^2}$

9. The period of a conical pendulum in terms of its length (l), semivertical angle (θ) and acceleration due to gravity (g) is: **[Mar 15]**
(A) $\frac{1}{2\pi}\sqrt{\frac{l\cos\theta}{g}}$ (B) $\frac{1}{2\pi}\sqrt{\frac{l\sin\theta}{g}}$
(C) $4\pi\sqrt{\frac{l\cos\theta}{4g}}$ (D) $4\pi\sqrt{\frac{l\tan\theta}{g}}$

10. The kinetic energy of a rotating body depends upon **[Mar 15]**
(A) distribution of mass only.
(B) angular speed only.
(C) distribution of mass and angular speed.
(D) angular acceleration only.

11. A particle rotates in U.C.M. with tangential velocity 'v' along a horizontal circle of diameter 'D'. Total angular displacement of the particle in time 't' is _____. **[Mar 16]**
(A) vt (B) $\left(\frac{v}{D}\right)-t$ (C) $\frac{vt}{2D}$ (D) $\frac{2vt}{D}$

12. A body of moment of inertia 5 kgm^2 rotating with an angular velocity 6 rad/s has the same kinetic energy as a mass of 20 kg moving with a velocity of _____. **[Mar 16]**
(A) 5 m/s (B) 4 m/s
(C) 3 m/s (D) 2 m/s

13. The difference in tensions in the string at lowest and highest points in the path of the particle of mass 'm' performing vertical circular motion is **[July 16]**
(A) 2 mg (B) 4 mg
(C) 6 mg (D) 8 mg

14. The body is rotating with uniform angular velocity (ω) having rotational kinetic energy (E). Its angular momentum (L) is: **[July 16]**
(A) $\frac{2E}{\omega}$ (B) $\frac{E^2}{\omega}$ (C) $\frac{E}{\omega^2}$ (D) $\frac{E}{2\omega}$

15. When the angular acceleration of a rotating body is zero, which physical quantity will be equal to zero? **[Mar 17]**
(A) Angular momentum
(B) Moment of inertia
(C) Torque
(D) Radius of gyration

16. A body of mass 'm' performs uniform circular motion along a circular path of radius 'r' with velocity 'v'. If its angular momentum is L, then the centripetal force acting on it is _____. **[July 17]**
(A) $\frac{mL^2}{r^3}$ (B) $\frac{L^2}{mr}$ (C) $\frac{L^2}{mr^2}$ (D) $\frac{L^2}{mr^3}$

17. If a rigid body of radius 'R' starts from rest and rolls down an inclined plane of inclination 'θ' then linear acceleration of body rolling down the plane is _____. **[July 17]**
(A) $\frac{g\sin\theta}{1+\frac{K}{R}}$ (B) $g\sin\theta\left(1+\frac{K}{R}\right)$
(C) $\frac{g\sin\theta}{1+\frac{K^2}{R^2}}$ (D) $g\sin\theta\left(1+\frac{K^2}{R^2}\right)$

18. A particle of mass m performs vertical motion in a circle of radius r. Its potential energy at the highest point is _____.
(g is acceleration due to gravity) **[Mar 18]**
(A) 2 mgr (B) mgr
(C) 0 (D) 3 mgr

19. A thin ring has mass 0.25 kg and radius 0.5 m. Its moment of inertia about an axis passing through its centre and perpendicular to its plane is _____. **[Mar 18]**
(A) 0.0625 kg m^2 (B) 0.625 kg m^2
(C) 6.25 kg m^2 (D) 62.5 kg m^2

20. The dimensions of angular momentum are _____. **[Mar 08, July 18]**
(A) $[L^{-2} M^1 T^{-1}]$ (B) $[L^2 M^1 T^{-1}]$
(C) $[L^1 M^2 T^1]$ (D) $[L^2 M^2 T^{-2}]$

21. In rotational motion of a rigid body, all particles move with _____. **[Feb 20]**
(A) same linear velocity and same angular velocity
(B) same linear velocity and different angular velocity
(C) different linear velocities and same angular velocities
(D) different linear velocities and different angular velocities

22. When the bob performs a vertical circular motion and the string rotates in a vertical plane, the difference in the tension in the string at horizontal position and uppermost position is _____. **[Mar 22]**
(A) mg (B) 2mg (C) 3mg (D) 6mg

23. A body performing uniform circular motion has constant _____. **[July 23]**
(A) velocity (B) kinetic energy
(C) displacement (D) acceleration

24. The moment of inertia (MI) of a disc of radius R and mass M about its central axis is _____. **[Feb 24]**
(A) $\frac{MR^2}{4}$ (B) $\frac{MR^2}{2}$
(C) MR^2 (D) $\frac{3MR^2}{2}$

Theory Questions

1.2 Characteristics of Circular Motion

1. Explain the concept of centripetal force. **[Mar 17]**
2. Distinguish between centripetal force and centrifugal force. **[Mar 10, 18]**
3. What is the value of tangential acceleration in U.C.M.? **[Mar 19]**
4. Define U.C.M.
Name the forces acting on a body executing nonuniform circular motion. **[July 19]**
5. Define uniform circular motion. **[Feb 20]**
6. Define centripetal force. **[Feb 24]**

1.3 Applications of Uniform Circular Motion

1. Derive an expression for period of a conical pendulum. **[Mar 08]**
2. For a conical pendulum prove that $\tan\theta = \frac{v^2}{rg}$ **[Oct 09]**
3. Obtain an expression for maximum speed with which a vehicle can be driven safely on a banked road. Show that the safety speed limit is independent of the mass of the vehicle. **[Mar 10, Oct 10]**
4. Draw a diagram showing all components of forces acting on a vehicle moving on a curved banked road. Write the necessary equation for maximum safety speed and state the significance of each term involved in it. **[Oct 14]**
5. Draw a neat labelled diagram of conical pendulum. State the expression for its periodic time in terms of length. **[Oct 15]**
6. Draw a neat labelled diagram showing the various forces and their components acting on a vehicle moving along curved banked road. **[July 16]**

7. Draw neat, labelled diagram showing different forces acting on a vehicle moving along a banked road. **[July 17]**
8. If friction is made zero for a road, can a vehicle move safely on this road? **[Feb 23]**
9. Derive an expression for maximum speed of a vehicle moving along a horizontal circular track. **[Feb 24]**

1.4 Vertical Circular Motion

1. A particle of mass m, just completes the vertical circular motion. Derive the expression for the difference in tensions at the highest and the lowest points. **[Mar 13]**
2. Derive expressions for linear velocity at lowest position, mid-way position and the top-most position for a particle revolving in a vertical circle, if it has to just complete circular motion without string slackening at top. **[Feb 23]**

1.5 Moment of Inertia as an Analogous Quantity for Mass

1. Define moment of inertia. State its SI unit and dimensions. **[Oct 08, Mar 18]**

OR

Define moment of inertia of a rotating rigid body. State its SI unit and dimensions. **[Mar 22]**

2. Derive an expression for kinetic energy of a rotating body. **[July 22]**

OR

Derive an expression for the kinetic energy of a body rotating with a uniform angular speed. **[Mar 22]**

1.6 Radius of Gyration

1. Explain the physical significance of radius of gyration. **[July 17]**
2. Define radius of gyration and give its physical significance. **[Mar 08, Oct 13, July 18]**
3. Define radius of gyration. Write its physical significance. **[Mar 19]**

1.7 Theorem of Parallel Axes and Theorem of Perpendicular Axes

1. State and prove the principle of perpendicular axes. **[Mar 10]**
2. State and prove theorem of parallel axes. **[Mar 14]**
3. State theorem of parallel axes and theorem of perpendicular axes about moment of inertia. **[Mar 15]**
4. State an expression for the moment of inertia of a solid uniform disc, rotating about an axis passing through its centre, perpendicular to its plane. **[Oct 15]**
5. State and prove theorem of parallel axes about moment of inertia. **[Mar 16]**

OR

State and prove principle of parallel axes in roational motion **[Feb 20]**

OR

State and prove the principle of parallel axes. **[July 23]**

1.8 Angular Momentum or Moment of Linear Momentum

1. Show that the kinetic energy of a rotating body about a given axis is equal to $\frac{1}{2}L\omega$, where L is angular momentum and ω is angular velocity. **[Mar 08]**

1.9 Expression for Torque in Terms of Moment of Inertia

1. Obtain an expression for torque acting on a body rotating with uniform angular acceleration. **[July 16]**
2. Obtain an expression for torque acting on a rotating body with constant angular acceleration. Hence state the dimensions and SI unit of torque. **[Mar 17]**

1.10 Conservation of Angular Momentum

1. State the law of conservation of angular momentum and explain with a suitable example. **[Oct 14]**
2. State and prove: law of conservation of angular momentum. **[Oct 15]**
3. State and prove principle of conservation of angular momentum. **[Mar 18, Feb 23]**
4. Explain the principle of conservation of angular momentum with the help of two appropriate examples. **[July 19]**
5. State the law of conservation of angular momentum. **[July 22]**

1.11 Rolling Motion

1. Derive an expression for kinetic energy, when a rigid body is rolling on a horizontal surface without slipping. Hence find kinetic energy for a solid sphere. **[Mar 13]**
2. Obtain an expression for total kinetic energy of a rolling body in the form $\frac{1}{2}MV^2\left[1+\frac{K^2}{R^2}\right]$. **[Mar 16]**

Numericals

1.2 Characteristics of Circular Motion

1. An object of mass 2 kg attached to wire of length 5 m is revolved in a horizontal circle. If it makes 60 r.p.m. Find its
   i. angular speed
   ii. linear speed
   iii. centripetal acceleration
   iv. centripetal force **[Mar 09]**

2. A car of mass 1500 kg rounds a curve of radius 250 m at 90 km/hour. Calculate the centripetal force acting on it. **[Mar 13]**

3. A racing car completes 5 rounds of a circular track in 2 minutes. Find the radius of the track if the car has uniform centripetal acceleration of π^2 m/s^2. **[Oct 13]**

4. A stone of mass 1 kg is whirled in horizontal circle attached at the end of a 1 m long string. If the string makes an angle of 30° with vertical, calculate the centripetal force acting on the stone. (g = 9.8 m/s^2). **[Mar 14]**

5. The spin dryer of a washing machine rotating at 15 r.p.s. slows down to 5 r.p.s. after making 50 revolutions. Find its angular acceleration. **[Mar 15]**

6. A coin kept at a distance of 5 cm from the centre of a turntable of radius 1.5 m just begins to slip when the turntable rotates at a speed of 90 r.p.m. Calculate the coefficient of static friction between the coin and the turntable. [g = 9.8 m/s^2]. **[Mar 16]**

7. The frequency of revolution of a particle performing circular motion changes from 60 r.p.m. to 180 r.p.m. in 20 seconds. Calculate the angular acceleration of the particle. (π = 3.142) **[July 18]**

8. Find the frequency of revolution of a round disco stage revolving with an angular speed of 300 degree/second. **[July 19]**

1.3 Applications of Uniform Circular Motion

1. In a conical pendulum, a string of length 120 cm is fixed at rigid support and carries a mass of 150 g at its free end. If the mass is revolved in a horizontal circle of radius 0.2 m around a vertical axis, calculate tension in the string. (g = 9.8 m/s^2) **[Oct 13]**

2. A stone of mass 2 kg is whirled in a horizontal circle attached at the end of 1.5 m long string. If the string makes an angle of 30° with vertical, compute its period. (g = 9.8 m/s^2) **[July 16]**

3. A vehicle is moving on a circular track whose surface is inclined towards the horizon at an angle of 10°. The maximum velocity with which it can move safely is 36 km / hr. Calculate the length of the circular track. [π = 3.142] **[Mar 17]**

4. A small body of mass 0.3 kg oscillates in vertical plane with the help of a string 0.5 m long with a constant speed of 2 m/s. It makes an angle of 60° with the vertical. Calculate tension in the string (g = 9.8 m/s^2). **[July 17]**

5. A flat curve on a highway has a radius of curvature 400 m. A car goes around a curve at a speed of 32 m/s. What is the minimum value of coefficient of friction that will prevent the car from sliding? (g = 9.8 m/s^2) **[Mar 18]**

6. A metre-gauge train is moving at 72 km/ hr along a curved rail-way of radius of curvature 500 m at a certain place. Find the elevation of the outer rail above the inner rail so that there is no side pressure on the rail. (g = 9.8 m/s^2) **[July 18]**

7. A car rounds a curve of radius 625 m with a speed of 45 m/s. What is the minimum value of coefficient of friction which prevents the car from sliding? **[July 19]**

8. A motorcyclist performs stunt along the cylindrical wall of a 'Well of Death' of inner radius 4 m. Coefficient of static friction between the tyres and the wall is 0.4. Calculate the maximum period of revolution.
   [Use g = 10 m/s^2] **[July 23]**

9. The radius of a circular track is 200 m. Find the angle of banking of the track, if the maximum speed at which a car can be driven safely along it is 25 m/sec. **[Feb 24]**

1.4 Vertical Circular Motion

1. An object of mass 1 kg is tied to one end of a string of length 9 m and whirled in a vertical circle. What is the minimum speed required at the lowest position to complete a circle? **[Oct 08]**

2. A stone of mass 5 kg, tied to one end of a rope of length 0.8 m, is whirled in a vertical circle. Find the minimum velocity at the highest point and at the midway point. [g = 9.8 m/s^2] **[Oct 14]**

3. A stone of mass 100 g attached to a string of length 50 cm is whirled in a vertical circle by giving velocity at lowest point as 7 m/s. Find the velocity at the highest point.
   [Acceleration due to gravity = 9·8 m/s^2] **[Oct 15]**

4. In a Circus, a motor-cyclist having mass of 50 kg moves in a spherical cage of radius 3 m. Calculate the least velocity with which he must pass the highest point without losing contact. Also calculate his angular speed at the highest point. **[Feb 20]**

1.5 Moment of Inertia as an Analogous Quantity for Mass

1. Energy of 1000 J is spent to increase the angular speed of a wheel from 20 rad/s to 30 rad/s. Calculate the moment of inertia of the wheel. **[Feb 20]**

1.7 Theorem of Parallel Axes and Theorem of Perpendicular Axes

1. A solid cylinder of uniform density of radius 2 cm has mass of 50 g. If its length is 12 cm, calculate its moment of inertia about an axis passing through its centre and perpendicular to its length. **[Mar 14]**

2. A uniform solid sphere has a radius 0.1 m and density 6×10^3 kg/m^3. Find its moment of inertia about a tangent to its surface. **[July 16]**

3. A uniform solid sphere has radius 0.2 m and density 8×10^3 kg/m^3. Find the moment of inertia about the tangent to its surface. ($\pi = 3.142$) **[July 17]**

4. The radius of gyration of a body about an axis, at a distance of 0.4 m from its centre of mass is 0.5 m. Find its radius of gyration about a parallel axis passing through its centre of mass. **[Mar 19]**

5. Find the radius of gyration of a rod of length 3 m about its transverse axis passing through its one end. **[July 19]**

6. The M.I. of solid sphere about an axis passing through its centre is 2 kg-m^2. Calculate its M.I. about a tangent passing through any point on its surface. **[July 19]**

7. Calculate the moment of inertia of a uniform disc of mass 10 kg and radius 60 cm about an axis perpendicular to its length and passing through its centre. **[Mar 22]**

8. The surface density of a uniform disc of radius 10 cm is 2 kg/m^2. Find its MI about an axis passing through its centre and perpendicular to its plane. **[July 22]**

1.8 Angular Momentum or Moment of Linear Momentum

1. A wheel of moment of inertia 1 kg m^2 is rotating at a speed of 40 rad/s. Due to friction on the axis, the wheel comes to rest in 10 minutes. Calculate the angular momentum of the wheel, two minutes before it comes to rest. **[Mar 13]**

1.9 Expression for Torque in Terms of Moment of Inertia

1. A torque of 1500 Nm acting on a body produces an angular acceleration of 3.2 rad/s^2. Find M.I. of the body. **[Mar 09]**

2. A torque of magnitude 1000 N m acting on a body produces an angular acceleration of 2 rad/s^2. Calculate the moment of inertia of the body. **[Oct 09, Mar 10]**

3. A body starts rotating from rest. Due to a couple of 20 Nm it completes 60 revolutions in one minute. Find the moment of inertia of the body. **[Oct 14]**

4. A solid sphere of diameter 50 cm and mass 25 kg rotates about an axis through its centre. Calculate its moment of inertia. If its angular velocity changes from 2 rad/s to 12 rad/s in 5 seconds, calculate the torque applied. **[July 18]**

5. A wheel of moment of inertia 1 kg m^2 is rotating at a speed of 30 rad/s. Due to friction on the axis, it comes to rest in 10 minutes. Calculate the average torque of the friction. **[Mar 19]**

6. An automobile engine develops 62.84 kW while rotating at a speed of 1200 rpm. What torque does it deliver? **[July 22]**

1.10 Conservation of Angular Momentum

1. A horizontal disc is freely rotating about a transverse axis passing through its centre at the rate of 100 revolutions per minute. A 20 gram blob of wax falls on the disc and sticks to the disc at a distance of 5 cm from its axis. Moment of inertia of the disc about its axis passing through its centre of mass is 2×10^{-4} kg m^2. Calculate the new frequency of rotation of the disc. **[Mar 15]**

1.11 Rolling Motion

1. A solid sphere of mass 1 kg rolls on a table with linear speed 2 m/s, find its total kinetic energy. **[Mar 17]**

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01 Solid State

Multiple Choice Questions

1. In body centred cubic structure, the space occupied is about _____. **[Mar 13]**
   (A) 68 % (B) 53 %
   (C) 38 % (D) 32 %

2. To prepare n-type semiconductor, the impurity to be added to silicon should have the following number of valence electrons: **[Mar 14]**
   (A) 2 (B) 3 (C) 4 (D) 5

3. The major binding force in diamond is _____. **[Oct 14]**
   (A) covalent bond
   (B) ionic bond
   (C) metallic bond
   (D) coordinate covalent bond

4. p-type semi-conductors are made by mixing silicon with impurities of _____. **[Mar 15]**
   (A) germanium (B) boron
   (C) arsenic (D) antimony

5. An ionic compound crystallises in FCC type structure with 'A' ions at the centre of each face and 'B' ions occupying corners of the cube. The formula of compound is _____. **[Mar 17]**
   (A) AB_4 (B) A_3B (C) AB (D) AB_3

6. Number of types of orthorhombic unit cell is _____. **[July 18]**
   (A) 7 (B) 3 (C) 4 (D) 2

7. The number of atoms per unit cell of body centred cube is: **[Mar 20]**
   (A) 1 (B) 2 (C) 4 (D) 6

8. The co-ordination number of atoms in body centred cubic structure (bcc) is _____. **[Mar 22]**
   (A) 4 (B) 6 (C) 8 (D) 12

9. The CORRECT relation between edge length and radius of an atom in simple cubic lattice is _____. **[July 22]**
   (A) $2a = r$ (B) $\sqrt{3}a = 4r$
   (C) $a = 2r$ (D) $\sqrt{2}a = 4r$

10. The relation between radius of sphere and edge length in body centered cubic lattice is given by formula: **[Mar 23]**
    (A) $\sqrt{3}r = 4a$ (B) $r = \frac{\sqrt{3}}{a} \times 4$
    (C) $r = \frac{\sqrt{3}}{4} a$ (D) $r = \frac{\sqrt{2}}{4} \times a$

11. The number of particles present in face centred cubic unit cell is/are _____. **[Feb 24]**
    (A) 1 (B) 2
    (C) 3 (D) 4

Theory Questions

1.2 Types of solids

1. Distinguish between crystalline solids and amorphous solids. **[Mar 13, 14, 17, 19]**
2. Define isomorphism. **[July 2023]**

1.3 Classification of crystalline solids

1. Classify the following molecular solids into different types: **[July 18]**
   i. HCl ii. CO_2
   iii. Solid ice iv. SO_2

2. Classify the following solids into different types: **[Mar 20]**
   i. Silver ii. P_4
   iii. Diamond iv. NaCl

1.5 Cubic system

1. A face centred cube (fcc) consists of how many atoms? Explain. **[July 16]**
   OR
   Calculate the number of atoms in a unit cell of a metal crystallising in face centred cubic structure. **[July 17]**
2. Write the number of particles present in fcc per unit cell. **[July 23]**
3. Derive the relationship between molar mass, density of the substance and unit cell edge length. **[Feb 24]**

1.6 Packing of particles in crystal lattice

1. What is the ratio of octahedral holes to the number of anions in hexagonal closed packed structure? **[Mar 19]**

1.7 Packing efficiency

1. Calculate the percentage efficiency of packing in case of simple cubic cell. **[Mar 17]**
2. Give the relation between radius of atom and edge length in body centered cubic crystal. **[July 19]**

1.8 Crystal defects or imperfections

1. What are Schottky defect and Frenkel defect? **[Oct 13]**
2. Explain impurity defect in stainless steel with diagram. **[Mar 15]**
3. What is Schottky defect? **[July 19]**
4. Write the consequences of Schottky defect with reasons. **[Mar 22]**
5. Explain metal deficiency defect with example. **[Mar 22]**
6. Distinguish between Schottky and Frenkel defect. **[July 22]**
7. Explain the following terms: **[Mar 23]**

i. Substitutional impurity defect
ii. Interstitial impurity defect

1.10 Magnetic properties of solids

1. What is ferromagnetism? **[Mar 16]**

Numericals

1.5 Cubic system

1. Face centred cubic crystal lattice of copper has density of 8.966 g cm^{-3}. Calculate the volume of the unit cell.
   [Given: Molar mass of copper is 63.5 g mol^{-1} and Avogadro number N_A is 6.022×10^{23} mol^{-1}] **[Mar 14]**
2. A unit cell of iron crystal has edge length 288 pm and density 7.86 g cm^{-3}. Find the number of atoms per unit cell and type of the crystal lattice.
   [Given: Molar mass of iron = 56 g mol^{-1}, Avogadro's number $N_A = 6.022 \times 10^{23}$ mol^{-1}] **[Oct 14]**
3. Silver crystallises in fcc (face-centred cubic crystal) structure. The edge length of the unit cell is found to be 408.7 pm. Calculate density of the unit cell.
   [Given: Molar mass of silver is 108 g mol^{-1}] **[Oct 15]**
4. Silver crystallises in fcc structure. If density of silver is 10.51 g cm^{-3}, calculate the volume of unit cell. **[Mar 16]**
5. Determine the density of cesium chloride which crystallizes in bcc type structure with the edge length 412.1 pm. The atomic masses of Cs and Cl are 133 and 35.5 respectively. **[July 16]**
6. A metal crystallises into two cubic faces namely face centred (fcc) and body centred (bcc), whose unit cell edge lengths are 3.5 Å and 3.0 Å respectively. Find the ratio of the densities of fcc and bcc. **[July 17]**
7. The density of iron crystal is 8.54 g cm^{-3}. If the edge length of unit cell is 2.8 Å and atomic mass is 56 g mol^{-1}, find the number of atoms in the unit cell.
   [Given: Avogadro's number $=6.022\times10^{23}$ mol^{-1}, 1 Å = 1×10^{-8} cm] **[Mar 18]**
8. The density of silver having atomic mass 107.8 g mol^{-1} is 10.8 g cm^{-3}. If the edge length of cubic unit cell is 4.05×10^{-8} cm, find the number of silver atoms in the unit cell.
   [$N_A = 6.022 \times 10^{23}$ mol^{-1}, 1 Å = 10^{-8} cm] **[July 18]**
9. Unit cell of a metal has edge length of 288 pm and density of 7.86 g cm^{-3}. Determine the type of crystal lattice. [Atomic mass of metal = 56 g mol^{-1}] **[Mar 20]**
10. Gold crystallises into face-centred cubic cells. The edge length of unit cell is 4.08×10^{-8} cm. Calculate the density of gold. [Molar mass of gold = 197 g mol^{-1}] **[Mar 22]**
11. Silver crystallizes in fcc structure. If edge length of unit cell is 400 pm, calculate density of silver [Atomic mass of Ag = 108] **[Mar 23]**
12. An element with molar mass 27 g mol^{-1} forms cubic unit cell with edge length of 405 pm. If density of the element is 2.7 g cm^{-3}, what is the nature of cubic unit cell? **[July 23]**
13. Predict the type of cubic lattice of a solid element having edge length of 400 pm and density is 6.25 g mL^{-1}.
    [Atomic mass of element = 60] **[Feb 24]**

1.7 Packing efficiency

1. Gold occurs as face centred cube and has a density of 19.30 kg dm^{-3}. Calculate atomic radius of gold. [Molar mass of Au = 197] **[Mar 13]**
2. Niobium crystallises as body centred cube (bcc) and has density of 8.55 kg dm^{-3}. Calculate the atomic radius of niobium. [Given: Atomic mass of niobium = 93] **[Mar 15]**
3. Calculate the number of atoms and unit cells present in 0.5 g of Niobium if it forms body centred cubic structure. The density of Niobium is 8.55 g cm^{-3} and edge length of unit cell is 330.6 pm. **[July 22]**

02 Solutions

Multiple Choice Questions

1. Among the following equimolar aqueous solutions, identify the one having highest boiling point. **[Mar 08]**
   (A) Urea (B) Sucrose
   (C) Sodium chloride (D) Sodium sulphate

2. The addition of non-volatile solute into the pure solvent _____. **[Oct 08]**
   (A) increases the vapour pressure of solvent
   (B) decreases the boiling point of solvent
   (C) decreases the freezing point of solvent
   (D) increases the freezing point of solvent

3. Which of the following solutions shows maximum depression in freezing point? **[Mar 13]**
   (A) 0.5 M Li_2SO_4 (B) 1 M NaCl
   (C) 0.5 M $Al_2(SO_4)_3$ (D) 0.5 M $BaCl_2$

4. The temperature at which vapour pressure of a liquid becomes equal to the atmospheric pressure is _____. **[Oct 13]**
   (A) melting point (B) boiling point
   (C) 273 K (D) 373 K

5. Which of the following is NOT a colligative property? **[Mar 14]**
   (A) Vapour pressure
   (B) Depression in freezing point
   (C) Elevation in boiling point
   (D) Osmotic pressure

6. Colligative property depends only on _____ in a solution. **[Mar 15]**
   (A) number of solute particles
   (B) number of solvent particles
   (C) nature of solute particles
   (D) nature of solvent particles

7. The substance 'X', when dissolved in solvent water gave molar mass corresponding to the molecular formula 'X_3'. The van't Hoff factor (i) is _____. **[Oct 15]**
   (A) 3 (B) 0.33 (C) 1.3 (D) 1

8. The determination of molar mass from elevation in boiling point is called as _____. **[Mar 16]**
   (A) cryoscopy (B) colorimetry
   (C) ebullioscopy (D) spectroscopy

9. Which of the following 0.1 M aqueous solutions will exert the highest osmotic pressure? **[Mar 18]**
   (A) $Al_2(SO_4)_3$ (B) Na_2SO_4
   (C) $MgCl_2$ (D) KCl

10. In calculating osmotic pressure, the concentration of solute is expressed in _____. **[Mar 22]**
    (A) molarity (B) molality
    (C) mole fraction (D) percentage mass

11. Which solution shows positive deviation from Raoult's law? **[July 23]**
    (A) Phenol and Aniline
    (B) Chloroform and Acetone
    (C) Ethanol and Acetone
    (D) Chloroform and Ethanol

Theory Questions

2.4 Solubility

1. What is the effect of temperature on solubility of a gas in a liquid? **[Oct 15]**

2. State Henry's law. How does solubility of a gas in water varies with the temperature? **[Oct 13; July 17]**

3. State Henry's law. **[July 16; Mar 18]**

2.6 Colligative properties of nonelectrolyte solutions

1. Define colligative properties. **[Oct 08]**

2.7 Vapour pressure lowering

1. Derive the relationship between relative lowering of vapour pressure and molar mass of non-volatile solute. **[Mar 13, 17]**

2.8 Boiling point elevation

1. What is 'boiling point'? **[Mar 14]**

2. Define ebullioscopic constant.
   Write its unit. **[Oct 15]**

3. Derive the relation between elevation of boiling point and molar mass of solute. **[Mar 18]**
   OR
   Derive the mathematical expression between molar mass of a non-volatile solute and elevation of boiling point. **[Mar 20]**
   OR
   How will you determine molar mass of non volatile solute by elevation of boiling point? **[Mar 23]**

4. Define ebullioscopic constant. **[Oct 09; July 22]**

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01 Mathematical Logic

Multiple Choice Questions

1. If A = {2, 3, 4, 5, 6}, then which of the following is not true? **[Oct 13]**
   (A) $\exists\, x \in A$ such that $x + 3 = 8$
   (B) $\exists\, x \in A$ such that $x + 2 < 5$
   (C) $\exists\, x \in A$ such that $x + 2 < 9$
   (D) $\forall\, x \in A$ such that $x + 6 \geq 9$

2. The negation of $p \wedge (q \rightarrow r)$ is **[Mar 16]**
   (A) $p \vee (\sim q \vee r)$ (B) $\sim p \wedge (q \rightarrow r)$
   (C) $\sim p \wedge (\sim q \rightarrow \sim r)$ (D) $\sim p \vee (q \wedge \sim r)$

3. Inverse of the statement pattern $(p \vee q) \rightarrow (p \wedge q)$ is **[July 16]**
   (A) $(p \wedge q) \rightarrow (p \vee q)$
   (B) $\sim(p \vee q) \rightarrow (p \wedge q)$
   (C) $(\sim p \vee \sim q) \rightarrow (\sim p \wedge \sim q)$
   (D) $(\sim p \wedge \sim q) \rightarrow (\sim p \vee \sim q)$

4. The negation of $p \wedge (q \rightarrow r)$ is _____. **[Mar 22]**
   (A) $\sim p \wedge (\sim q \rightarrow \sim r)$ (B) $p \vee (\sim q \vee r)$
   (C) $\sim p \wedge (\sim q \rightarrow r)$ (D) $p \rightarrow (q \wedge \sim r)$

5. The negation of $(p \vee \sim q) \wedge r$ is _____. **[July 22]**
   (A) $(\sim p \wedge q) \wedge r$ (B) $(\sim p \wedge q) \vee r$
   (C) $(\sim p \wedge q) \vee \sim r$ (D) $(\sim p \vee q) \wedge \sim r$

6. If $p \wedge q = F$, $p \rightarrow q = F$, then the truth values of p and q are : **[Oct 15]**
   (A) T, T (B) T, F
   (C) F, T (D) F, F

   OR

   If $p \wedge q$ is F, $p \rightarrow q$ is F then the truth values of p and q are _____ respectively. **[Mar 23]**
   (A) T, T (B) T, F
   (C) F, T (D) F, F

7. The dual of statement $p \wedge \sim q$ is equivalent to _____. **[July 23]**
   (A) $\sim p \wedge q$ (B) $p \leftrightarrow q$
   (C) $\sim p \vee q$ (S) $\sim p \rightarrow \sim q$

8. The dual of statement $t \vee (p \vee q)$ is _____. **[Mar 24]**
   (A) $c \wedge (p \vee q)$ (B) $c \wedge (p \wedge q)$
   (C) $t \wedge (p \wedge q)$ (D) $t \wedge (p \vee q)$

Questions

Based on Exercise 1.1

1. Write down the following statements in symbolic form:
   i. A triangle is equilateral if and only if it is equiangular.
   ii. Price increases and demand falls. **[Mar 13]**

2. If p : It is a day time, q : It is warm, write the compound statements in verbal form denoted by–
   i. $p \wedge \sim q$ ii. $\sim p \rightarrow q$ iii. $q \leftrightarrow p$ **[Oct 14]**

3. Write truth value of the following statement: $\sqrt{5}$ is an irrational number but $3 + \sqrt{5}$ is a complex number. **[Oct 14]**

4. If p, q, r are the statements with truth values T, F, T, respectively then find the truth value of $(r \wedge q) \leftrightarrow \sim p$. **[July 16]**

5. Write the truth values of the following statements:
   i. 2 is a rational number and $\sqrt{2}$ is an irrational number.
   ii. $2 + 3 = 5$ or $\sqrt{2}+\sqrt{3}=\sqrt{5}$ **[Mar 19]**

6. Write the truth values of the following statements:
   i. Two is the only even prime number.
   ii. $\cos(2\theta) = \cos^2\theta - \sin^2\theta$, for all $\theta \in R$ **[July 19]**

7. If the statement p, q are true statements and r, s are false then determine the truth value of $(p \rightarrow q) \vee (r \rightarrow s)$. **[July 22]**

8. Write the following compound statements symbolically:
   i. Nagpur is in Maharashtra and Chennai is in Tamilnadu.
   ii. If ΔABC is right angled at B, then $m\angle A + m\angle C = 90°$ **[July 23]**

9. Write the compound statement 'Nagpur is in Maharashtra and Chennai is in Tamilnadu' symbolically. **[Mar 24]**

Based on Exercise 1.2

1. Using truth table, prove that:
$p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$ **[Mar 98, Oct 00, 01, 04]**

2. Using truth table, prove that :
$p \wedge q \equiv \sim(p \rightarrow \sim q)$ **[Mar 08]**

3. Using truth table examine whether the following statement pattern is tautology, contradiction or contingency.
$(p \wedge \sim q) \leftrightarrow (p \rightarrow q)$ **[Mar 13]**

4. Using truth table, prove that
$\sim p \wedge q \equiv (p \vee q) \wedge \sim p$ **[Oct 13, Mar 14]**

5. Using truth table, prove the following logical equivalence $(p \wedge q) \rightarrow r \equiv p \rightarrow (q \rightarrow r)$. **[Oct 14]**

6. Discuss the statement pattern, using truth table:
$\sim(\sim p \wedge \sim q) \vee q$ **[Mar 15]**

7. Examine whether the following logical statement pattern is tautology, contradiction or contingency. $[(p \rightarrow q) \wedge q] \rightarrow p$ **[Mar 16]**

8. Using truth tables, examine whether the statement pattern $(p \wedge q) \vee (p \wedge r)$ is a tautology, contradiction or contingency. **[Mar 17]**

9. Using truth table prove that
$p \leftrightarrow q \equiv (p \wedge q) \vee (\sim p \wedge \sim q)$. **[Oct 15; Mar 18]**

10. Using truth table, examine whether the following statement pattern is a tautology, a contradiction or a contingency:
$(p \vee q) \vee r \leftrightarrow p \vee (q \vee r)$ **[July 18]**

11. Using truth table, prove that:
$p \leftrightarrow q \equiv (p \wedge q) \vee (\sim p \wedge \sim q)$ **[July 19]**

12. Using truth table, prove that:
$\sim(p \vee q) \equiv \sim p \wedge \sim q$ **[Mar 96; Feb 20]**

13. Using truth table verify that:
$(p \wedge q) \vee \sim q \equiv p \vee \sim q$ **[Mar 22]**

14. Examine whether the statement pattern $(p \rightarrow q) \leftrightarrow (\sim p \vee q)$ is a tautology, contradiction or contingency. **[July 22]**

15. Construct the truth table for the statement pattern $(p \rightarrow q) \wedge [(q \rightarrow r) \rightarrow (p \rightarrow r)]$ and interpret your result. **[July 23]**

16. Construct the truth table for the statement pattern:
$[(p \rightarrow q) \wedge q] \rightarrow p$ **[Mar 24]**

Based on Exercise 1.3

1. Write the dual of the following statements:
i. $(p \vee q) \wedge T$
ii. Madhuri has curly hair and brown eyes. **[Mar 14]**

2. Write truth value of the following statement:
$\exists\ n \in N$ such that $n + 5 > 10$ **[Oct 14]**

3. Write the converse and contrapositive of the statement-
"If two triangles are congruent then their areas are equal." **[Mar 15]**

4. Write the following statement in symbolic form and find its truth value:
$\forall\ n \in N$, $n^2 + n$ is an even number and $n^2 - n$ is an odd number. **[Mar 17]**

5. Write the negations of the following statements:
i. $\forall\ n \in N, n + 7 > 6$
ii. The kitchen is neat and tidy. **[July 17]**

6. Write the converse, inverse and contrapositive of the following statement.
"If it rains then the match will be cancelled." **[July 17]**

7. Write converse, inverse and contrapositive of the following conditional statement:
If an angle is a right angle then its measure is 90°. **[Mar 18]**

8. Write the negations of the following statements:
i. All students of this college live in the hostel.
ii. 6 is an even number or 36 is a perfect square. **[Mar 18]**

9. Write the negations of the following statements:
i. If diagonals of a parallelogram are perpendicular, then it is a rhombus.
ii. Mangoes are delicious, but expensive.
iii. A person is rich if and only if he is a software engineer. **[July 18]**

10. Write the dual of each of the following statements:
i. $\sim p \wedge (q \vee c)$
ii. "Shweta is a doctor or Seema is a teacher." **[July 18]**

11. Write the dual of $p \wedge \sim p \equiv F$. **[Feb 20]**

12. State the converse, inverse and contrapositive of the conditional statement:
'If a sequence is bounded, then it is convergent'. **[Feb 20]**

13. Write inverse and contrapositive of the following statement:
If $x < y$ then $x^2 < y^2$ **[Mar 23]**

Based on Exercise 1.4

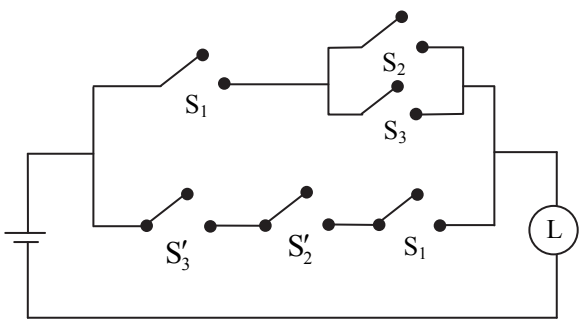
1. Without using truth table show that
$p \leftrightarrow q \equiv (p \wedge q) \vee (\sim p \wedge \sim q)$ **[Mar 13]**

2. Without using truth table prove that
$(p \wedge q) \vee (\sim p \wedge q) \vee (p \wedge \sim q) \equiv p \vee q$
[Mar 22]

3. Without using truth table show that
$\sim (p \vee q) \vee (\sim p \wedge q) \equiv \sim p$
[Mar 16; July 22]

Based on Exercise 1.5

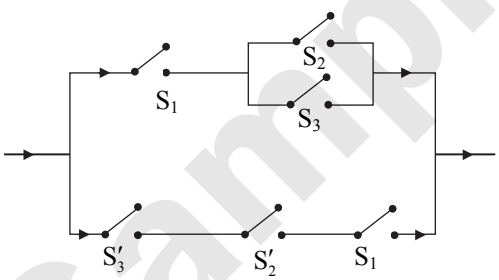
1. Construct the new switching circuit for the following circuit with only one switch by simplifying the given circuit:



[Oct 13]

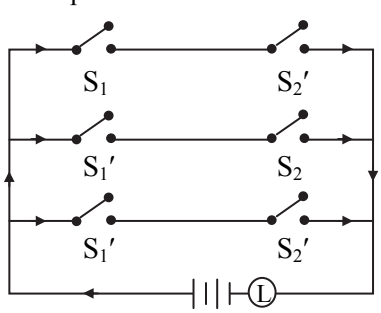
2. Construct the switching circuit for the following statement:
$[p \vee (\sim p \wedge q)] \vee [(\sim q \wedge r) \vee \sim p]$ **[Mar 15]**

3. Construct the simplified circuit for the following circuit:



[Oct 15]

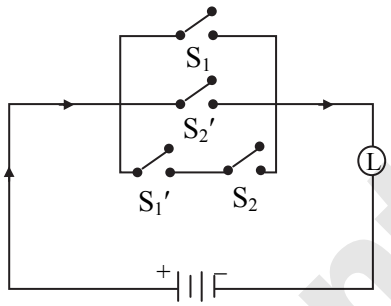
4. Simplify the following circuit so that new circuit has minimum number of switches. Also draw simplified circuit.



[July 16]

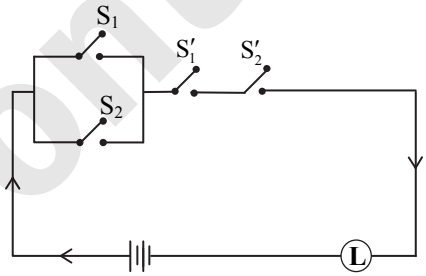
5. Construct the switching circuit for the statement $(p \wedge q) \vee (\sim p) \vee (p \wedge \sim q)$. **[Mar 17]**

6. Express the following switching circuit in symbolic form of logic. Construct its switching table and write your conclusion from it:



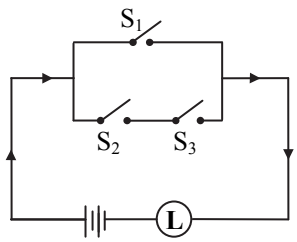
[Mar 14; July 17]

7. Find the symbolic form of the given switching circuit. Construct its switching table and interpret your result.



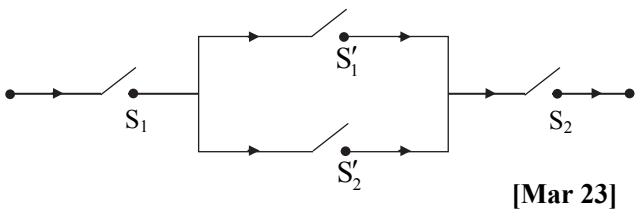
[Mar 19]

8. Express the following circuit in symbolic form:



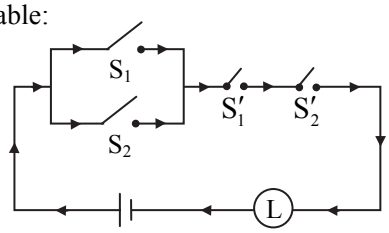
[Feb 20]

9. Simplify the given circuit by writing its logical expression. Also write your conclusion.



[Mar 23]

10. Express the following switching circuit in the symbolic form of logic. Construct the switching table:



[Mar 24]

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01 Differentiation

Multiple Choice Questions

1. If $x^y = e^{x-y}$, then $\frac{dy}{dx}$ = _____ **[Oct 13]**

(A) $\frac{1+x}{1+\log x}$ (B) $\frac{\log x}{(1+\log x)^2}$

(C) $\frac{1-\log x}{1+\log x}$ (D) $\frac{1-x}{1+\log x}$

2. If $y = 1 - \cos\theta$, $x = 1 - \sin\theta$, then $\frac{dy}{dx}$ at $\theta = \frac{\pi}{4}$ is **[Mar 14]**

(A) -1 (B) 1

(C) $\frac{1}{2}$ (D) $\frac{1}{\sqrt{2}}$

3. If $\sec\left(\frac{x+y}{x-y}\right) = a^2$, then $\frac{d^2y}{dx^2}$ = _____. **[Oct 14]**

(A) y (B) x

(C) $\frac{y}{x}$ (D) 0

4. If $y = \sec^{-1}\left(\frac{\sqrt{x}-1}{\sqrt{x}+1}\right) + \sin^{-1}\left(\frac{\sqrt{x}+1}{\sqrt{x}-1}\right)$, then $\frac{dy}{dx}$ = _____. **[Oct 15]**

(A) x (B) $\frac{1}{x}$

(C) 1 (D) 0

5. Derivative of $\tan^3\theta$ with respect to $\sec^3\theta$ at $\theta = \frac{\pi}{3}$ is _____. **[Mar 17]**

(A) $\frac{3}{2}$ (B) $\frac{\sqrt{3}}{2}$ (C) $\frac{1}{2}$ (D) $-\frac{\sqrt{3}}{2}$

6. If $f(x) = x^5 + 2x - 3$, then $\left(f^{-1}\right)'(-3)$ = _____. **[Mar 22]**

(A) 0 (B) -3

(C) $-\frac{1}{3}$ (D) $\frac{1}{2}$

7. If y is a function of x and $\log(x + y) = 2xy$, then the value of $y'(0)$ = _____. **[Mar 23]**

(A) 2 (B) 0

(C) -1 (D) 1

8. If $x = at^4$, $y = 2at^2$, then $\frac{dy}{dx}$ = _____. **[July 23]**

(A) $\frac{1}{t^2}$ (B) t^2

(C) $2t^2$ (D) $-\frac{1}{t^2}$

Questions

Based on Exercise 1.1

1. If $y = \sec\sqrt{x}$, then find $\frac{dy}{dx}$. **[July 16]**

2. If $y = \tan^2(\log x^3)$, find $\frac{dy}{dx}$. **[Mar 18]**

3. If $y = f(u)$ is a differentiable function of u and $u = g(x)$ is a differentiable function of x, then prove that $y = f[g(x)]$ is a differentiable function of x and $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$. **[Mar 96, 98, 04, 14; Oct 98, 99, 03, 15; July 18]**

4. Differentiate $\sin(x^2 + x)$ w.r.t. x. **[Feb 20]**

5. Differentiate $\log(\sec x + \tan x)$ w.r.t. x. **[Feb 20]**

Based on Exercise 1.2

1. If $y = \sin^{-1}(3x) + \sec^{-1}\left(\frac{1}{3x}\right)$, find $\frac{dy}{dx}$. **[Oct 14]**

2. Differentiate $\cos^{-1}\left(\frac{3\cos x - 2\sin x}{\sqrt{13}}\right)$ w. r. t. x. **[Oct 15]**

3. If $y = \cos^{-1}\left(2x\sqrt{1-x^2}\right)$, find $\frac{dy}{dx}$. **[Mar 16]**

4. Find $\frac{dy}{dx}$ if $y = \tan^{-1}\left(\frac{5x+1}{3-x-6x^2}\right)$. **[Mar 18]**

5. If $y = \cos^{-1}(1 - 2\sin^2 x)$, find $\frac{dy}{dx}$. **[July 18]**

6. If $y = f(x)$ is a differentiable function of x such that inverse function $x = f^{-1}(y)$ exists, then prove that x is a differentiable function of y and $\frac{dx}{dy} = \frac{1}{\left(\frac{dy}{dx}\right)}$, where $\frac{dy}{dx} \neq 0$.

[Mar 99, 03, 05, 06, 09, 17; July 16; Oct 96, 02, 04, 05, 06, 13]

Hence find $\frac{d}{dx}(\tan^{-1}x)$ **[Mar 15, 17]**

Hence if $y = \sin^{-1}x, -1 \leq x \leq 1, \frac{-\pi}{2} \leq y \leq \frac{\pi}{2}$

then show that $\frac{dy}{dx} = \frac{1}{\sqrt{1-x^2}}$, where $|x| < 1$.

[July 17]

Hence find $\frac{d}{dx}\left[\sin^{-1}x\right]$. **[July 19]**

7. If $y = \tan^{-1}\left(\frac{8x}{1-15x^2}\right)$ then find $\frac{dy}{dx}$.

[July 22]

8. If $y = f(x)$ is a differentiable function of x on interval I and y is one-one, onto and $\frac{dy}{dx} \neq 0$ on I.

Also if $f^{-1}(y)$ is differentiable function on f(I) then prove that: $\frac{dx}{dy} = \frac{1}{\frac{dy}{dx}}$ where $\frac{dy}{dx} \neq 0$

Hence find the derivative of the inverse of function $y = 2x^3 - 6x$.

[July 22]

9. If $y = f(x)$ is a differentiable function of x on an interval 1 and y is one-one, onto and $\frac{dy}{dx} \neq 0$ on 1, then prove that $\frac{dx}{dy} = \frac{1}{\frac{dx}{dy}}$.

where $\frac{dy}{dx} \neq 0$.

Hence prove that $\frac{d}{dx}(\cot^{-1}x) = \frac{-1}{1+x^2}$

[July 23]

Based on Exercise 1.3

1. If $\sqrt{1-x^2} + \sqrt{1-y^2} = a(x - y)$, show that $\frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}$. **[Oct 13]**

2. If $x^p y^q = (x+y)^{p+q}$, then prove that $\frac{dy}{dx} = \frac{y}{x}$. **[Mar 14]**

3. If $y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + ...\infty}}}$, then show that $\frac{dy}{dx} = \frac{\cos x}{2y-1}$. **[Mar 15]**

4. If $y = e^{\tan x} + (\log x)^{\tan x}$, then find $\frac{dy}{dx}$. **[July 16]**

5. Find $\frac{dy}{dx}$ if $x \sin y + y \sin x = 0$. **[Mar 17]**

6. If $\sec^{-1}\left(\frac{x+y}{x-y}\right) = a^2$, show that $\frac{dy}{dx} = \frac{y}{x}$.

[July 18]

7. If $y = x^x$, find $\frac{dy}{dx}$. **[Mar 16, 19]**

8. If $e^x + e^y = e^{x+y}$, show that $\frac{dy}{dx} = -e^{y-x}$.

[Feb 20]

9. If $y = \sqrt{\tan x + \sqrt{\tan x + \sqrt{\tan x + ...+\infty}}}$, then show that $\frac{dy}{dx} = \frac{\sec^2 x}{2y-1}$. Find $\frac{dy}{dx}$ at $x = 0$.

[Mar 23]

10. If $\log_{10}\left(\frac{x^3-y^3}{x^3+y^3}\right) = 2$, then show that $\frac{dy}{dx} = -\frac{99x^2}{101y^2}$. **[Mar 15; July 23]**

11. Find $\frac{dy}{dx}$, if $y = (\log x)^x$. **[Mar 24]**

Based on Exercise 1.4

1. If $x = a\left(t - \frac{1}{t}\right)$, $y = a\left(t + \frac{1}{t}\right)$, then show that $\frac{dy}{dx} = \frac{x}{y}$. **[Mar 13]**

2. If $x = at^2$, $y = 2at$, then find $\frac{dy}{dx}$. **[Mar 13]**

3. Differentiate 3^x w.r.t. $\log_3 x$. **[July 17]**

4. If $x = a\cos^3 t$, $y = a\sin^3 t$,

show that $\frac{dy}{dx} = -\left(\frac{y}{x}\right)^{\frac{1}{3}}$. **[Mar 18]**

5. If $x = f(t)$, $y = g(t)$ are differentiable functions of parameter 't' then prove that y is a differentiable function of 'x' and

$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}, \frac{dx}{dt} \neq 0$ **[Mar 00, 05; Oct 97, 00, 14]**

Hence find $\frac{dy}{dx}$ if $x = a\cos t, y = a\sin t$.

[Oct 14]

Hence find $\frac{dy}{dx}$ if $x = a\cos^2 t$ and $y = a\sin^2 t$.

[Mar 19]

6. Differentiate $\log(1 + x^2)$ with respect to $\tan^{-1}x$.

[July 19]

7. If $x = f(t)$ and $y = g(t)$ are differentiable functions of t so that y is differentiable function of x and $\frac{dx}{dt} \neq 0$, then prove that:

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$$

Hence find $\frac{dy}{dx}$ if $x = \sin t$ and $y = \cos t$.

[Mar 22]

8. Find the derivative of $\cos^{-1}x$ w.r.t. $\sqrt{1-x^2}$.

[July 22]

9. If $x = f(t)$ and $y = g(t)$ are differentiable functions of t, so that y is function of x and $\frac{dx}{dt} \neq 0$, then prove that $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$.

Hence find $\frac{dy}{dx}$, if $x = at^2, y = 2at$. **[Mar 24]**

Based on Exercise 1.5

1. If $ax^2 + 2hxy + by^2 = 0$, show that $\frac{d^2y}{dx^2} = 0$.

[Mar 13]

2. If $y = (\tan^{-1}x)^2$, show that

$(1 + x^2)^2 \frac{d^2y}{dx^2} + 2x(1 + x^2)\frac{dy}{dx} - 2 = 0$.

[Mar 15]

3. If $y = x\log x$, then find $\frac{d^2y}{dx^2}$. **[Feb 20]**

4. If $y = e^{m\tan^{-1}x}$, then show that

$(1 + x^2)\frac{d^2y}{dx^2} + (2x - m)\frac{dy}{dx} = 0$ **[Mar 22]**

5. If $y = \cos(m\cos^{-1}x)$ then show that

$(1 - x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + m^2y = 0$ **[Mar 23]**

6. If $y = \sin^{-1}x$, then show that:

$(1 - x^2)\frac{d^2y}{dx^2} - x \times \frac{dy}{dx} = 0$. **[Mar 24]**

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To see complete chapter buy **Target Notes** or **Target E-Notes**

01 Reproduction in Lower and Higher Plants

Multiple Choice Questions

1. The types of pollination exhibited by *Vallisneria* and *Zea mays* respectively are_____ **[Oct 08]**
   (A) Anemophily and Hydrophily
   (B) Entomophily and Hydrophily
   (C) Hydrophily and Anemophily
   (D) Hydrophily and Entomophily

2. The endosperm cells in an angiospermic plant has 18 chromosomes, the number of chromosomes in its roots cells will be _____ **[Mar 09]**
   (A) 12 (B) 6 (C) 18 (D) 24

3. In porogamy, the pollen tube enters into the ovule through _____ **[Mar 09]**
   (A) micropyle (B) integument
   (C) chalaza (D) funicle

4. Egg apparatus consists of _____ **[Oct 09]**
   (A) egg and antipodals
   (B) egg and polar nuclei
   (C) egg and synergids
   (D) egg and secondary nucleus

5. Synergids are _____ **[Mar 10]**
   (A) haploid (B) triploid
   (C) diploid (D) tetraploid

6. How many meiotic divisions are required for the formation of 100 seeds? **[Oct 13]**
   (A) 25 (B) 50 (C) 100 (D) 125

7. During fertilization, male gametes are carried by pollen tube. This is called **[Oct 13]**
   (A) Syngamy (B) Mesogamy
   (C) Polygamy (D) Siphonogamy

8. For formation of 50 seeds, how many minimum meiotic divisions are necessary? **[Mar 14]**
   (A) 25 (B) 50 (C) 75 (D) 63

9. In bisexual flowers, maturation of gynoecium before androecium is known as _____. **[Mar 14]**
   (A) protandry (B) protogyny
   (C) gynandry (D) dicliny

10. If the number of chromosomes in an endosperm cell is 27, what will be the chromosome number in the definitive nucleus? **[Mar 15]**
    (A) 9 (B) 18 (C) 27 (D) 36

11. Lever mechanism of pollination is observed in _____. **[Mar 15]**
    (A) *Salvia* (B) *Jasmine*
    (C) *Bougainvillea* (D) *Butea*

12. Vegetative propagation takes place with the help of leaves in _____ plant. **[Oct 15]**
    (A) *Kalanchoe* (B) *Oxalis*
    (C) *Cynodon* (D) *Dahlia*

13. How many meiotic divisions will be needed to produce 44 female gametophytes in angiosperms? **[Oct 15]**
    (A) 11 (B) 22 (C) 44 (D) 66

14. Endosperm of angiosperm is _____. **[July 16]**
    (A) haploid (B) diploid
    (C) triploid (D) tetraploid

15. A versatile anther is an adaptation for _____ type of pollination. **[July 18]**
    (A) anemophilous (B) entomophilous
    (C) hydrophilous (D) ornithophilous

16. During double fertilization second male gamete fuses with _____. **[Mar 19]**
    (A) antipodal cell (B) egg cell
    (C) secondary nucleus (D) synergids

17. How many meiotic and mitotic divisions are required for the formation of male gametophyte from pollen mother cell? **[Mar 20]**
    (A) 2 meiotic and 1 mitotic
    (B) 1 meiotic and 1 mitotic
    (C) 1 meiotic and 2 mitotic
    (D) 2 meiotic and 2 mitotic

18. How many meiotic and mitotic divisions occur during the development of male gametophyte from the microspore mother cell? **[Mar 22]**
    (A) One meiotic and two mitotic
    (B) Two meiotic only
    (C) Two mitotic only
    (D) One mitotic and one meiotic

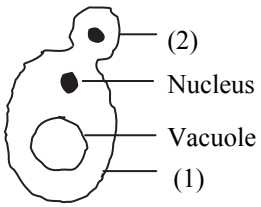
19. How many mitotic divisions take place during the formation of a female gametophyte from a functional megaspore? **[Mar 23]**
    (A) One (B) Two
    (C) Three (D) Four

20. Which of the following types require pollinator but result is genetically similar to autogamy? **[Mar 24]**
    (A) Geitonogamy (B) Xenogamy
    (C) Apogamy (D) Cleistogamy

Theory Questions

1.1 Asexual Reproduction

1. What is vegetative reproduction? Describe any 'three' natural methods of vegetative reproduction with examples. **[Oct 14]**
2. Define vegetative propagation**.** **[Mar 15]**
3. Label the parts (1) and (2) in budding of yeast cell. **[Oct 15]**



4. What is 'vegetative reproduction'? Explain 'any three'natural methods of vegetative reproduction. **[July 18]**
5. Define stock and scion. **[July 18]**
6. What is artificial method of vegetative propagation? Describe:
   i. Cutting ii. Budding. **[Mar 20]**
7. Explain following term:
   Grafting **[Mar 24]**

1.2 Sexual Reproduction

1. Sketch and label T.S. of anther. **[Mar 15]**
2. Sketch and label the T.S. of undehisced anther. **[Oct 15]**

1.3 Microsporogenesis

1. Explain the structure of male gametophyte of angiosperms with the help of a suitable diagram. **[Mar 13]**
2. What is microsporogenesis? **[Oct 13]**
3. Give a neat and labelled sketch of the germinating angiospermic pollen grain. **[Oct 14]**
4. Sketch and label typical angiospermic pollen grain. **[Mar 08]**

   OR

   Sketch and label a pollen grain of angiosperms. **[Mar 18]**
5. Sketch and label structure of male gametophyte in angiosperm. **[Mar 10; Mar 19]**

1.4 Structure of Anatropous Ovule

1. Sketch and label V. S. of anatropous ovule. **[Mar 09; Oct 13; Mar 17]**
2. Sketch and label the diagram of ovule most commonly seen in angiosperms. **[July 22]**

1.5 Megasporogenesis

1. Sketch and label stages in development of angiospermic female gametophyte from functional megaspore. **[July 16]**
2. Describe the development of Female gametophyte in Angiosperms. **[Oct 09]**

   OR

   With the help of a neat and labelled diagram describe the development of female gametophyte of angiosperms. **[Mar 18]**
3. Sketch and label female gametophyte of Angiosperms. **[Oct 08]**

   OR

   Sketch and label angiospermic embryo sac. **[Mar 20]**

1.6 Pollination

1. Give floral adaptations in anemophily and entomophily. **[Mar 09]**

   OR

   Describe floral adaptations in Anemophily and Entomophily. **[Oct 09]**
2. Define geitonogamy and xenogamy.
   Explain how dichogamy favours cross pollination. **[Mar 13]**
3. Give the floral adaptations for chiropterophily. **[Mar 16]**
4. Give the floral adaptations for anemophily. **[July 16]**
5. Enlist any 'two' floral adaptations in *Salvia*. **[Mar 17]**
6. Differentiate between anemophily and entomophily. **[Mar 17]**
7. Give the floral adaptations of entomophily. **[July 17]**
8. Add a note on pollination mechanism in *Salvia*. **[July 17]**
9. Complete the following chart and rewrite:

	Agencies	Type of Pollination
i.	Water	_ _ _ _ _ _ _
ii.	_ _ _ _ _ _ _	Entomophily
iii.	Bat	_ _ _ _ _ _ _
iv.	_ _ _ _ _ _ _	Ornithophily

   [Mar 19]
10. Define pollination. Explain different types of self and cross pollination with suitable examples. **[July 19]**

11. i. Describe any three adaptations in anemophilous flowers.
Mention any one example of the anemophilous flower.
ii. Describe any three adaptations in hydrophilous flowers.
Mention any one example of the hydrophilous flower. **[Mar 23]**

12. i. What is pollination?
ii. Differentiate between Anemophily and Entomophily with reference to :
a. pollinating agent
b. stigma
c. nectar
d. fragrance **[July 23]**

1.7 Outbreeding Devices (Contrivances)

1. With the help of a suitable example, explain protandry. **[Oct 15]**

2. Explain outbreeding devices in angiospermic plants. **[Mar 19]**

OR

Explain any four contrivances to prevent self - pollination in plants with an appropriate example of each type. **[July 23]**

3. Describe outbreeding devices which encourages cross pollination. **[Mar 22]**

1.8 Pollen-Pistil Interaction

1. Name the part of gynoecium that determines the compatibility of pollen grains. **[Mar 22]**

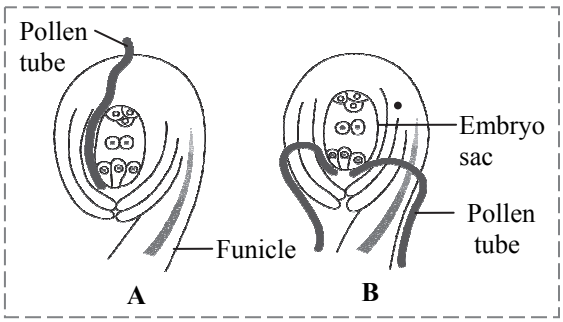
1.9 Double Fertilization

1. What is 'double fertilization'? Describe it with the help of a neat and well labelled diagram. Give its importance. **[Mar 14]**

2. 'Formation of primary endosperm nucleus is called triple fusion'. Give reason. **[Mar 15]**

3. What is double fertilization? Describe the process in brief. **[Mar 16]**

4. i. Following are the diagrams of entry of pollen tube into ovule. Identify the type A and B.



ii. Give any four points of significance of double fertilization. **[Mar 23]**

5. If the megaspore mother cell has 26 chromosomes, what will be the total number of chromosomes in endosperm of the same plant? **[July 23]**

6. What are the significances of double fertilization? **[Mar 24]**

7. How many meiotic divisions are required for the formation of 300 seeds in angiosperm? **[Mar 24]**

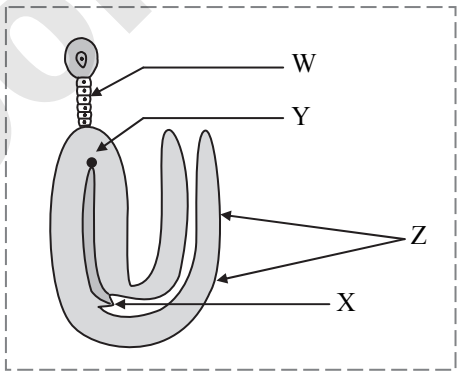
1.10 Development of Endosperm

1. Describe the formation of helobial endosperm. **[July 16]**

1.11 Development of Embryo

1. Explain the development of dicot embryo in angiosperms. **[Mar 10]**

2. Name the parts W, X, Y and Z from the following figure: **[Mar 17]**



1.12 Seed and Fruit Development

1. Sketch and label the V.S. of anatropous ovule and answer the following questions:
i. How many mitotic divisions are required to produce embryo sac?
ii. Which part of ovule is converted into seed coat?
iii. Which part provides the passage for entry of pollen tube during fertilization? **[July 19]**

2. Match the parts of ovule given in column I with parts of seed given in column II:

	Column I		Column II
(a)	egg	(1)	testa
(b)	nucellus	(2)	tegmen
(c)	outer integument	(3)	perisperm
(d)	inner integument	(4)	embryo

[Mar 22]

3. i. Kabban Park in Bengaluru is having dull flowers with strong fragrance, abundant nectar and edible pollen grains. Identify the type of pollination, the flowers are adapted for.

ii. The process of fruit formation without fertilization is termed as _____.

iii. Differentiate between albuminous and exalbuminous seeds. **[July 22]**

1.13 Apomixis

1. Explain following term:
Apomixis **[Mar 24]**

1.14 Parthenocarpy

1. Define parthenocarpy. **[Oct 15]**
OR
Explain following term: Parthenocarpy **[Mar 24]**

1.15 Polyembryony

1. Define polyembryony. State its different types. **[July 22]**

2. Explain following term:
Polyembryony **[Mar 24]**

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