Follows the revised HSC syllabus prescribed by the Maharashtra State Board of Secondary and Higher Secondary Education, Pune.

STD. XII Sci.

A collection of

Board Questions

2013 to 2017

Physics • **C**hemistry • **M**athematics • **B**iology

Includes all board questions from 2013 to 2017 and several other relevant questions from previous years.

Salient Features

- Subjects covered: Physics, Chemistry, Mathematics and Biology.
- Includes all board questions from 2013 till date.
- Also covers questions from previous years which fall under the current revised syllabus.
- Board questions include: MCQs, Theory questions and Numericals.
- Topic-wise flow of the board questions.

Printed at: **Dainik Saamana,** Navi Mumbai

P.O. No. 80100

10300_12030_JUP

Contents

Chapter No.	Units	Page No.
	Physics - I	**1**
1	Circular Motion	2
2	Gravitation	6
3	Rotational Motion	10
4	Oscillations	14
5	Elasticity	19
6	Surface Tension	22
7	Wave Motion	25
8	Stationary Waves	30
9	Kinetic Theory of Gases and Radiation	34
	Physics – II	**39**
10	Wave Theory of light	40
11	Interference and Diffraction	43
12	Electrostatics	48
13	Current Electricity	52
14	Magnetic Effect of Electric Current	55
15	Magnetism	58
16	Electromagnetic Induction	60
17	Electrons and Photons	64
18	Atoms, Molecules and Nuclei	67
19	Semiconductors	70
20	Communication System	72
	Chemistry – I	**74**
1	Solid State	75
2	Solutions and Colligative Properties	77
3	Chemical Thermodynamics and Energetics	79
4	Electrochemistry	82
5	Chemical Kinetics	84
6	General Principles and Processes of Isolation of Elements	86
7	p–Block Elements	88
	Chemistry – II	**90**
8	d and f–Block Elements	91
9	Coordination Compounds	93
10	Halogen Derivatives of Alkanes and Arenes	94
11	Alcohols, Phenols and Ethers	96
12	Aldehydes, Ketones and Carboxylic Acids	98
13	Compounds Containing Nitrogen	100
14	Biomolecules	102
15	Polymers	104
16	Chemistry in Everyday Life	105

Chapter No.	Units	Page No.
	Maths – I	**106**
1	Mathematical Logic	107
2	Matrices	109
3	Trigonometric Functions	111
4	Pair of Straight Lines	113
5	Vectors	115
6	Three Dimensional Geometry	117
7	Line	118
8	Plane	119
9	Linear Programming	120
	Maths – II	**121**
1	Continuity	122
2	Differentiation	124
3	Applications of Derivatives	126
4	Integration	128
5	Definite Integral	130
6	Applications of Definite Integral	131
7	Differential Equations	132
8	Probability Distribution	134
9	Binomial Distribution	136
	Biology – I	**137**
1	Genetic Basis of Inheritance	138
2	Gene: It's Nature, Expression and Regulation	139
3	Biotechnology: Process and Application	140
4	Enhancement in Food Production	142
5	Microbes in Human Welfare	143
6	Photosynthesis	145
7	Respiration	146
8	Reproduction in Plants	147
9	Organisms and Environment - I	149
	Biology – II	**151**
10	Origin and Evolution of Life	152
11	Chromosomal Basis of Inheritance	153
12	Genetic Engineering and Genomics	154
13	Human Health and Diseases	156
14	Animal Husbandry	157
15	Circulation	158
16	Excretion and Osmoregulation	159
17	Control and Co-ordination	160
18	Human Reproduction	161
19	Organisms and Environment – II	163

Physics - I

01 Circular Motion

Multiple Choice Questions

1. Angular speed of a minute hand of a wrist watch in rad/s is **[Oct 10]**
   (A) $\frac{\pi}{60}$ (B) $\frac{\pi}{900}$
   (C) $\frac{\pi}{1800}$ (D) $\frac{\pi}{3600}$

2. The bulging of earth at the equator and flattening at the poles is due to _____. **[Mar 14]**
   (A) centripetal force
   (B) centrifugal force
   (C) gravitational force
   (D) electrostatic force

3. If a cycle wheel of radius 0.4 m completes one revolution in 2 seconds, then acceleration of the cycle is _____. **[Mar 11]**
   (A) $0.4\ \pi\ m/s^2$ (B) $0.4\ \pi^2\ m/s^2$
   (C) $\frac{\pi^2}{0.4}\ m/s^2$ (D) $\frac{0.4}{\pi^2}\ m/s^2$

4. A body performing uniform circular motion has _____. **[Oct 08]**
   (A) constant velocity
   (B) constant acceleration
   (C) constant kinetic energy
   (D) constant displacement

5. 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

6. 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 the 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

7. The time period of conical pendulum is _____. **[Oct 11]**
   (A) $\sqrt{\frac{l\cos\theta}{g}}$ (B) $2\pi\sqrt{\frac{l\sin\theta}{g}}$
   (C) $2\pi\sqrt{\frac{l\cos\theta}{g}}$ (D) $\sqrt{\frac{l\sin\theta}{g}}$

8. 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) $4\pi\sqrt{\frac{l\tan\theta}{g}}$

9. 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

10. Out of the following equations which is WRONG? **[Mar 12]**
    (A) $\vec{\tau} = \vec{r} \times \vec{F}$ (B) $\vec{a}_r = \vec{\omega} \times \vec{v}$
    (C) $\vec{a}_t = \vec{\alpha} \times \vec{r}$ (D) $\vec{v} = \vec{r} \times \vec{\omega}$

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) $\frac{2vt}{D}$

Theory Questions

1. Define linear velocity. Derive the relation between linear velocity and angular velocity. **[Mar 96, 02 08, 12; Oct 09]**

2. Derive an expression for linear acceleration of a particle performing U.C.M. **[Mar 98, 08]**

3. In U.C.M. (Uniform Circular Motion), prove the relation $\vec{v} = \vec{\omega} \times \vec{r}$, where symbols have their usual meanings. **[Mar 16]**

4. For a particle performing uniform circular motion $\vec{v} = \vec{\omega} \times \vec{r}$. Obtain an expression for linear acceleration of the particle performing non-uniform circular motion. **[Mar 14]**

5. In circular motion, assuming $\vec{v} = \vec{\omega} \times \vec{r}$, obtain an expression for the resultant acceleration of a particle in terms of tangential and radial component. **[Mar 15]**

6. Derive an expression for radial acceleration of a particle performing uniform circular motion. Why is it so called? **[Mar 04; Oct 05]**

7. What is centripetal and centrifugal force? **[Mar 04]**

8. Define centripetal force and give its any two examples. **[Mar 11]**

9. What is pseudo force? Why centrifugal force is called pseudo force? **[Oct 99]**

10. Distinguish between centripetal force and centrifugal force. **[Mar 05, 09, 10; Feb 13 old course]**

11. Derive an expression for centripetal acceleration of a particle performing uniform circular motion. **[Mar 02, 06]**

12. Explain the concept of centripetal force. **[Mar 17]**

13. Explain
    i. Centripetal force
    ii. Centrifugal force. **[Mar 00]**

14. What is banking of road? **[Mar 99, 12; Oct 01, 06]**

15. Define angle of banking. Draw a neat labelled diagram showing different forces and their components acting on a vehicle moving on a banked road. **[Oct 97]**

16. Draw a neat labelled diagram showing the various forces and their components acting on a vehicle moving along curved banked road. **[July 16]**

    OR

    Draw neat, labelled diagram showing different forces acting on a vehicle moving along a banked road. **[July 17]**

17. Define angle of banking. Obtain an expression for angle of banking of a curved road and show that angle of banking is independent of the mass of the vehicle. **[Mar 03, 97; Oct 03]**

18. What is banking of road? Obtain an expression for angle of banking. On what factors does it depend? **[Oct 00, 02, 04; Mar 06]**

19. Derive the expression for the maximum speed of a vehicle on the banked road. State the factors on which the optimum speed depends. **[Mar 01]**

20. 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]**

21. Obtain an expression for optimum speed of a car on a banked road. **[Oct 99]**

22. Explain the necessity of banking of the road. **[Mar 99; Oct 01, 06]**

23. Show that the angle of banking is independent of mass of vehicle. **[Mar 10; Oct 10]**

24. Obtain an expression for maximum safety speed with which a vehicle can be safely driven along curved banked road. **[Mar 10, 12; Oct 10]**

25. 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]**

26. Define angle of banking. Obtain an expression for angle of banking of a curved road and show that angle of banking is independent of the mass of the vehicle. **[Mar 03, 97; Oct 03]**

27. A certain body remains stationary on the vertical inner wall of a cylindrical drum of radius 'r', rotating at a constant speed. Show that the minimum angular speed of the drum is $\sqrt{\frac{g}{\mu r}}$, where "μ" is coefficient of friction between the body and surface of the wall. **[Oct 06]**

28. For a conical pendulum prove that $\tan\theta = \frac{v^2}{rg}$ **[Oct 09]**

29. Define period of conical pendulum and obtain an expression for its time period. **[Oct 08, 09]**

30. Derive an expression for period of a conical pendulum. **[Mar 08]**

31. Draw a neat labelled diagram of conical pendulum. State the expression for its periodic time in terms of length. **[Oct 15]**

32. Show that total energy of a body performing vertical circular motion is conserved. **[Mar 11]**

33. 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]**

34. Derive an expression for linear velocity at lowest point and at highest point for a particle revolving in vertical circular motion. **[Oct 11]**

Numericals

1. What is the angular speed of the minute hand of a clock? If the minute hand is 5 cm long. What is the linear speed of its tip? **[Oct 04]**

2. The minute hand of a clock is 8 cm long. Calculate the linear speed of an ant sitting at its tip. **[Mar 05]**

3. The frequency of a particle performing circular motion changes from 60 r.p.m to 180 r.p.m in 20 second. Calculate the angular acceleration. **[Oct 98]**

4. 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]**

5. The frequency of a spinning top is 10 Hz. If it is brought to rest in 6.28 sec, find the angular acceleration of a particle on its surface. **[Oct 05]**

6. If the frequency of revolution of an object changes from 2 Hz to 4 Hz in 2 second, calculate its angular acceleration. **[Oct 03]**

7. 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]**

8. An object of mass 400 g is whirled in a horizontal circle of radius 2 m. If it performs 60 r.p.m, calculate the centripetal force acting on it. **[Oct 96; Mar 01]**

9. 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]**

10. A coin kept on a horizontal rotating disc has its centre at a distance of 0.1 m from the axis of the rotating disc. If the coefficient of friction between the coin and the disc is 0.25; find the angular speed of disc at which the coin would be about to slip off.
(Given g = 9.8 m/s^2) **[Oct 11]**

11. 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 turnable 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]**

12. Calculate the maximum speed with which a car can be safely driven along a curved road of radius 30 m and banked at 30° with the horizontal [g = 9.8 m/s^2]. **[Mar 96]**

13. A motorcyclist rounds a curve of radius 25 m at the speed of 36 km/hr. The combined mass of motorcycle and motorcyclist is 150 kg. (g = 9.8 m/s^2)
What angle the motorcycle makes with vertical? **[Feb 13 old course]**

14. 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]**

15. A train rounds a curve of radius 150 m at a speed of 20 m/s. Calculate the angle of banking so that there is no side thrust on the rails. Also find the elevation of the outer rail over the inner rail, if the distance between the rails is 1 m. **[Oct 96]**

16. Find the angle which the bicycle and its rider will make with the vertical when going round a curve at 27 km/hr on a horizontal curved road of radius 10 m. [g = 9.8 m/s^2] **[Mar 98]**

17. Find the angle of banking of curved railway track of radius 600 m, if the maximum safety speed limit is 54 km/hr. If the distance between the rails is 1.6 m. find the elevation of the outer track above the inner track. [g = 9.8 m/s^2] **[Oct 98]**

18. Calculate the angle of banking for a circular track of radius 600 m as to be suitable for driving a car with maximum speed of 180 km/hr. [g = 9.8 m/s^2] **[Mar 06]**

19. A vehicle is moving along a curve of radius 200 m. What should be the maximum speed with which it can be safely driven if the angle of banking is 17°? (Neglect friction)
[g = 9.8 m/s^2] **[Mar 07]**

20. 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]**

21. 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]**

22. The vertical section of a road over a bridge in the direction of its length is in the form of an arc of a circle of radius 4.4 m. Find the greatest velocity at which a vehicle can cross the bridge without losing contact with the road at the highest point, if the center of the vehicle is 0.5 m from the ground.
[Given: $g = 9.8\ m/s^2$] **[Oct 01]**

23. 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]**

24. A stone of mass one kilogram is tied to the end of a string of length 5 m and whirled in a verticle circle. What will be the minimum speed required at the lowest position to complete the circle?
[Given: $g = 9.8\ m/s^2$] **[Oct 10]**

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

26. 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 = $9{\cdot}8\ m/s^2$]
[Oct 15]

27. 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. [$g = 9{\cdot}8\ m/s^2$]
[Oct 14]

28. 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]**

29. 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]**