SAMPLE CONTENT

16 Model

Question Papers

with solutions (PCMB)

BASED ON NEW PAPER PATTERN 2020-21

Std. XII Sci.

Target Publications® Pvt. Ltd.

Based on **New Board Paper Pattern 2020-21** prescribed by the Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04

Model Question Papers 2020-21

With Solutions

STD XII Sci.

As per the New Board Paper Pattern within the purview of reduced syllabus 2020-21

Salient Features

- A set of 4 Model Question Papers with solutions each for Physics, Chemistry, Maths & Biology (Total 16 Model Question Papers)
- Created as per the New Board Paper Pattern within the purview of reduced syllabus for the academic year 2020 - 2021.
- Complete answer to every question with relevant marks
- Graphs and diagrams provided where applicable

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Preface

HSC is the cornerstone of a student's career as it opens up the doors to turn their dreams into reality. It acts as a platform for students to specialise in a field that interests them the most. However, to achieve this it becomes imperative to get into the details of each subject and to clarify its fundamentals. Adequate knowledge base thus helps students to boost their self confidence and pave their way up in the final examinations.

It is rightly said, 'Practice makes a man perfect'. Keeping this in mind, we are proud to introduce **"Std XII Sci. Model Question Papers With Solutions".** This set of question papers provides students thorough practice for preparation of their final examinations. The book consists of 16 Model Question Papers in all; based on Physics, Chemistry, Maths and Biology (*a set of four model question papers for each subject*). In the light of current pandemic, the reduction of syllabus for the academic year 2020 - 2021 proposed by Board of Higher Secondary Education is taken into consideration while preparing each model paper. Along with these question papers, we've provided Model Answers with relevant marks so as to make sure that students understand the importance of each question. These question papers reflect the latest changes in paper pattern as updated by the Board of Higher Secondary Education.

We are sure that, these question papers would provide ample practice to students in a systematic manner and would boost their confidence to face the challenges posed in examinations.

We welcome your valuable suggestions and feedback towards this book.

We wish the students all the best for their examinations!

Yours faithfully
Publisher

Edition: First

Index

Scan the adjacent QR code to download the Reduced / Non-Evaluative Portion for the upcoming board exam of academic year 2020-21.

PHYSICS : PAPER PATTERN

- There will be one single paper of 70 Marks in Physics.
- Duration of the paper will be 3 hours.

Section A: **(18 Mark**

This section will contain Multiple Choice Questions and Very Short Answer (VSA) type of questions. There will be 10 MCQs and 8 VSA type of questions, each carrying one mark.
Students will have to attempt all these questions.

Section B: **(16 M rks)**

This section will contain 12 Short Answer (SA-I) type of questions, each carrying mark .
Students will have to attempt any 8 questions.

Section C: **(24 Marks)**

This section will contain 12 Short Answer (SA-II) type of questions, e ch carrying rks.
Students will have to attempt any 8 questions.

Section D: **(12 Marks)**

This section will contain 5 Long Answer (LA) type of que ons, ea carr ng 4 marks.
Students will have to attempt any 3 questions.

Distribution of Marks Accor ing to the Type of Questions

Type of Questions		
MCQ	1 Mark each	10 Marks
VSA	1 Mark each	8 Marks
SA - I	2 Marks each	16 Mar s
SA - II	3 Marks each	24 Ma ks
LA	4 Marks each	Mar

tage wise distribution of marks	
Theory	63%
Numerical	37%

No.	T pic N me	Marks	Marks with option
1	Rotational Dynam s	05	07
2	Mechanical P rtie f luids	05	07
3	Kinetic Th ory of ases nd Radiation	05	07
4	Therm dyna ics	05	07
5	Oscilla ons	04	05
6	S rpos on of Waves	04	06
7	Wa e ptics	05	07
8	E ctro tatics	04	06
9	C nt Electricity	04	06
10	Magnetic Fields due to Electric Current	04	06
11	Magnetic Materials	04	05
	Electromagnetic Induction	05	07
13	AC circuits	04	06
14	Dual Nature of Radiation and Matter	04	05
15	Structure of Atoms and Nuclei	04	06
16	Semiconductor Devices	04	05
	Total	**70**	**98**

MODEL QUESTION PAPER – I

PHYSICS

Time: 3 Hours **Total Marks: 70**

General instructions:

i. The question paper is divided into four sections.

ii. **Section A:** Q.No.1 contains Ten multiple choice type of questions carrying **One mark** each.
Q. No.2 contains Eight very short answer type of questions carrying **One mark** each.

iii. **Section B:** Q.No.3 to Q. No. 14 contains Twelve short answer type of questions carrying **Two marks** each. (Attempt any Eight).

iv. **Section C:** Q.No.15 to Q. No. 26 contains Twelve short answer type of questions carrying **Three marks** each. (Attempt any Eight).

v. **Section D:** Q.No.27 to Q. No. 31 contains Five long answer type of questions carrying **Four marks** each. (Attempt any Three).

vi. Use of log table is allowed. Use of calculator is not allowed.

vii. Figures to the right indicate full marks.

viii. For each MCQ, correct answer must be written along with its alphabet.
e.g., (a)...../ (b)..../ (c)..../ (d)..... Only first attempt will be considered for evaluation.

ix. Physical constants:
a. Latent heat of vaporisation, L_{vap} = 2256 kJ/kg
b. Acceleration due to gravity, g = 9.8 m/s^2

SECTION A

Q.1. Select and write the correct answer: **[10]**

i. When the balance point is obtained in the potentiometer, a current is drawn from
(A) both the cells and auxiliary battery
(B) cell only
(C) auxiliary battery only
(D) neither cell nor auxiliary battery

ii. The minimum velocity (in ms^{-1}) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is (g = 10 m/s^2)
(A) 60 (B) 30 (C) 15 (D) 25

iii. A circular coil of 100 turns with a cross-sectional area (A) of 0.5 m^2 is kept with its plane perpendicular to the magnetic field (B) of 4 T. What is the magnetic flux linkage with the coil?
(A) 400 Wb (B) 100 Wb (C) 50 Wb (D) 200 Wb

iv. In moving coil galvanometer, we use a radial magnetic field so that the galvanometer scale is
(A) linear (B) algebraic (C) logarithmic (D) exponential

v. The forward voltage drop of an LED is
(A) much larger than the ordinary diode. (B) much less than that of the ordinary diode.
(C) almost 1.5 to 3.5 volts. (D) Both (A) and (C)

vi. If the incident energy is 200 cal, absorptive power is 0.31 and reflection coefficient is 0.41, then the amount of energy transmitted will be
(A) 48 cal (B) 56 cal (C) 58 cal (D) 54 cal

vii. A parallel plate capacitor is charged. If the plates are pulled apart,
(A) the potential difference increases.
(B) the capacitance increases.
(C) the total charge increases.
(D) the charge and the potential difference remain the same.

viii. In the purely resistive A.C. circuit _____
(A) current leads e.m.f. by a phase angle of π radians.
(B) current leads e.m.f. by a phase angle of $\frac{\pi}{2}$ radians.
(C) current and e.m.f. are in phase
(D) current lags behind e.m.f. by a phase angle of $\frac{\pi}{2}$ radians.

ix. In the hydrogen atom spectrum, the series which lies in ultraviolet region is
(A) Lyman series (B) Balmer series (C) Paschen series (D) Brackett series

x. The number of photoelectrons emitted _____.
(A) varies inversely with frequency
(B) varies directly with frequency
(C) varies inversely with intensity
(D) varies directly with intensity

Q.2. Answer the following: **[8]**

i. What are eddy currents?

ii. A wave is represented by an equation y = A sin (Bx – Ct). Given that the constants A, B and C are positive, can you tell in which direction the wave is moving?

iii. The half life of radium is 1600 years. Find the fraction of a sample of radium that would remain after 6400 years.

iv. What will be the direction of angular displacement and angular velocity, if angular acceleration is constant and is along the axis of rotation?

v. In a common-base connection, a certain transistor has an emitter current of 11 mA and collector current of 10.7 mA. Calculate the value of the base current.

vi. Define S.I. unit of magnetic field.

vii. What will happen to the mean square speed of the molecules of a gas if the temperature of the gas decreases?

viii. Define Potential Gradient.

SECTION B

Attempt Any Eight: **[16]**

Q.3. In SI units, the differential equation of an S.H.M. is $\frac{d^2x}{dt^2} = -16x$. Find its frequency and period.

Q.4. Explain relation between electric field and electric potential.

Q.5. State the properties of an ideal fluid.

Q.6. Calculate molar specific heat of mono-atomic gases at constant volume and constant pressure.

Q.7. Find the time required for a 25 Hz alternating current to change its value from zero to the r.m.s. value.

Q.8. On what factors, does the frequency of a conical pendulum depend? Is it independent of some factors?

Q.9. Two coherent sources whose intensity ratio is 16:9 produce interference fringes. Calculate the ratio of amplitudes of light waves coming from them.

Q.10. Derive an expression for the energy stored in a magnetic field.

Q.11. State the difficulties faced by Rutherford's atomic model.

Q.12. A sound wave in a certain fluid medium is reflected at an obstacle to form a standing wave. The distance between two successive nodes is 4.5 cm. If the velocity of sound is 1629 m/s, find the frequency.

Q.13. Explain resultant magnetic moment of an atom with the help of Pauli's exclusion principle.

Q.14. The common-base DC current gain of a transistor is 0.982. If the emitter current is 15 mA, what is the value of base current?

SECTION C

Attempt Any Eight: **[24]**

Q.15. A wire of length 0.5 m is stretched by 2 kg wt. If mass of the wire is 2×10^{-3} kg, find the velocity of transverse wave along the wire and its fundamental frequency.

Q.16. Calculate the M.I of thin uniform rod of mass 300 g and length 50 cm about an axis perpendicular to its length and passing through
i. its centre and ii. one end.

Q.17. What is series LCR resonant circuit? State condition for series resonance. Obtain an expression for resonant frequency.

Q.18. Derive the relation between surface tension and surface energy per unit area.

Q.19. Discuss the maximum and minimum values of displacement, velocity and acceleration of a particle performing linear S.H.M.

Q.20. The maximum value of permeability of a nickel (77% Ni, 16% Fe, 5% Cu, 2% Cr) is 0.126 T mA^{-1}. Find the maximum relative permeability and susceptibility.

Q.21. Explain the variation of temperature according to Prevost's theory of heat exchange.

Q.22. Explain the Huygens construction of plane wavefront.

Q.23. 2.0 kg of liquid water is boiled at 100 °C and all of it is converted to steam. If the change of state takes place at the atmospheric pressure (1.01×10^5 Pa), calculate
i. the energy transferred to the system,
ii. the work done by the system during this change, and
iii. the change in the internal energy of the system. Given, the volume of 2 kg of water changes from 2.0×10^{-3} m^3 in liquid form to 3.342 m^3 when in the form of steam.

Q.24. Define the following terms:
i. Excitation energy of an electron in an atom
ii. Binding energy of an electron in an atom
iii. Dark resistance of a photodiode

Q.25. An electric dipole consists of two opposite charges each of magnitude 1 μC separated by 2.5 cm. The dipole is placed in an external electric field of 1.2×10^5 NC^{-1}. Find:
i. The maximum torque exerted by the field on the dipole
ii. The work the external agent will have to do in turning the dipole through 180° starting from the position θ = 0°

Q.26. State Lenz's law and explain how it is incorporated in Faraday's law.

SECTION D

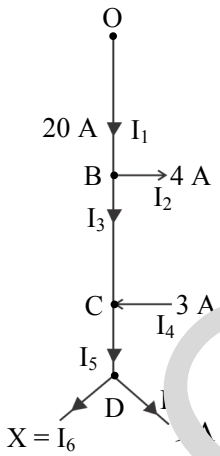
Attempt Any Three: **[12]**

Q.27. i. State and explain Newton's law of viscosity.

ii. Plane wavefront of light of wavelength 6500 Å is incident on two slits in a screen perpendicular to the direction of light rays. If the total separation of 10 bright fringes on a screen 1.5 m away is 3 cm, find the distance between the slits.

Q.28. i. State and explain Kirchhoff's current law in electric circuit.

ii. Figure shows currents in a part of electrical circuit. Find the current X.



Q.29. Describe the experimental set-up for a photoelectric effect with the help of neat and labelled schematic diagram.

Q.30. i. Derive the relation for magnetic force acting on an arbitrarily shaped wire assuming relation for a straight wire.

ii. A straight conductor 1 m long carrying current of 12 A is kept at right angles to a uniform magnetic field of induction 5.5×10^{-3} Wb/m^2. What is the force acting upon it?

Q.31. With the help of p-V diagram explain the work done by the system while expanding when

i. System undergoes first volume change at constant pressure and then the pressure changes at constant volume.

ii. System undergoes first pressure change at constant volume and then the volume change at constant pressure.

iii. In which case will the work done be more?

MODEL ANSWER PAPERS

MODEL ANSWER PAPER – I

PHYSICS

Note: *Answers to every section must be written on a new page.*

SECTION A

Q.1.

i. (C) auxiliary battery only [1]

ii. (B) 30 [1]

iii. (D) 200 Wb [1]

$N\phi = NBA$

$= 100 \times 4 \times 0.5$

$= 200$ Wb

iv. (A) linear [1]

v. (D) Both (A) and (C) [1]

vi. (B) 56 cal [1]

vii. (A) the potential difference increases. [1]

viii. (C) current and e.m.f. are in phase [1]

ix. (A) Lyman series [1]

x. (D) varies directly with intensity [1]

Q.2.

i. The circulating currents induced in a metal block, when it is placed or moved in a changing magnetic field are called eddy currents.

[1]

ii. The wave is moving in direction of positive X-axis.

[1]

iii. The fraction of sample that is left after disintegration is,

$$\frac{N(t)}{N_0} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^t = \left(\frac{1}{2}\right)^{\frac{6400}{1600}} = \left(\frac{1}{2}\right)^4 = \mathbf{\frac{1}{16}}$$

[1]

v. If the angular acceleration $\vec{\alpha}$ is constant and is along the axis of rotation, then all $\vec{\theta}$, $\vec{\omega}$ and $\vec{\alpha}$ will be directed along the same axis.

[1]

For a common base connection, $I_E = I_B + I_C$

$\therefore$ $I_B = I_E - I_C$

$= 11 - 10.7$

$=$ **0.3 mA**

[1]

vi. Tesla(T) is the SI unit of magnetic field. If the force F is 1 N acting on the charge of 1 C moving with a speed of 1 ms^{-1} perpendicular to $\vec{B}$, then magnetic field is said to be 1 tesla.

[1]

vii. The mean square speed of the molecules of the gas is,

$\overline{v^2} = \frac{3RT}{M_0}$

$\therefore \quad \overline{v^2} \propto T$

Hence, the mean square speed of molecules of the gas decreases in same proportion with the decrease in temperature.

[

viii. Potential gradient is defined as potential difference per unit length of wire.

[

SECTION B

Q.3. ***Solution:***

Given: $\frac{d^2x}{dt^2} = -16x$

$\therefore \quad \frac{d^2x}{dt^2} + 16x = 0$

Comparing with differential equation, $\frac{d^2x}{dt^2} + \omega^2 x = 0$

$\therefore \quad \omega^2 = 16$

$\therefore \quad \omega = 4$ rad/s

i. For frequency,

$\omega = 2\pi n$

$\therefore \quad n = \frac{\omega}{2\pi} = \frac{4}{2\pi} = \frac{2}{3.142} =$ **0.6365 H**

ii. For period,

$\omega = \frac{2\pi}{T}$

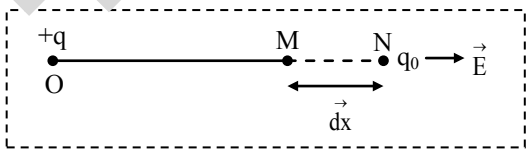
$\therefore \quad T = \frac{2\pi}{\omega} = \frac{3.14}{2} =$ **1.571**

[2]

Q.4. i. Consider the electric field produced by a charge +q kept at point O.

ii. A unit positive charge ($+q_0$) is present in vicinity is moved towards charge +q through small distance dx.

iii. As direction of electric field of charge +q is outward, displacement dx is in direction opposite to field as shown in figure below.



iv. As electrostatic force is along $\vec{E}$, work done is

$dW = \vec{F} \cdot \vec{dx} = -Fdx = -Edx$

Negative sign indicates displacement of charge is in direction opposite to field.

v. But $dW = dV \times q_0 = dV$ ….($\because$ q_0 is a unit charge)

$\therefore$ Potential difference between M and N,

$dV = -Edx$

$\therefore \quad E = \frac{-dV}{dx}$

Thus the electric field at a point in an electric field is the negative of the potential gradient at that point.

[2]

Q.5. An ideal fluid has the following properties:

i. It is incompressible i.e., its density is constant.

ii. Its flow is irrotational i.e., its flow is smooth with no turbulences in the flow.

iii. It is non-viscous i.e., there is no internal friction in the flow and hence the fluid has no viscosity.

iv. Its flow is steady i.e., its velocity at each point is constant in time.

[2]

Q.6. i. For a monatomic gas enclosed in a container, held at a constant temperature T and containing N_A atoms, each atom has only 3 translational dof.

ii. Therefore, average energy per atom is $\frac{3}{2}k_BT$ and the total internal energy per mole is

$E = \frac{3}{2}N_Ak_BT$

iii. Molar specific heat at constant volume

$C_V = \frac{dE}{dT} = \frac{3}{2}N_Ak_B = \frac{3}{2}R$

iv. Using Mayer's relation, $C_P = R + C_V$

$\therefore$ $C_P = \frac{5}{2}R$

[2]

Q.7. ***Solution:***

Given: $f = 25$ Hz; $i_{rms} = \frac{i_0}{\sqrt{2}}$

To find: Time required (t)

Formula: $i = i_0 \sin \omega t$

Calculation: From formula,

$\frac{i_0}{\sqrt{2}} = i_0 \sin(2\pi \times 25 \times t)$ ....($\because \omega = 2\pi f$)

$\therefore$ $\frac{1}{\sqrt{2}} = \sin(50\pi$

$\therefore$ $\sin\left(\frac{\pi}{4}\right) = \sin(50$

On simplifying, we get

$\therefore$ $50 \cdot t = \left(\frac{\pi}{4}\right.$

$\therefore$ $t = \frac{1}{200} = \mathbf{5 \times 10^{-3}\ s}$

Ans: The time required for the alternating current to change its value from zero to rms is **5×10^{-3} s.**

[2]

Q.8. i. Frequency of conical pendulum depends on following factors:

a. **Length of pendulum (L):** Frequency of conical pendulum increases with decrease in length of pendulum.

i.e., $n \propto \frac{1}{\sqrt{L}}$

b. **Acceleration due to gravity (g):** Frequency of conical pendulum increases with increase in g. i.e., $n \propto \sqrt{g}$

c. **Angle of inclination (θ):** As θ increases, cos θ decreases, hence, frequency of conical pendulum increases with increase in θ.

i.e., $n \propto \frac{1}{\sqrt{\cos\theta}}$ (For $0 < \theta < \pi$)

ii. Frequency at conical pendulum is independent of mass of the bob.

[2]

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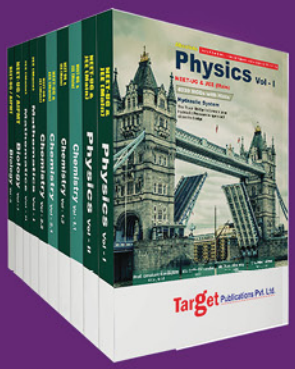

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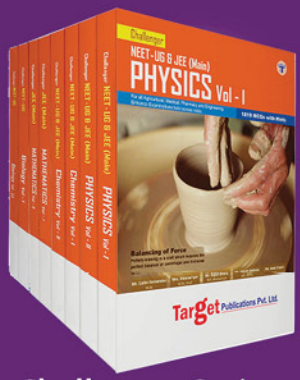

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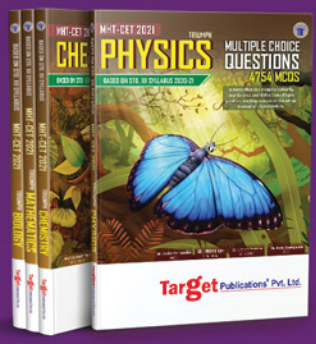

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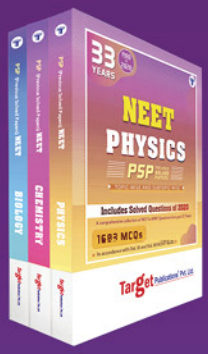

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