A

2013 – GP

Test Paper Code : GP

Time : 3 Hours Maximum Marks : 100

INSTRUCTIONS

1. This question-cum-answer booklet has **40** pages and has 45 questions in three sections. Please ensure that the copy of the question-cum-answer booklet you have received contains all the questions.
2. Write your **Registration Number, Name and the name of the Test Centre** in the appropriate space provided on the right side.
3. **Attempt any two sections and indicate your selection below with a tick-mark (✓)**

GEOLOGY	PHYSICS	MATHEMATICS

4. Write the answers to the objective questions against each Question No. in the **Answer Table for Objective Questions, provided on Page No. 36.** Do not write anything else on this page.
5. Each objective question has **4 choices** for its answer: (A), (B), (C) and (D). Only **ONE** of them is the correct answer. There will be **negative marking** for wrong answers to objective questions. The following marking scheme for objective questions shall be used :
   (a) For each correct answer, you will be awarded **2 (Two)** marks.
   (b) For each wrong answer, you will be awarded **–0.5 (Negative 0.5)** mark.
   (c) Multiple answers to a question will be treated as a wrong answer
   (d) For each un-attempted question, you will be awarded **0 (Zero)** mark.
   (e) Negative marks for objective part will be carried over to total marks.
6. Answer the fill in the blank type and descriptive type questions only in the space provided after each question. No negative marks for fill in the blank type questions.
7. Do not write more than one answer for the same question. In case you attempt a fill in the blank or a descriptive question more than once, please cancel the answer(s) you consider wrong. Otherwise, the answer appearing last only will be evaluated.
8. All answers must be written in blue/black/blue-black ink only. Sketch pen, pencil or ink of any other colour should not be used.
9. All rough work should be done in the space provided and scored out finally.
10. No supplementary sheets will be provided to the candidates.
11. **Clip board, log tables, slide rule, cellular phone and electronic gadgets in any form are NOT ALLOWED. Non-Programmable Calculator is ALLOWED.**
12. The question-cum-answer booklet must be returned in its entirety to the Invigilator before leaving the examination hall. Do not remove any page from this booklet.

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READ INSTRUCTIONS ON THE LEFT SIDE OF THIS PAGE CAREFULLY

REGISTRATION NUMBER						

Name :

Test Centre :

Do not write your Registration Number or Name anywhere else in this question-cum-answer booklet.

I have read all the instructions and shall abide by them.

.....

Signature of the Candidate

I have verified the information filled by the candidate above.

.....

Signature of the Invigilator

A

IMPORTANT NOTE FOR CANDIDATES

Select any TWO Sections (Objective, Fill in the Blanks & Descriptive) among the three listed below:

- **GEOLOGY SECTION** : **Q. Nos. 01-05** (Objective Questions)
  Q. Nos. 06-10 (Fill in the Blank Questions)
  Q. Nos. 11-15 (Descriptive Questions)
- **PHYSICS SECTION** : **Q. Nos. 16-20** (Objective Questions)
  Q. Nos. 21-25 (Fill in the Blank Questions)
  Q. Nos. 26-30 (Descriptive Questions)
- **MATHEMATICS SECTION** : **Q. Nos. 31-35** (Objective Questions)
  Q. Nos. 36-40 (Fill in the Blank Questions)
  Q. Nos. 41-45 (Descriptive Questions)

Distribution of Marks in each section:

05 x 02 = 10 marks	05 x 03 = 15 marks	05 x 05 = 25 marks	Total : 50 marks

Questions: (1-5, 16-20 & 31-35) OBJECTIVE QUESTIONS carry two marks each.

- For each correct answer, you will be awarded 2 (Two) marks.
- For each wrong answer, you will be awarded -0.5 (Negative 0.5) mark.
- Multiple answers to a question will be treated as a wrong answer.
- For each un-attempted question, you will be awarded 0 (Zero) mark.
- Negative marks for objective part will be carried over to total marks.

Questions: (06-10, 21-25 & 36-40) FILL IN THE BLANK QUESTIONS carry three marks each.

- For each correct answer, you will be awarded 3 (Three) marks.
- For each wrong answer, you will be awarded 0 (Zero) mark.
- For each un-attempted question, you will be awarded 0 (Zero) mark.
- There is no negative marking for fill in the blank questions.

Questions: (11-15, 26-30 & 41-45) DESCRIPTIVE QUESTIONS carry five marks each.

- For each correct answer, you will be awarded 5 (Five) marks.
- For each wrong answer, you will be awarded 0 (Zero) mark.
- For each un-attempted question, you will be awarded 0 (Zero) mark.
- There is no negative marking for Descriptive questions.

Write the objective type question's answers for any TWO of the above attempted sections in the *Answer Table for Objective Questions* provided on page 36 only.

A

GEOLOGY SECTION : (Objective Questions)

Q.1 Match the natural features listed in **Group I** with the corresponding geological environments listed in **Group II**

Group I	**Group II**
P. Atoll	1. River
Q. Esker	2. Volcano
R. Caldera	3. Sea
S. Braid bar	4. Glacier

(A) P-1, Q-3, R-4, S-2
(B) P-3, Q-4, R-2, S-1
(C) P-3, Q-4, R-1, S-2
(D) P-3, Q-2, R-4, S-1

Q.2 Orogenic belts are associated with
(A) divergent plate boundaries
(B) transform faults
(C) convergent plate boundaries (collision zones)
(D) convergent plate boundaries (subduction zones)

Q.3 Which one of the following sequences, show arrangement of the stratigraphic units in the increasing order of their ages?
(A) Subathu Formation, Po Formation, Umia Formation, Bijaigarh Shale
(B) Subathu Formation, Umia Formation, Po Formation, Bijaigarh Shale
(C) Subathu Formation, Umia Formation, Bijaigarh Shale, Po Formation
(D) Bijaigarh Shale, Po Formation, Umia Formation, Subathu Formation

Q.4 Match the fossils listed in **Group I** with the corresponding morphological features listed in **Group II**

Group I	**Group II**
P. *Arca*	1. Broad pallial sinus
Q. *Trochus*	2. Dysodont dentition
R. *Mya*	3. Taxodont dentition
S. *Ostrea*	4. Conical-spiral

(A) P-3, Q-4, R-1, S-2
(B) P-1, Q-4, R-3, S-2
(C) P-3, Q-2, R-4, S-1
(D) P-2, Q-4, R-1, S-3

Q.5 Match the items listed in **Group I** with the those listed in **Group II**

Group I	**Group II**
P. Perthite	1. Intergrowth of quartz and alkali Feldspar
Q. Graphic texture	2. Intergrowth of albite and potasic Feldspar
R. Ophitic texture	3. Plagioclase laths enclosed by augite
S. Myrmekitic texture	4. Intergrowth of quartz and sodic plagioclase

(A) P-1, Q-4, R-2, S-3
(B) P-1, Q-2, R-3, S-4
(C) P-2, Q-4, R-3, S-1
(D) P-2, Q-1, R-3, S-4

A

GEOLOGY SECTION : (Fill in the blank Questions)

Q.6 The concept of hanging wall/foot wall does not hold good in the case of faults which are/have _____.

Ans:

Q.7 A light blue mineral occurring in bladed form, is of composition Al_2SiO_5. A specimen of this mineral has hardness (Mohs scale) 4-5 as well as 6-7. The name of the mineral is _____.

Ans:

Q.8 Volcanic equivalents of granite, syenite and diorite are _____, _____ and _____ respectively.

Ans:

Q.9 Individual suture lines characterized by 'cerrated lobes' alternating with 'rounded saddles' in ammonoids are called _____.

Ans:

Q.10 In an area of normal stratigraphic sequence of conformable beds, an older bed gets exposed by erosional process only. Such an exposure of an older bed surrounded by younger beds is termed as_____.

Ans:

GEOLOGY SECTION : (Descriptive Questions)

Q.11 Name the crystal system in which the mineral galena crystallizes. Give its element of symmetry in terms of number of (i) axial and diagonal planes of symmetry and (ii) axes of various folds of symmetry. Write its chemical composition, streak and hardness. With which ore mineral is it commonly found associated in the Zawar mines of Rajasthan?

Space for the answer

Q.12 With the help of neat sketches, describe characteristic features of the following drainage patterns (i) Dendritic (ii) Trellised (iii) Centripetal (iv) Radial and (v) Annular.

Space for the answer

Space for the answer

Q.13 What is an anticline? How does it differ from an antiform? In an east-west trending, doubly plunging antiform, the northern limb dips steeper than the southern limb. Sketch this fold by stratum contours.

Space for the answer

Q.14 Define the term sand. What is ϕ-scale for measuring the grain size of sediments? Giving reasons, explain which one of the following two samples of sandstone has better sorting

	Standard Deviation (grain size, ϕ)
Sample P	0.38
Sample Q	0.74

A sequence of sandstone, shale and limestone has undergone metamorphism. Name possible resultant metamorphic rocks.

Space for the answer

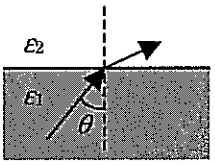
A

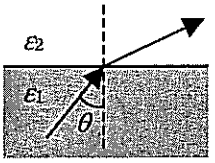
Q.15 What is the difference between petroleum pool and petroleum field. What is a reservoir trap? Define the terms absolute porosity and effective porosity.

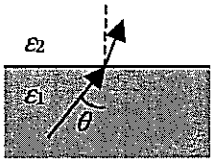
Space for the answer

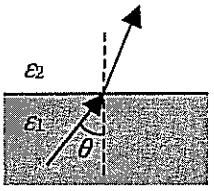
PHYSICS SECTION : (Objective Questions)

Q.16 A uniform electric field is directed at an angle θ from vertical in a dielectric medium of permittivity ε_1. This field extends to another dielectric medium of permittivity ε_2 ($\varepsilon_2 > \varepsilon_1$). There is no charge at the interface between the two dielectric regions. Which of the following figure depicts correct electric field lines?

(A) 

(B) 

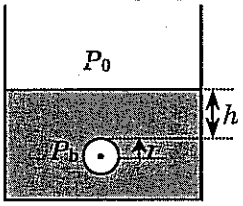
(C) 

(D) 

Q.17 Consider an X-ray diffraction experiment using a cubic crystal. The smallest angle of Bragg scattering from (001) planes is 14.5°. The smallest angle of Bragg scattering from (002) planes would be

(A) 14.5° (B) 21° (C) 30° (D) 42°

Q.18 A container is filled with a liquid of density ρ and surface tension S. There is a bubble of radius r at a depth h below the surface of the liquid (see figure). P_b is the pressure inside the bubble whereas P_0 is atmospheric pressure. P_b-P_0 will be equal to



(A) $h\rho g$ (B) $(h+r)\rho g$ (C) $h\rho g + \frac{2S}{r}$ (D) $h\rho g + \frac{4S}{r}$

Q.19 In an experiment, two masses of a liquid, each being m, are taken. One mass is at temperature T_1 whereas the other is at temperature T_2 ($T_2 > T_1$). These masses are mixed. The change in the entropy of the system is

(A) $mC_p ln\left[\frac{T_2+T_1}{2\sqrt{T_2 T_1}}\right]$ (B) $2mC_p ln\left[\frac{T_2+T_1}{2\sqrt{T_2 T_1}}\right]$

(C) $2mC_p ln\left[\frac{T_2-T_1}{2\sqrt{T_2 T_1}}\right]$ (D) $2mC_p ln\left[\frac{T_2+T_1}{2T_2 T_1}\right]$

Q.20 Consider two reference frames S (xy) and S′($x'y'$). S′ is moving with a velocity v with respect to S along the common axes, x & x'. A rod of 1 meter length in S′ makes an angle 20° with the x'-axis. The angle of the rod is observed to be 30° with respect to the x-axis in S. If c is the speed of light in free space, v is

(A) 0.30 c (B) 0.50 c (C) 0.77 c (D) 0.90 c

A

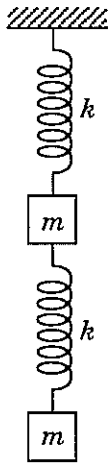
PHYSICS SECTION : (Fill in the blank Questions)

Q.21 A particle is thrown vertically upward with an initial velocity of 49 m/s from the ground. After rising vertically for 3 seconds, particle breaks into two pieces of mass ratio 1 : 3. The lighter mass acquires a horizontal velocity of 10 m/s at the instant of breaking. With respect to the point from where the particle was thrown initially, heavier piece will land at _____ . ($g = 9.8$ m/s^2)

Ans:

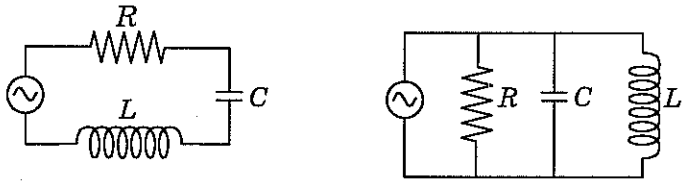
Q.22 Two equal masses, each being m (= 1 kg), are connected with two identical springs of spring constant k (200 N/m) as shown in the figure. The angular frequencies of the two normal modes of vertical oscillations are _____ .

Ans:



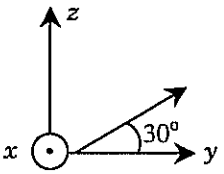
A

Q.23 A resistor R (2 Ω), a capacitor C (2 mF) and an inductor L (4 mH) are connected in series with a generator operating at a frequency of 40 Hz in one experiment. The impedance of this circuit is Z_S. In another experiment, the same R, C and L are connected in parallel to the same generator as shown in the figure. The impedance of this circuit is Z_P. The ratio Z_S/Z_P is _____.



Ans:

Q.24 A plane electromagnetic (EM) wave is travelling in yz-plane at an angle 30° from y-axis. Motion is confined in vacuum and the wavelength of the EM wave is 500 nm (1 nm = 10^{-9} m). Electric field, associated with the EM wave, is confined along x-axis and has a magnitude of 10V/m. The expression of the associated magnetic field $\vec{H}$ would be _____.



Ans:

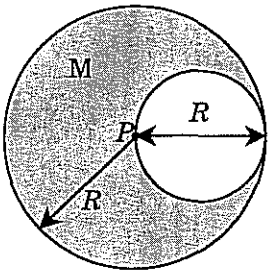
Q.25 The activity of 3×10^{-9} kg of a radioactive sample, ^{222}Rn, is 46 Ci. The activity of the same sample exactly after one hour, correct to one decimal digit, would be _____Ci .
(Avogadro's no = 6.025×10^{26} kmol^{-1}, 1 Ci = 3.7×10^{10} decays/sec)

Ans :

A

PHYSICS SECTION : (Descriptive Questions)

Q.26 A disc of radius $R/2$ is removed from a disc of radius R as shown in the figure. Mass of the new structure is M. Find the moment of inertia of the new structure about an axis, which is normal to the plane of the disc and passing through the center (P) of the big disc.

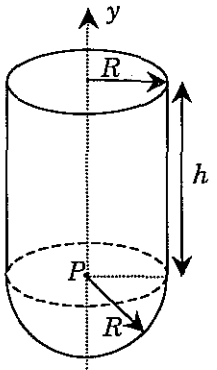


Space for the answer

Space for the answer

A

Q. 27 A metallic hemispherical bowl is attached to a hollow metallic circular cylinder at the bottom as shown in the figure. Radius of hemisphere as well as of the cylinder is R. Height of the cylinder is h. Entire system carries a uniform surface charge density σ. Find electric field $(\vec{E})$ at point P.



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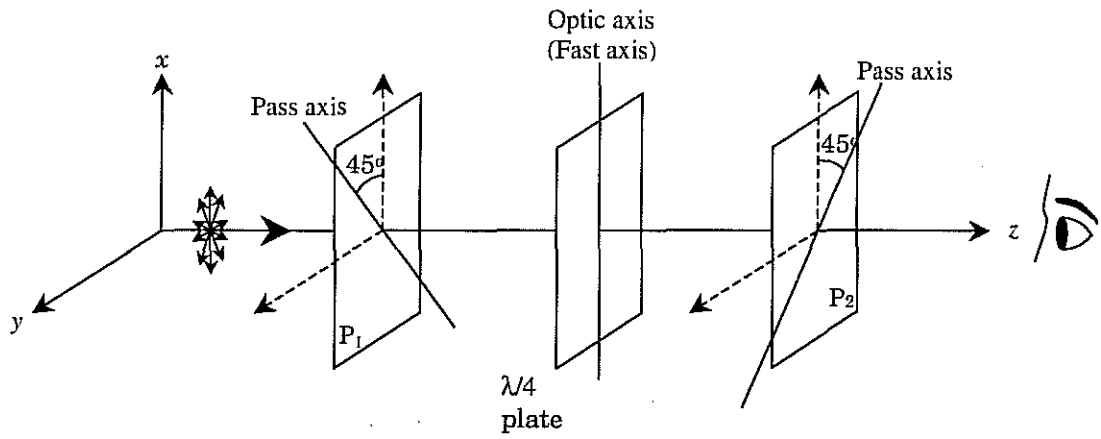
Space for the answer

A

Q.28 A Calcite $\lambda/4$ plate is introduced between the two crossed polarizers (P_1 & P_2) as shown in the figure. An unpolarized beam is incident normal to P_1 from left hand side. Write down the expressions for the electric fields associated with the beam after P_1, after $\lambda/4$ plate and after P_2. Also find the state-of-polarization after P_1, after $\lambda/4$ plate and after P_2 as observed by an observer shown in the figure.



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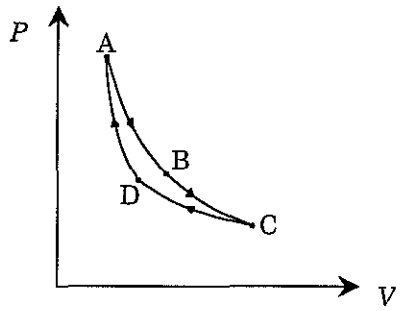
Space for the answer

A

Q.29 An ideal monatomic gas ($\gamma = 5/3$) is taken through a cyclic process ABCDA as shown in the figure. A→B is an isothermal expansion at temperature 900 K, B→C is an adiabatic expansion, C→D is an isothermal compression at temperature 300 K and D→A is an adiabatic compression. The volume at the point B is 60 liters. The volume and pressure at the point D are 30 liters and P_0, respectively. Calculate pressure at points A, B and C. Also calculate volume at A and C.



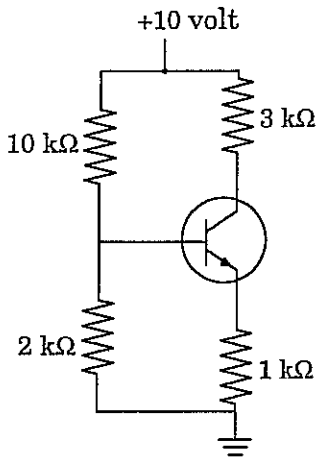
Space for the answer

A

Space for the answer

A

Q.30 Assume that the transistor shown in the figure is biased in the active region. Calculate the value of V_{CE}, I_C and I_B (take $\beta = 100$ and $V_{BE} = 0.7$ volt).



Space for the answer

A

Space for the answer

A

MATHEMATICS SECTION : (Objective Questions)

Q.31 The sum of the series $\sum_{n=0}^{\infty} \frac{4n+6}{(n+1)^2(n+2)^2}$ is

(A) 2 (B) 1 (C) 1/4 (D) 1/2

Q.32 The orthogonal trajectories of the family of curves represented by $\frac{dy}{dx} = (x - 3y)$ are

(A) $x - 3y + 3 + ce^y = 0$ (B) $-x + 3y - 3 + ce^{-y} = 0$

(C) $3x + y + ce^y = 0$ (D) $-3x + y + ce^y = 0$

Q.33 A unit normal vector to the surface $z^2 = 4x^2 - 2y$ at the point (2, 0, 4) is

(A) $\frac{1}{9}(\hat{i} + 4\hat{j} + 8\hat{k})$ (B) $\frac{1}{9}(8\hat{i} + 4\hat{j} - \hat{k})$

(C) $\frac{1}{9}(8\hat{i} - \hat{j} + 4\hat{k})$ (D) $\frac{1}{9}(-8\hat{i} + \hat{j} + 4\hat{k})$

Q.34 Let T: $R^2 \to R^3$ be a linear transformation such that T(1, 2) = (1, 3, 2) and T(2, 3) = (0, 4, 2). Then T(10, 17) is

(A) (2, 22, 12) (B) (6, 26, 16) (C) (4, 24, 14) (D) (0, 20, 10)

Q.35 Consider the polynomial $f(x) = \frac{1}{120}(x^6 + 7x^5 + 4x^3 + 2x + 5)$. If the interval of differencing is 2, then the value of $\Delta^6 f(x)$ is

(A) 720 (B) 1920 (C) 384 (D) 320

MATHEMATICS SECTION : (Fill in the blank Questions)

Q.36 The area bounded by the curves $2y - 2x + 1 = 0$ and $y = x(x-1)$ is _____

Ans:

Q.37 The solution of the differential equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = e^{2x}$ subject to the initial conditions $y(0) = 5$, $\frac{dy}{dx}(0) = \frac{1}{5}$ is _____

Ans:

Q.38 An eigenvector of the matrix $A = \begin{bmatrix} 5 & 0 & 1 \\ 1 & 1 & 0 \\ -7 & 1 & 0 \end{bmatrix}$ is _____

Ans:

Q.39 A random sample of size 100 is taken from an infinite population. The population mean, $\mu = 75$ and the variance, $\sigma^2 = 256$. Using the central limit theorem, the probability that the mean of the sample will fall between 73 and 77 is _____(correct to four decimal places).

Given: If Z is the standard normal variate, then $P(0 < Z < 1.2) = 0.3849$, $P(0 < Z < 1.25) = 0.3944$ and $P(0 < Z < 1.3) = 0.4032$.

Ans:

Q.40 The cubic polynomial $p(x)$, which takes on values $p(0) = -2, p(1) = 0, p(2) = 8, p(3) = 34$ and $p(4) = 90$, is _____

Ans:

MATHEMATICS SECTION : (Descriptive Questions)

Q.41 Find the maximum and minimum values of the function $f(x) = xe^{-|x-2|}, -\infty < x < \infty$.

Space for the answer

A

Space for the answer

Q.42 Consider the region that lies inside the sphere $x^2 + y^2 + z^2 = 2$ and outside the cylinder $x^2 + y^2 = 1$. Find the volume of this region using triple integral.

Space for the answer

A

Space for the answer

Q.43 Use Stokes' theorem to evaluate $\int_C \vec{F} \cdot d\vec{r}$, where $\vec{F} = (x+z)\hat{i} + (2y-z)\hat{j} + (x-z)\hat{k}$ and C is the boundary of the triangle with vertices P (6, 0, 0), Q (0, 4, 0) and R (0, 0, 3).

Space for the answer

Space for the answer

Q.44 In a university, 15% of the students are female and the remaining students are male. Furthermore, 10% of the male students and 2% of the female students are over 6 feet tall. A student is randomly selected and is observed to be over 6 feet tall. Find the probability (correct to three decimal places) that this student is a female.

Space for the answer

Space for the answer

Q.45 It was proposed to compare the average earnings per day of men and women in an industry. From a sample data of 60 men, it was observed that the average earning of men per day is Rs. 285 and a standard deviation is Rs.15. On the other hand, a sample data of 60 women showed their average earning as Rs. 251 per day and the standard deviation as Rs.18. Test the hypothesis that the average earning of men per day exceeds that of the women by more than Rs. 30. Use 0.05 level of significance.

Given: If Z is the standard normal variate, then $P(0 < Z < 1.645) = 0.45$ and $P(0 < Z < 1.96) = 0.475$

Space for the answer

Space for the answer

A

Answer Table for Objective Questions

Write the Code of your chosen answer only in the 'Answer' column against each Question Number. Do not write anything else on this page.

GEOLOGY SECTION

Question Number	Answer	Do not write in this column
01		
02		
03		
04		
05		

PHYSICS SECTION

Question Number	Answer	Do not write in this column
16		
17		
18		
19		
20		

MATHEMATICS SECTION

Question Number	Answer	Do not write in this column
31		
32		
33		
34		
35		

FOR EVALUATION ONLY

Number of Correct Answers		Marks	(+)
Number of Incorrect Answers		Marks	(–)
Total Marks in any TWO attempted sections			( )

A

Space for rough work

A

Space for rough work

A

Space for rough work

A

Space for rough work

A

2013 – GP

FOR EVALUATION ONLY – DO NOT WRITE ON THIS PAGE

GEOLOGY SECTION			PHYSICS SECTION			MATHEMATICS SECTION		
Q. No.	Marks	Signature	Q. No.	Marks	Signature	Q. No.	Marks	Signature
Objective Part			Objective Part			Objective Part		
Total 1-5			Total 16-20			Total 31-35		
Fill in the Blank Part			Fill in the Blank Part			Fill in the Blank Part		
6			21			36		
7			22			37		
8			23			38		
9			24			39		
10			25			40		
Total 6-10			Total 21-25			Total 36-40		
Descriptive Part			Descriptive Part			Descriptive Part		
11			26			41		
12			27			42		
13			28			43		
14			29			44		
15			30			45		
Total 11-15			Total 26-30			Total 41-45		

Total (Objective Part)	:	
Total (Fill in the blanks Part)	:	
Total (Descriptive Part)		
GRAND TOTAL	:	
Total Marks (in words)	:	
Signature of Examiner(s)	:	
Signature of Head Examiner(s)	:	
Signature of Scrutinizer	:	
Signature of Chief Scrutinizer	:	
Signature of Coordinating Head Examiner	:	