

IIT-JEE PART TEST-1**PAPER – I****Time: 3 hours****Maximum marks: 240****Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.****INSTRUCTIONS****A. General:**

1. This booklet is your Question Paper containing 60 questions. The booklet has 14 pages.
2. The Test ID is printed on the right hand top corner of this booklet. This should be entered on the OMR sheet.
3. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers, and electronic gadgets in any form are not allowed to be carried inside the examination hall.
4. The answer sheet, a machine-readable Optical mark recognition sheet (OMR Sheet), is provided separately.
5. DO NOT TAMPER WITH / MUTILATE THE OMR OR THE BOOKLET.
6. Do not break the seals of the question-paper booklet before being instructed to do so by the invigilators.

B. Question paper format:

7. The question paper consists of 3 parts (Part I: Chemistry, Part II: Mathematics, Part III: Physics). Each part has 4 sections.
8. **Section I** contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **only one is correct**
9. **Section II** contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **one or more is/are correct**.
10. **Section III** contains 2 groups of questions. Each group has 3 questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **only one is correct**.

11. **Section IV** contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and five statements (p, q, r, s and t) in Column II. Any given statement in Column I can have correct matching with **one or more** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for that particular question, against statement B, darken the bubbles corresponding to q and r in the OMR Sheet.

C. Marking Scheme:

12. For each question in **Section I**, you will be **awarded 3 marks** if you darken the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In case of bubbling of incorrect answer, **minus one (-1) mark** will be awarded.
13. For each question in **Section II**, you will be **awarded 4 marks** if you darken the bubble(s) corresponding to the correct choice(s) for the answer, and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.
14. For each question in **Section III**, you will be **awarded 4 marks** if you darken the bubble corresponding to the correct answer, and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.
15. For each question in **Section IV**, you will be **awarded 2 marks** for **each row** in which you have darkened the bubble(s) corresponding to the correct answer. Thus, each question in this section carries a maximum of 8 marks. There is **no negative marking** for incorrect answer(s) for this section.

CHEMISTRY

SECTION – I

Single Correct Choice Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct.

- If a real gas obey following equation $P(V - nb) = nRT$, at very low pressure, then the intercept and slope of graph between $\frac{d}{p}$ Vs P are respectively.

(A) $\frac{MR}{T}, \frac{M(RT)^2}{b}$	(B) $\frac{M}{RT}, \frac{-Mb}{(RT)^2}$
(C) $\frac{Mb}{RT}, \frac{-M}{(RT)^2}$	(D) $\frac{RT}{M}, \frac{-b}{M(RT)^2}$
- Arrange the following in the increasing order of s-character in central atom (hybrid orbital)

(A) $PH_3 < NH_3 < NCl_3 < N_3^-$	(B) $PH_3 < NCl_3 < NH_3 < N_3^-$
(C) $NH_3 < PH_3 < NCl_3 < N_3^-$	(D) $PH_3 = NCl_3 = NH_3 < N_3^-$
- The correct order of bond length of Si–O, P–O, S–O and Cl–O in SiO_4^{4-} , PO_4^{3-} , SO_4^{2-} and ClO_4^- is

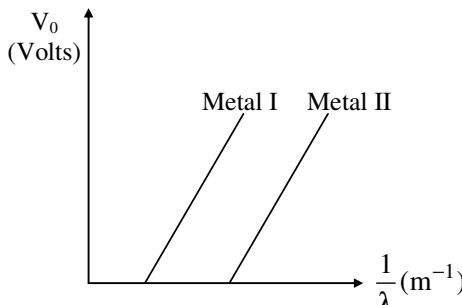
(A) $ClO_4^- > SO_4^{2-} > PO_4^{3-} > SiO_4^{4-}$	(B) $PO_4^{3-} > SiO_4^{4-} > SO_4^{2-} > ClO_4^-$
(C) $SiO_4^{4-} > PO_4^{3-} > SO_4^{2-} > ClO_4^-$	(D) $SO_4^{2-} > SiO_4^{4-} > PO_4^{3-} > ClO_4^-$
- In O_2F_2 , which of the following statement is incorrect?

(A) O-F bond length in O_2F_2 is longer than O-F bond length in OF_2

(B) The O.N. of oxygen in O_2F_2 is +1.

(C) The O–O bond length in O_2F_2 is shorter than O–O bond length in H_2O_2 .

(D) None of these
- In a photoelectric experiment, the stopping potential is plotted against $\frac{1}{\lambda}$ of incident radiation for two different metals, the curve is like as shown in the figure. Predict which of the following statement is correct:

(A) Slope of the curves for both the metals is $1.242 \times 10^{-6} \text{ J m coulomb}^{-1}$	 <p style="text-align: center;">Work function of metal I = 0.24 eV</p>
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- (B) When an electromagnetic radiation of wavelength 100 nm strikes the two metals separately, the stopping potential for metal (I) is 12.18 V.
 (C) The stopping potential for metal (I) is more than that of metal (II), if both the metals are exposed to electromagnetic radiation of wavelength 200 nm separately.
 (D) All are correct.
6. A sample of H_2O_2 solution labelled as 33.6 volume has density 264 gL^{-1} . Mark the correct option representing concentration of same solution in other units. (Assume that solution contains only H_2O and H_2O_2).
 (A) Mole fraction of H_2O_2 in the solution = 0.20
 (B) % w/V = 102%
 (C) Molarity (M) = 6 M
 (D) Molality (m) = $\frac{1000}{54} \text{ m}$
7. If 250 mL of N_2 over water at 30°C and a total pressure of 740 torr is mixed with 300 mL of Ne over water at 25°C and a total pressure of 780 torr, what will be the total pressure if the mixture is in a 500 mL vessel over water at 35°C
 (Given : Vapour pressure (Aqueous tension) of H_2O at 25°C , 30°C and 35°C are 23.8, 31.8 and 42.2 torr respectively. Assume volume of $\text{H}_2\text{O}(l)$ is negligible in final vessel)
 (A) 760 torr (B) 828.4 torr
 (C) 807.6 torr (D) 870.6 torr
8. Virial equation of state for real gas $Z = 1 + \frac{B}{V} + \frac{C}{V^2} + \frac{D}{V^3} \dots$
 Where B = IInd virial coefficient
 C = IIIrd virial coefficient
 D = IVth virial coefficient
 Find out the value of $\frac{B}{Z}$ at Boyle's temperature.
 (A) 0 (B) 1
 (C) $\left(b - \frac{a}{RT}\right)$ (D) $\frac{a}{bR}$

SECTION – II

Multiple Correct Choice Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONE OR MORE is/are correct.

9. Which of the following statement(s) is/are correct?
 (A) The removal of one electron from $\text{Na}^+(\text{g})$ ion requires more energy than that from $\text{Mg}^+(\text{g})$
 (B) The extent of hydration of Na^+ ion is more than that of K^+ ion.
 (C) Ionic radii follows the order for three elements (X, Y, Z) of same period belonging to group 1, 2 and 3 (i.e. IA, IIA and III A) in the periodic table is $X^+ > Y^{2+} > Z^{3+}$.
 (D) With the increasing electronegativity (which increases with increasing positive charge), the basic strength of any elemental oxide decreases.

10. In I_3^-
 (A) I_2 is Lewis acid and I^- is Lewis base (B) I_2 is Lewis base and I^- is Lewis acid
 (C) I_3^- itself behaves as amphoteric anion (D) I_3^- is linear
 $y = mx + c$
11. A, B and C are hydroxy compounds of the elements X, Y and Z respectively. X, Y and Z are in the same period of periodic table. A gives an aqueous solution of pH less than 7. B reacts with both strong acid and strong base. C gives an aqueous solution which is strongly basic. Which of the following statements is/are true?
 (A) The three elements are non-metal
 (B) The electronegativities decrease from X to Y to Z.
 (C) The atomic radius decreases in the order $Z > Y > X$
 (D) X, Y and Z may be phosphorous, aluminium and potassium respectively.
12. Which of the following statement is incorrect :
 (A) O_2 is paramagnetic, O_3 is also paramagnetic
 (B) O_2 is paramagnetic N_2^{+2} is also paramagnetic
 (C) B_2 is paramagnetic, C_2 is also paramagnetic
 (D) Different observation is found in their bond length when $NO \rightarrow NO^+$ and $CO \rightarrow CO^+$

SECTION – III

Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct.

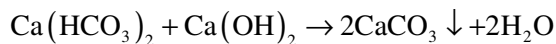
Paragraph for Questions Nos. 13 to 15

A water is said to be a soft water if it produces sufficient foam with the soap and water that does not produce foam with soap is known as hard water.

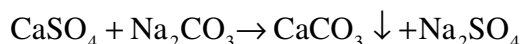
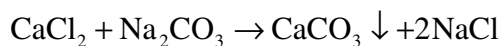
Temporary hardness is due to presence of calcium and magnesium bicarbonate. It is simply removed by boiling as



Temporary hardness can also be removed by addition of slaked lime, $Ca(OH)_2$



Permanent hardness is due to presence of sulphate and chlorides of Ca, Mg etc. It is removed as



The degree of hardness is measured in terms of ppm of $CaCO_3$. 100 ppm means 100 gm of $CaCO_3$ is present in 10^6 gm of H_2O . If any water contain 120 ppm of $MgSO_4$ its hardness in terms of $CaCO_3 = 100$ ppm.

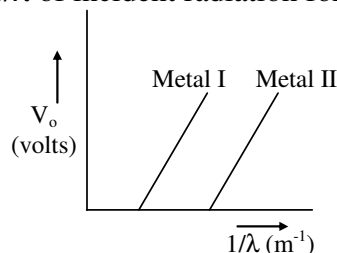
13. A sample of drinking water was found to be contaminated with chloroform. The level of contamination was 15 ppm. The molality of chloroform in the water sample is
 (A) 3.42×10^{-4} (B) 5.21×10^{-6}
 (C) 1.25×10^{-4} (D) 1.25×10^{-6}
14. The weight of Ca(OH)_2 required for 10 litre of water to remove the temporary hardness of 100 ppm due to $\text{Ca(HCO}_3)_2$?
 (A) 16.6 g (B) 1.66 g
 (C) 0.74 g (D) 7.4 g
15. RH_2 (ion exchange resin) can replace Ca^{2+} ions in hard water as
 $\text{RH}_2 + \text{Ca}^{2+} \rightarrow \text{RCa} + 2\text{H}^+$
 If 1 litre of hard water after passing through RH_2 has $\text{pH} = 3$, then hardness in ppm of Ca^{2+} ion is?
 (A) 50 (B) 40
 (C) 25 (D) 20

Paragraph for Questions Nos. 16 to 18

de-Broglie proposed dual nature of particle by giving an equation $\lambda = \frac{h}{mv}$

whereas Heisenberg proposed uncertainty principle as $\Delta x \Delta p \geq \frac{h}{4\pi}$.

On the contrary particle nature of electron was established on the basis of photoelectric effect. When a photon strikes the metal surface it gives up its energy to the electron. Part of this energy (say W) is used by the electrons to escape from the metal and the remaining imparts the KE $\left(\frac{1}{2}mv^2\right)$ to the photoelectron. The potential applied on the surface to reduce the velocity of photoelectron to zero is known as stopping potential; the stopping potential is plotted against $1/\lambda$ of incident radiation for two different metals as:



Work function of metal I is 0.24 eV.

16. Select the incorrect statement.
 (A) KE of photo-electron does not depend upon the wavelength of incident radiation.
 (B) Photoelectric current depends on intensity of incident radiation and not on frequency.
 (C) Stopping potential depends on frequency of radiation and not on intensity.
 (D) None of these
17. Energy required to stop the ejection of electrons from Cu plate is 0.24 eV. Calculate the work function when radiations of wavelength 253.7 nm strikes the plate.
 (A) 24.3 eV (B) 24 eV
 (C) 4.95 eV (D) 4.65 eV

18. The slope of the curve for metal II is
 (A) $12.18 \times 10^{-4} \text{ JmC}^{-1}$ (B) $1.242 \times 10^{-6} \text{ JmC}^{-1}$
 (C) $11.24 \times 10^{-6} \text{ JmC}^{-1}$ (D) none of these

SECTION – IV

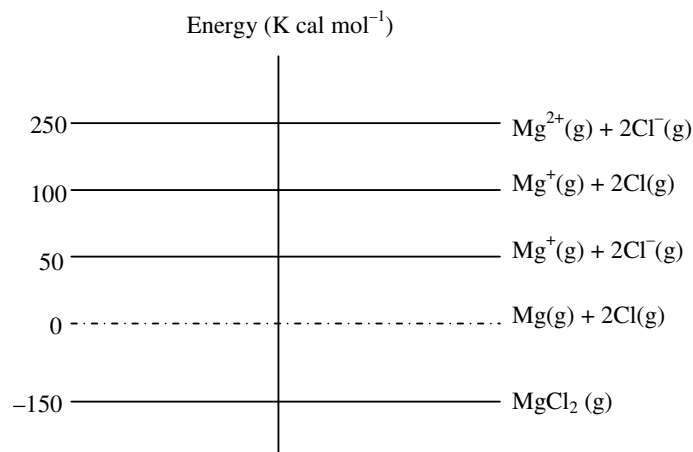
Matrix-Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in Column I are labelled A, B, C and D, while the statements in Column II are labelled p, q, r, s and t. Any given statement in Column I can have correct matching with ONE OR MORE statement(s) in Column II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example: If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following.

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

19. For any chemical change
 Reactants \rightarrow Products

The net energy change involved in the process is $E_{\text{Products}} - E_{\text{Reactant}}$. Using this and the following ENERGY diagram representing energy of each collection, Match the column I and column II.



Column I (Process)

Column II (Energy Change)

- | | |
|--|---------|
| (A) IE ₁ of Mg(g) | (p) 25 |
| (B) EA ₁ of Cl(g) | (q) 100 |
| (C) IE ₂ of Mg(g) | (r) 200 |
| (D) ΔH for $\text{MgCl}_2(\text{s}) \rightarrow \text{Mg}^{2+}(\text{g}) + 2\text{Cl}^{-}(\text{g})$ | (s) 400 |

20. Match the following

Column – I

Column II

- | | |
|---|--|
| (A) When Bi_2S_3 converted in Bi^{+5} and S. | (p) Eq. wt. = $\frac{\text{Molecular weight}}{27}$ |
| (B) When CrI_3 converted in $\text{Cr}_2\text{O}_7^{2-}$ and IO_4^- . | (q) Eq. wt. = $\frac{\text{Molecular weight}}{11}$ |
| (C) When NH_4SCN converted in SO_4^{2-} , CO_3^{2-} and NO_3^- . | (r) Eq. wt. = $\frac{\text{Molecular weight}}{10}$ |
| (D) When FeS_2 converted in Fe_2O_3 and SO_2 . | (s) Eq. wt. = $\frac{\text{Molecular weight}}{24}$ |

MATHEMATICS

SECTION – I

Single Correct Choice Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct.

21. Which of following functions is derivable at $x = 0$;
- (A) $\sin |x| + \cos |x|$ (B) $|x| + \cos |x|$
 (C) $|x| + \sin |x|$ (D) $|\cos x| + \cos |x|$
22. If $f(x) = \sqrt{4-x^2} + \frac{1}{\sqrt{|\sin x| - \sin x}}$, then the domain of $f(x)$ is
- (A) $[-2, 0]$ (B) $(0, 2]$
 (C) $[-2, 2]$ (D) $[-2, 0)$
23. Let $f(x) = \begin{cases} x^n \sin \frac{1}{x} & , x \neq 0 \\ 0 & , x = 0 \end{cases}$, then $f(x)$ is continuous, but not differentiable at $x = 0$, if
- (A) $n \in (0, 1]$ (B) $n \in [1, \infty)$
 (C) $n \in (-\infty, 0)$ (D) $n = 0$
24. If the equation $x^5 - 10a^3x^2 + b^4x + c^5 = 0$ has three equal roots, then
- (A) $2b^2 - 10a^3b^2 + c^5 = 0$ (B) $6a^5 + c^5 = 0$
 (C) $2c^5 - 10a^3b^2 + b^4c^5 = 0$ (D) $b^4 = 15a^5$
25. $I = \int \frac{dx}{1+e^x}$ is equal to
- (A) $\log_e \left(\frac{1+e^x}{e^x} \right) + c$ (B) $\log_e \left(\frac{e^x}{1+e^x} \right) + c$
 (C) $\log_e (e^x) (e^x + 1) + c$ (D) $\log_e (e^{2x} + 1) + c$

26. Let $f(x) = \min \{ \ln(\tan x), \ln(\cot x) \}$, which of the following statement is incorrect
- (A) $f(x)$ is continuous for $x \in \left(0, \frac{\pi}{2}\right)$
- (B) Lagrange's mean value theorem is applicable on $f(x)$ for $x \in \left[\frac{\pi}{8}, \frac{\pi}{4}\right]$
- (C) Rolle's theorem is not applicable on $f(x)$ for $x \in \left[\frac{\pi}{4}, \frac{3\pi}{8}\right]$
- (D) Rolle's theorem is applicable on $f(x)$ for $x \in \left[\frac{\pi}{8}, \frac{3\pi}{8}\right]$
27. The number of solutions of $[\sin x] + |\cos x| = 1$, in $\pi \leq x \leq 4\pi$, [where $[x]$ = greatest integer function], is
- (A) 3 (B) 4 (C) 5 (D) 6
28. Let $f(x) = 2 \operatorname{cosec} 2x + \sec x + \operatorname{cosec} x$, then minimum value of $f(x)$, for $x \in (0, \pi/2)$, is
- (A) $\frac{1}{\sqrt{2}-1}$ (B) $\frac{2}{\sqrt{2}-1}$
- (C) $\frac{1}{\sqrt{2}+1}$ (D) $\frac{2}{\sqrt{2}+1}$

SECTION – II

Multiple Correct Choice Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONE OR MORE is/are correct.

29. Let $f(x+y) = f(x) + f(y) + 2xy - 1 \quad \forall x, y \in \mathbb{R}$. If $f(x)$ is differentiable and $f'(0) = \sin\phi$, then
- (A) $f(x) < 0 \quad \forall x \in \mathbb{R}$ (B) $f(x) > 0 \quad \forall x \in \mathbb{R}$
- (C) $f(x) \geq \frac{3}{4} \quad \forall x \in \mathbb{R}$ (D) $-1 \leq f(x) \leq 1 \quad \forall x \in \mathbb{R}$
30. $f(x)$ is a real valued function, satisfying $f(x+y) + f(x-y) = 2f(x)f(y) \quad \forall x, y \in \mathbb{R}$. Then
- (A) $f(x)$ is an even function (B) $f(x)$ is even if $f(0) = 1$
- (C) $f(x)$ is odd if $f(0) = 0$ (D) $f(x)$ is even if $f(0) = 0$
31. If $f(x) = (\sin^2 x - 1)^n (2 + \cos^2 x)$, then $x = \pi/2$ is a point of
- (A) local maximum, if n is odd (B) local minimum, if n is odd
- (C) local maximum, if n is even (D) local minimum, if n is even
32. If $\int \frac{dx}{x^{22}(x^7-6)} = \lambda \left[\ln(z)^6 + 9z^2 - 2z^3 - 18z \right] + c$, then
- (A) $\lambda = \frac{1}{54432}$ (B) $z = \left(\frac{x^7-6}{x^7} \right)$
- (C) $\lambda = \frac{1}{24432}$ (D) $z = \left(\frac{x^6-7}{x^6} \right)$

SECTION – III

Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct.

Paragraph for Questions Nos. 33 to 35

Let $I_n = \int x^n \sqrt{a^2 - x^2} dx$, ($a > 0$) and n be a non negative integer and

$$I_n = -\frac{x^{n-1}(a^2 - x^2)^{3/2}}{A} + a^2 B I_{n-1}. \text{ Where } A \text{ and } B \text{ are constant, and } I_1 = -\frac{1}{3}(a^2 - x^2)^{3/2}$$

33. A must be equal to

- (A) n (B) $n + 1$
 (C) $n + 2$ (D) $n + 3$

34. B must be equal to

- (A) $\frac{n}{n+2}$ (B) $\frac{n-1}{n+2}$
 (C) $\frac{n-2}{n+2}$ (D) $\frac{n+1}{n+2}$

35. $\int_0^a x^5 \sqrt{a^2 - x^2} dx$ must be equal to

- (A) $\frac{8}{35}a^7$ (B) $\frac{8}{21}a^5$
 (C) $\frac{8}{105}a^7$ (D) $\frac{8\pi}{105}a^7$

Paragraph for Questions Nos. 36 to 38

If $f(x)$ is defined in $[a, b]$ and

- (i) $f(x)$ is continuous in $[a, b]$
 (ii) $f(x)$ is derivable in (a, b) , then $f'(c) = \frac{f(b) - f(a)}{b - a}$

For at least one value of c . Using the passage of the above paragraph answer the followings.

36. $f(x)$ be a function which is continuous and differentiable for all real x . If $f(2) = -4$ and $f'(x) \geq 6 \forall x \in [2, 4]$, then

- (A) $f(4) < 8$ (B) $f(4) \geq 8$
 (C) $f(4) \geq 12$ (D) none of these

37. If $f(x)$ is differentiable in the interval $(2, 5)$, where $f(2) = \frac{1}{5}$ and $f(5) = \frac{1}{2}$, then there exists a number c , $2 < c < 5$ for which $f'(c)$ will be
- (A) $\frac{1}{2}$ (B) $\frac{1}{5}$
 (C) $\frac{1}{10}$ (D) none of these
38. The value of 'c' for the function $f(x) = \log \sin x$ in the interval $\left[\frac{\pi}{6}, \frac{5\pi}{6}\right]$ will be
- (A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$
 (C) $\frac{2\pi}{3}$ (D) none of these

SECTION – IV

Matrix-Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in Column I are labelled A, B, C and D, while the statements in Column II are labelled p, q, r, s and t. Any given statement in Column I can have correct matching with ONE OR MORE statement(s) in Column II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example: If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following.

	p	q	r	s	t
A	<input checked="" type="radio"/> p	<input type="radio"/> q	<input type="radio"/> r	<input type="radio"/> s	<input type="radio"/> t
B	<input type="radio"/> p	<input checked="" type="radio"/> q	<input checked="" type="radio"/> r	<input type="radio"/> s	<input type="radio"/> t
C	<input checked="" type="radio"/> p	<input checked="" type="radio"/> q	<input type="radio"/> r	<input type="radio"/> s	<input type="radio"/> t
D	<input type="radio"/> p	<input type="radio"/> q	<input type="radio"/> r	<input checked="" type="radio"/> s	<input checked="" type="radio"/> t

39. Let $f(x) = ax^2 + bx + c$, Given that $f'(1) = 8$, $f(2) + f''(2) = 33$ and $2a + 3b + 6c = 14$, then match the following

Column – I

Column – II

- | | |
|--|-----------------|
| (A) Global maximum value of $f(x)$ | (p) Not defined |
| (B) If global minimum value of $f(x) = k$ then $28k$ is equal to | (q) 48 |
| (C) Number of real roots of $f(x) = 0$ | (r) 0 |
| (D) Number of real roots of $f(x) = 3$ | (s) 2 |

40. Match the following pair of curves with their angle of intersections :

Column- I

Column – II

- | | |
|--|-----------------------|
| (A) $x^2 + y^2 = 2\pi^2$ and
$y = \sin^{-1} \left[x^2 + \frac{1}{2} \right] + \cos^{-1} \left[x^2 - \frac{1}{2} \right]$ (where
[x] = greatest integer function) | (p) $\frac{\pi}{4}$ |
| (B) $y^2 = 2x$ and $y = [\sin x + \cos x]$ where [x]
= greatest integer function | (q) $\cot^{-1} (1/3)$ |
| (C) $x^2 = 4ay$, $y = \frac{8a^3}{x^2 + 4a^2}$ | (r) $\frac{3\pi}{4}$ |
| (D) $y^2 = \frac{2x}{\pi}$, $y = \sin x$ | (s) $\cot^{-1} (\pi)$ |

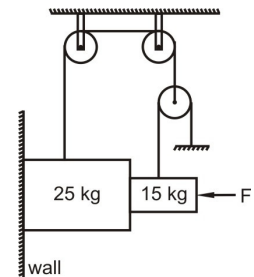
PHYSICS

SECTION – I

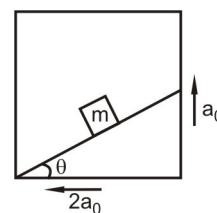
Single Correct Choice Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct.

41. If the Planck's constant h , velocity of light C and time T are taken as fundamental units, then the dimension of force in the new system will be
 (A) $hc^{-1} T^{-1}$ (B) $hc^{-1} T^2$
 (C) $hc^{-1} T^{-2}$ (D) $h^{-1} c^{-1} T^{-2}$.
42. Twelve persons are initially at the twelve corners of a regular polygon of twelve sides of side a . Each person now moves with uniform speed V in such a manner that 1 is always directed towards 2, 2 towards 3, 3 towards 4 and so on. The distance travelled by each person before they meet is
 (A) $\frac{2a}{2+\sqrt{3}}$ (B) $\frac{2a}{2-\sqrt{3}}$
 (C) $\frac{2a}{\sqrt{3}}$ (D) $\frac{a}{2+\sqrt{3}}$
43. If coefficient of friction between all surfaces is 0.4, then the minimum force F to have the equilibrium of the system will be, (take $g = 10 \text{ m/s}^2$)
 (A) 62.5 N (B) 150 N
 (C) 135 N (D) 50 N

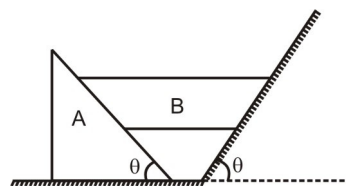


44. For the situation shown in the figure, the block is stationary w.r.t inclined fixed in an elevator. The elevator is having an acceleration of $\sqrt{5} a_0$ whose components are shown in the figure. The surface is rough and coefficient of static friction between the incline and block is μ_s . Determine the magnitude of force exerted by incline on the block. (take $a_0 = \frac{g}{2}$, $\theta = 37^\circ$, $\mu_s = 0.6$)



- (A) $\frac{mg}{10}$ (B) $\frac{3mg}{25} \times \sqrt{41}$
 (C) $\frac{9mg}{25}$ (D) $\frac{\sqrt{13}mg}{2}$
45. A particle moves with a constant speed u along the curve $y = \sin x$. The magnitude of acceleration at the point corresponding to $x = \pi/2$ is :
- (A) $\frac{u^2}{2}$ (B) $\frac{u^2}{\sqrt{2}}$
 (C) u^2 (D) $\sqrt{2}u^2$

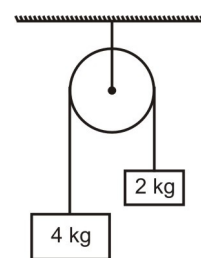
46. In the situation as shown in figure if acceleration of B is a then find the acceleration of A
- (A) $a \sin \theta$ (B) $a \cot \theta$
 (C) $2a \tan \theta$ (D) $2a \cos \theta$



47. For the system shown in the figure, a small block of mass m and smooth irregular shaped block of mass M , both free to move are placed on a smooth horizontal plane. The minimum velocity V_0 imparted to block so that it will overcome the highest point of M is



- (A) $\sqrt{2gh}$ (B) $\sqrt{2\left(1 + \frac{m}{M}\right)gh}$
 (C) $\sqrt{\frac{2m}{M}gh}$ (D) $\sqrt{2\left(1 + \frac{M}{m}\right)gh}$
48. For the system shown in the figure, String is light and pulley is frictionless. The 4 kg block is given an upward velocity of 1 m/s. The centre of mass of the two block will.
- (A) Accelerate down with $g/3$
 (B) Initially accelerate downward with g and then after some time accelerate down with $g/3$
 (C) Initially accelerate down with g and then afterwards the acceleration is zero.
 (D) Initially accelerate with g and then afterwards its acceleration is $g/9$.



SECTION – II

Multiple Correct Choice Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONE OR MORE is/are correct.

49. It is desired to construct a toy by attaching a solid cone on the top of solid hemisphere as shown in the figure. The radius of the hemisphere and the base of cone is R . If the toy is to be in a stable equilibrium in the shown position then (Given that both the cone and hemisphere are made of same material)

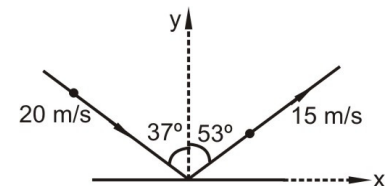


- (A) $H < \sqrt{3}R$
 (B) $H > \sqrt{3}R$
 (C) $\sqrt{3}R < H < 2R$
 (D) Centre of mass of the combined system must be above O.

50. In a collision between two objects, the motion of objects can change abruptly because of

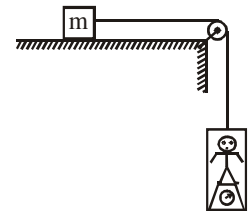
- (A) Gravity force (B) Interaction force
 (C) Friction force (D) Electromagnetic force

51. A ball of mass 2 kg strikes a floor as shown in figure. For this situation mark the correct statement(s)



- (A) The impulse experienced by ball during the collision is acting along the +ve y-direction and is having a magnitude of 50 N-S.
 (B) Floor may be rough or smooth
 (C) Coefficient of restitution between floor and ball is 9/16
 (D) The direction of impulse experienced by ball during the collision is along some where between the y axis and -ve x-axis

52. In the figure, a man of true mass M is standing on a weighing machine placed in a cabin. The cabin is joined by a string with a body of mass m . Assuming no friction, and negligible mass of cabin and weighing machine, the measured mass of man is (normal force between the man and the machine is proportional to the mass)



- (A) measured mass of man is $\frac{Mm}{(M+m)}$ (B) acceleration of man is $\frac{mg}{(M+m)}$
 (C) acceleration of man is $\frac{Mg}{(M+m)}$ (D) measured mass of man is M

SECTION – III

Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ONLY ONE is correct.

Paragraph for Questions Nos. 53 to 55

A student performs two experiments to determine the coefficient of static and kinetic friction between a block of mass 100 kg and the horizontal floor.

Ist Experiment : He applies a gradual increasing force on the block and is just able to slide the block when force is 450 N.

IInd Experiment : He applies constant force of different magnitudes for a duration of 2 s and determine the distance traveled by the block in this duration

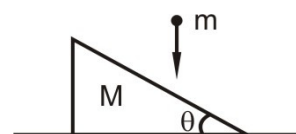
SET	FORCE	DISTANCE
1.	300 N	0.5 m
2.	600 N	2.0 m
3.	750 N	3.0 m

Assume all forces are applying horizontally (Take $g = 10 \text{ m/s}^2$)

53. The coefficient of static friction between block and floor is
 (A) 0.45 (B) 0.3 (C) 0.5 (D) 1.45
54. Which set of readings of experiment II is absolutely wrong ?
 (A) 1 (B) 2 (C) 3 (D) None of these
55. The speed of the block after 3s (beginning from starting of application of force) in set 2 for 2nd experiment is
 (A) 6 m/s (B) 2 m/s
 (C) 3 m/s (D) Information is insufficient.

Paragraph for Questions Nos. 56 to 58

A ball of mass $m = 1 \text{ kg}$ is colliding with a wedge of mass $M = 0.9 \text{ kg}$ with a velocity of 15 m/s as shown in the figure. After striking the wedge, the ball rebounds in some arbitrary direction and due to the impulse the wedge recoils in backward direction with a speed of 10 m/s. Assume all the surfaces to be smooth take $\theta = 37^\circ$ and $g = 10 \text{ m/s}^2$.



56. Velocity of ball after collision would be
 (A) $\sqrt{90} \text{ m/s}$ (B) 10 m/s (C) 5 m/s (D) 14.3 m/s
57. The coefficient of restitution between ball and wedge is
 (A) 0.5 (B) 0.75 (C) 0.68 (D) 0.4
58. Magnitude of Impulse would be
 (A) 18 N–S (B) 110 N–S (C) 8 N/S (D) 15 NS

SECTION – IV

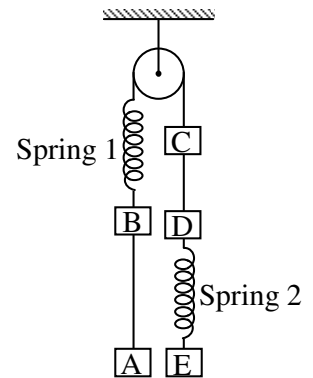
Matrix-Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in Column I are labelled A, B, C and D, while the statements in Column II are labelled p, q, r, s and t. Any given statement in Column I can have correct matching with ONE OR MORE statement(s) in Column II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example: If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following.

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

59. The system shown below is in equilibrium. Match the following :

<i>Column I</i>	<i>Column II</i>
(A) Just after the spring 2 is cut the block D	(p) Accelerates up
(B) Just after the spring 2 is cut the block C	(q) Accelerates down
(C) Just after the spring 2 is cut the block A	(r) Momentarily rest
(D) Just after the string connecting A and B is cut, the block D	(s) Moves up with acceleration g .



60. A long wire PQR is made by joining two wires PQ and QR of equal radii. PQ has length 4.8 m and mass 0.06 kg. QR has length 2.56 m and mass 0.2 kg. The wire PQR is under a tension of 80 N. A sinusoidal wave-pulse of amplitude 3.5 cm is sent along the wire PQ from the end P. No power is dissipated during the propagation of the wave-pulse.

<i>Column I</i>	<i>Column II</i>
(A) The time taken by the wave pulse to reach the other end R of the wire (in sec)	(p) 0.14
(B) The amplitude of the reflected wave pulses after the incident wave pulse cross the joint Q. (in cm)	(q) 2.0
(C) The amplitude of the transmitted wave pulses after the incident wave pulse cross the joint Q. (in cm)	(r) 32
(D) Velocity of wave in QR (in m/s)	(s) 1.5

