



CLASSROOM CONTACT PROGRAMME

(Academic Session : 2019 - 2020)

JEE(Advanced)
FULL SYLLABUS
29-06-2020

JEE(Main + Advanced) : ENTHUSIAST COURSE [SCORE-II (PHASE-TEAS, T-AS, TOAS, TNAS, TRAS & TMAS)]

PAPER-2

Time : 3 Hours

Maximum Marks : 240

READ THE INSTRUCTIONS CAREFULLY

GENERAL :

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.
2. Use the Optical Response sheet (ORS) provided separately for answering the questions.
3. Blank spaces are provided within this booklet for rough work.
4. Write your name, form number and sign in the space provided on the back cover of this booklet.
5. After breaking the seal of the booklet, verify that the booklet contains **36** pages and that all the **24** questions in each subject and along with the options are legible. If not, contact the invigilator for replacement of the booklet.
6. You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET :

7. The ORS will be collected by the invigilator at the end of the examination.
8. Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
9. Write your name, form number and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else on the ORS.** Darken the appropriate bubble under each digit of your form number.

DARKENING THE BUBBLES ON THE ORS :

10. Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11. Darken the bubble **COMPLETELY.**
12. The correct way of darkening a bubble is as :
13. The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14. Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.
15. Take **$g = 10 \text{ m/s}^2$** unless otherwise stated.

Please see the last page of this booklet for rest of the instructions

SOME USEFUL CONSTANTS

Atomic No. : H = 1, B = 5, C = 6, N = 7, O = 8, F = 9, Al = 13, P = 15, S = 16, Cl = 17, Br = 35, Xe = 54, Ce = 58

Atomic masses : H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, P = 31, S = 32, Cl = 35.5, Ca=40, Fe = 56, Br = 80, I = 127, Xe = 131, Ba=137, Ce = 140,

- **Boltzmann constant** $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$
- **Coulomb's law constant** $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$
- **Universal gravitational constant** $G = 6.67259 \times 10^{-11} \text{ N-m}^2 \text{ kg}^{-2}$
- **Speed of light in vacuum** $c = 3 \times 10^8 \text{ ms}^{-1}$
- **Stefan-Boltzmann constant** $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{-K}^{-4}$
- **Wien's displacement law constant** $b = 2.89 \times 10^{-3} \text{ m-K}$
- **Permeability of vacuum** $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$
- **Permittivity of vacuum** $\epsilon_0 = \frac{1}{\mu_0 c^2}$
- **Planck constant** $h = 6.63 \times 10^{-34} \text{ J-s}$

Space for Rough Work

HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS

BEWARE OF NEGATIVE MARKING

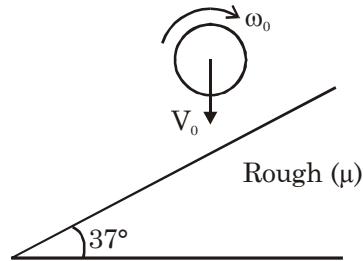
PART-1 : PHYSICS

SECTION-I(i) : (Maximum Marks: 16)

- This section contains **FOUR** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
 - Full Marks* : +4 If only (all) the correct option(s) is (are) chosen.
 - Partial Marks* : +3 If all the four options are correct but **ONLY** three options are chosen.
 - Partial Marks* : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
 - Partial Marks* : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
 - Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered).
 - Negative Marks* : -2 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

Space for Rough Work

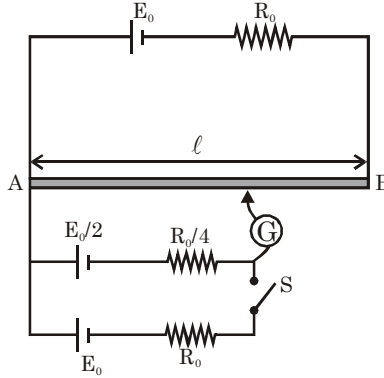
1. 1. A solid uniform ball of mass m and radius R collides elastically with a rough fixed inclined surface as shown. Velocity and angular velocity of ball just before collision are V_0 and $\omega_0 = \frac{5V_0}{R}$. Choose **CORRECT** option(s) -



- (A) If $\mu = \frac{3}{4}$ then the velocity of ball just after collision is vertically upwards.
- (B) If $\mu = \frac{3}{4}$ then the velocity of ball just after collision is horizontal leftwards.
- (C) If $\mu = \frac{3}{4}$ then angular velocity after collision is $\frac{2V_0}{R}$
- (D) If $\mu = \frac{3}{4}$ then velocity of ball after collision is V_0 .

Space for Rough Work

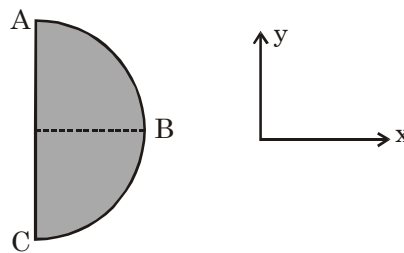
2. The resistance per unit length of potentiometer wire of uniform cross section is $\left(\frac{3R_0x}{\ell^2}\right)$, where x is measured from end A. Balance length is also measured from A. Select **CORRECT** option (s) :



- (A) When S is open balance length is at $\frac{\ell}{2}$.
- (B) When S is open balance length is at $\ell\sqrt{\frac{5}{6}}$.
- (C) When S is closed balance length is at $\ell\sqrt{\frac{3}{4}}$.
- (D) When S is closed balance length is at $\ell\sqrt{\frac{7}{8}}$.

Space for Rough Work

3. The pitch of screw gauge is 1 mm and its circular scale is divided into 100 divisions. When nothing is put between the studs the zero of main scale is not seen but when circular scale is rotated by 450° the zero of main scale is just visible and the zero of main scale coincides with the zero of circular scale. When a glass plate is placed between the studs, the circular scale lies between 18th and 19th division of main scale and circular scale reads 34 divisions. Then,
- (A) There is positive zero error and its magnitude is 1.25 mm.
 - (B) There is negative zero error and its magnitude is 1.25 mm.
 - (C) The thickness of the glass plate is 19.59 mm.
 - (D) The thickness of the glass plate is 17.09 mm.
4. A semi circular disc of radius R is placed on a smooth horizontal surface. Figure shows top view of this. If temperature is increased by Δt then displacement of (coefficient of linear expansion is α) :



- (A) A along y-axis is $R\alpha\Delta t$.
- (B) A along x-axis is $-\frac{4R}{3\pi}\alpha\Delta t$.
- (C) B along x-axis is $R\alpha\Delta t$.
- (D) B along y-axis is zero.

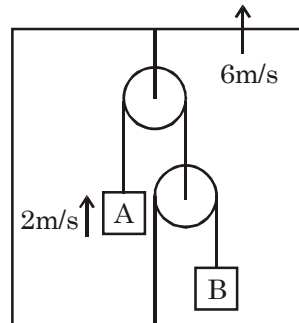
Space for Rough Work

SECTION-I(ii) : (Maximum Marks : 24)

- This section contains **THREE** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -2 In all other cases

Paragraph for Questions 5 and 6

Consider the given system shown in figure. At certain instant velocity of lift (w.r.t. ground), velocity of A (relative to lift) is shown. Velocity of lift is constant.

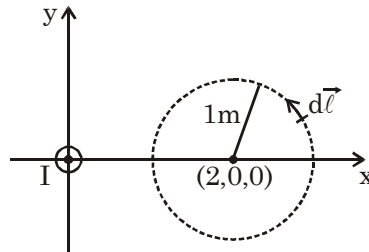


5. Choose the **CORRECT** options.
- (A) Velocity of A relative to ground is 6 m/s upward.
 - (B) Velocity of B relative to ground is 2 m/s upward.
 - (C) Velocity of B relative to ground is 4 m/s downward.
 - (D) Velocity of A relative to ground is 4 m/s upward.
6. If $m_A = m_B = m$, choose the **CORRECT** options.
- (A) acceleration of A is $\frac{g}{3}$ downward.
 - (B) acceleration of A is $\frac{g}{5}$ upward.
 - (C) force on the ceiling of lift by string is $\frac{6mg}{5}$.
 - (D) acceleration of B is $\frac{g}{5}$ downward.

Space for Rough Work

Paragraph for Questions 7 and 8

An infinitely long wire lying along z-axis carries a current I, flowing towards positive z-direction. There is no other current, consider a circle in x-y plane with centre at (2 meter, 0, 0) and radius 1 meter. Divide the circle in small segments and let $d\vec{\ell}$ denote the length of a small segment in anticlockwise direction, as shown.

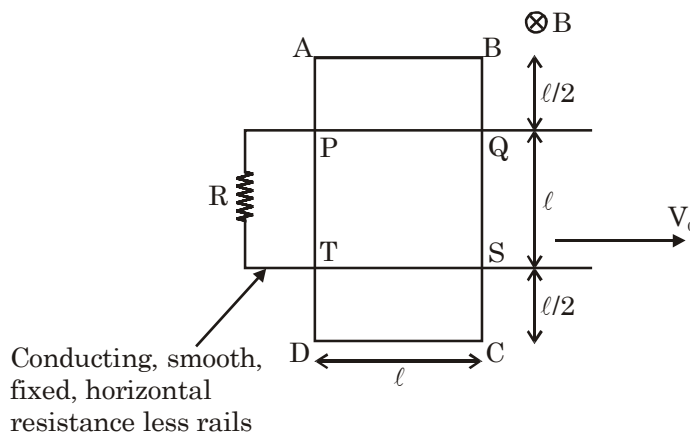


7. Consider two points A(3,0,0) and B(2,1,0) on the given circle. The path integral $\int_A^B \vec{B} \cdot d\vec{\ell}$ of the total magnetic field \vec{B} along the perimeter of the given circle from A to B is,
- (A) $\frac{\mu_0 I}{\pi} \tan^{-1} \frac{1}{2}$ (B) $\frac{\mu_0 I}{2\pi} \tan^{-1} \frac{1}{2}$ (C) $\frac{\mu_0 I}{2\pi} \sin^{-1} \frac{1}{2}$ (D) 0
8. The maximum value of path integral $\int \vec{B} \cdot d\vec{\ell}$ of the total magnetic field \vec{B} along the perimeter of the given circle between any two points on the circle is
- (A) $\frac{\mu_0 I}{12}$ (B) $\frac{\mu_0 I}{8}$ (C) $\frac{\mu_0 I}{6}$ (D) 0

Space for Rough Work

Paragraph for Questions 9 and 10

Resistance per unit length of wire frame ABCDA is $\frac{R}{2\ell}$. The wire frame is moving with constant velocity V_0 on two parallel conducting and smooth horizontal rails in uniform magnetic field B perpendicular to plane of rails as shown in figure.



9. Select **CORRECT** option :-

- (A) Current in resistor R is $\frac{2BV_0\ell}{5R}$.
- (B) Current in side AB is $\frac{4BV_0\ell}{5R}$.
- (C) Current in side CD is $\frac{4BV_0\ell}{5R}$.
- (D) Current in side ST is $\frac{2BV_0\ell}{5R}$.

10. Select **CORRECT** option :-

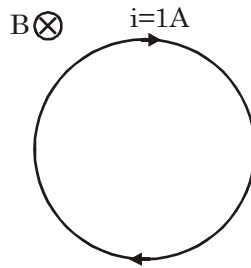
- (A) External force required to move to frame is $\frac{2B^2\ell^2V_0}{5R}$.
- (B) External force required to move to frame is $\frac{4B^2\ell^2V_0}{5R}$.
- (C) Potential difference between B and C is zero.
- (D) Potential difference between B and C is $2BV_0\ell$.

Space for Rough Work

SECTION-II : (Maximum Marks : 40)

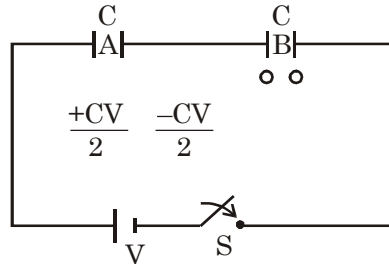
- This section contains **FOURTEEN** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- **There are 14 Questions & you have attempt any 10 Questions. If a student attempts more than 10 questions, then only first 10 questions which he has attempted will be checked.**
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 In all other cases.

1. A Physical quantity P is given as - $P = \frac{x^2 y}{(4-t)^3}$ where, $x = (2 \pm 0.01)$ SI unit; $y = (4 \pm 0.02)$ SI unit; $t = (2 \pm 0.01)$ SI unit. Find the percentage error in calculation of P.
2. A current carrying string in shape in ring of radius 1m is placed in uniform magnetic field perpendicular to plane of ring. The current and area of cross-section of ring are 1 amp and 0.2cm^2 . The density of string is $2 \times 10^3 \text{ kg/m}^3$. The speed of wave in the string (ring) is 10 m/sec. Find magnetic field (in T)? (Neglect any other interaction)

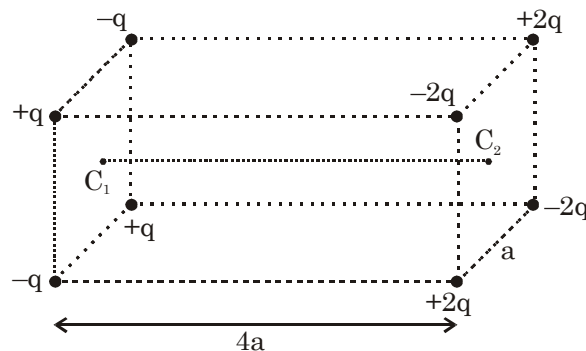


Space for Rough Work

3. Initially S is open and capacitor A is charged up to potential difference $\frac{V}{2}$ and capacitor B is uncharged. After closing the switch S the heat loss in the circuit is $\frac{CV^2}{2 \times n}$ J. Find n?

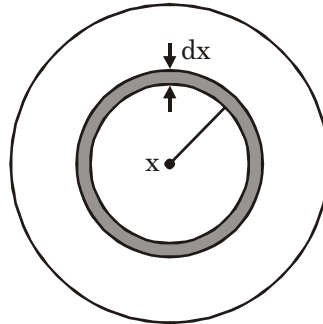


4. Two parallel square plates each of side length 'a' are arranged such that line joining centre of both the plates is perpendicular to planes of both plates. Eight fixed charges are placed at corners of plate as shown in figure. A charge particle of charge $+q$ and mass m is projected with initial velocity v_0 from centre C_1 of one square plate towards centre C_2 of other. The length of line C_1C_2 is $4a$. The speed of charge particle at mid-point of line C_1C_2 is $\frac{4v_0}{x}$. Find the value of x ? (Neglect effect of gravity).

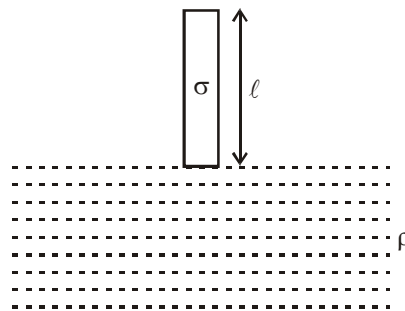


Space for Rough Work

5. The density of a solid spherical planet of radius R is given as $\rho = \rho_0 r$, where $\rho_0 = \text{constant}$ and r is distance measured from centre of planet. The acceleration due to gravity of this planet is half of maximum value at distance x from centre and also at a distance y from the centre. The value of $x + y$ is $R\sqrt{\frac{\alpha}{\beta}}$. Here α and β are single digit integer. Find the value of $\alpha - \beta$?

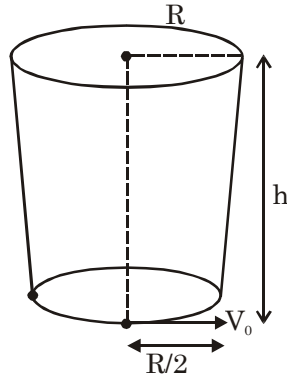


6. A uniform vertical cylinder (density = σ) is released from rest when its lower end just touches the liquid (density = ρ) surface of a deep lake. Calculate maximum displacement of cylinder (in meter) Take, $\ell = 8\text{m}$ and $\frac{\sigma}{\rho} = \frac{1}{2}$

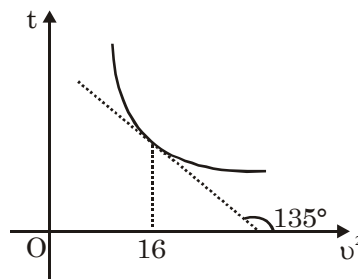


Space for Rough Work

7. A smooth cylindrical glass lies on the ground. A small particle of mass m lies on the bottom surface touching circumference as shown in the figure. The minimum value of V_0 (along the circumference) such that particle just reaches at the top of glass is $\sqrt{\frac{Kgh}{3}}$. Find the value of K .

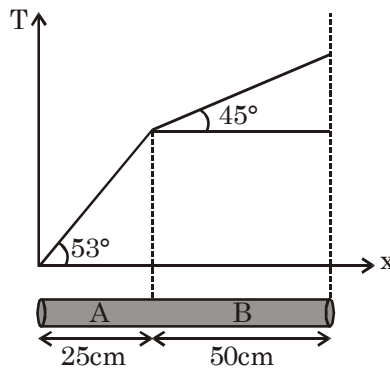


8. The square of speed of a particle moving along straight line varying with time as shown in graph. The equation of graph is $v = \frac{C^2}{\sqrt{t}}$, where $C = \text{constant}$, (v in meter/sec. and t in sec.) Find the value of constant C in SI units.



Space for Rough Work

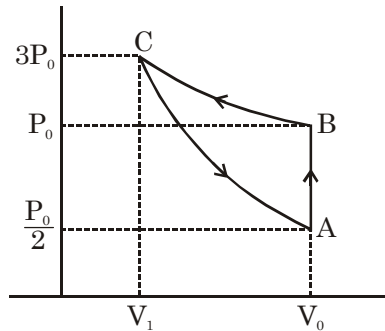
9. Two radioactive samples A_1 and A_2 having half life 3 years and 2 years respectively have been decaying for many years. Today the number of atoms in the sample A_1 is twice the number of atoms in the sample A_2 . Both the samples had same number of atoms X years ago, calculate X .
10. Two conductors A and B each of cross section area 5 cm^2 are connected in series. Variation of temperature (in $^\circ\text{C}$) along the length (in cm) is as shown in the figure. If thermal conductivity of A is $120 \text{ J/m-sec-}^\circ\text{C}$. The thermal conductivity of B is $40 \text{ K J/m-sec-}^\circ\text{C}$. Find the value of K .



11. An isolated and charged spherical soap bubble has a radius 'r' and the pressure inside is atmospheric. If T is the surface tension of soap solution, then charge on drop is $N\pi r\sqrt{2rT\epsilon_0}$, then find the value of N .

Space for Rough Work

12. An electric dipole (dipole moment = p) is placed in a uniform electric field in stable equilibrium position at rest. Now it is rotated by a small angle and released. The time after which it comes to the equilibrium position again (for first time) is t . If the moment of inertia of the dipole about the axis of rotation is $x \frac{t^2 p E}{\pi^2}$, then find the value of x .
13. One mole of an ideal gas undergoes a thermodynamic cyclic process as shown in the figure. The cyclic process consists of an isochoric, an isothermal and an adiabatic process. Adiabatic exponent of gas is $\frac{\ln 2\alpha}{\ln \alpha}$. Here α is an integer. Find α .



14. Find the effective value or rms value (in ampere) of an alternating current in one time period that changes according to the law (All quantities are in S.I. unit and symbols have their usual meaning)

$$I = 10, \text{ when } 0 < t < T/8 ; \quad I = 0, \text{ when } \frac{T}{8} < t < \frac{T}{2}$$

$$I = -10, \text{ when } \frac{T}{2} < t < \frac{5}{8}T; \quad I = 0, \text{ when } \frac{5}{8}T < t < T$$

$$I = 10, \text{ when } T < t < \frac{9}{8}T$$

Space for Rough Work

PART-2 : CHEMISTRY

SECTION-I(i) : (Maximum Marks: 16)

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1. λ of 0.01 M MgCl_2 is $220 \text{ S.cm}^2.\text{mol}^{-1}$

λ° of MgCl_2 is $240 \text{ S.cm}^2.\text{mol}^{-1}$

λ° of Mg^{2+} is $100 \text{ S.cm}^2.\text{mol}^{-1}$

All above measurements are done in an conductivity cell.

Assuming MgCl_2 to be a strong electrolyte, which of the following is incorrect?

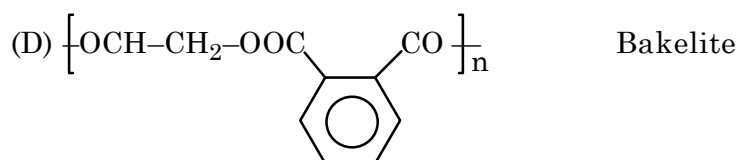
- (A) Limiting equivalent conductivity of MgCl_2 is $480 \text{ S.cm}^2.\text{eq}^{-1}$
- (B) λ of MgCl_2 varies linearly with its concentration
- (C) λ of 0.04 M MgCl_2 will be $160 \text{ S.cm}^2.\text{mol}^{-1}$
- (D) λ of 0.04 M MgCl_2 will be $200 \text{ S.cm}^2.\text{mol}^{-1}$

Space for Rough Work

2. When two phases of the same single substance remain in equilibrium with one another at a constant P and T, their molar——must be equal. Which of the following will not fit into the blank ?

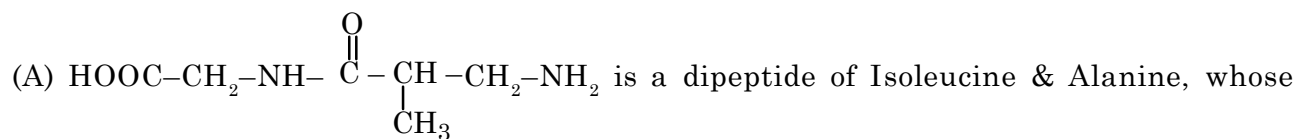
- (A) Internal energy (B) Enthalpy (C) Entropy (D) Gibb's free energy

3. Which of the following is/are correct name of the given polymer -

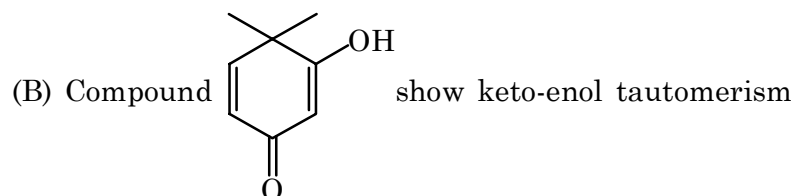


Space for Rough Work

4. Select the correct statements(s)-



abbreviated name ILE-ALA



(C) Phenol & benzoic acid can be distinguished by NaHCO_3

(D) Order of basicity in aqueous medium $\text{MeNH}_2 < \text{Me}_2\text{NH} < \text{Me}_3\text{N}$

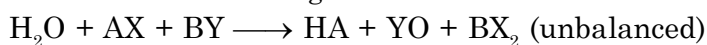
Space for Rough Work

SECTION-I(ii) : (Maximum Marks : 24)

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Paragraph for Questions 5 and 6

Consider the following redox reaction :



It is also known that oxidation number of X is -2 and neither X nor water is involved in the redox process. (In compound BY, B is cation and consider its oxidation number < 4).

Answer the following questions based on the information given.

5. Select the incorrect option :-
 - (A) The element A is undergoing reduction
 - (B) The element B is undergoing reduction
 - (C) The element B is undergoing oxidation.
 - (D) The element Y is undergoing oxidation.
6. If the given reaction is balanced with smallest whole number coefficients, then-
 - (A) Sum of stoichiometric coefficient of all the components is 8
 - (B) Sum of stoichiometric coefficient of all the components is 9
 - (C) Stoichiometric coefficient of AX is 6
 - (D) Stoichiometric coefficient of HA is 4

Space for Rough Work

Paragraph for Questions 7 and 8

Copper is the most noble of the first row transition metals and occurs in small deposits in several countries. Ores of copper include chalcantite ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), atacamite ($\text{Cu}_2\text{Cl}(\text{OH})_3$), cuprite (Cu_2O), copper glance (Cu_2S) and malachite ($\text{Cu}_2(\text{OH})_2\text{CO}_3$). However 80% of the world copper production comes from the ore chalcopyrites (CuFeS_2). The extraction of copper from chalcopyrites involves partial roasting, removal of iron and self reduction

7. Partial roasting of chalcopyrites with silica added to it, in this process does not produces :-

- (A) FeSiO_3 (B) FeS (C) Cu_2S (D) CuO

8. In self reduction the reducing agent is

Select the correct option for blank. -

- (A) Cu^+ (B) O^{-2} (C) S^{-2} (D) SiO_2

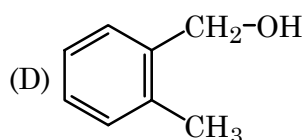
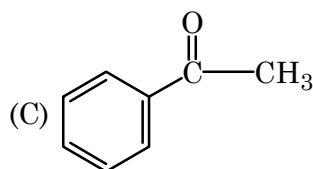
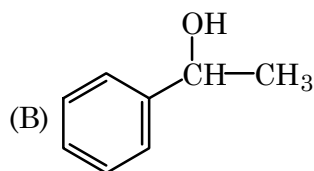
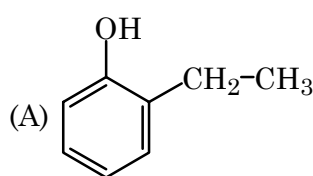
Space for Rough Work

Paragraph for Questions 9 and 10

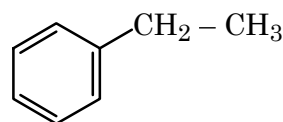
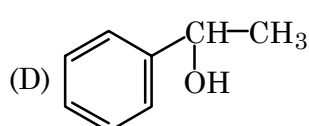
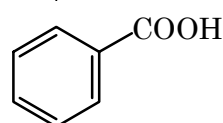
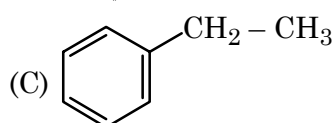
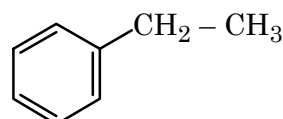
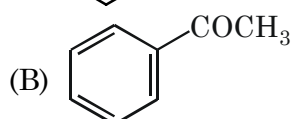
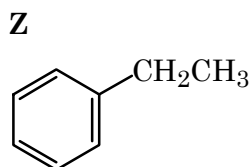
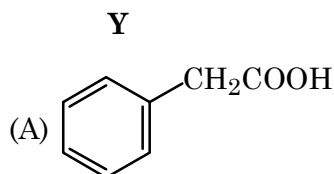
An organic compound (X) $C_8H_{10}O$ was subjected to a series of tests in the laboratory. It was found that this compound

- (i) Rotates the plane polarized light
- (ii) Evolves hydrogen gas with Na metal
- (iii) Reacts with I_2 and NaOH to produce pale yellow precipitate.
- (iv) Does not react with Br_2/CCl_4
- (v) Reacts with PCC to form (Y) C_8H_8O , which can also be synthesized by the reaction of benzene and ethanoyl chloride with anhydrous $AlCl_3$.
- (vi) Loses optical activity when it react with MnO_2/Δ followed by $Zn-Hg/Conc. HCl$ to form compound (Z).
- (vii) It gives +ve test with Lucas reagent

9. The compound X is :-



10. Compound Y and compound Z are respectively -



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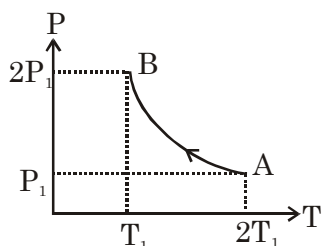
SECTION-II : (Maximum Marks : 40)

- This section contains **FOURTEEN** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- **There are 14 Questions & you have attempt any 10 Questions. If a student attempts more than 10 questions, then only first 10 questions which he has attempted will be checked.**
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.

Zero Marks : 0 In all other cases.

1. How many of the following contain peroxide linkage ?
 (a) $[\text{FeO}_4]^{2-}$ (b) Mn_2O_7 (c) HSO_5^- (d) CrO_5
 (e) PbO_3^{2-} (f) HNO_4 (g) $\text{Na}_2\text{B}_4\text{O}_7$ (h) MnO_2 (i) $\text{S}_4\text{O}_6^{2-}$
2. How many of the following orders are correct with respect to their properties indicated ?
 (i) $\text{HCl} < \text{HF}$ Boiling point
 (ii) $\text{PH}_3 < \text{NH}_3$ Dipole moment
 (iii) $\text{H}_2\text{O} < \text{D}_2\text{O}$ Strength of Hydrogen bonding
 (iv) $\text{F}_2 < \text{Cl}_2$ Bond energy
 (v) $\text{H}_2\text{O} < \text{OCl}_2$ Bond angle
 (vi) $\text{H}_2\text{O}_2 < \text{O}_2\text{F}_2$ Bond length of O–O bond
 (vii) $\text{NaCl} < \text{CuCl}$ Covalent character.
 (viii) $\text{SO}_2 < \text{SO}_3$ Acidic strength
3. Two moles of an ideal monoatomic gas is taken from state A to state B through a process AB in which the pressure and the temperature of the gas vary such that $PT = \text{constant}$. The process can be represented on a P–T graph as follows ($T_1 = 300 \text{ K}$) :



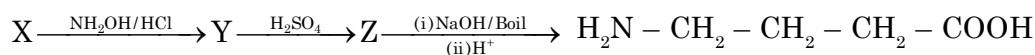
The magnitude of heat involved during process AB is (Give your answer after dividing by $300R$) :

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4. The volume of nitrogen gas (at STP) required to cover a sample of silica gel with a monomolecular layer is $112 \text{ cm}^3\text{g}^{-1}$ of gel. Calculate the surface area per gram (in m^2) of the gel if each nitrogen molecule occupies $16.0 \times 10^{-22} \text{ m}^2$. Give your answer to the nearest single digit integer $\{N_A = 6 \times 10^{23}\}$.
5. Number of crystal system having at least 2 interfacial angles equal is x
Number of crystal system having none of the interfacial angles equal is y
Number of crystal system having none of the axial length to be equal is z
Find the value of $x - y + z$.
6. What is the value of "n" in $\text{Na}_2\text{Mg}_3\text{Al}_n[(\text{Si}_4\text{O}_{11})_2](\text{OH})_2$?
7. An alcohol (A) on treatment with conc. $\text{H}_2\text{SO}_4 / \Delta$ gave an alkene (B). The compound (B), on reacting with Br_2/CCl_4 and subsequent didehydrobromination with $\text{NaNH}_2(2\text{eq.})$ produced a compound (C). The compound (C) with dil. H_2SO_4 in presence of HgSO_4 gave a compound 'D'. The compound D can also be obtained by oxidation of A by PCC or from distillation of calcium acetate. If molecular weight of 'C' is $Y \times 10$, then write the value of Y.

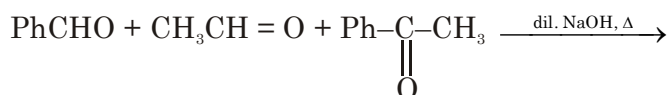
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8. Observe the following reaction

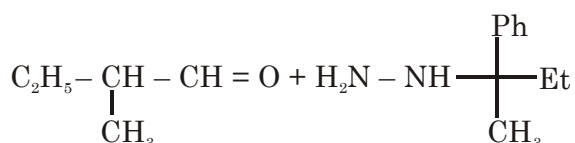


If the molar mass of X is $M \times 10$. Then the value of M is:

9. The total number of all possible Mono Aldols (β -Hydroxy carbonyl compounds) are formed in the following reaction. (Ignore stereoisomers)



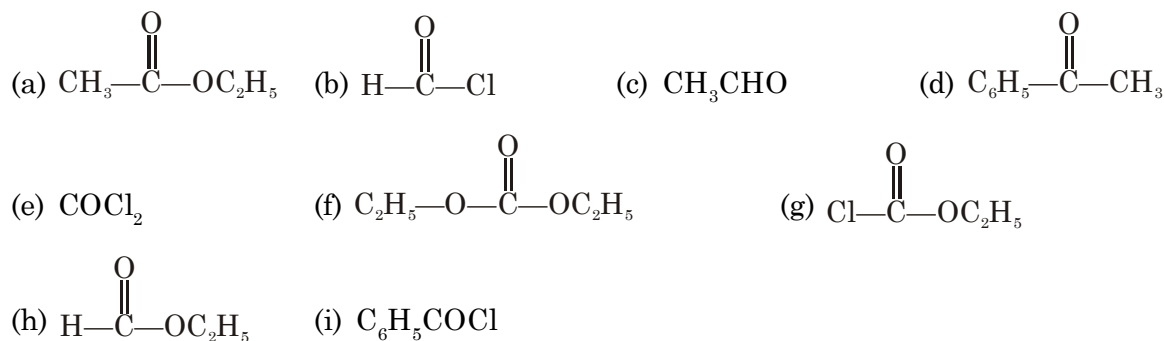
10. The number of stereoisomers of organic products containing $-\text{C}=\text{N}-\text{NH}-$ obtained in the following reaction in acidic medium.



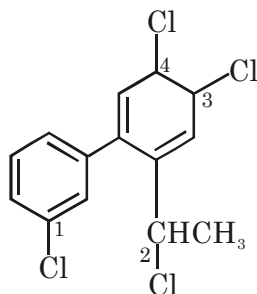
11. In a solid XY having the rock salt structure, Y atoms form the FCC arrangement and X atoms occupy all the octahedral voids. If the X atom at body centred octahedral void is missing, then the formula of the compound will be X_pY_q then $p + q$ is :

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12. Find number of molecules of NaOH consumed in the disproportionation reaction with one molecule of P_4 .
13. How many compounds out of following use two or more moles of Grignard reagent to convert into alcohol after complete hydrolysis.



14. Which Cl is most reactive toward $\text{AgNO}_3(\text{aq})$?



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PART-3 : MATHEMATICS

SECTION-I(i) : (Maximum Marks: 16)

- This section contains **FOUR** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
 - Full Marks* : +4 If only (all) the correct option(s) is (are) chosen.
 - Partial Marks* : +3 If all the four options are correct but **ONLY** three options are chosen.
 - Partial Marks* : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
 - Partial Marks* : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
 - Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered).
 - Negative Marks* : -2 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

1. If $f(x) = \frac{[x]+1}{\{x\}+1}$ for $f : \left[0, \frac{5}{2}\right] \rightarrow \left(\frac{1}{2}, 3\right]$. Then which of the following is true

(where $[.]$ denotes greatest integer function and $\{.\}$ denotes fractional part function)

- (A) $f(x)$ is injective, discontinuous function
- (B) $f(x)$ is surjective, non differentiable function
- (C) $\min \left(\lim_{x \rightarrow 1^-} f(x), \lim_{x \rightarrow 1^+} f(x) \right) = f(1)$
- (D) minimum value of $f(x) = \frac{1}{2}$

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2. A ray of light comes along line L and strikes the plane mirror kept along the plane $P = 0$ at B. $A(2, 1, 6)$ is a point on the line L whose image about $P = 0$ is A' . It is given that line L is $\frac{x-2}{3} = \frac{y-1}{4} = \frac{z-6}{5}$ and plane $P = 0$ is $x + y - 2z = 3$. then
- (A) The coordinates of A' are $(6, 5, -2)$
 (B) The coordinates of A' are $(6, 5, 2)$
 (C) Equation of the reflected ray is $\frac{x+10}{4} = \frac{y+15}{5} = \frac{z+14}{3}$
 (D) Equation of the reflected ray is $\frac{x+10}{4} = \frac{y-5}{4} = \frac{z+2}{3}$
3. If $\vec{a}, \vec{b}, \vec{c}$ be non-coplanar unit vectors equally inclined to one another at an acute angle θ if $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} = p\vec{a} + q\vec{b} + r\vec{c}$, then
- (A) $p = r$ (B) $p = \frac{1}{\sqrt{1+2\cos\theta}}, q = -\frac{2\cos\theta}{\sqrt{1+2\cos\theta}}$
 (C) $r = \frac{1}{\sqrt{1+2\cos\theta}}$ (D) $p = \frac{2\cos\theta}{\sqrt{1+2\cos\theta}}$
4. From a point P representing complex number z_1 on the curve $(|z| = 2)$ two tangents are drawn from P to the curve $|z| = 1$ meets at $A(z_2)$ and $B(z_3)$ then
- (A) centroid of ΔABP will be on curve $|z| = 1$
 (B) $\arg\left(\frac{z_2}{z_3}\right) = \pm \frac{2\pi}{3}$
 (C) $\left(\frac{4}{\bar{z}_1} + \frac{1}{\bar{z}_2} + \frac{1}{\bar{z}_3}\right)\left(\frac{4}{z_1} + \frac{1}{z_2} + \frac{1}{z_3}\right) = 9$
 (D) orthocenter and circumcentre of ΔABP will coincide.

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SECTION-I(ii) : (Maximum Marks : 24)

- This section contains **THREE** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -2 In all other cases

Paragraph for Questions 5 and 6

A and B are playing a badminton match with the agreement that winner of each set will get 1 point and the loser 0 point. The match ends as soon as one of them is ahead by 2 points or number of sets reaches six. It is supposed that the probabilities of A and B winning a set are

$\frac{2}{3}$ and $\frac{1}{3}$ respectively and each set is independent.

Let X_i denotes the event that atleast i sets are played and Y and Z denotes the event that match has won by A and B respectively.

On the basis of above information, answer the following questions :

5. Identify incorrect option –

(A) $P\left(\frac{Y}{X_5}\right) = \frac{4}{9}$

(B) $P\left(\frac{Z}{X_4}\right) = \frac{13}{81}$

(C) $P(X_{2k-1}) = P(X_{2k}) \forall k \in \{1, 2, 3\}$

(D) $P\left(\frac{Z}{X_1}\right) = \frac{64}{729}$

6. If it is known that A has won the third set then probability that A will win the match is equal to

(A) $\frac{4}{9}$

(B) $\frac{13}{18}$

(C) $\frac{22}{27}$

(D) $\frac{76}{81}$

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Paragraph for Questions 7 and 8

Consider the area S_n bounded by x-axis, $y = e^{-x}\sin x$ between $x = n\pi$ and $x = (n + 1)\pi$, where $x \geq 0$

On the basis of above information, answer the following questions :

7. The value of S_0 , is-

(A) $\frac{1}{2}(1 + e^\pi)$ sq. units

(B) $\frac{1}{2}(1 + e^{-\pi})$ sq. units

(C) $\frac{1}{2}(1 - e^{-\pi})$ sq. units

(D) $\frac{1}{2}(e^\pi - 1)$ sq. units

8. $\sum_{n=0}^{\infty} S_n$ is equal to-

(A) $\frac{1 + e^\pi}{1 - e^{-\pi}}$

(B) $\frac{1(1 + e^{-\pi})}{2(1 - e^{-\pi})}$

(C) $\frac{1}{2(1 - e^{-\pi})}$

(D) none of these

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Paragraph for Questions 9 and 10

Let $M_n = [M_{ij}]$ be a $n \times n$ matrix such that

$$M_{ij} = \begin{cases} a, & i = j \\ 1, & |i - j| = 1 \\ 0, & \text{otherwise} \end{cases}$$

Let D_n denotes the determinant value of matrix M_n .

On the basis of above information, answer the following questions :

9. If $a = 2$ then unit's place digit of D_{2017} is
(A) 5 (B) 6 (C) 7 (D) 8
10. If $a = 1$ then $\sum_{k=1}^{2017} |D_k|$ is ? (where $| \cdot |$ denotes absolute value function)
(A) 672 (B) 1007 (C) 1008 (D) 1345

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SECTION-II : (Maximum Marks : 40)

- This section contains **FOURTEEN** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- **There are 14 Questions & you have attempt any 10 Questions. If a student attempts more than 10 questions, then only first 10 questions which he has attempted will be checked.**
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 In all other cases.

-
1. If $(1 + ax + bx^2)^4 = a_0 + a_1x + a_2x^2 + \dots + a_8x^8$ where $a, b, a_0, a_1, \dots, a_8 \in \mathbb{R}$ and $a_0 + a_1 + a_2 \neq 0$ and $\begin{vmatrix} a_0 & a_1 & a_2 \\ a_1 & a_2 & a_0 \\ a_2 & a_0 & a_1 \end{vmatrix} = 0$, then value of $5\left(\frac{a}{b}\right)$.
 2. $z_1 = (8 + i)\sin\theta + (7 + 4i)\cos\theta$ and $z_2 = (1 + 8i)\sin\theta + (4 + 7i)\cos\theta$. If $z_1 \cdot z_2 = x + iy$ where $x, y \in \mathbb{R}$ and M is the greatest value of $x + y$ then value of $M^{1/3}$?
 3. If the locus of middle point of contact of tangent drawn to the parabola $y^2 = 8x$ and the foot of perpendicular drawn from its focus to the tangent is a conic then find latus rectum of the conic.

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4. Let $A \equiv (-4, 0)$ and $B \equiv (4, 0)$ if the number of points C on the circle $x^2 + y^2 = 16$, such that the area of triangle whose vertices are A, B and C is positive integer is N then value of $\left[\frac{N}{8} \right]$ is equal to ?
(where $[]$ denotes the greatest integer function)
5. A differentiable function f satisfies the relation $f(x + y) = f(x) + f(y) + 2xy(x + y) - \frac{1}{3}$
 $\forall x, y \in \mathbb{R}$ and $\lim_{h \rightarrow 0} \left(\frac{3f(h) - 1}{6h} \right) = \frac{2}{3}$, then value of $[f(2)]$ is, where $[.]$ denote greatest integer function
6. Let $f(x)$ be a non constant thrice differentiable function defined on $(-\infty, \infty)$ such that $f(x) = f(6 - x)$ and $f'(0) = 0 = f'(2) = f'(5)$. If n is the minimum number of roots of $(f''(x))^2 + f'(x) f'''(x) = 0$ in the interval $[0, 6]$ then value of $\frac{n}{3}$ is equal to ?

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7. A curve is represented by $x = \sec^2 t$ and $y = \cot t$, where t is the parameter. If the tangent at point P on curve where $t = \frac{\pi}{4}$ meets the curve again at Q then $|PQ| = \frac{p\sqrt{q}}{2}$, where p, q are coprime. Find $p + q$
8. $f(x) + f(y) = f\left(\frac{x+y}{1-xy}\right)$ for all $x, y \in \mathbb{R}$, ($xy \neq 1$) and $\lim_{x \rightarrow 0} \frac{f(x)}{x} = 2$. Then $f'(1)$ is
9. If the eccentricity of curve for which tangent at point P intersects the y axis at M above x-axis such that origin is equidistant from M and point of tangency is e then value of $6e^2$ is?
10. The solution of $x^2 \frac{dy}{dx} - xy = 1 + \cos \frac{y}{x}$ is $\tan\left(\frac{y}{px}\right) = c - \frac{1}{qx^2}$ where c is constant then, find the value of $p + q$?
11. The set of all real parameter 'a' for which the equation $x^4 - 2ax^2 + x + a^2 - a = 0$ has all real solutions, is given by $\left[\frac{m}{n}, \infty\right)$ where m and n are relatively prime positive integers, find the value of $(m + n)$.

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12. A fair coin is flipped n times let E be the event "a head is obtained on first flip" and F_k be the event "exactly k heads are obtained", then the value of n/k for which events E and F_k are independent is ?
13. In paper of english there are 5 questions such that the sum of marks is 30 and the marks for any question is not less than 2 and not more than 8. If the number of ways in which marks can be awarded is xyz where x, y, z are digits then $x + y - z$ is equal to ?
(Given that marks can be allotted in integers)
14. Let $\alpha + \beta = 1, 2\alpha^2 + 2\beta^2 = 1$ and $f(x)$ be a continuous function such that $f(2 + x) + f(x) = 2$ for all $x \in [0, 2]$ and $p = \int_0^4 f(x) dx - 4, q = \frac{\alpha}{\beta}$. Then the least positive integral values of 'a' for which the equation $ax^2 - bx + c = 0$ has both roots lies between p and q , where $a, b, c \in \mathbb{N}$

Space for Rough Work

QUESTION PAPER FORMAT AND MARKING SCHEME :

16. The question paper has three parts : Physics, Chemistry and Mathematics.
 17. Each part has two sections as detailed in the following table.

Section	Que. Type	No. of Que.	Category-wise Marks for Each Question				Maximum Marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
I(i)	One or more correct option(s)	4	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option darkened	0 If none of the bubbles is darkened	-2 In all other cases	16
I(ii)	Paragraph Based (Single correct option)	6	+4 If only the bubble corresponding to the correct option is darkened	—	0 If none of the bubbles is darkened	-2 In all other cases	24
II	Single digit Integer (0-9)	14	+4 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	40

NAME OF THE CANDIDATE FORM NO.	
I have read all the instructions and shall abide by them. <hr style="width: 80%; margin-left: auto; margin-right: auto;"/> Signature of the Candidate	I have verified the identity, name and Form number of the candidate, and that question paper and ORS codes are the same. <hr style="width: 80%; margin-left: auto; margin-right: auto;"/> Signature of the Invigilator