

Important Instructions

महत्वपूर्ण निर्देश

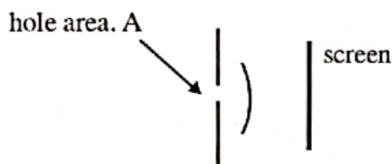
Do not open this Test Booklet until you are asked to do so.

1. Immediately fill in the form number on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **75** questions. The maximum marks are **300**.
5. There are **three** parts in the question paper 1, 2, 3 consisting of **Physics, Chemistry and Mathematics** having **25 questions** in each subject and each subject having **Two sections**.
 - (i) Section-I contains **20 multiple choice** questions with **only one correct** option.
Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
 - (ii) Section-II contains **5 Numerical Value Type** questions
Marking scheme : +4 for correct answer and 0 in all other cases.
6. Use **Blue/Black Ball Point Pen** only for writing particulars/markings responses on Side-1 and Side-2 of the Answer Sheet. **Use of pencil is strictly prohibited.**
7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
10. **Do not fold or make any stray marks on the Answer Sheet.**

इस परीक्षा पुस्तिका को तब तक न खोलें जब तक कहा न जाए।

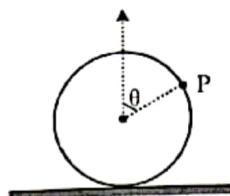
1. परीक्षा पुस्तिका के इस पृष्ठ पर आवश्यक विवरण नीले/काले बॉल पाइंट पेन से तकाल भरें। पेन्सिल का प्रयोग विल्कुल वर्जित है।
2. परीक्षार्थी अपना फार्म नं. (निर्धारित जगह के अतिरिक्त) परीक्षा पुस्तिका/उत्तर पत्र पर कहीं और न लिखें।
3. परीक्षा की अवधि 3 घंटे है।
4. इस परीक्षा पुस्तिका में 75 प्रश्न हैं। अधिकतम अंक 300 है।
5. इस परीक्षा पुस्तिका में तीन भाग 1, 2, 3 हैं, जिसके प्रत्येक भाग में भौतिक विज्ञान, रसायन विज्ञान एवं गणित के 25 प्रश्न हैं और प्रत्येक विषय में 2 खण्ड हैं।
 - (i) खण्ड-I में 20 बहुविकल्पीय प्रश्न हैं। जिनके केवल एक विकल्प सही हैं।
अंक योजना : +4 सही उत्तर के लिए, 0 प्रयास नहीं करने पर तथा -1 अन्य सभी अवस्थाओं में।
 - (ii) खण्ड-II में 5 संख्यात्मक मान प्रकार के प्रश्न हैं।
अंक योजना : +4 सही उत्तर के लिए तथा 0 अन्य सभी अवस्थाओं में।
6. उत्तर पत्र के पृष्ठ-1 एवं पृष्ठ-2 पर चांडित विवरण एवं उत्तर अंकित करने हेतु केवल नीले/काले बॉल पाइंट पेन का ही प्रयोग करें। पेन्सिल का प्रयोग सर्वथा वर्जित है।
7. परीक्षार्थी द्वारा परीक्षा कक्ष/हॉल में परिचय पत्र के अलावा किसी भी प्रकार की पाद्य सामग्री मुद्रित या हस्तलिखित कागज की पर्चियों, मोबाइल फोन या किसी भी प्रकार के इलेक्ट्रॉनिक उपकरणों या किसी अन्य प्रकार की सामग्री को ले जाने या उपयोग करने की अनुमति नहीं है।
8. रफ कार्य परीक्षा पुस्तिका में केवल निर्धारित जगह पर ही कीजिये।
9. परीक्षा समाप्त होने पर, परीक्षार्थी कक्ष/हॉल छोड़ने से पूर्व उत्तर पत्र कक्ष निरीक्षक को अवश्य सौंप दें। परीक्षार्थी अपने साथ इस परीक्षा पुस्तिका को ले जा सकते हैं।
10. उत्तर पत्र को न मोड़ें एवं न ही उस पर अन्य निशान लगाएं।

1. A beam of light of uniform intensity and of a single wavelength strikes a screen in which there is a small circular hole of area A. Some of the light passes through, and then spreads by diffraction, as shown below. At the centre of the diffracted wave which reaches the centre of the screen, the intensity of the light is I_0 (intensity is the power per unit area). When the hole is made narrower, then the angular width of the beam increases, in such a way that for the diffracted beam, half the diameter of the hole will result in twice the width of the beam. If the diameter of the hole is halved, then what will be the new intensity at the centre of the diffracted beam?



- (A) $I_0/2$ (B) $I_0/4$
 (C) $I_0/8$ (D) $I_0/16$
2. The antenna current of an AM transmitter is 8A when only carrier is sent but increases to 8.96 A when the carrier is sinusoidally modulated. The percentage modulation is :-
- (A) 50% (B) 60%
 (C) 65% (D) 71%

3. A uniform disc of mass m has a particle P of same mass rigidly fixed at its circumference as shown. the disc is placed on rough surface such that there is no slipping. Initially.



- (A) friction is zero for all values of θ
 (B) friction on disc is in direction of motion

$$\text{for } 0 < \theta < \frac{\pi}{2}$$

- (C) friction on disc is in direction of motion

$$\text{for } 0 \leq \theta \leq \frac{\pi}{2}$$

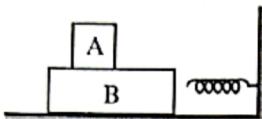
- (D) friction on disc is $2\mu mg$

4. When some one jumps, one always bends one's knees to lower the centre of mass. A person lowers its center of mass of the body by 40 cm and then jumps up. One can usually reach a height of 50 cm above your normal height. If a man of mass 80 kg jumps as described above, the work done by the man is (take $g = 10 \text{m/s}^2$)

- (A) 720 J (B) 400 J
 (C) 320 J (D) 0

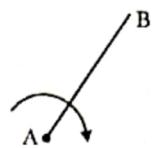
SPACE FOR ROUGH WORK / कच्चे कार्य के लिए स्थान

5. A block A is placed over block B having mass m & $2m$ respectively. Block B is resting on a frictionless surface and there is friction between block A and B. The system of blocks is pushed towards a spring with a velocity v_0 such that A doesn't slip on B by the time the system comes to momentary rest. The correct statement is :-



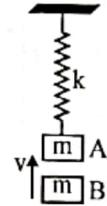
- (A) Work done by friction on A is zero
 (B) Work done by friction on B is $-\frac{1}{2}mv_0^2$
 (C) Work done by spring on B is $-\frac{3}{2}mv_0^2$
 (D) Work done by friction on A & B is zero
6. The magnetic susceptibility of a paramagnetic substance at -73°C is 0.0060, then its value at -173°C will be :
 (A) 0.0030
 (B) 0.0120
 (C) 0.0180
 (D) 0.0045

7. A non conducting rod AB of length 'l' has a positive linear charge density ' λ '. The rod is rotated about point 'A' with an angular velocity ' ω ' in plane of paper. What is the magnetic moment of rod :-



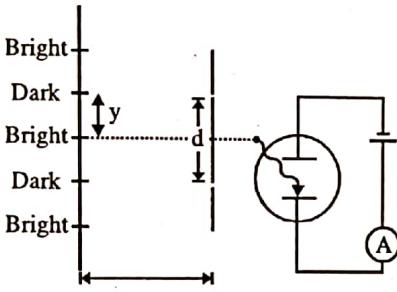
(A) $\frac{\lambda\omega l^2}{2}$ (B) $\frac{2\lambda\omega l^2}{3}$
 (C) $\frac{3\lambda\omega l^3}{2}$ (D) $\frac{\lambda\omega l^3}{6}$

8. Block A is hanging from a vertical spring and is at rest. Block B strikes the block A with velocity v and sticks to it. Then the minimum time after which the spring just attains natural length is :-

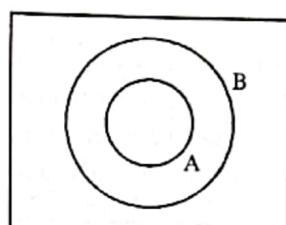


(A) $\frac{\pi}{2}\sqrt{\frac{2m}{k}}$ (B) $\frac{\pi}{3}\sqrt{\frac{2m}{k}}$
 (C) $\frac{\pi}{3}\sqrt{\frac{m}{k}}$ (D) $\frac{\pi}{6}\sqrt{\frac{2m}{k}}$

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9. In a photocell bi-chromatic light of wavelength 2475 \AA and 6000 \AA are incident on cathode whose work function is 4.8 eV . If a uniform magnetic field of $3 \times 10^{-5} \text{ T}$ exists parallel to the plate, the radius of path described by the photoelectron will be. (Mass of electron = $9 \times 10^{-31} \text{ kg}$).
- (A) 1 cm (B) 5 cm
 (C) 10 cm (D) 25 cm
10. In the following arrangement $y = 1.00 \text{ mm}$, $d = 0.24 \text{ mm}$ and $D = 1.2 \text{ m}$. The work function of the material of the emitter is 2.2 eV . The stopping potential V needed to stop the photo current will be :-
- 
- (A) 0.9 V (B) 0.5 V
 (C) 0.4 V (D) 0.1 V
11. Two planets A and B have radius in the ratio $1 : 6$. A satellite revolving near the surface of planets have same time period of revolution. The ratio of density of planets A and B is :
- (A) $1 : 6$ (B) $6 : 1$
 (C) $1 : 1$ (D) $36 : 1$
12. One mole of a diatomic gas undergoes a process $P = \frac{P_0}{\left(1 + \frac{V}{V_0}\right)^3}$, where P_0 , V_0 are constants. The translational kinetic energy of the gas when $V = V_0$ is given by :
- (A) $\frac{3P_0V_0}{2}$ (B) $\frac{3P_0V_0}{16}$
 (C) $\frac{3P_0V_0}{4}$ (D) $\frac{5P_0V_0}{2}$

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13. An experiment measures quantities a , b , c and x the value of x is calculated from $x = ab/c^3$. If the maximum percentage error in a , b and c are 1%, 1% and 2%, respectively, then
- The error in x is zero
 - For any particular reading, error in x may be 10 %
 - Maximum percentage error in x is - 4%
 - Maximum percentage error in x is 8%
14. A motorcyclist going around a circular track of radius 50 m with a speed of 25 m/s, is at a point X. A static siren at Y is emitting sound of frequency n . How many times (approximately) in an hour will the motor cyclist hear the sound of actual frequency Y ?
- 24
 - 287
 - 600
 - 573
15. A closed organ pipe of radius r_1 and an open organ pipe of radius r_2 and having same length 'L' resonate when excited with a given tuning fork. Closed organ pipe and open organ pipe resonates in fundamental mode, then :
- $1.2(r_2 - r_1) = L$
 - $r_2 - r_1 = L$
 - $r_2 - 2r_1 = 2.5 L$
 - $2r_2 - r_1 = 2.5 L$
16. Two highly conducting shells A and B have radius R and $2R$ and are concentric. Temperature of A is maintained at $2T_0$ and the arrangement is kept in an enclosure of temperature T_0 as shown. In steady state the temperature of B is :
- 

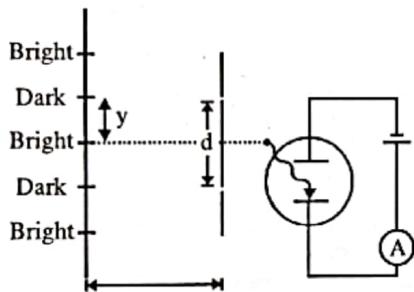
- $2^{\frac{1}{4}}T_0$
- $\left(\frac{5}{2}\right)^{\frac{1}{4}}T_0$
- $2^{\frac{1}{2}}T_0$
- None of these

SPACE FOR ROUGH WORK / कंच्चे कार्य के लिए स्थान

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SPACE FOR ROUGH WORK / कच्चे कार्य के लिए स्थान

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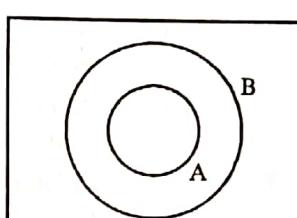
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 - (A) 24
 - (B) 287
 - (C) 600
 - (D) 573

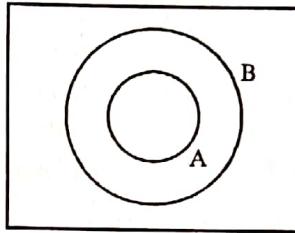
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 - (C) $r_2 - 2r_1 = 2.5 L$
 - (D) $2r_2 - r_1 = 2.5 L$

16. Two highly conducting shells A and B have radius R and $2R$ and are concentric. Temperature of A is maintained at $2T_0$ and the arrangement is kept in an encloser of temperature T_0 as shown. In steady state the temperature of B is :



(A) $2^{\frac{1}{4}}T_0$ (B) $\left(\frac{5}{2}\right)^{\frac{1}{4}}T_0$
 (C) $2^{\frac{1}{2}}T_0$ (D) None of these



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17. Two bodies A and B each of mass 'm' and carrying charge 'Q' are rotating with constant speed 'v' in a circle of radius $r/2$ on a smooth horizontal surface and are connected by spring of natural length l_0 and spring constant 'k' the total energy of the system is.

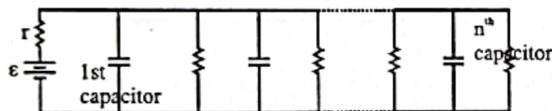
(A) $mv^2 + \frac{Q^2}{4\pi\epsilon_0 r}$

(B) $\frac{1}{2}k(r-l_0)^2$

(C) $\frac{kr}{2}(r-l_0) + \frac{1}{2}k(r-l_0)^2$

(D) None of these

18. n resistances each of resistance R are joined with capacitors of capacitance C (each) and a battery of emf 'e' as shown in the figure. In steady state condition ratio of charge stored in the first and the last capacitor is :-



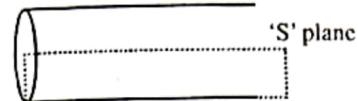
(A) $n : 1$

(B) $(n-1) : R$

(C) $\frac{n^2+1}{n^2-1}$

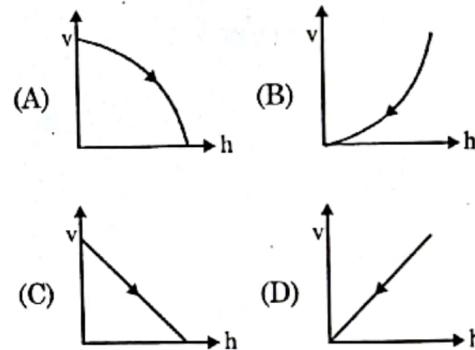
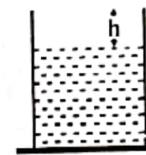
(D) $1 : 1$

19. A long copper wire of circular cross-section carries a current of 10A. "S" is a plane surface as shown in figure wholly inside the wire passing through axis of cylinder. The magnetic flux per meter of wire, for the plane surface is, in wb/m.



(A) 1×10^{-6} (B) 1.5×10^{-6}
 (C) 1×10^{-5} (D) 1.5×10^{-5}

20. A rectangular tank is filled completely with water. A hole at its bottom is unplugged. The graph between the velocity of efflux (through a small hole) vs depth of water h from the top of tank.

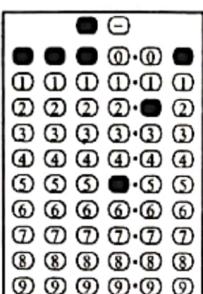
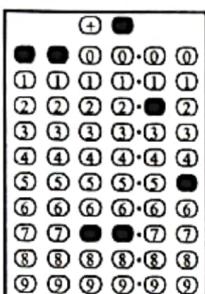


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SECTION-II : (Maximum Marks: 20)

- This section contains **FIVE** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places; e.g. 6.25, 7.00, -0.33, -30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

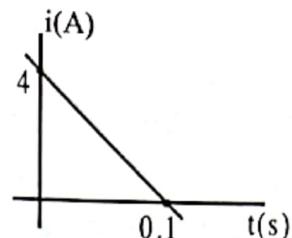


- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks : 0 In all other cases.

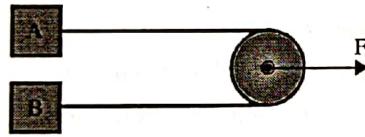
1. Some magnetic flux is changed from a coil of resistance 10Ω . As a result an induced current is developed in it which varies with time as shown in figure. Find the magnitude of change in flux through the coil in weber.



2. A simple telescope consisting of an objective of focal length 60 cm and a single eye lens of focal length 5 cm is focussed on a distant object in such a way that parallel rays emerge from the eye lens. If the object subtend an angle of 2° at the objective then find the angular width of the image (in degree).
3. The optical system consist of a thin convex lens of focal length 30 cm and a plane mirror 15 cm behind the lens. An object is placed 15 cm in front of lens. Find the distance (in cm) of final image from lens.

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4. A block was observed to move on a straight line uniformly. It displaces 10 cm in 2 second. The straight line has calibrations of 1mm. and the stop watch used to measure time has least count of 0.1s. Using this data its speed is calculated. Now the displacement of the block is calculated for next 10s using same stop watch. Find the absolute error in the calculated value of displacement (in cm).
 5. On a horizontal surface two blocks A and B of mass 2kg and 4kg are arranged with a light pulley as shown in figure. A horizontal force $F = 20t$ is applied on the pulley. The coefficient of friction between the blocks and surface is $\mu = 0.5$. The block A starts to move at time t_1 and block B starts to move at time t_2 . Find the value of $t_1 - t_2$ in seconds.



SECTION-I : (Maximum Marks : 80)

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3. In manufacturing of Cl_2 gas, according to the reaction : $\text{HCl} + \text{O}_2 \xrightarrow{\text{O}_2\text{O}_2}$

{ Cl is one isotope of chlorine}

The probable products for this reaction are

- (i) $\text{Cl}_2 + \text{H}_2\text{O}$ (ii) $\text{Cl}_2 + \text{H}_2\text{O}$ (iii) $\text{Cl}-\text{Cl} + \text{H}_2\text{O}$

Which of the above three set of products can actually be obtained ?

- (A) only (i) (B) (i) & (ii)
(C) only (iii) (D) (i), (ii) & (iii)

4. A colourless oily liquid P ($\text{C}_2\text{HCl}_3\text{O}$) when treated with chlorobenzene in the presence of a catalytic amount of sulfuric acid form a colorless, crystalline compound Q ($\text{C}_{14}\text{H}_9\text{Cl}_5$)

which is used as insecticide. Hydrate of P is stable

Choose incorrect option

- (A) Q is dichlorodiphenyltrichloroethane .
(B) P is chloral
(C) P disproportionate on treatment with NaOH .
(D) Q is Non-biodegradable pollutant

5. Which of the following is INCORRECT :
(A) BeCO_3 is kept in the atmosphere of CO_2 since, it is thermally unstable

- (B) Magnesium can be burnt in the atmosphere of CO_2 and SO_2

- (C) The function of $\text{Ca}(\text{H}_2\text{PO}_4)_2$ in baking powder is to react with NaHCO_3 because of its acidic nature.

- (D) Gypsum when added to cement makes the setting of the cement faster.

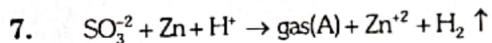
6. Which of the following is CORRECT ?

- (A) $\text{C}_6\text{H}_{13}\text{COOK}$ has a lower CMC than $\text{C}_{11}\text{H}_{23}\text{NH}_4\text{Cl}$

- (B) Blood can be purified by coagulation

- (C) A fat soluble dye can not give consistent colouration to the entire volume when added to milk

- (D) A protective colloid that has higher gold number, is a better protective colloid.



Which of the following is correct for gas A.
(A) $\text{Zn}(\text{NO}_3)_2$ solution gives white ppt. with gas A

- (B) Violet colouration is NOT obtained when the gas A is passed through a solution of sodium nitroprusside

- (C) gas A is of oxidising nature.

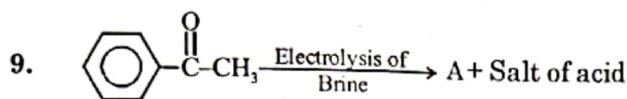
- (D) gas A is colourless and odourless.

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8. For a process involving gases which behave ideally which of the following can be a criteria for spontaneity (Here, U = Internal energy,

S = Entropy, T = Temperature in Kelvin, H = Enthalpy)

- (A) $(dU)_{S,V} > 0$ (B) $(dG)_{T,P} > 0$
 (C) $(dS)_{U,V} < 0$ (D) $(dH)_{S,P} < 0$



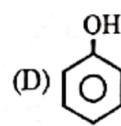
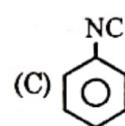
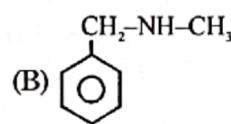
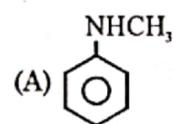
A is :

- (A) CH₄ (B) CHI₃
 (C) CHCl₃ (D) CH₃-COONa

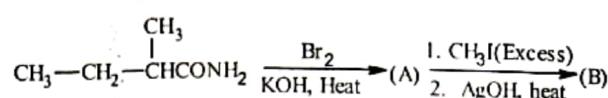
10. Which of the following can produce fair amount of H₂ gas at anode on the electrolysis of the fused mass

- (A) NaCl (B) KHF₂
 (C) BeH₂ (D) CaH₂

11. (Q) in following sequence is :



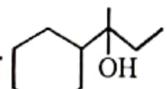
12. Consider the following sequence of reactions.

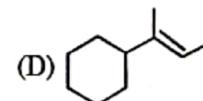
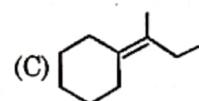
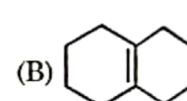
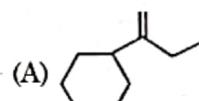


The major product (B) is :

- (A) $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$
 (B) $\text{CH}_3-\text{CH}_2-\overset{\text{CH}_3}{\underset{|}{\text{CH}}} \text{CON}(\text{CH}_3)_2$
 (C) $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}_2$
 (D) $\text{CH}_3-\text{CH}_2-\overset{\text{CH}_3}{\underset{|}{\text{CH}}}-\text{N}(\text{CH}_3)_2$

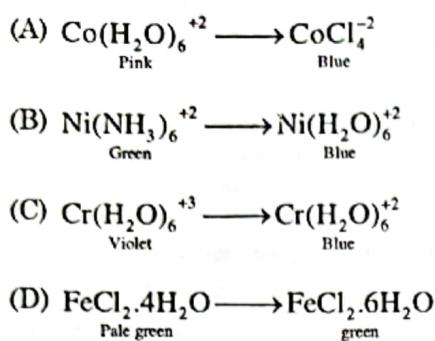
13. Which of the following is not the product

of acidic dehydration of  ?



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14. Exchange of ligands in complex results in colour change. In the view of the above statement which of the following is incorrect?



15. For two different reactions having the activation energy E_{a1} & E_{a2} , the rate constants at temperature $T_1\text{K}$ are k_1 & k_2 respectively. If $k_1 < k_2$, then which of the following can never be true for the rate constant k'_1 & k'_2 at some higher temperature T_2 , for the two reactions respectively.

- (A) $k'_1 > k'_2$, if $E_{a1} > E_{a2}$
(B) $k'_1 < k'_2$, if $E_{a1} > E_{a2}$
(C) $k'_1 > k'_2$, if $E_{a1} < E_{a2}$
(D) $k'_1 < k'_2$, if $E_{a1} < E_{a2}$

16. Which of the following is incorrect order for the indicated property?
- (A) Cr < Mn < Fe: Ionisation energy
(B) I < Br < F < Cl : Electron affinity
(C) 2nd ionisation energy : C < N < F < O
(D) $\text{N}^- > \text{P}^- > \text{O}^- > \text{S}^-$: Ionisation energy

17. Which of the following contains thioether (R-S-R) group?

- (A) Cystine (B) Cytosine
(C) Cysteine (D) Methionine

18. On Heating $(\text{NH}_4)_2\text{C}_2\text{O}_4$ decomposes as,
 $(\text{NH}_4)_2\text{C}_2\text{O}_4 \xrightarrow{\Delta} x + y + z + \text{H}_2\text{O}$

Given that, x has a distinct smell & y is used in solvay ammonia process to produce baking soda.

Then x,y,z are respectively.

- (A) CO_2 , NH_3 , N_2 (B) NH_3 , CO_2 , N_2
(C) CO_2 , NH_3 , CO (D) NH_3 , CO_2 , CO

19. Which of the following is a condensation homopolymer?

- (A) Nylon 6 (B) Nylon 6,6
(C) Dacron (D) Acrilane

20. Which of the following statements is INCORRECT

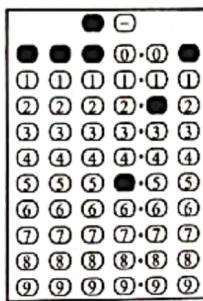
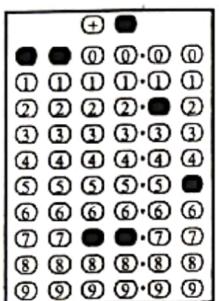
- (A) $\text{BeSO}_4 < \text{MgSO}_4 < \text{CaSO}_4 < \text{SrSO}_4$ is the thermal stability order for group II sulphates
(B) $(\text{SiH}_3)_2\text{O}$ & H_2O have the same hybridisation of O atom.
(C) $\text{OF}_2 < \text{H}_2\text{O} < \text{Cl}_2\text{O} < \text{ClO}_2$ is the bond angle order
(D) The dipole moments of chlorobenzene & m-Dichlorobenzene are equal

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SECTION-II : (Maximum Marks: 20)

- This section contains **FIVE** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

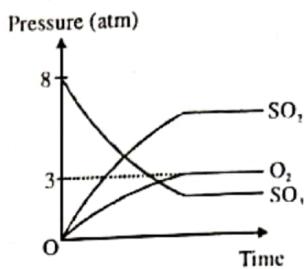


- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks : 0 In all other cases.

- Find E_{cell} for
 $\text{Ag(s)} \mid \text{AgBr(s)} \mid \text{KBr(aq., } 10^{-1}\text{M}) \parallel \text{KCl(aq., } 10^{-6}\text{ M), AgCl(aq., } 10^{-6}\text{ M)} \mid \text{Ag(s)}$
Given, $K_{sp}(\text{AgCl}) = 10^{-10} \text{ M}^2$.
 $K_{sp}(\text{AgBr}) = 10^{-15} \text{ M}^2$.
- For the dissociation of SO_3 into SO_2 and O_2 , at a given temperature, the equilibrium constant $K_p = x \text{ atm}^2$, then find x . The variation of the partial pressure of the three gases with time is as shown :



- Dissociation constant for HNO_2 and HF are $4.5 \times 10^{-4}\text{M}$ and $6.75 \times 10^{-4} \text{ M}$ respectively. What will be the ratio of the concentration of F^- to NO_2^- in the solution that is 0.5M in HF and 0.5M in HNO_2 .
- According to Bravais, how many of the 7 crystal systems have only two possible lattice?
- A certain substance A tetramerises in water to the extent of 80%. A solution of 5gm of A in 100gm of water lowers the freezing point by $0.6 \text{ }^\circ\text{C}$. Then molar mass of A is
 $[K_f = 1.86 \text{ K mol Kg}^{-1}]$

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PART 3 - MATHEMATICS

SECTION-I : (Maximum Marks : 80)

- This section contains TWENTY 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 option is darkened.
- Zero Marks : 0* If none of the bubbles is darkened.
- Negative Marks : -1* In all other cases

1. If in a sequence $\langle T_n \rangle$, $T_1 = 1$, $T_2 = 1$ and $T_n = T_{n-1} + T_{n-2}$; $n \geq 3$, then value of the limit

$$\lim_{n \rightarrow \infty} \frac{T_n}{T_{n-1}}$$

(A) $\frac{\sqrt{5}-1}{2}$ (B) $\frac{\sqrt{5}+1}{2}$

(C) $\frac{\sqrt{3}+1}{2}$ (D) $\frac{\sqrt{3}-1}{2}$

2. If $f(a) = \int_0^a \frac{du}{(1+u^2)^{3/2}}$, then value of the expression $3\sqrt{2}f(2\sqrt{2})$ is equal to
 (A) 2 (B) 3
 (C) 4 (D) 6

3. Let $f(x) = \ln\left(x + \sqrt{x^2 + 1}\right)$, then value of determinant

$$\begin{vmatrix} f(\sin 2017\pi) & f\left(\sin \frac{\pi}{6}\right) & f(e^*) \\ f\left(\cos \frac{2\pi}{3}\right) & f\left(\cos \frac{2017\pi}{2}\right) & f\left(\tan \frac{\pi}{3}\right) \\ f(-e^*) & f\left(\cot \frac{5\pi}{6}\right) & f(0) \end{vmatrix}$$

- (A) 0 (B) $\sqrt{3}$
 (C) $e^{\sqrt{3}}$ (D) π

4. If square matrix $A = \begin{bmatrix} -2 & -9 \\ 1 & 4 \end{bmatrix}$

and $A^n = B + nC$ where B and C are two square matrices then trace of $2B + C$ is equal to (where A & B matrices are independent of n)

- (A) 1
 (B) 2
 (C) 3
 (D) 4

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5. If $\sin^{-1}x + \cos^{-1}x + \tan^{-1}\frac{1}{x} + \tan^{-1}x = \pi k$. The value of k for different values of x are k_1 and k_2 , satisfy the equation $\frac{x^2}{4k_1} + \frac{y^2}{5} = 1$ and

$y^2 = 12(x - k_2)$, then the equation of their common tangent is

- (A) $y = 2x - 5$ (B) $3y = x + 3$
 (C) $y = x + 3$ (D) $y = 3x + 1$

6. Consider the equation $\frac{x^2}{\sin\sqrt{2}} + \frac{y^2}{\cos\sqrt{3}} = 1$

- $(\sqrt{2} = 1.4142, \sqrt{3} = 1.73205, \pi = 3.1415)$
 (A) The curve is an ellipse with major axis as x-axis
 (B) The curve is an ellipse with major axis as y-axis
 (C) The curve is hyperbola with transverse axis as x-axis
 (D) The curve is hyperbola with transverse axis as y-axis

7. There are 3 similar purse. Each have 2 similar pockets. Every pocket contains only 1 coin. The pockets of purse one contain, one 1 Re coin each. The pockets of the second purse contain one 50 p coin each and the pockets of the last purse contain one 1 Re coin and one 50 p coin. A purse is selected by lottery and a 1 Re coin is found from the pocket of the selected purse. What is the probability that it was from purse one?

- (A) $\frac{3}{4}$ (B) $\frac{1}{3}$
 (C) $\frac{2}{3}$ (D) $\frac{1}{2}$

8. If $b + \log_2 5$, $b + \log_4 5$ and $b + \log_8 5$ form a geometric progression in that order. Then find the common ratio of this geometric progression, where $b \in \mathbb{R}$

- (A) $r = \frac{1}{2}$ (B) $r = \frac{1}{3}$
 (C) $r = \frac{1}{4}$ (D) $r = \frac{1}{5}$

9. How many squares are these (of any size) on a chessboard of size 9×11 ?
 (A) 99 (B) 475
 (C) 300 (D) 375

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SECTION-II : (Maximum Marks: 20)

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For Example : If answer is -77.25 , 5.2 then fill the bubbles as follows.

A 5x5 grid of black and white dots. The pattern follows a specific rule: the first row has all black dots; the second row has the first and last dots black; the third row has the first, middle, and last dots black; the fourth row has the first, second, and last dots black; and the fifth row has all white dots. This creates a visual representation of a 5x5 matrix where the non-zero elements are at positions (1,1), (2,1), (2,5), (3,1), (3,3), (3,5), (4,1), (4,2), and (4,5).

A 5x5 grid of black squares arranged in a square pattern.

- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks : 0 In all other cases.

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1. If a & b be two positive real numbers and value of x which gives the absolute maximum value of $f(x) = x^a(1-x)^b$ on the

interval $[0, 1]$ is $\frac{a}{ap+bq}$, then $p+q$ equals

2. If P_n denotes the product of all the coefficient of $(1+x)^n$ and $9! P_{n+1} = 10^9 P_n$, then n is equal to
3. Consider the equations $P, Q, R \in \text{Real number}$

$$PQR + 3P + 3QR = 121$$

$$PQR + 3R + 3PQ = 59$$

$$PQR + 3Q + 3PR = 63$$

Find the value of $(P+1)(Q+1)(R+1)$?

4. A plane passing through $(1, 1, 1)$ and parallel to the lines L_1, L_2 having direction ratios $(1, 0, -1)$ $(1, -1, 0)$. If v is the volume of tetrahedron formed by origin and the points where the plane intersect the coordinate axes, then value of $2v$ is equal to
5. The number of solutions of the equation $\cot^2 x - \operatorname{cosec}^{80} x + 1 = 0$ in $(0, 13)$ is

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