

SAMPLE TEST PAPER

Paper : Physics, Chemistry &
Mathematics

This Booklet contains 12 pages.

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

Read carefully the Instructions on this Test Booklet.

Important Instructions :

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 **90** 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 **30 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 and 0 if not Attempted and -1 in all other cases.
 - (ii) Section-II contains **10 Numerical Value Type** questions. Attempt any 5 questions. First 5 attempted questions will be considered for marking.
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. If you want to attempt any question then circle should be properly darkened as shown below, otherwise leave blank.

Correct Method



Wrong Method



11. Do not fold or make any stray marks on the Answer Sheet.

Name of the Candidate (in Capitals) _____

Form Number : in figures _____

: in words _____

Centre of Examination (in Capitals) : _____

Candidate's Signature : _____ Invigilator's Signature : _____

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SECTION-I : (Maximum Marks : 80)

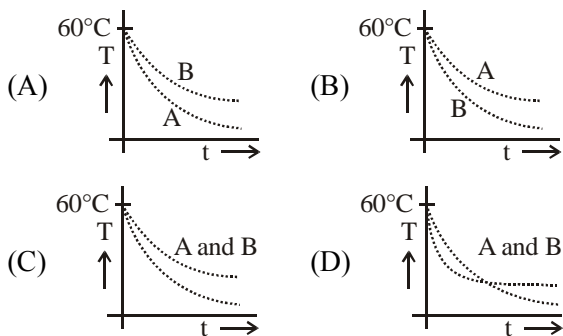
- This section contains **TWENTY** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following 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. Water from a pipe is coming at a rate of 100 litres per minute. If the radius of the pipe is 5 cm, the Reynolds number for the flow is of the order of : (density of water = 1000 kg/m^3 , coefficient of viscosity of water = 1 mPas)
(A) 10^6 (B) 10^3 (C) 10^4 (D) 10^2
2. Two identical breakers A and B contain equal volumes of two different liquids at 60°C each and left to cool down. Liquid in A has density of $8 \times 10^2 \text{ kg/m}^3$ and specific heat of $2000 \text{ J kg}^{-1} \text{ K}^{-1}$ while liquid in B has density of 10^3 kg m^{-3} and specific heat of $4000 \text{ J kg}^{-1} \text{ K}^{-1}$. Which of the following best describes their temperature versus time graph schematically? (assume the emissivity of both the beakers to be the same)



3. A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross-section and of negligible mass. The boy keeps a stone weighing 0.02 kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of 20 ms^{-1} . Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closest to:

- (A) 10^4 Nm^{-2} (B) 10^8 Nm^{-2}
(C) 10^6 Nm^{-2} (D) 10^3 Nm^{-2}

4. A thermally insulated vessel contains 150 g of water at 0°C . Then the air from the vessel is pumped out adiabatically. A fraction of water turns into ice and the rest evaporates at 0°C itself. The mass of evaporated water will be closest to :

(Latent heat of vaporization of water = $2.10 \times 10^6 \text{ J kg}^{-1}$ and Latent heat of Fusion of water = $3.36 \times 10^5 \text{ J kg}^{-1}$)

- (A) 130 g (B) 35 g (C) 20 g (D) 150 g

5. The temperature, at which the root mean square velocity of hydrogen molecules equals their escape velocity from the earth, is closest to :

[Boltzmann Constant $k_B = 1.38 \times 10^{-23} \text{ J/K}$

Avogadro Number $N_A = 6.02 \times 10^{26} / \text{kg}$

Radius of Earth : $6.4 \times 10^6 \text{ m}$

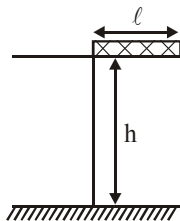
Gravitational acceleration on Earth = 10 ms^{-2}]

- (A) 650 K (B) $3 \times 10^5 \text{ K}$
(C) 10^4 K (D) 800 K

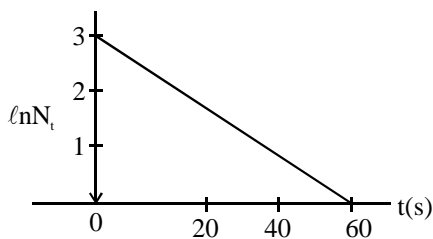
6. A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to :-

- (A) 100 s (B) 20 s (C) 10 s (D) 50 s

7. A rectangular solid box of length 0.3 m is held horizontally, with one of its sides on the edge of a platform of height 5m. When released, it slips off the table in a very short time $\tau = 0.01s$, remaining essentially horizontal. The angle by which it would rotate when it hits the ground will be (in radians) close to :-

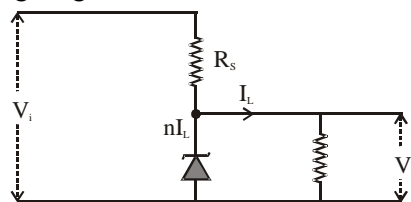


- (A) 0.02 (B) 0.28
(C) 0.5 (D) 0.3
8. Choose **CORRECT** statement :-
 (A) Electron & proton which are accelerated through same potential difference from rest will have same de-broglie wavelength.
 (B) Proton and α particle which are accelerated through same potential difference from rest will have same de-broglie wavelength.
 (C) Two particles having same kinetic energy must have same de-broglie wavelength.
 (D) Two particles having different momentum may have same de-broglie wavelength.
9. The graph shows the number of particles N_t emitted per second by a radioactive source as a function of time t , the relationship between N_t and t is -

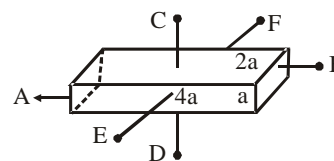


- (A) $N_t = 20e^{-(0.05t)}$ (B) $N_t = 20 e^{-20t}$
 (C) $N_t = 3e^{-0.05t}$ (D) $N_t = 3e^{-20t}$

10. The value of the resistor, R_s , needed in the dc voltage regulator circuit shown here, equals :-

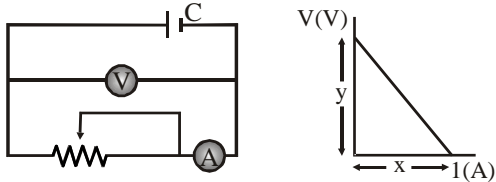


- (A) $(V_i - V_L)/nI_L$ (B) $(V_i + V_L)/n I_L$
 (C) $(V_i + V_L)/(n+1) I_L$ (D) $(V_i - V_L)/(n+1)I_L$
11. A radioactive nucleus A with a half life T , decays into a nucleus B. At $t = 0$, there is no nucleus B. At sometime t , the ratio of the number of B to that of A is 0.3. Then, t is given by :
- (A) $t = T \log (1.3)$ (B) $t = \frac{T}{\log(1.3)}$
 (C) $t = \frac{T \log 2}{2 \log 1.3}$ (D) $t = T \frac{\log 1.3}{\log 2}$
12. A steady current is passing through a linear conductor of non-uniform cross-section. The current density in the conductor is :-
 (A) independent of area of cross-section
 (B) directly proportional to area of cross-section
 (C) inversely proportional to area of cross-section
 (D) Inversely proportional to the square root of area of cross-section
13. A conductor with rectangular cross section has dimensions $(a \times 2a \times 4a)$ as shown in figure. Resistance across AB is x , across CD is y and across EF is z . Then :-

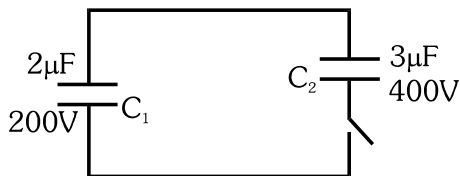


- (A) $x = y = z$ (B) $x > y > z$
 (C) $y > z > x$ (D) $x > z > y$

14. The diagram besides shows a circuit used in an experiment to determine the emf and internal resistance of the cell C. A graph was plotted of the potential difference V between the terminals of the cell against the current I , which was varied by adjusting the rheostat. The graph is shown on the right ; x and y are the intercepts of the graph with the axes as shown. What is the internal resistance of the cell ?



- (A) x (B) y (C) x/y (D) y/x
15. Two capacitor of capacity C_1 and C_2 are connected according to figure. Now switch is closed. Calculate charge on each capacitor.



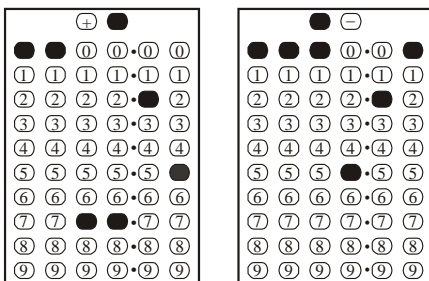
- (A) $640 \mu\text{C}$, $960 \mu\text{C}$ (B) $600 \mu\text{C}$, $1000 \mu\text{C}$
 (C) $600 \mu\text{C}$, $900 \mu\text{C}$ (D) $300 \mu\text{C}$, $1000 \mu\text{C}$
16. Two conducting spheres of different radius are having equal charges, connected by a connecting wire then :-
- (A) Charge always flows from smaller sphere to larger sphere
 (B) Charge may flows from smaller sphere to larger sphere
 (C) Charge will not flow at all
 (D) None

17. Two lenses of power -15 D and $+5 \text{ D}$ are in contact with each other. The focal length of the combination is :
- (A) -20 cm
 (B) -10 cm
 (C) $+20 \text{ cm}$
 (D) $+10 \text{ cm}$
18. A source emits a sound of frequency of 400 Hz but the listener hears it to be 390 Hz . Then :-
- (A) The listener is moving towards the source
 (B) The source is moving towards the listener
 (C) The listener is moving away from the source
 (D) The listener has a defective ear
19. In Young's experiment, the distance between two slits is made three times then the fringe width with become :-
- (A) 9 times
 (B) $1/9$ times
 (C) 3 times
 (D) $1/3$ times
20. A polaroid examines two adjacent polarised light beams A and B whose planes of polarisation are mutually at right angles. In one position of the polaroid, then beam B shows zero intensity. From this position, a rotation of 30° in polaroid shows the two beams of equal intensities. Find the intensity ratio I_A/I_B of the two beams.
- (A) $1 : 3$
 (B) $\sqrt{3} : 2$
 (C) $1 : 1$
 (D) $1 : \sqrt{2}$

SECTION-II : (Maximum Marks: 20)

- This section contains **TEN** Questions. Attempt any five Questions. First five Questions Attempt will be considered for marking.
- 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 darkening 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:

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1. A thin circular plate of mass M and radius R has its density varying as $\rho(r) = \rho_0 r$ with ρ_0 as constant and r is the distance from its centre. The moment of Inertia of the circular plate about an axis perpendicular to the plate and passing through its edge is $I = aMR^2$. The value of the coefficient a is :

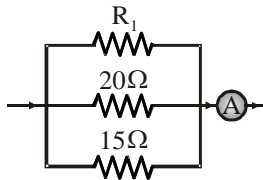
2. Two Carnot engines A and B are operated in series. The first one, A, receives heat at $T_1 (= 600 \text{ K})$ and rejects to a reservoir at temperature T_2 . The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at $T_3 (= 400 \text{ K})$. Calculate the temperature T_2 if the work outputs of the two engines are equal :

3. Young's moduli of two wires A and B are in the ratio 7 : 4. Wire A is 2 m long and has radius R . Wire B is 1.5 m long and has radius 2 mm. If the two wires stretch by the same length for a given load, then the value of R is close to :-

4. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measured by using a watch of 1 second least count. The mean value of time taken comes out to be 30 s. The length of pendulum is measured by using a meter scale of least count 1 mm and the value obtained is 55.0 cm. The percentage error in the determination of g is close to :-

5. Assuming photoemission to take place, the factor by which the maximum velocity of the emitted photoelectrons changes when the wavelength of the incident radiation is increased four times, is (about):-


6. Highly energetic electrons are bombarded on a target of an element containing 30 neutrons. The ratio of radii of nucleus to that of Helium nucleus is $14^{1/3}$. The atomic number of nucleus will be:-
7. In the given circuit the current flowing through the resistance $20\ \Omega$ is 0.3 ampere while the ammeter reads 0.8 ampere. What is the value of R_i (in Ω)?



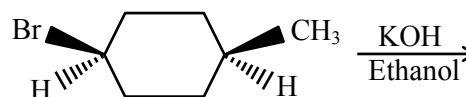
8. The bulbs one of 200 volts, 40 watts & the other of 200 volts, 100 watts are connected in series to a 100 volt supply. The power consumed will be (in Watt) :-
9. A compound microscope has an eyepiece of focal length 10 cm and an objective of focal length 4cm. Calculate the magnification, if an object is kept at a distance of 5 cm from the objective so that final image is formed at the least distance of distinct vision (20 cm) :-
10. A tuning fork gives 4 beats with 50 cm length of a sonometer wire. If the length of the wire is shortened by 1 cm, the number of beats is still the same. The frequency of the fork is :-

SECTION-I : (Maximum Marks : 80)

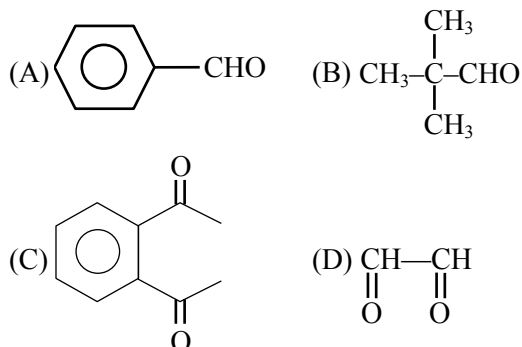
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1. Uranium is a member of :-
 (A) Transition elements (B) Actinide series
 (C) III period (D) None of these
2. Which type of element are yet unknown in the VII period :-
 (A) S (B) P
 (C) d (D) F
3. Which rule is not followed by configuration :-

- (A) Hund's rule (B) $(n + \ell)$ rule
 (C) Aufabau rule (D) Pauli's rule
4. Which of the following option with respect to increasing bond order is correct :-
 (A) $\text{No} < \text{C}_2 < \text{O}_2^- < \text{He}^+$
 (B) $\text{He}_2^+ < \text{O}_2^- < \text{NO} < \text{C}_2$
 (C) $\text{C}_2 < \text{NO} < \text{He}_2^+ < \text{O}_2^-$
 (D) $\text{He}_2^+ < \text{O}_2^- < \text{C}_2 < \text{NO}$

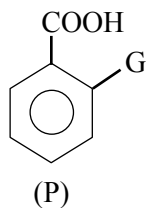
5. In the protonation of NH_3 molecule, following statement is true :-
 (A) a covalent bond is formed
 (B) Hybridisation of N is changed
 (C) Hydrogen bond is formed
 (D) Shape of NH_3 is changed
6. In which of the following KI is highly soluble :-
 (A) $(\text{CH}_3)_2\text{CO}$ ($\epsilon = 21$) (B) CCl_4 ($\epsilon = 0$)
 (C) CH_3OH ($\epsilon = 32$) (D) C_6H_6 ($\epsilon = 0$)
7. Correct order of magnetic moment (spin only):-
 (A) $(\text{Fe}(\text{CN})_6)^{4-} > [\text{MnCl}_4]^{2-} > [\text{CoCl}_4]^{2-}$
 (B) $[\text{MnCl}_4]^{2-} > [\text{Fe}(\text{CN})_6]^{4-} > [\text{CoCl}_4]^{2-}$
 (C) $[\text{MnCl}_4]^{2-} > [\text{CoCl}_4]^{2-} > [\text{Fe}(\text{CN})_6]^{4-}$
 (D) $[\text{Fe}(\text{CN})_6]^{4-} > [\text{CoCl}_4]^{2-} > [\text{MnCl}_4]^{2-}$
8. Select the correct statement regarding major product of following reaction ?



- (A) Only a single alkene is formed
 (B) A pair of geometrical isomers are formed
 (C) A pair of enantiomers are formed
 (D) A pair of Diastereomers are formed
9. Which of the following compound undergo aldol condensation ?



10. For which group 'G', (P) is more acidic than benzoic acid :



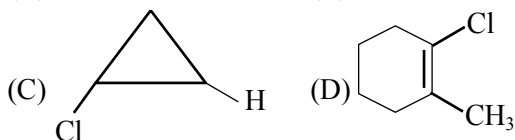
- (A) -OH (B) -CH₃
(C) -COOH (D) All of these

11. Correct order of Bond length is :-

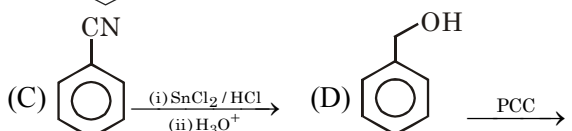
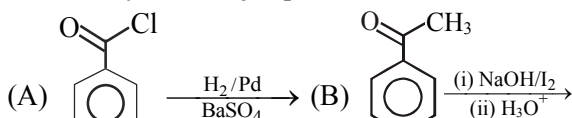
- (A) x = y = z (B) x = y > z
(C) z > y > x (D) x > y = z

12. Which among the following is likely to show geometrical isomerism.

- (A) CH₃-CH=CH₂ (B) CH₃-CH=N-OH



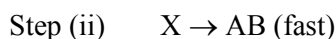
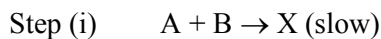
13. Which of following will not produce benzaldehyde as major product:-



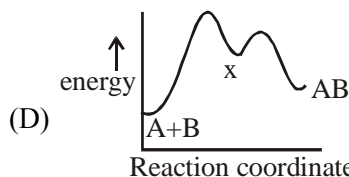
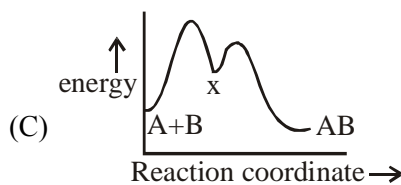
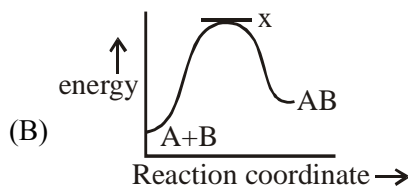
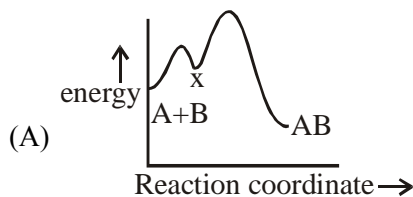
14. R₁ and R₂ are :-

- (A) Cold alkaline KMnO₄, OSO₄/H₂O₂
(B) Cold alkaline KMnO₄, HCO₃H and H₃O[⊕]
(C) Cold alkaline KMnO₄, C₆H₅CO₃H
(D) C₆H₅CO₃H, HCO₃H

15. For an exothermic reaction; A+B → AB following two steps are involved :-



The progress of reaction can be best represented by :-



16. Reaction N₂O_{4(g)} ⇌ 2NO_{2(g)} degree of dissociation (α) is terms of K_p and total equilibrium pressure P is :-

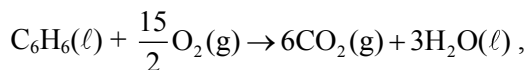
(A) $\alpha = \sqrt{\frac{4P + K_p}{K_p}}$ (B) $\alpha = \sqrt{\frac{K_p}{4P + K_p}}$

(C) $\alpha = \sqrt{\frac{K_p}{4P}}$ (D) None

17. If boiling point of an aqueous solution is 100.1°C, what is its freezing point ? Given, enthalpy of fusion and vaporisation of water are 80 cal g⁻¹ and 540 cal g⁻¹ respectively :-

- (A) 0.361°C (B) -0.361°C
(C) -3.61°C (D) None of these

18. Consider the reaction at 300 K



$$\Delta H = -3271 \text{ kJ}$$

What is ΔU for the combustion of 1.5 mole of benzene at 27°C ?

- (A) -326.25 kJ (B) -4900.25 kJ
(C) -4906.5 kJ (D) -3274.75 kJ

19. A weak acid of dissociation constant 10^{-5} is being titrated with aqueous NaOH solution. The pH at the point of one-third neutralization of the acid will be:

- (A) $5 + \log 2 - \log 3$ (B) $5 - \log 2$
(C) $5 - \log 3$ (D) $5 - \log 6$

20. The $[HCO_3^-]/[H_2CO_3]$ ratio in the buffer present in blood (pH = 7.4) is approximately

- (pK_a = 6.1 for H₂CO₃)
(A) 20 (B) 16
(C) 24 (D) 10

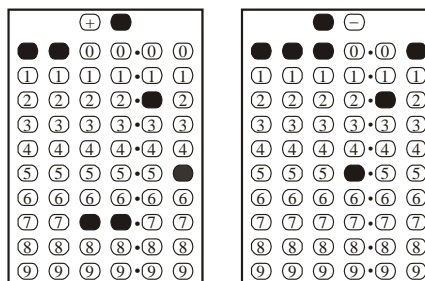
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1. Find out the total coloured species out of following Cl₂, NO₂, NH₃, CdS, N₂O₄, Cu₂[Fe(CN)₆]

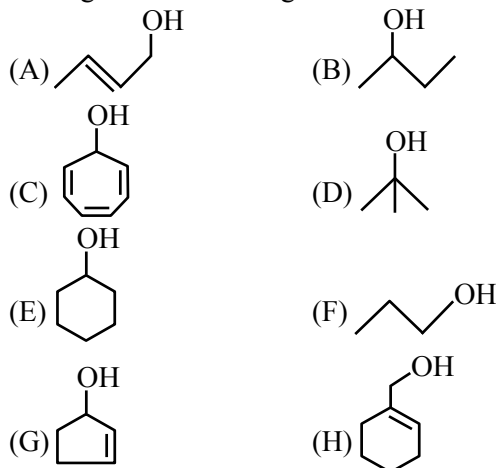
2. How many of the following contains Mg. Magnetite, Carnalite, Epsom salt, Siderite

3. When conc. H₂SO₄ is added to charcoal the number of gases evolved is/are –

4.
$$CH_3 - \overset{\text{OH}}{\underset{|}{CH}} - CH = CH - \overset{\text{OH}}{\underset{|}{CH}} - Me$$

Total number of stereoisomers for above compound.

5. How many alcohols give immediate turbidity on heating with luca's Reagent?



6. If total number of chiral centre in α -D-Glucopyranose is 'P' and sucrose is 'Q' then what would be value of $(P \times Q)$?
7. Half life of first order reaction is 30 minute. Calculate the time of completion of 99.999% of reaction [in (min)]
8. An ideal solution was found to have a vapour pressure of 80 torr when the mole fraction of a non-volatile solute was 0.2. What would be the vapour pressure of the pure solvent at the same temperature ?
9. What is the final temperature (in kelvin) of 0.10 mole monoatomic ideal gas that performs 75 cal of work adiabatically if the initial temperature is 227°C ? (use $R = 2 \text{ cal/K-mol}$)
10. A weak acid 0.1M HA is 1% ionised, pH of the solution will be -

SECTION-I : (Maximum Marks : 80)

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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

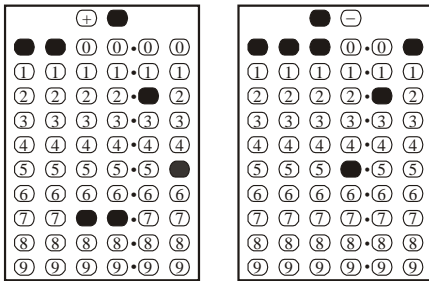
1. Two vertical poles of heights, 20 m and 80 m stand a part on a horizontal plane. The height (in meters) of the point of intersection of the lines joining the top of each pole to the foot of the other, from this horizontal plane is :
 (A) 12 (B) 15 (C) 16 (D) 18
2. The logical statement $(p \Rightarrow q) \wedge (q \Rightarrow \sim p)$ is equivalent to :
 (A) p (B) q (C) $\sim p$ (D) $\sim q$
3. Let M be a 3×3 invertible matrix with real entries and I denote the 3×3 identity matrix $M^{-1} = \text{adj}(\text{adj}M)$ then $\text{adj}(M^2)$:
 (A) M (B) I (C) $5 \cdot M^2$ (D) None
4. Let $2p + 3q + 4r = 15$ and if the expression $p^3 q^5 r^7$ takes the maximum value, then $p : q : r$ is equal to (where $p, q, r \in \mathbb{R}^+$) –
 (A) 18 : 20 : 21 (B) 3 : 5 : 7
 (C) 2 : 3 : 4 (D) 6 : 15 : 28
5. The coefficient of x^{210} in the expression $(x-1)(x^2-2)(x^3-3)\dots(x^{20}-20)$ is
 (A) 11 (B) 111 (C) 1 (D) 0

6. If equation $x^2 + ax + b = 0$ ($a, b \in \mathbb{Q}$) and $2x^3 + 5x^2 + 2x - 1 = 0$ may have a common root, then sum of all possible values of $(a - b)$ is –
 (A) 2 (B) 3 (C) -3 (D) 0
7. If complex number z satisfying $|z - 3| \leq |z - 1|$, $|z - 3| \leq |z - 5|$, $|z - i| \leq |z + i|$ and $|z - i| \leq |z - 5i|$, then area of the region in which z lies is : –
 (A) 16 (B) 12
 (C) 4 (D) 6
8. If the system of equation $\lambda p + r = 0$
 $2p + \lambda q + r = 0$
 $-q + r = 0$
 has non trivial solution then the value of λ can be the roots of quadratic equation which is : –
 (A) $x^2 - x - 2 = 0$ (B) $x^2 + x - 2 = 0$
 (C) $x^2 + 4x + 1 = 0$ (D) $x^2 - 3x + 2 = 0$
9. Let $f(x) = \begin{cases} -1, & -2 \leq x < 0 \\ x^2 - 1, & 0 \leq x \leq 2 \end{cases}$
 and $g(x) = |f(x)| + f(|x|)$. Then, in the interval $1(-2, 2)$, g is : –
 (A) differentiable at all points
 (B) not differentiable at two points
 (C) not continuous
 (D) not differentiable at one point
10. If $x \log_e(\log_e x) - x^2 + y^2 = 4$ ($y > 0$), then dy/dx at $x = e$ is equal to :
 (A) $\frac{e}{\sqrt{4 + e^2}}$ (B) $\frac{(1 + 2e)}{2\sqrt{4 + e^2}}$
 (C) $\frac{(2e - 1)}{2\sqrt{4 + e^2}}$ (D) $\frac{(1 + 2e)}{\sqrt{4 + e^2}}$
11. The tangent to the curve $y = x^2 - 5x + 5$, parallel to the line $2y = 4x + 1$, also passes through the point.
 (A) $(\frac{1}{4}, \frac{7}{2})$ (B) $(\frac{7}{2}, \frac{1}{4})$
 (C) $(-\frac{1}{8}, 7)$ (D) $(\frac{1}{8}, -7)$

12. The maximum volume (in cu. m) of the right circular cone having slant height 3m is :
 (A) $3\sqrt{3}\pi$ (B) 6π (C) $2\sqrt{3}\pi$ (D) $\frac{4}{3}\pi$
13. $\int \frac{x+x^{2/3}+x^{1/6}}{x(1+x^{1/3})} dx$ equals to
 (Where C is constant of integration)
 (A) $\frac{3}{2}x^{2/3} + \tan^{-1}x^{1/6} + C$
 (B) $\frac{2}{3}x^{2/3} + 6\tan^{-1}x^{1/6} + C$
 (C) $\frac{3}{2}x^{2/3} - 6\tan^{-1}x^{1/6} + C$
 (D) $\frac{3}{2}x^{2/3} + 6\tan^{-1}x^{1/6} + C$
14. The value of $\int_{-1/8}^{1/8} \cos^{-1}(x^5 + 5x) dx$ is
 (A) $\frac{\pi}{2}$ (B) $\sqrt{2}\pi$ (C) $\frac{\pi}{8}$ (D) None
15. The solution of differential equation $xy \frac{dy}{dx} = \frac{1+y^2}{1+x^2}(1+x+x^2)$ given that $x=1, y=0$ is
 (A) $\ln\sqrt{1+y^2} = \ln x + \tan^{-1}x - \frac{\pi}{2}$
 (B) $\ln\left(\frac{1+y^2}{x^2}\right) = 2\tan^{-1}x - \frac{\pi}{2}$
 (C) $\ln\left(\frac{1+y^2}{x^2}\right) = \frac{\pi}{4} - 2\tan^{-1}x$
 (D) $\ln\left(\frac{1+y^2}{x^2}\right) = \tan^{-1}x - \frac{\pi}{4}$
16. The image of the point with position vector $i + 3k$ in the plane $r \cdot (i + j + k) = 1$ is :-
 (A) $i + 2j + k$ (B) $i - 2j + k$
 (C) $-i - 2j + k$ (D) $i + 2j - k$
17. OABC is a tetrahedron whose vertices are $O(0, 0, 0)$; $A(a, 2, 3)$; $B(1, b, 2)$ and $C(2, 1, c)$. If its centroid be $(1, 2, -1)$, then distance of the point (a, b, c) from the origin is-
 (A) $\sqrt{14}$ (B) $\sqrt{107}$
 (C) $\sqrt{107/14}$ (D) None of these
18. Tangents OP and OQ are drawn from origin O to the circle $x^2 + y^2 + 2x + 4y + 1 = 0$. The circumcenter of ΔOPQ is-
 (A) $(-1, -2)$ (B) $(1, 2)$
 (C) $(-2, -1)$ (D) $\left(-\frac{1}{2}, -1\right)$
19. Tangents are drawn from (α, β) to the hyperbola $3x^2 - 2y^2 = 6$ making angles θ_1 and θ_2 with transverse axis. If $\tan\theta_1 \tan\theta_2 = 2$ then $\beta^2 =$
 (A) $2\alpha^2 - 5$ (B) $2\alpha^2 - 7$
 (C) $2\alpha^2 - 3$ (D) $2\alpha^2 - 1$
20. If normal to ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at $\left(ae, \frac{b^2}{a}\right)$ is passing through $(0, -2b)$, then value of eccentricity is-
 (A) $\sqrt{2} - 1$ (B) $2(\sqrt{2} - 1)$
 (C) $\sqrt{2(\sqrt{2} - 1)}$ (D) None of these

SECTION-II : (Maximum Marks: 20)

- This section contains **TEN** Questions. Attempt any five Questions. First five Questions Attempt will be considered for marking.
 - 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 darkening 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.

- Let α and β be two real roots of the equation $(k + 1) \tan^2 x - \sqrt{2} \cdot \lambda \tan x = (1 - k)$, where $k(\neq -1)$ and λ are real numbers. If $\tan^2(\alpha + \beta) = 50$, then a value of λ is :-
- If the variance of the first n natural numbers is 10 and the variance of the first m even natural numbers is 16, then $m + n$ is equal to _____.
- How many words can be made by using all letters of word 'BAHUBALI'. If all word starts and end with vowels?
- Three randomly chosen non negative integers x, y and z are found to satisfy eq. $x + y + z = 10$ and the probability that z is even is p/q (p, q coprime) then $p+q =$ _____
- $\lim_{x \rightarrow 0} \frac{x \cot(4x)}{\sin^2 x \cot^2(2x)}$ is equal to
- If the function f given by $f(x) = x^3 - 3(a - 2)x^2 + 3ax + 7$, for some $a \in \mathbb{R}$ is increasing in $(0, 1]$ and decreasing in $[1, 5)$, then a root of the equation, $\frac{f(x) - 14}{(x - 1)^2} = 0 (x \neq 1)$ is.

- The area of the region bounded by $x + 1 = 0, y = 0, y = x^2 + x + 1$ and tangent to $y = x^2 + x + 1$ at $x = 1$ will be
- $\int_0^5 [x] \{x\} dx$ (where $[.]$ denotes greatest integer function and $\{.\}$ denotes fractional part of function) is
- The number of common tangents to the circle $x^2 + y^2 - 2x - 4y - 4 = 0$ and $x^2 + y^2 + 4x + 8y - 5 = 0$ is -
- If the length of the normal chord to the parabola $y^2 = 4x$, which subtends right angle at the vertex is L then the value of L^2 is