

General Instructions

1. The test is of 3 hours duration and the maximum marks is 300.
2. The question paper consists of 3 Parts (Part I: Physics, Part II: Chemistry, Part III: Mathematics). Each Part has two sections (Section 1 & Section 2).
3. Section 1 contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.
4. Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 questions have to be attempted.

The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. In the OMR, do not bubble the sign for positive values. However, for negative values, \ominus sign should be bubbled. (Example: 6, 81, 1.50, \oplus 3.25, 0.08)

5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
8. Do not fold or make any stray mark on the Answer Sheet (OMR).

Marking Scheme

1. Section – 1: +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. Section – 2: +4 for correct answer, 0 for all other cases. There is no negative marking.

Name of the Candidate (In CAPITALS) :

Roll Number :

OMR Bar Code Number :

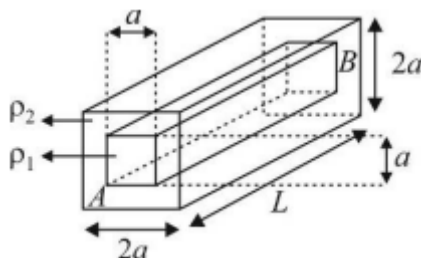
Candidate's Signature : Invigilator's Signature

PART - I : PHYSICS**100 MARKS****SECTION-1**

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. If mass M , area A' and velocity V are chosen as fundamental units, then the dimension of coefficient of viscosity will be:
(a) $M V / A'$ (b) $M A' / V$ (c) $M V A'$ (d) $M / V A'$
2. A particle of mass m with an initial velocity $u\hat{i} + 2u\hat{j}$ collides with a particle of mass $3m$ at rest. After collision, the two particles stick together and the combined particle moves with a velocity $v\hat{i} + v'\hat{j}$. Which of the following is incorrect?
(a) $v = v' / 2$ (b) $v = 2v'$ (c) $v = u / 4$ (d) $v' = u / 2$
3. If the wavelength of α -line of Lyman series in hydrogen atom is λ , find the wavelength of β -line of Paschen series.
(a) $\frac{3^2 \times 5^6}{2^3} \times \lambda$ (b) $\frac{3^6 \times 5^3}{2^2} \times \lambda$ (c) $\frac{3^3 \times 5^2}{2^6} \times \lambda$ (d) $\frac{3^2 \times 5^3}{2^6} \times \lambda$
4. A wave of frequency of 10 kHz and amplitude 20 volts is being used to modulate amplitude of carrier wave of frequency 1000 kHz and peak voltage 40 volts. Choose correct option regarding carrier modulated wave.
(a) Equation of carrier modulated wave is $40\{1 + 0.25 \sin 20\pi \times 10^3 t\} \sin(2\pi \times 10^6 t)$ and modulation index is 0.2
(b) Equation of carrier modulated wave is $40\{1 + 0.5 \sin 20\pi \times 10^5 t\} \sin(2\pi \times 10^4 t)$ and modulation index is 0.5
(c) Equation of carrier modulated wave is $40\{1 + 0.5 \sin 20\pi \times 10^3 t\} \sin(2\pi \times 10^6 t)$ and modulation index is 2
(d) Equation of carrier modulated wave is $40\{1 + 0.5 \sin 20\pi \times 10^3 t\} \sin(2\pi \times 10^6 t)$ and depth of modulation is 0.5

5. A composite rod made up of two conductors of resistivity ρ_1 and ρ_2 is shown in the figure. If face A and B are connected to a battery, find the resistance of the rod.



- (a) $\frac{(\rho_1 + \rho_2)L}{4a^2}$ (b) $\frac{(3\rho_1 + \rho_2)L}{3a^2}$ (c) $\frac{\rho_1\rho_2L}{a^2(3\rho_1 + \rho_2)}$ (d) $\frac{3\rho_1\rho_2L}{a^2(3\rho_1 + \rho_2)}$
6. A point source surrounded by vacuum emits an electromagnetic wave of frequency of 900 kHz. If the power emitted by the source is 15 W, the amplitude of the electric field of the wave (in 10^{-3} V/m) at a distance 15 km from the source is :
- ($\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \frac{Nm^2}{C^2}$ and speed of light in vacuum = $3 \times 10^8 \text{ ms}^{-1}$)
- (a) 2 (b) 4 (c) 20 (d) 40
7. The speed of sound in a particular gas at a temperature 27°C is 340 m/s. Then, the speed of sound in the same gas at a temperature 90°C is:
- (a) 340 m/s (b) 357 m/s (c) 374 m/s (d) 411.4 m/s
8. If temperature of a liquid is increased, choose the correct option regarding change in its surface tension and viscosity.
- (a) Surface tension decreases while viscosity increases
 (b) Surface tension increases while viscosity decreases
 (c) Both increases
 (d) Both decreases
9. Two trains are approaching each other on the same track with velocity 100 km/h and 50 km/h. When they are at a distance of 300 km from each other, a bird starts flying from train 1 towards train 2. When the bird reaches train 2, it instantly reverses its direction and flies again towards train 1. This process continues till the bird is trapped between the trains when they collide. If the bird always travels at a constant speed 200 km/h, the total distance the bird flies is:
- (a) 200 km (b) 400 km (c) 300 km (d) 600 km

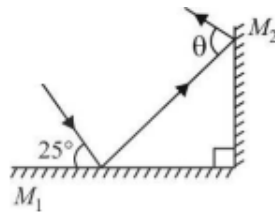
10. If the intensity of light in double slit experiment from slit 1 and slit 2 are I_0 and $25I_0$ respectively, find the ratio of intensities of light at minima and maxima in the interference pattern.

(a) 0 (b) $\frac{4}{9}$ (c) $\frac{24}{26}$ (d) $\frac{4}{6}$

11. A proton of mass m and charge q enters a region of uniform magnetic field of a magnitude B with a velocity v directed perpendicular to the magnetic field. It moves in a circular path and leaves the magnetic field after completing a quarter of a circle. The time spent by the proton inside the magnetic field is proportional to:

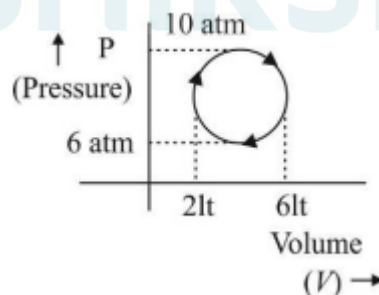
(a) $v^{-1/2}$ (b) $v^{1/2}$ (c) v^0 (d) v

12. A ray of light is reflected by two perpendicular plane mirrors as shown. The angle θ is equal to:



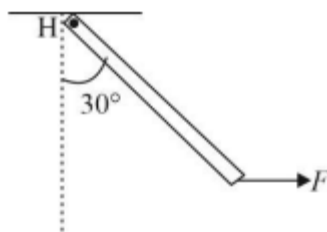
(a) 65° (b) 25° (c) 50° (d) 90°

13. An ideal gas undergoes a cyclic process whose indicator diagram is as shown in the figure. Find the work done by the gas in 1 complete cycle.



(a) $4\pi \text{ lt} \cdot \text{atm}$ (b) $16 \text{ lt} \cdot \text{atm}$ (c) $8\pi \text{ lt} \cdot \text{atm}$ (d) $16\pi \text{ lt} \cdot \text{atm}$

14. A rod of mass m and length L is hinged at its top end. If the rod is in equilibrium making an angle of 30° with the vertical when a horizontal force F is applied as shown in figure, then the value of F is:



- (a) $mg/2$ (b) $2mg$ (c) $mg/2\sqrt{3}$ (d) $\sqrt{3}mg$

15. Abhishek and Deepak have two samples of magnetic materials X and Y. Experimentally they determine the following properties of the samples.

Retentivity	Coercivity
X 1.5 T	20 Am^{-1}
Y 1.0 T	100 Am^{-1}

Considering this, choose best choice

- (a) X and Y both for electromagnets
 (b) X for electromagnetic and Y for permanent magnets
 (c) X and Y both for permanent magnets
 (d) X for permanent magnets and Y for electromagnets
16. In free space, two particles of mass m each are initially both at rest at a distance a from each other. They start moving towards each other due to their mutual gravitational attraction. The

time after which the distance between them has reduced to $\frac{a}{2}$ is

- (a) $\left(\frac{\pi+2}{4\sqrt{2}}\right)\left(\frac{a^3}{Gm}\right)^{1/2}$ (b) $\left(\frac{\pi-2}{4\sqrt{2}}\right)\left(\frac{a^3}{Gm}\right)^{1/2}$ (c) $\left(\frac{\pi+2}{8}\right)\left(\frac{a^3}{Gm}\right)^{1/2}$ (d) $\left(\frac{\pi-2}{8}\right)\left(\frac{a^3}{Gm}\right)^{1/2}$

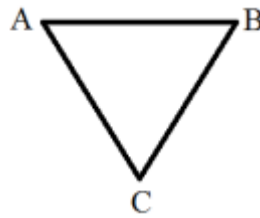
17. A charge q of mass m enters a region of electric field $E = -E_0\hat{j}$ with a velocity $v_0\hat{i} + i_0\hat{j}$ at origin. Find the x coordinate where the charge hits the x axis again. (Neglect effect of gravity)

- (a) $\frac{v_0^2 m}{E_0 q}$ (b) $\frac{2v_0^2 m}{E_0 q}$ (c) $\frac{v_0^2 m}{2E_0 q}$ (d) $\frac{3v_0^2 m}{2E_0 q}$

18. Distance travelled by linear scale of screw gauge during two full rotation of circular scale is 1mm and circular scale has 50 divisions. In an experiment to measure thickness of a plate, six divisions of main scale are clearly visible and 28th division of circular scale coincides with reference line. Moreover when studs touch each other, zero of circular scale lies 4 division below the reference line, thickness of the plate will be:

- (a) 3.28 mm (b) 2.74 mm (c) 3.32 mm (d) 3.24 mm

19. A car goes on a circular horizontal road of radius 100 m. What should be the minimum coefficient of friction between the tyres and the road so that it completes the circle with velocity 10 m/s without slipping ? (Take $g = 10 \text{ m/s}^2$)
- (a) 0.1 (b) 0.2 (c) 0.15 (d) 1
20. Three thin rods of mass m and length a each are joined to form a triangle ABC in vertical plane. The triangle is pivoted at the vertex A such that it can rotate in the vertical plane. It is released from rest when the side AB is horizontal as shown. As the triangle rotates, the maximum velocity of the vertex B, v_{MAX} , is given by:



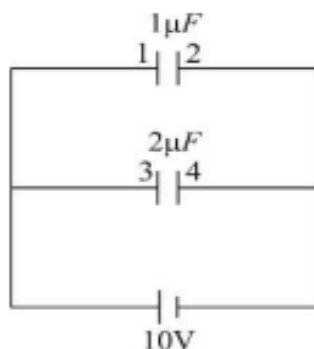
- (a) $v_{MAX}^2 = \frac{4ga}{\sqrt{3}}$ (b) $v_{MAX}^2 = \sqrt{3}ga$ (c) $v_{MAX}^2 = \frac{2ga}{\sqrt{3}}$ (d) $v_{MAX}^2 = \frac{ga}{\sqrt{3}}$

SECTION – 2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 questions have to be attempted.

The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is sign for positive ⊕ an Integer value, then do not add zero in the decimal places. In the OMR, do not bubble the values. However, for negative values, ⊖ sign should be bubbled. (Example: 6, 81, 1.50, 3.25, 0.08)

21. When monochromatic light of wavelength 620 nm is used to illuminate a metallic surface, the maximum kinetic energy of photoelectrons emitted is 1 eV. Find the maximum kinetic energy of photoelectron emitted (in eV) if a wavelength of 155 nm is used on the same metallic surface. ($hc = 1240 \text{ eV-nm}$)
22. Two capacitors are fully charged by a battery as shown in the figure.

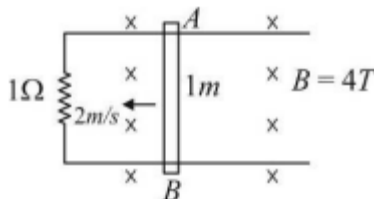


If the capacitors are disconnected from battery and plate 1 is connected to plate 4 & plate 2 to plate 3, then find the potential difference (in volts) across capacitors finally.

23. A plank of mass 5 kg is kept on a smooth surface. A block of 1 kg is kept on it and is given a velocity of 12 m/s. There is friction between the block and the plank. Assuming the plank to be very long, find the magnitude of work done (in Joules) by friction on block till the relative sliding between them stops.



24. If the molar specific heat at constant pressure for a polyatomic non-linear gas is x and the molar specific heat at constant volume for a diatomic gas is y , find the value of x/y .
25. Two fixed long parallel horizontal rails, a distance 1 m apart are joined at one end by a resistance 1Ω . A rod AB of negligible resistance slides towards the resistance. A magnetic field of magnitude 4T perpendicular to the plane of rails exists. Find the current flowing (in Ampere) in the resistance, at an instant when the velocity of the rod is 2 m/s.



26. A radioactive sample decays with a constant of $\frac{1}{3} \log_e 2 s^{-1}$. If initially there are 200 nuclei present, find the number of nuclei decayed during the first 9 seconds.
27. In the colour coding system of carbon resistors, the tolerance (in %) shown by gold band is ____.
28. The fundamental frequency of an organ pipe open at one end is 300 Hz. The frequency of 3rd overtone of n Find n. × this organ pipe is 100 Hz.

29. A carnot engine works between temperatures 327°C and 27°C . If the engine takes 1600 J of heat from the higher temperature reservoir, the work done by the engine per cycle (in Joule) is equal to _____.
30. Consider a p-n junction diode which has a potential drop of 0.5 V which is to be taken independent of current (under forward bias). If we want to use 1.5 V cell to forward bias the diode then what should be the value of resistor (in Ω) used in series with the diode so that current may not exceed 10 mA, and hence may work safely.

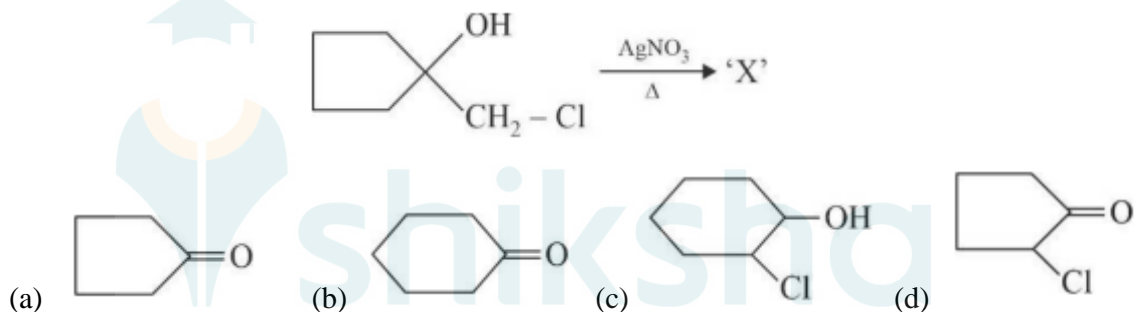
PART - II : CHEMISTRY

100 MARKS

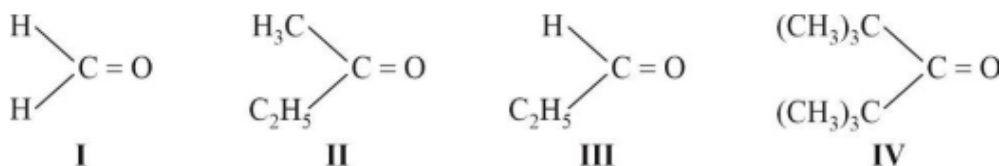
SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct

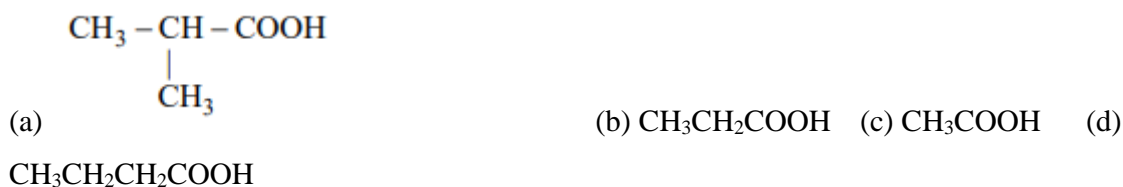
1. The product 'X' formed in following reaction is:



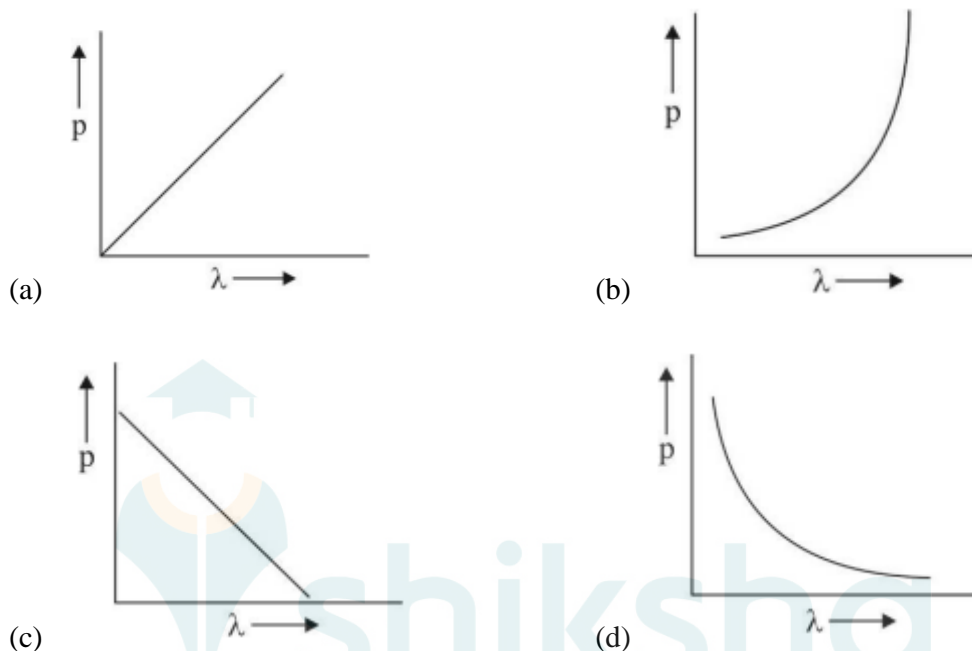
2. The correct order of reactivity for the nucleophilic addition reaction of the following carbonyl compounds with ethyl magnesium iodide is:



- (a) $\text{III} > \text{II} > \text{I} > \text{IV}$ (b) $\text{IV} > \text{III} > \text{II} > \text{I}$ (c) $\text{I} > \text{II} > \text{IV} > \text{III}$ (d) $\text{I} > \text{III} > \text{II} > \text{IV}$
3. An organic compound (P) upon reacting with NH_3 gives (Q). On heating, (Q) gives (R). (R) in presence of KOH reacts with Br_2 to give ethylamine. (P) is :

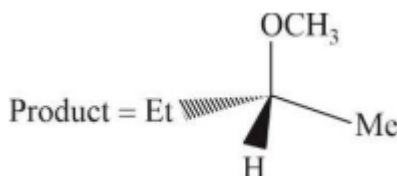


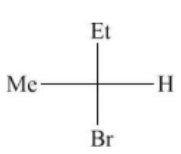
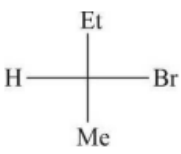
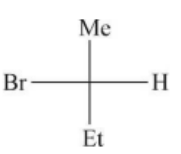
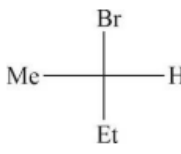
4. Which among the following is a false statement ?
- SiO_2 has a structure similar to that of CO_2
 - Natural Si exists only in the combined state
 - Si can be prepared by reducing SiO_2 with Mg
 - Si does not exist in graphite-like structure, but exists only in diamond like structure
5. Which of the following graphs correctly represents the variation of particle momentum with associated de-Broglie wavelength ?

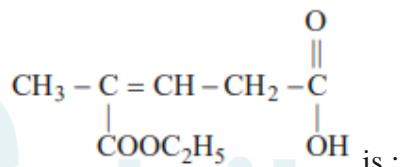


6. To stop bleeding, FeCl_3 is applied locally because :
- FeCl_3 seals the blood vessels
 - FeCl_3 changes the direction of blood flow
 - FeCl_3 reacts with blood to form a solid substance which seals the blood vessel
 - FeCl_3 causes denaturation of proteins present in blood
7. Which of the following combination will produce H_2 gas ?
- Zn metal and $\text{NaOH}(\text{aq})$
 - Au metal and $\text{NaCN}(\text{aq})$ in the presence of air
 - Cu metal and conc. HNO_3
 - Fe metal and conc. HNO_3
8. Which one of the following is an inner orbital complex as well as diamagnetic in behavior ?
- $[\text{Zn}(\text{NH}_3)_6]^{2+}$
 - $[\text{Ni}(\text{NH}_3)_6]^{2+}$
 - $[\text{Cr}(\text{NH}_3)_6]^{3+}$
 - $[\text{Co}(\text{NH}_3)_6]^{3+}$

9. $\text{FeCl}_3 + \text{Potassium thiocyanate} \rightarrow \text{product}$, the colour of this product is :
 (a) Red (b) Chocolate colour (c) Prussian blue (d) Colourless
10. Which of the following can react with both HCl and NaOH ?
 (a) Zn(OH)_2 (b) BeO (c) Al_2O_3 (d) All of these
11. The back-side attack on 2-bromobutane by methoxide (CH_3O^-) gives the product shown below. Which Fischer projection represents 2-bromobutane used as the reactant in this reaction?



- (a)  (b)  (c)  (d) 

12. The IUPAC name of  is :
 (a) 4-ethoxycarbonylpent-3-enoic acid
 (b) 4-ethanoyloxpent-3-enoic acid
 (c) 3-ethoxycarbonylbut-2-enecarboxylic acid
 (d) 3-ethoxycarbonylpent-3-enoic acid
13. The value of the spin only magnetic moment for one of the following configurations is 2.84 BM. The correct one is :
 (a) d^5 (in strong field ligand)
 (b) d^3 (in weak as well as strong field ligand)
 (c) d^4 (in weak field ligand)
 (d) d^4 (in strong field ligand)
14. The function of “sodium pump” is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a constituent of this pump ?
 (a) Ca^{2+} (b) Mg^{2+} (c) K^+ (d) Fe^{2+}

15. Lassaigne's test used in qualitative analysis to detect :
 (a) Nitrogen (b) Sulphur (c) Chlorine (d) All of these
16. The decreasing order of second ionization energy of K, Ca and Ba is :
 (a) $K > Ca > Ba$ (b) $Ca > Ba > K$ (c) $Ba > K > Ca$ (d) $K > Ba > Ca$
17. Which of the following pairs form the same osazone ?
 (a) Glucose and fructose (b) Glucose and galactose
 (c) Glucose and arabinose (d) Lactose and maltose
18. A mixture of 2 mol of carbon monoxide and 1 mol of oxygen in a closed vessel is ignited to get carbon dioxide, then :
 (a) $\Delta H > \Delta E$ (b) $\Delta H < \Delta E$ (c) $\Delta H = \Delta E$ (d) Not definite
19. The halide which is inert to water is :
 (a) PCl_5 (b) $SiCl_4$ (c) BCl_3 (d) SF_6
20. One mole of water is converted to vapour at its boiling point which is $100^\circ C$ and at 1 atm. For this process, which one of following statement is correct?
 (a) $\Delta S = 0$ (b) $\Delta G = 0$ (c) $\Delta H = 0$ (d) $\Delta E = 0$

SECTION-2

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21. The oxidation number of phosphorus in ATP (adenosine triphosphate) is :
22. The total number of stereoisomers in open-chain aldohexose (such as glucose) is :
23. ΔH_f^0 of $CO_2(g)$, $CO(g)$, $N_2O(g)$ and $NO_2(g)$ in $kJ\ mol^{-1}$ respectively is -393, -110, 81 and 34. Calculate the ΔH in kJ for the following reaction :
 $2NO_2(g) + 3CO(g) \longrightarrow N_2O(g) + 3CO_2(g)$.
24. The maximum number of electrons with $n = 3$ and $\ell = 3$ is :
25. A 500g tooth-paste sample has 0.2g fluoride concentration. What is the concentration of fluoride in terms of ppm level ?

26. Two glass bulbs A and B are connected by a very small tube having a stop-cock. Bulb A has a volume of 100 cm^3 and contained the gas; while bulb B was empty. On opening the stop-cock, the pressure fell down to 40%. The volume (in mL) of the bulb B must be :
27. The equilibrium constant K_p for a homogenous gaseous reaction is 10^{-3} , the standard Gibb's free energy change (ΔG°) in cal mol^{-1} for the reaction at 27°C (using $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$) is :
28. Time required for complete decomposition of 4 mol of water using a current of 4 ampere is $y \times 10^5$ seconds. Value of y is ? (Use $F = 96500 \text{ Cmol}^{-1}$)
29. For a photochemical reaction $A \rightarrow B$, 1.0×10^{-5} mole of B were formed on absorbing 1.2×10^{19} photons, quantum efficiency is : ($N_A = 6 \times 10^{23}$)
30. The temperature coefficient of a reaction is 2. When the temperature is increased from 30°C to 90°C , the rate of reaction is increased by x times. Value of x is ?

PART - III : MATHEMATICS

100 MARKS

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct

1. A JEE aspirant estimates that he will be successful with an 80% chance if he studies 10 hr/day with 60% chance if he studies 7hr/day and with 40% chance if he studies 4 hr/day. Further, he believes that he will study 10 hr, 7hr and 4 hr/day with probability 0.1, 0.2 and 0.7 respectively. Given that he is successful, the probability that he studies for 4 hr/day equals.

(a) $\frac{14}{19}$
(b) $\frac{1}{4}$
(c) $\frac{7}{12}$
(d) $\frac{2}{5}$
2. If the system of equations
$$\left. \begin{aligned} x - \lambda y - z &= 0 \\ \lambda x - y - z &= 0 \\ x + y - z &= 0 \end{aligned} \right\}$$
 has a unique solution, then the range of λ is $\mathbb{R} - \{a, b\}$. Then the value of $(a^2 + b^2)$ is:

(a) 1
(b) 2
(c) 4
(d) 9
3. Let b_1, b_2, \dots , be a geometric sequence such that $b_1 + b_2 = a$ and $\sum_{k=1}^{\infty} b_k = 2$. Given that $b_2 < 0$, then the value of b_1 is :

- (a) $2 - \sqrt{2}$ (b) $1 + \sqrt{2}$ (c) $2 + \sqrt{2}$ (d) $4 - \sqrt{2}$
4. If M is a 3×3 matrix such that $M^2 = O$, then $\det((I + M)^{50} - 50M)$ where I is an identity matrix of order 3, is equal to :
- (a) 3 (b) 50 (c) 2 (d) 1
5. The equation of the common tangent touching the circle $(x-3)^2 + y^2 = 9$ and the parabola $y^2 = 4x$ above the x-axis, is
- (a) $\sqrt{3}y = 3x + 1$ (b) $\sqrt{3}y = -(x + 3)$ (c) $\sqrt{3}y = x + 3$ (d) $\sqrt{3}y = -(3x + 1)$
6. Let T_r be the r^{th} term of a sequence, for $r = 1, 2, 3, \dots$. If $3T_{r+1} = T_r$ and $T_7 = \frac{1}{243}$, then the value of $\sum_{r=1}^{\infty} (T_r \cdot T_{r+1})$ is
- (a) $\frac{9}{2}$ (b) $\frac{27}{8}$ (c) $\frac{81}{8}$ (d) $\frac{81}{4}$
7. The negation of the compound proposition $p \vee (\sim p \vee q)$ is
- (a) $(p \wedge \sim q) \wedge \sim p$ (b) $(p \wedge \sim p) \vee \sim q$ (c) $(p \vee \sim q) \vee \sim p$ (d) $(p \wedge \sim q) \vee \sim p$
8. For the curve defined parametrically as $y = 3 \sin \theta \cdot \cos \theta, x = e^{\theta} \cdot \sin \theta$ where $\theta \in [0, \pi]$, the tangent is parallel to x-axis when θ is :
- (a) $\frac{3\pi}{4}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) $\frac{\pi}{6}$
9. The variance of 20 observations is 5. If each observation is multiplied by 2 then the new variance of the resulting observations, is:
- (a) 5 (b) 10 (c) 20 (d) 40
10. The area bounded by the curve $y = (x-1)(x-2)(x-3)$, x-axis and ordinates $x = 0, x = 3$ is :
- (a) $\frac{9}{4}$ (b) $\frac{11}{4}$ (c) $\frac{11}{2}$ (d) None of these
11. If z satisfies the equation $\left(\frac{z-2}{z+2}\right)\left(\frac{\bar{z}-2}{\bar{z}+2}\right) = 1$, then minimum value of $|z|$ is equal to:
- (a) 0 (b) 2 (c) 4 (d) 6
12. A quadratic function $f(x)$ satisfies $f(x) \geq 0$ for all real x . If $f(2) = 0$ and $f(4) = 12$, then the value of $f(6)$ is :
- (a) 12 (b) 24 (c) 48 (d) 64

13. The largest integral value of x satisfying the inequality $(\tan^{-1}(x))^2 - 4(\tan^{-1}(x)) + 3 > 0$ is :
 (a) 0 (b) 1 (c) 2 (d) 3
14. The constant term in the expansion of $(\log_{10}(x^{\log_{10} x}) - \log_{x^2} 100)^{12}$ is:
 (a) 495 (b) 924 (c) 1050 (d) 5050
15. Suppose y is a function of x that satisfies $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{x^2}$ and $y = 0$ at $x = \frac{2}{\pi}$, then $y\left(\frac{3}{\pi}\right)$ is equal to:
 (a) 0 (b) $\frac{1}{2}$ (c) 1 (d) 2
16. The graph of function $f(x) = \frac{x^5}{20} - \frac{x^4}{12} + 5$ has :
 (a) no local extremum, one point of inflection.
 (b) two local maximum, one local minimum, two point of inflection
 (c) one local maximum, one local minimum, one point of inflection.
 (d) one local maximum, one local minimum, two point of inflection.
17. A curve $y = f(x)$ is passing through $(0, 0)$. If the slope of the curve at any point (x, y) is equal to $(x + xy)$, then the number of solution of the equation $f(x) = 1$, is:
 (a) 0 (b) 1 (c) 2 (d) 4
18. The equation of plane which passes through the point of intersection of lines $\vec{r} = \hat{i} + 2\hat{j} + 3\hat{k} + \lambda(3\hat{i} + \hat{j} + 2\hat{k})$ and $\vec{r} = 3\hat{i} + \hat{j} + 2\hat{k} + \mu(\hat{i} + 2\hat{j} + 3\hat{k})$ where $\lambda, \mu \in R$ and has the greatest distance from the origin is :
 (a) $\vec{r} \cdot (7\hat{i} + 2\hat{j} + 4\hat{k}) = 54$ (b) $\vec{r} \cdot (5\hat{i} + 4\hat{j} + 3\hat{k}) = 57$
 (c) $\vec{r} \cdot (3\hat{i} + 4\hat{j} + 5\hat{k}) = 49$ (d) $\vec{r} \cdot (4\hat{i} + 3\hat{j} + 5\hat{k}) = 50$
19. If the function $f(x) = \begin{cases} ax + b, & -\infty < x \leq 2 \\ x^2 - 5x + 6, & 2 < x < 3 \\ px^2 + qx + 1, & 3 \leq x < \infty \end{cases}$ is differentiable is $(-\infty, \infty)$, then:
 (a) $a = -1, p = -\frac{4}{9}$ (b) $b = 2, q = \frac{5}{3}$ (c) $a = 1, b = 2$ (d) $a = -1, q = -\frac{5}{3}$
20. The number of elements in the set $\{(a, b) : 2a^2 + 3b^2 = 35, a, b \in Z\}$, where Z is the set of all integers, is :
 (a) 2 (b) 4 (c) 8 (d) 12

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 questions have to be attempted.

The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is sign for positive an Integer value, then do not add zero in the decimal places. In the OMR, do not bubble the \oplus sign for positive values. However, for negative values, \ominus sign should be bubbled. (Example: 6, 81, 1.50, 3.25, 0.08)

21. Number of ways in which three distinct numbers can be selected between 1 and 20 both inclusive, whose sum is even is_____.
22. A circle passes through the points (2, 2) and (9, 9) and touches the x-axis. The absolute value of the difference of possible x-coordinate of the point of contact is_____.
23. If \vec{a}, \vec{b} are any two perpendicular vectors of equal magnitude and $|3\vec{a} + 4\vec{b}| + |4\vec{a} - 3\vec{b}| = 20$, then $|\vec{a}|$ equals:
24. The value of $\int_0^{\pi/2} x \sin^2 x - \frac{1}{2} dx$ is equal to $\frac{a\pi}{b}$ where a, b are co-prime numbers, then a.b is _____.
25. $\lim_{x \rightarrow 0} \frac{ae^{2x} - b \cos x + c}{x \sin x} = 1$, then a + b + c is equal to _____.
26. The value of $\sum_{i=0}^3 {}^8C_r ({}^5C_{r+1} - {}^4C_r)$ equals _____.
27. Let A be a square matrix of order 2 such that $A^2 - 4A + 4I = 0$, where I is an identity matrix of order 2. If $B = A^5 + 4A^4 + 6A^3 + 4A^2 + A - 162I$, then $\det(B)$ is equal to _____.
28. If $1 + x^4 - x^5 = \sum_{i=0}^5 a_i (1+x)^i$, for all $x \in R$, then a_2 is equal to _____.
29. Let $g(x) = ||x + 2| - 3|$. If a denotes the number of relative minima, b denotes the number of relative maxima and c denotes the product of the zeros. Then the value of (a + 2b - c) is _____.
30. Normals of parabola $y^2 = 4x$ at P and Q meets at $R(x_2, 0)$ and tangents at P and Q meets at $T(x_1, 0)$. If $x_2 = 3$, then find the area of quadrilateral PTQR.