SAMPLE PAPER FOR JEE MAIN 2018

Duration: 3 Hours. **Maximum Marks: 360**

[Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.]

INSTRUCTIONS

A. General Instructions:

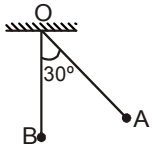
1. Attempt ALL the questions. Answers have to be marked on the OMR sheet.
2. This question paper contains three Parts: Physics, Chemistry & Mathematics.
3. Part-A is Physics, Part-B is Chemistry and Part-C is Mathematics.
4. Each part has only one section and it contains **30 objective type questions** with only one choice correct.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Paper, clip boards, log tables, slide rule, calculator, mobile, phones, pagers and electronic devices, in any form, are not allowed.

B. Marking Scheme:

7. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer. In case the question is not attempted, your will be awarded **0 (zero) mark**.

PART-A : PHYSICS

1. Pendulum is released from rest from point A. When the string of the pendulum becomes vertical in position OB as shown, the acceleration of the bob is



(A) along $\overrightarrow{BO}$

(B) along $\overrightarrow{OB}$

(C) in a direction in-between $\overrightarrow{BO}$ and the horizontal

(D) in a direction in-between $\overrightarrow{OB}$ and the horizontal

2. In projectile motion, power of the gravitational force

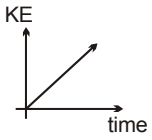
(A) varies linearly with time

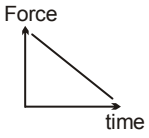
(B) is negative for the first half, positive for the rest half

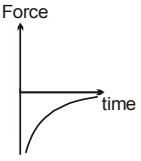
(C) is zero for the whole path

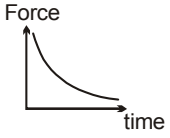
(D) all of the above

3. The kinetic energy (KE) vs time graph for a particle is shown in the figure. The force vs time graph for the particle may be



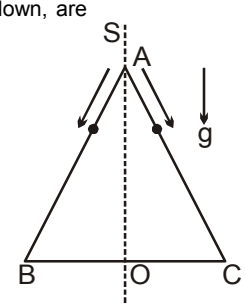
(A) 

(B) 

(C) 

(D) both B and C

4. An equilateral triangle ABC formed of a uniform wire has two small identical beads initially located at A. The triangle is set rotating about the vertical axis OA. Then the beads are released from rest simultaneously and allowed to slide down, one along AB and the other along AC as shown. Neglecting frictional effects, the quantities that are conserved as the beads slide down, are



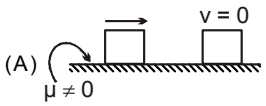
(A) angular velocity and total energy (kinetic and potential)

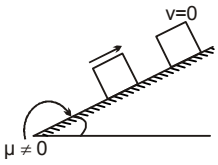
(B) total angular momentum and total energy

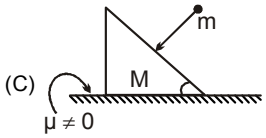
(C) angular velocity and moment of inertia about the axis of rotation

(D) total angular momentum and moment of inertia about the axis of rotation.

5. In which of the following cases frictional force is impulsive

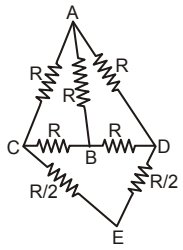
(A) 

(B) 

(C) 

(D) All of these

6. The adjacent figure shows a resistance network with value of each resistance mentioned. R_{AB}, R_{AC}, and R_{CB} denotes the equivalent resistances between A and B, A and C, and C and B, respectively. Then



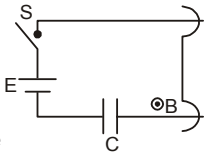
(A) $R_{AB} = R_{AC} = R_{CB}$

(B) $R_{AB} = 2R_{AC}$

(C) $R_{AC} = 2R_{CB}$

(D) $R_{AB} = R/3$

7. The circuit shown in the adjacent figure lies in a uniform magnetic field B. Initially, capacitor C is uncharged and the switch S is open. A conducting slider of mass m and length ℓ can move freely over parallel tracks. The velocity of the slider as soon as switch S is closed is (neglect self inductance)



(A) $\frac{B\ell CE}{2m}$ (B) $\frac{B\ell CE}{m}$

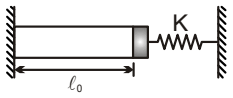
(C) $\frac{CE^2}{2\ell m}$ (D) none of the above

8. The sun having surface temperature T_S radiates like a black body. The radius of sun is R_S and earth is at a distance R from the surface of sun. Earth absorbs radiations falling on its surface from sun only and is at constant temperature T. If radiations falling on earth's surface are almost parallel and earth also radiates like blackbody, then

(A) $T = T_S\sqrt{\frac{R_S}{2R}}$ (B) $T = T_S$

(C) $T = \frac{T_S}{2}\sqrt{\frac{R_S}{R}}$ (D) $T = T_S\sqrt{\frac{R_S}{R}}$

9. A light uniform rod of Young's modulus Y, cross sectional area A, coefficient of linear expansion α and length ℓ_0 is rigidly connected to support at one end and the other end of the rod is connected to the spring as shown in the figure. The temperature of the rod is increased by $\Delta\theta$ with supports remaining fixed. Initially, the spring is in natural length position. Spring force on the rod acts uniformly over the cross section during elongation of the rod. Find the net elongation of the rod. (Assume thermal strain to be small)



(A) $\frac{K\ell_0\alpha\Delta\theta}{(K + YA/\ell_0)}$ (B) $\frac{YA\alpha\Delta\theta}{(K + YA/\ell_0)}$

(C) $YA\alpha\Delta\theta$ (D) none of the above

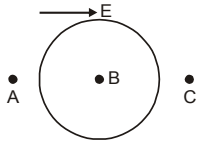
10. In a uniform electric field E, a dielectric (dielectric constant $\neq 1$) in the form of a sphere is introduced. How will the intensity of the field at points A, B and C change?

(A) Field at A will increase

(B) Field at B will increase

(C) Field at C will decrease

(D) Field at all points will remain same



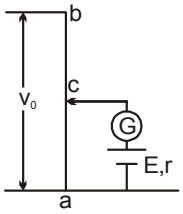
11. A constant potential difference is maintained across the wire ab of length ℓ. A battery is connected with galvanometer as shown in the figure. The galvanometer shows no deflection when the length ac is $3\ell/4$. A resistance 4Ω is now connected across the battery such that the galvanometer shows no deflection when length ac is $\ell/8$. The internal resistance of the battery is

(A) 2Ω

(B) 10Ω

(C) 20Ω

(D) 8Ω



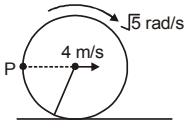
12. The centre of mass of a disc of radius $\frac{8}{\sqrt{5}}$m is moving with a velocity of 4 m/s on a horizontal plane. The angular velocity of the disc about it's centre is $\sqrt{5}$ rad/s. Find the radius of curvature of the point 'P', at the instant shown in the figure.

(A) 5 m

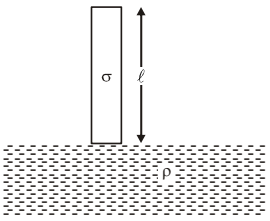
(B) 10 m

(C) 15 m

(D) 20 m



13. A uniform vertical cylinder is released from rest when its lower end just touches the liquid surface of a deep lake. Calculate maximum displacement of cylinder (in meter)



Take, $\ell = 4$m and $\frac{\sigma}{\rho} = \frac{1}{2}$

(A) 4 (B) 2

(C) 1.5 (D) none of these

14. One mole of ideal monoatomic gas is taken through a cyclic process ABCDA. It is given that $\frac{V_B}{V_A} = \frac{V_D}{V_C} = K$. It is also given that the total work done by gas in one cyclic process ABCDA is

equal to zero. Using the details given in the diagram, Find the value of 4 ln K

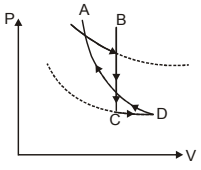
Given -

AB = Isothermal expansion

BC = Isochoric cooling

CD = Isothermal expansion

DA = Adiabatic compression.



The temperature of upper isotherm is 2T and of lower isotherm is T.

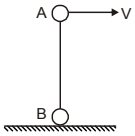
(A) 2 (B) 0.5 (C) 1 (D) none of these

15. A system consists of two stars of equal masses that revolve in a circular orbit about a centre of mass midway between them. Orbital speed of each star is v & period is T. Find the mass M of each star : (G is gravitational constant)

(A) $\frac{2Gv^3}{\pi T}$ (B) $\frac{v^3T}{\pi G}$ (C) $\frac{v^3T}{2\pi G}$ (D) $\frac{2Tv^3}{\pi G}$

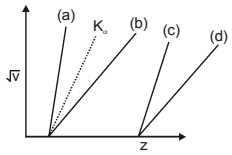
16. Two particles A and B of mass m each are connected together by a rigid massless rod of length 20 cm. Initially rod is vertical and particle A is given velocity V horizontally, while particle B is at rest. Consider the adjacent figure. Find the minimum value of V (in m/s) for which particle B loose contact with ground immediately after giving velocity V. (Take g = 10 m/s^2)

(A) 3
(B) 2
(C) 5
(D) none of these

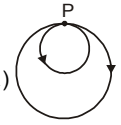


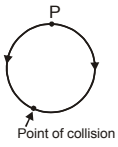
17. In the given graph K_α line is drawn for square root of frequency and atomic number. Then choose the K_β line graph in the figure shown.

(A) (a)
(B) (b)
(C) (c)
(D) (d)

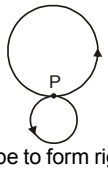


18. A neutral particle at rest in a uniform magnetic field, decays into two charged particles of different masses at point P as shown in the figure. The energy released goes to their kinetic energy and particles move in the plane of the paper. Magnetic field is into the plane of paper. Select the diagram which describes path followed by the particles most appropriately.

(A) 

(B) 

(C) 

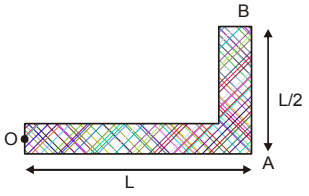
(D) 

19. A uniform rod OAB is bent in L shape to form right angle at A. Length of OA is L and that of AB is $\frac{L}{2}$ respectively as shown in figure. The rod is higed at the end O and is free to rotate in a vertical plane about O. It is set free from rest, when larger sectionof it is in horizontal position. Maximum angular acceleration of rod is :

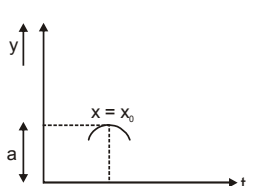
(A) $2\sqrt{65}\frac{g}{L}$

(B) $\frac{\sqrt{65}}{7}\frac{g}{L}$

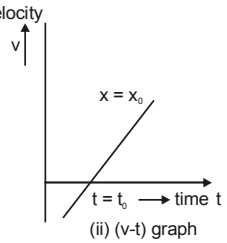
(C) $\frac{8}{7}\frac{g}{L}$ (D) $\frac{16}{9}\frac{g}{L}$



20. A progressive simple harmonic wave is moving in air along the x-axis. The part of this wave at a given point $x = x_0$ from the source and at a certain instant $t = t_0$ has the waveform shown below in the displacement (y-t) time graph and velocity (v-t) time graph respectively.



(i) (y-t) graph



(ii) (v-t) graph

Velocity of the wave has value v_0 and its angular velocity is ω. Which of the following equations will correctly represent the complete wave at x_0 agreeing with above wave forms ?

(A) $y = -a\left[\cos\left\{\frac{2\pi}{T}(t-t_0)-\frac{\pi}{2}\right\}\right]$

(B) $y = -a\left[\sin\left\{\frac{2\pi}{T}(t-t_0)+\frac{\pi}{2}\right\}\right]$

(C) $y = a\left[\sin\left\{\frac{2\pi}{T}(t-t_0)+\frac{\pi}{2}\right\}\right]$

(D) $y = a\left[\cos\left\{\frac{2\pi}{T}(t-t_0)-\frac{\pi}{2}\right\}\right]$

21. A neutron of energy 1 MeV and mass 1.6×10^{-27} kg passes a proton at such a distance that the angular momentum of neutron relative to proton approximately equals 10^{-33} Js. The distance of closest approach neglecting the interaction between particles is

(A) 0.44 mm (B) 0.44 nm (C) 0.44 Å (D) 44 fm

22. The lateral magnifications of the lens with an object located at two different positions u_1 and u_2 are m_1 and m_2 respectively. Then the focal length of the lens is

(A) $f = \sqrt{m_1 m_2}(u_2 - u_1)$ (B) $\frac{u_2-u_1}{m_2-m_1}$

(C) $\frac{(u_2-u_1)}{\sqrt{(m_1)-(m_2)}}$ (D) $\frac{(u_2-u_1)}{(m_2)^{-1}-(m_1)^{-1}}$

23. A long horizontal slit is placed 1 mm above a horizontal plane mirror. The interference between the light coming directly from the slit and that after reflection is seen on a screen 1 m away from the slit. If the mirror reflects only 64% of the light falling on it, the ratio of the maximum to the minimum intensity in the interference pattern observed on the screen is

(A) 8 : 1 (B) 3 : 1 (C) 81 : 1 (D) 9 : 1

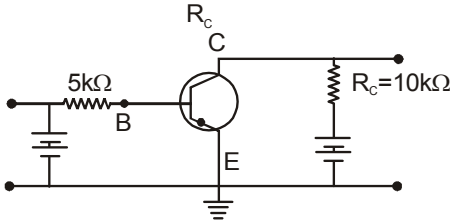
24. A given length L of wire carries a current I. The wire can be formed into a circular coil of any number of turns. The maximum value of the torque τ that can be developed on the coil when placed in a given magnetic field is

(A) $\tau = \frac{L^2IB}{2\pi}$ (B) $\tau = \frac{L^2IB}{4\pi}$ (C) $\tau = \frac{L^2IB}{2}$ (D) $\tau = L^2IB$

25. A series circuit has a resistance of 60Ω and an impedance of 135Ω. When the total potential difference is 120 V, the power consumed in the circuit will be

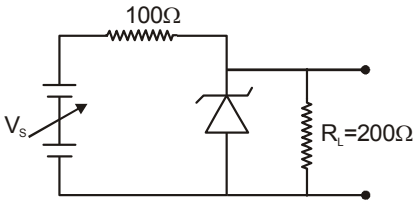
(A) 47.4 W (B) 95 W (C) zero (D) 52.3 W

26. The adjoining diagram shows the biasing of an npn transistor in common emitter configuration used in an amplifier. The design of the transistor is such that 98% of the charge carriers passing through the emitter reach the collector. If base current changes from $50\mu A$ to $100\mu A$, then the corresponding change in the voltage across the load resistance R_L wll be.



(A) 0.25 V (B) 0.5 V (C) 24.5 V (D) 49.0 V

27. The diagram drawn shows a circuit used for obtaining a constant voltage across the load resistance $R_L = 200\Omega$. The zener diode in the ciruit has breakdown voltage of 10 V. Find the correct range of the supply voltage V_S in which it can fluctuate so that we always get a constant voltage across R_L. The maximum power rating of the zener diode is 5W.



(A) $0 < V_S < 10$ V (B) $10\text{ V} < V_S < 60$ V

(C) $60\text{ V} < V_S < 100$ V (D) $V_S > 100$ V

28. Number of amplitude modulation broadcast stations that can be accommodated in a 100 KHz bandwidth if the highest frequency modulating a carrier is 5 KHz

(A) 10 (B) 100 (C) 1000 (D) 10,000

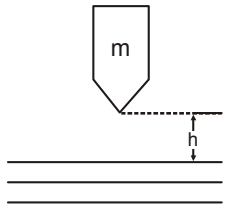
29. Two nicols A and B are placed in the path of a beam of unpolarised light. In between these two a third nicol C is placed that its principal section is at an angle of 30° with that of A. The percentage of intensity of incident unpolarized light that emerges from C to B.

(A) 2.8 % (B) 9.4 % (C) 15.3 % (D) 10. 2 %

30. An iron nail is falling from a height 'h'. If it penetrates through a distance 'x' into the sand, the average resistance of the sand is :

(A) $mg\frac{h}{x}$ (B) $mg\left(\frac{h}{x}+1\right)$

(C) $mg\frac{x}{h}$ (D) mg



PART-B : CHEMISTRY

31. At high pressure Van der waal equation can be expressed as P (V-nb) = nRT. If molar volume of gas under this condition is twenty one times of co-volume then compressibility factor is :

(A) $\frac{1}{20}$ (B) $\frac{22}{21}$ (C) $\frac{21}{20}$ (D) $\frac{20}{21}$

32. The equivalent conductance of CH_3COOH at concentration C and at infinite dilution are Λ_m and Λ_m^∞ respectively and K_a is the ionisation constant of CH_3COOH. The correct relationship is given as :

(A) $\Lambda_m = \Lambda_m^\infty + K_a \cdot \frac{\left(\Lambda_m^\infty\right)^2}{\Lambda_m C}$ (B) $\frac{1}{\Lambda_m} = \frac{1}{\Lambda_m^\infty} + \frac{\Lambda_m C}{K_a\left(\Lambda_m^\infty\right)^2}$

(C) $\frac{1}{\Lambda_m} = \frac{1}{\Lambda_m^\infty} + \frac{\Lambda_m C}{\left(\Lambda_m^\infty\right)^2}$ (D) $\frac{1}{\Lambda_m} = \frac{1}{\Lambda_m^\infty} + \frac{\Lambda_m C}{K_a \Lambda_m^\infty}$

33. A freshly prepared radioactive substance has a half life of 15 min. It emits radiations whose intensity is 32 times the permissible safe value. The minimum time after which it would be possible to work with this sample is :

(A) 60 min. (B) 75 min (C) 90 min (D) 120 min

34. 40 mL of 0.05 M solution of sodium sesquicarbonate ($Na_2CO_3.NaHCO_3.2H_2O$) is titrated against 0.05 M HCl. When phenolphthalein is used as indicator, X mL HCl is used. In a separate titration of same solution using methyl orange as indicator y mL of HCl is used. Then :

(A) y – x = 40 (B) y = 2 x (C) y – x = 80 (D) y = x

35. If W_2g of benzoic acid is dissolved in W_1g of benzene, boiling point of solution increased by ΔT. If it is known that benzoic acid dimerises in benzene to the extent of y% then molar mass of benzoic acid (M_2) can be obtained from relation (Given that K_b= molal elevation constant of benzene and benzoic acid is nonvolatile)

(A) $\Delta T = \left[1+\left(\frac{1}{2}-1\right)\frac{y}{100}\right]\times K_b \times \frac{W_2 \times M_2}{W_1 \times 1000}$

(B) $\Delta T = \left[1+\left(\frac{1}{2}-1\right)\frac{y}{100}\right]\frac{K_b \times W_2}{M_2 \times W_1}\times 1000$

(C) $\Delta T = \left[1-\left(1-\frac{1}{2}\right)y\right]\times \frac{K_b \times W_2}{M_2 \times W_1}\times 1000$

(D) $\Delta T = K_b \times \frac{W_2/M_2}{W_1/1000}$

36. Starch on complete hydrolysis produces :

(A) $\alpha-(D)-$Glucose (B) $\beta-(D)-$Glucose

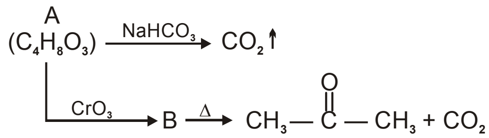
(C) $\alpha-(D)-$Fructose (D) $\alpha-(D)-$Glactose

37. Ethanal is treated with ethanol(excess) in presence of dry HCl gas. The product formed is :

(A) Ethoxy ethane (B) 1,2-diethoxyethane

(C) 1,1-diethoxyethane (D) 1-ethoxyethanol

38. Identify (A) and (B) in the following reaction sequence :

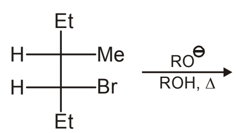


(A) A: $CH_3—CH(OH)—CH_2—COOH$;
B : $CH_2(OH)—CH_2—CH_2—COOH$

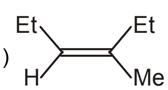
(B) A : $CH_3—CH(OH)—CH_2—COOH$;
B : $CH_3—C(=O)—CH_2—COOH$

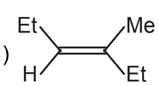
(C) A : $CH_2(OH)—CH_2—CH_2—COOH$;
B : $CH(=O)—CH_2—CH_2—COOH$

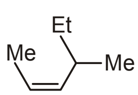
(D) A : $CH_2(OH)—CH_2—COOH$;
B : $CH(=O)—CH_2—COOH$

39. 

X (Major product) ; Compound X is :

(A) 

(B) 

(C) 

(D) None of these

40. Which of the following polymer is used for making non sticking cooking pans ?

(A) PAN (B) PMMA (C) PTFE (D) Nylon-6

41. $Fe + (v.dil)HNO_3 \rightarrow Salt(A) + Salt(B),$

$(A) + NaOH \rightarrow$ greenish white ppt. + Salt(C)

$(B) \xrightarrow{\Delta} gas(X)$, $(C) \xrightarrow{\Delta} gas(Y)$; (X) and (Y) are

(A) NO, NO_2 (B) N_2O, NO_2 (C) NO, O_2 (D) N_2O, O_2

42. About borax, the correct statement is

(A) All the Boron atom are sp^3 hybridised

(B) Two are sp^3 and rest two are sp^2 hybridised

(C) Aqueous solution of borax is acidic in nature

(D) The structure is planar

43. Which one of the following is expected to exhibit optical isomerism (*en* = ethylenediamine)

(A) *cis* – $[Pt(NH_3)_2Cl_2]$ (B) *trans* – $[Co(en)_2Cl_2]$

(C) *trans* – $[Pt(NH_3)_2Cl_2]$ (D) *cis* – $[Co(en)_2Cl_2]$

44. The pair of the compounds in which both the metals are in the highest possible oxidation state is

(A) $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$ (B) CrO_2Cl_2, MnO_4^-

(C) TiO_3, MnO_2 (D) $[Co(CN)_6]^{3-}$, MnO_3

45. General configuration of outermost and penultimate shell is $(n-1)s^2(n-1)p^6(n-1)d^xns^2$. If *n* = 4 and *x* = 5 then no. of proton in the nucleus will be

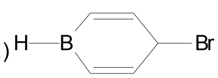
(A) > 25 (B) < 24 (C) 25 (D) 30

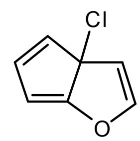
46. Which of the following has the highest melting point ?

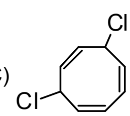
(A) Chlorobenzene (B) o-Dichlorobenzene

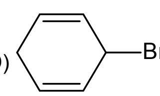
(C) m-Dichlorobenzene (D) p-Dichlorobenzene

47. Which compound on reaction with $SbCl_5$ gives an aromatic product ?

(A) 

(B) 

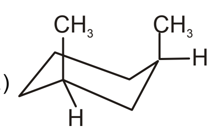
(C) 

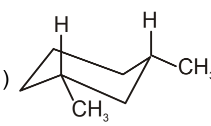
(D) 

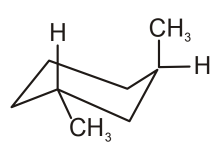
48. In the estimation of Nitrogen by Duma's method, 118 g of an organic compound gave 224 ml of N_2 at NTP. The percentage of nitrogen in the compound is about :

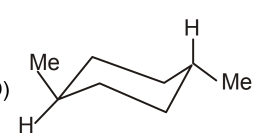
(A) 20.0 (B) 11.8 (C) 47.5 (D) 23.7

49. The most stable conformer of trans-1,3-dimethyl cyclohexane is :

(A) 

(B) 

(C) 

(D) 

50. Chloroxylenol is a commonly used antiseptic and is a component of Dettol. Chemically chloroxylenal is :

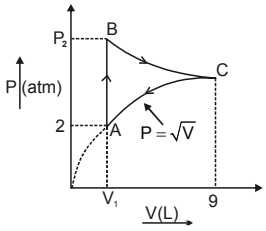
(A) 4-Chloro-3,5-dimethylphenol

(B) 3-Chloro-4,5-dimethylphenol

(C) 4-Chloro-2,5-dimethylphenol

(D) 5-Chloro-3,4-dimethylphenol

51. An ideal gas goes through following cyclic process ABCA in which AB = isochoric process, BC = isothermal process and CA is a process in which $P = \sqrt{V}$ then heat absorbed during the cycle is :



(A) $q = 27\ln\frac{9}{4} - 19$

(B) $q = 27\ln\frac{9}{4} + 19$

(C) $q = -54\ln\frac{3}{2} + \frac{38}{3}$

(D) $q = 54\ln\frac{3}{2} - \frac{38}{3}$

52. When 5 moles of an ideal gas is heated under isochoric condition from 300 K to 325 K. Heat supplied to the gas is 1000 J. Then which of the following statement is correct :

(A) q = W = 1000 J, $\Delta U = 0$ (B) q = ΔU = 1000 J, w = 0

(C) q = W = 1000 J = ΔU (D) W = ΔU = 1000 J, q = 0

53. E.m.f of the following cell

$Zn(s) \mid ZnSO_4(aq) \parallel KI(aq) \mid PbI_2(s) \mid Pb$

0.010 M 0.1 M

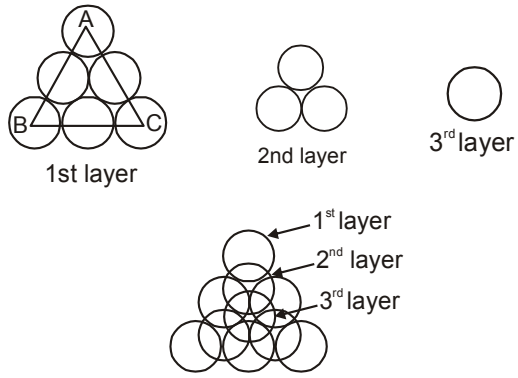
at 298 K is

Given, $E^0_{Zn^{+2}/Zn} = -0.76$ v $E^0_{Pb^{+2}/Pb} = -0.13$

$\left(\frac{RT}{F} \times 2.303 = 0.06\right)$; $K_{sp}(PbI_2) = 8.1 \times 10^{-9}$ (log 3 = 0.48)

(A) 0.4254 (B) 0.5076 V (C) 0.63 V (D) 0.76 V

54. Ten spheres each of radius 'R' are used to form three layers :



Now spheres of 2nd layer is placed over the depression of first layer and spheres of 3rd layer is placed over depression of 2nd layer. When a plane ABC is passed through centres of each sphere in 1st layer. The perpendicular distance of this plane from centre of sphere in 3rd layer is:

(A) 4R (B) $4R\frac{\sqrt{2}}{\sqrt{3}}$ (C) $\frac{4R}{\sqrt{3}}$ (D) $4\sqrt{2}R$

55. Which of the following statement is correct :

(A) Lower the gold number, more will be protective power

(B) Micells are formed by surfactant molecules below the critical micellar concentration (CMC)

(C) The conductivity of a solution having surfactant molecules increases sharply at the CMC.

(D) Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature for adsorption of a gas on solid surfaces.

56. Among the following, the compound that is both paramagnetic and coloured is

(A) $K_2Cr_2O_7$ (B) $(NH_4)_2[TiCl_6]$

(C) $VOSO_4$ (D) $K_3[Cu(CN_4)]$

57. The correct sequence in decreasing order of the percentage of nitrogen in the given compounds is

(A) Urea > Ammonium chloride > Ammonium nitrate > Ammonium nitrite

(B) Urea > Ammonium nitrate > Ammonium nitrite > Ammonium chloride

(C) Urea > Ammonium nitrite > Ammonium nitrate > Ammonium chloride

(D) Urea > Ammonium nitrite > Ammonium chloride > Ammonium nitrate

58. Total number of lone pair of electrons for Xe in $XeOF_4$ is

(A) 0 (B) 1 (C) 2 (D) 3

59. Ozone with dry iodine give :

(A) I_4O_9 (B) I_2O_3 (C) IO_2 (D) I_4O_4

60. Pb and Sn are extracted from their chief ore by

(A) Carbon reduction and self reduction.

(B) Self reduction and carbon reduction.

(C) Electrolysis and self reduction.

(D) Self reduction and electrolysis

PART-C : MATHEMATICS

61. Number of triplets of primes such that pq = r + 1 and $2(p^2 + q^2) = r^2 + 1$ is

(A) 0 (B) 1 (C) 2 (D) infinite

62. A point P(x,y) moves in such a way that [x + y + 1] = [x] (where [.] denotes greatest integer function) and $x \in (0,2)$. Then the area of the region containing all possible positions of P is

(A) 2 sq. units (B) 4 sq. units

(C) 6 sq. units (D) 8 sq. units

63. Let f(x) = |x –2| and $g(x) = \underbrace{f(f(f(f.....(f(x)))).....))}_{n \text{ times}}$. If the equation g(x) = k, $k \in (0,2)$ has 10 distinct solutions then the value of n is

(A) 3 (B) 4 (C) 5 (D) 8

64. Let

$$f(x) = \begin{cases} \left[\frac{3x^2 - |x| + 3}{x^2 + 1}\right], & |x| \le 2 \text{ (where [.] denotes G.I.F.)} \\ \frac{8}{\pi}\tan^{-1}(-|x| + 3), & |x| > 2 \end{cases}$$

then the number of integers in the range of f(x) is

(A) 4 (B) 5 (C) 6 (D) 7

65. If $\lim\limits_{x\to 0}\left(\left[\frac{\sin^{-1}x}{x}\right]+\left[\frac{2^2\sin^{-1}2x}{x}\right]+\left[\frac{3^2\sin^{-1}3x}{x}\right]+\ldots.+\left[\frac{n^2\sin^{-1}nx}{x}\right]\right)=225$

(where [.] denotes the greatest integer function), then the value of n is

(A) 2 (B) 3 (C) 4 (D) 5

66. If the function $f(x) = |x^2 + (a - 2)|x| - 2a|$ is non-differentiable at five points, then the maximum integral value of $a^3 + a$ is

(A) –2 (B) –4 (C) 8 (D) None of these

67. Let $f(x) = ax^3 + bx^2 + cx + 5$. If $|f(x)| \le |e^x - e^2| \ \forall x \ge 0$ and if maximum value of $|12a + 4b + c|$ is P then greatest integer less than P is

(A) 4 (B) 5 (C) 6 (D) 7

68. Given two circles

$x^2 + y^2 + 3\sqrt{2}(x + y) = 0$ and $x^2 + y^2 + 5\sqrt{2}(x + y) = 0$. Let the radius of the third circle, which touches the two given circles and to their common diameter, be $\frac{2\lambda - 1}{\lambda}$. The value of λ is

(A) 5 (B) 7 (C) 8 (D) 10

69. If $x^5 = 1, (x \ne 1)$, then $\frac{x}{1+x^2}+\frac{x^2}{1+x^4}+\frac{x^3}{1+x}+\frac{x^4}{1+x^3}$ equals

(A) 1 (B) 2

(C) 3 (D) None of these

70. If $\vec{a}$ and $\vec{b}$ are any two unit vectors, then the number of integers in the range of $2|\vec{a}-\vec{b}|+\frac{3}{2}|\vec{a}+\vec{b}|$ is

(A) 3 (B) 5 (C) 9 (D) 11

71. A fair coin is tossed repeatedly, the probability of obtaining five consecutive heads before two consecutive tails is

(A) $\frac{1}{17}$ (B) $\frac{1}{34}$ (C) $\frac{2}{17}$ (D) $\frac{3}{34}$

72. If $A=\begin{bmatrix}1 & 2 & 0\\ 2 & -1 & 0\\ 0 & 0 & -1\end{bmatrix}$, then $A^2 + A - 5I$ is

(A) A^{-1} (B) $3A^{-1}$

(C) $5A^{-1}$ (D) None of these

73. $\int_0^1\left((e-1)\sqrt{\ln(1+(e-1)x)}+e^{x^2}\right)dx$ equals

(A) 0 (B) 1 (C) e (D) e^2

74. Let C_1 and C_2 be the two curves in the complex plane defind respectively as $z+\bar{z}=2|z-1|$ and $\arg(z)=\alpha$, where $\alpha\in(0,\pi)$ have exactly one point in common which is denoted as $P(z_0)$. If $P(z_0)$ is rotated about origin through an angle 2α in clockwise direction to become the point $Q(z_0')$, then the area bounded by C_1 and the line PQ is

(A) $\frac{2}{3}$ sq. unit (B) $\frac{5}{6}$ sq. unit

(C) 1 sq. unit (D) 2 sq. unit

75. Let f(n) denotes the number of non-negative integral solutions of the equation $x_1 + x_2 + x_3 + x_4 + x_5 = n$. If $\sum_{k=1}^{11} k\, f(11-k) = {}^pC_q$ where p > 10, q > 6 and $p, q \in N$, then (p + q) is

(A) 23 (B) 24 (C) 25 (D) 26

76. If $x \in R$ & a > 0, then the maximum value of $y = 2(a - x)\left(x + \sqrt{x^2 + b^2}\right)$ is

(A) $a^2 - 2b^2$ (B) $a^2 - b^2$ (C) $a^2 + b^2$ (D) $a^2 + 2b^2$

77. The slope of the line belonging to the family of lines $(1+\lambda)x + (\lambda - 1)y + 2(1-\lambda) = 0$ on which $x^2 = 4y - 4$ makes shortest intercept is

(A) 0 (B) 1/2 (C) 1 (D) 2

78. Let $\vec{a}, \vec{b}, \vec{c}$ be coplanar unit vectors such that $\vec{b}\cdot\vec{c} = \cos\alpha,\ \vec{c}\cdot\vec{a} = \cos\beta,\ \vec{a}\cdot\vec{b} = \cos\gamma$, then the value of $\cos^2\alpha + \cos^2\beta + \cos^2\gamma - 2\cos\alpha\cos\beta\cos\gamma$ is

(A) –1 (B) 0 (C) 1 (D) 2

79. If $\left(10^{2017} + 5\right)^2 = 225\lambda$ and the sum of digits in λ is N then the number of even digits in N is

(A) 0 (B) 1

(C) 2 (D) None of these

80. If in a rectangular hyperbola $xy = c^2$, the locus of the middle points of chords of constant length 2*l* is $(x^2 + y^2)(x y - c^2) = \ell^{\lambda} xy$, then the value of λ is

(A) –1 (B) 0 (C) 1 (D) 2

81. A function $f: R \to R$ satisfies the equation $f(x)\cdot f(y) - f(xy) = x + y \ \forall x, y \in R$ and f(1) > 0, then $f(x)\cdot f^{-1}(x)$ is

(A) $x^2 - 6$ (B) $x^2 - 4$

(C) $x^2 - 1$ (D) None of these

82. If n is a natural number, then $n^n - {}^nC_1(n-1)^n + {}^nC_2(n-2)^n - {}^nC_3(n-3)^n + \ldots\ldots$ is

(A) 0 (B) n! (C) $(n!)^n$ (D) $(n^n)!$

83. The value of $\lim_{n\to\infty} \frac{1}{n^4}\sum_{r=1}^{n} r^2(2r+1)$ is

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

84. The equation of the largest circle with centre (1,0) that can be inscribed in the ellipse $x^2 + 4y^2 = 16$, is

(A) $(x-1)^2 + y^2 = \frac{11}{3}$ (B) $(x-1)^2 + y^2 = \frac{22}{3}$

(C) $(x-1)^2 + y^2 = 11$ (D) None of these

85. Let $f(x) = \begin{cases} e^x & , x < 0 \\ q & , x = 0 \\ \lambda x + p & , x > 0 \end{cases}$ is differentiable $\forall x \in R$, where [.] and {.} denote greatest integer & fractional part functions respectively, then the value of $p + q + \lambda$ is

(A) 0 (B) 1 (C) 2 (D) 3

86. If f be a polynomial function satisfying $f(x^2 + x + 3) + 2f(x^2 - 3x + 5) = 6x^2 - 10x + 17 \ \forall x \in R$, then

(A) f is a decreasing function

(B) f(x) = 0 has a root in (0, 2)

(C) f(x) is an odd function

(D) no such polynomial exists

87. If the equation $2^{2x} + (a-1)2^{x+1} + a = 0$ has roots of opposite signs, then the number of possible values of [a] is (where [.] denotes greatest integer function)

(A) 1 (B) 2 (C) 4 (D) infinite

88. If m, n are relatively prime positive integers and coefficients of x^2 and x^3 in the expansion of $(mx + n)^{2000}$ are equal, then m + n equals

(A) 766 (B) 667 (C) 676 (D) 677

89. If each observation of a raw data, whose variance is σ^2, is multiplied by λ, then the variance of the new set is

(A) σ^2 (B) $\lambda^2\sigma^2$ (C) $\lambda + \sigma^2$ (D) $\lambda^2 + \sigma^2$

90. The number of integral values of n for which $n^2 + 19n + 92$ is a perfect square is

(A) 0 (B) 2 (C) 4 (D) 9

ANSWER-KEY

PART-A : PHYSICS

1. (A)	**2. (D)**	**3. (D)**	**4. (B)**	**5. (C)**	**6. (A)**	**7. (B)**
8. (A)	**9. (B)**	**10. (A)**	**11. (C)**	**12. (A)**	**13. (A)**	**14. (A)**
15. (D)	**16. (B)**	**17. (A)**	**18. (B)**	**19. (B)**	**20. (C)**	**21. (D)**
22. (D)	**23. (C)**	**24. (B)**	**25. (A)**	**26. (C)**	**27. (B)**	**28. (A)**
29. (B)	**30. (B)**					

PART-B : CHEMISTRY

31. (C)	**32. (B)**	**33. (B)**	**34. (C)**	**35. (B)**	**36. (A)**	**37. (C)**
38. (B)	**39. (A)**	**40. (C)**	**41. (D)**	**42. (B)**	**43. (D)**	**44. (B)**
45. (C)	**46. (D)**	**47. (C)**	**48. (D)**	**49. (C)**	**50. (A)**	**51. (D)**
52. (B)	**53. (B)**	**54. (B)**	**55. (A)**	**56. (C)**	**57. (C)**	**58. (B)**
59. (A)	**60. (B)**					

PART-C : MATHEMATICS

61. (C)	**62. (A)**	**63. (C)**	**64. (D)**	**65. (D)**	**66. (D)**	**67. (D)**
68. (C)	**69. (B)**	**70. (A)**	**71. (D)**	**72. (C)**	**73. (C)**	**74. (A)**
75. (D)	**76. (C)**	**77. (A)**	**78. (C)**	**79. (C)**	**80. (D)**	**81. (C)**
82. (B)	**83. (C)**	**84. (A)**	**85. (D)**	**86. (B)**	**87. (A)**	**88. (B)**
89. (B)	**90. (B)**					