Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec:Sr.Super60_NUCLEUS & STERLING_BT	**Paper -1(Adv-2020-P1-Model)**	**Date: 08-10-2023**
Time: 09.00Am to 12.00Pm	**RPTA-10**	**Max. Marks: 198**

08-10-2023_Sr.Super60_NUCLEUS&STERLING_BT_Jee-Adv(2020-P1)_RPTA-10_Syllabus

PHYSICS : Properties of matter, Experiments

CHEMISTRY : 1.Group-15, 2.Group-16, 3.Group-17

MATHEMATICS : Stragith Lines, Pair of Straight Lines & Complete Circles

Name of the Student: _____   H.T. NO: ☐☐☐☐☐☐☐

JEE-ADVANCE-2020-P1-Model

Time: 3:00Hour's   **IMPORTANT INSTRUCTIONS**   **Max Marks: 198**

<u>**PHYSICS:**</u>

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total mark
Sec – I(Q.N : 1 – 6)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 7 – 12)	**Questions with Multiple Correct Choice +1 partial marks**	4	-2	6	24
Sec – III(Q.N : 13 – 18)	Questions with Numerical Value Answer Type	4	0	6	24
Total				**18**	**66**

<u>**CHEMISTRY:**</u>

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 19 – 24)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 25 – 30)	**Questions with Multiple Correct Choice +1 partial marks**	4	-2	6	24
Sec – III(Q.N : 31 – 36)	Questions with Numerical Value Answer Type	4	0	6	24
Total				**18**	**66**

<u>**MATHEMATICS:**</u>

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 37 – 42)	Questions with Single Correct Choice	3	-1	6	18
Sec – II(Q.N : 43 – 48)	**Questions with Multiple Correct Choice +1 partial marks**	4	-2	6	24
Sec – III(Q.N : 49 – 54)	Questions with Numerical Value Answer Type	4	0	6	24
Total				**18**	**66**

**PHYSICS**   **Max Marks: 66**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains **SIX** (06) questions.
• Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.
• For each question, choose the option corresponding to the correct answer.
• Answer to each question will be evaluated **according to the following marking scheme:**
Full Marks:+3 If ONLY the correct option is chosen;
*Zero Marks:*0 If none of the options is chosen (i.e. the question is unanswered);
*Negative Marks-*1 In all other cases

1.   A uniform bar of square cross-section is lying along a frictionless horizontal surface. A horizontal force is applied to pull it from one of its ends. Then
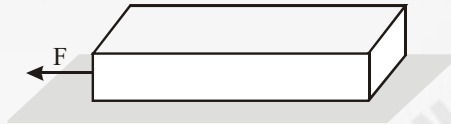
   A) the bar is under same stress throughout its length.
   B) the strain is zero at the end of the bar where force is applied.
   C) the stress developed is zero at the end of the bar where force is applied.
   D) the stress developed is zero at the end of the bar where no force is applied.

2.   Each of the pictures shows four objects tied together with rubber bands being pulled to the right across a horizontal frictionless surface by a horizontal force F. All the objects have the same mass; all the rubber bands obey Hooke's law, have the same natural length, and the same force constant. Which of these pictures drawn most correctly depicts the steady state of configuration ?

   A)

   B)

   C)

   D)
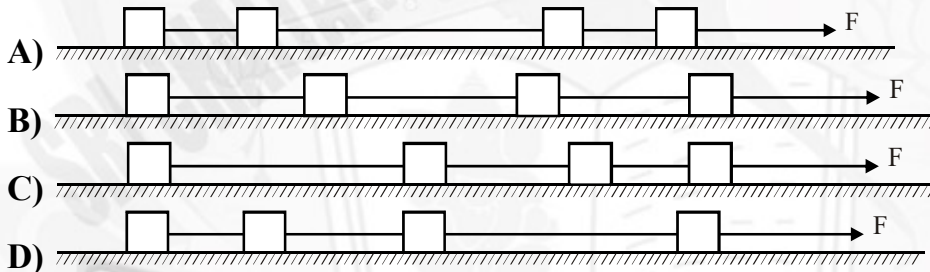
3.   A spherical ball of radius 'r' and mass 'm' is dropped into a lake having liquid of density one-third of density of ball and viscosity η. Choose incorrect statement for steady state having terminal speed v_T.

   A) Heat produced at rate $\dfrac{4}{3}mgv_T$ in steady state.

   B) Ball looses gravitational potential energy at the rate mgv_T in steady state.

   C) Drag force at steady state is $\dfrac{2}{3}mg$.

   **D)** Ball gains $\dfrac{63v_T}{100}$ speed after time $t = \dfrac{m}{6\pi\eta r}$.

4.   A liquid having surface tension S is forming a film between a horizontal surface and a cylindrical object of radius R, as shown in figure. Cylindrical liquid surface has radius r. The contact angle is $\theta = 0°$. Find the downward force (by atmosphere + liquid) acting on unit length of the cylinder due to presence of the liquid. Height of liquid column above horizontal surface is greater than r.
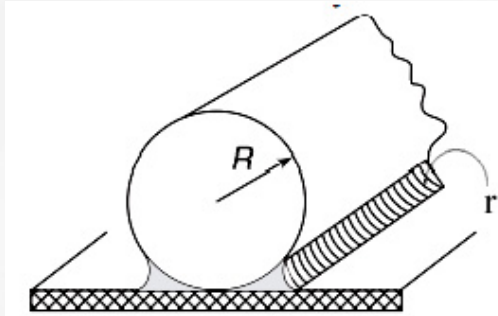

A) $4S\sqrt{\dfrac{R}{r}}$ **B)** $2S\sqrt{\dfrac{R}{r}}$ **C)** $S\sqrt{\dfrac{R}{r}}$ **D)** $3S\sqrt{\dfrac{R}{r}}$

5.   A tube AB of fine bore is connected to a manometer M as shown. The stop cork S controls the flow of air. AB is dipped into and taken out of a liquid whose surface tension is σ. A film of liquid is formed, which closes the end B. On opening the stop cork for a while, air is forced into the tube and a bubble is formed at B. The manometer level is recorded, showing a difference h in the levels in the two arms. If ρ be the density of monometer liquid and r the radius of curvature of the bubble, then the surface tension σ of the liquid is given by
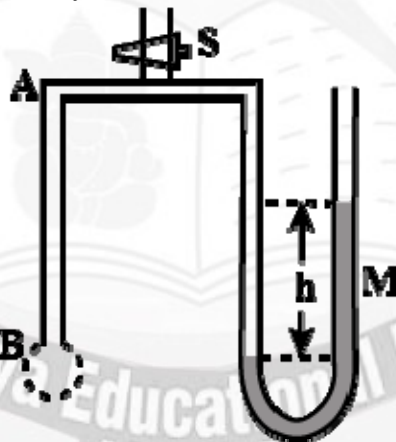
A) $rh\rho g$ **B)** $2rhg\rho$ **C)** $4rh\rho g$ **D)** $\dfrac{rh\rho g}{4}$

6.   There is an air bubble of radius R inside a drop of water of radius $3R$. The ratio of gauge pressure at point A to the gauge pressure at point B is
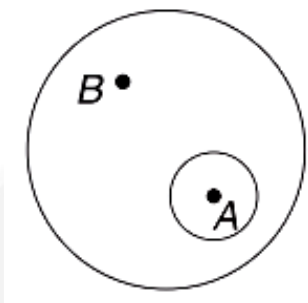
A) 4   **B)** 1   **C)** 3   **D)** 2

SECTION – II
(ONE OR MORE CORRECT ANSWER TYPE)

• This section contains **SIX** (06) questions.
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• For each question, choose the option(s) corresponding to (all) the correct answer(s).
• Answer to each question will be evaluated **according to the following marking scheme**:
Full Marks:+4 If only (all) the correct option(s) is(are) chosen;
Partial Marks:+3 If all the four options are correct but ONLY three options are chosen;
*Partial Marks*:+2 If three or more options are correct but ONLY two options are chosen, both of which are correct;
Partial Marks:+1 If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks:0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks: -2 In all other cases

7. Three wires AP, BP and CP are made of same materials and have same cross sectional area. They are fixed to points A, B and C on a ceiling and their free ends are knotted together at P. Lengths of the three wires are $AP = CP = l_2$ and $BP = l_1$. A weight W is suspended at P and the wires get taut. Assume the deformations to be small.
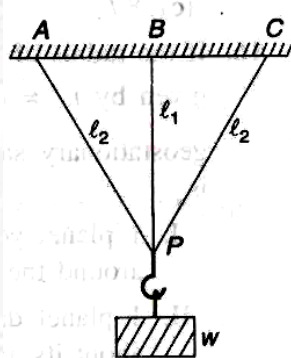
A) Extension in wire AP is more than extension in BP.

**B)** Extension in wire BP is more than extension in AP.

C) Stress in wire AP is more than stress in BP.

D) Tension in wire BP is $\dfrac{W}{1 + 2\left(\dfrac{l_1}{l_2}\right)^3}$

8. A body of mass M is attached to the lower end of a metal wire, whose upper end is fixed. The elongation of the wire at final equilibrium state is l.

A) Loss in gravitational potential energy of M is Mgl

B) The elastic potential energy stored in the wire is Mgl

C) The elastic potential energy stored in the wire is $\dfrac{1}{2}Mgl$

D) Heat produced is $\dfrac{1}{2}Mgl$

9. A cylindrical capillary tube of 0.2 mm radius is made by joining two capillaries T_1 and T_2 of different materials having water contact angles of $0°$ and $60°$ respectively. The capillary tube is dipped vertically in water in two different configurations, case I and II as shown in figure. Which of the following option(s) is (are) correct? [Surface tension of water = 0.075 N/m, density of water $= 1000 \ kg \ / \ m^3$, take $g = 10 \ m/s^2$]
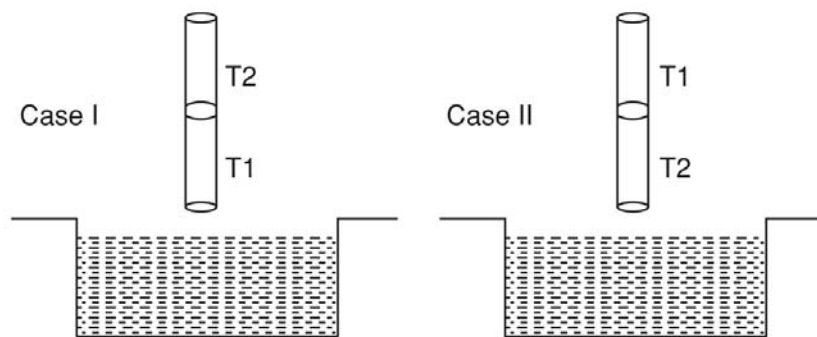

A) For case I, if the joint is kept at 8 cm above the water surface, the height of water column in the tube will be 7.5 cm. (Neglect the weight of the water in the meniscus)

B) For case I, if the capillary joint is 5 cm above the water surface, the height of water column raised in the tube will be more than 8.75 cm. (Neglect the weight of the water in the meniscus)

C) The correction in the height of water column raised in the tube, due to weight of water contained in the meniscus, will be different for both cases.

D) For case II, if the capillary joint is 5 cm above the water surface, the height of water column raised in the tube will be 3.75 cm. (Neglect the weight of the water in the meniscus)

10. A ball of mass "$1kg$" and specific gravity $\left(\dfrac{\rho_m}{\rho_w}\right) = 2$ is released inside the tank filled with water as shown. Resistance offered by water to ball is $2.5V$ where V is velocity of the ball. Select the correct statement (ρ_m & ρ_w are density of ball and water respectively)
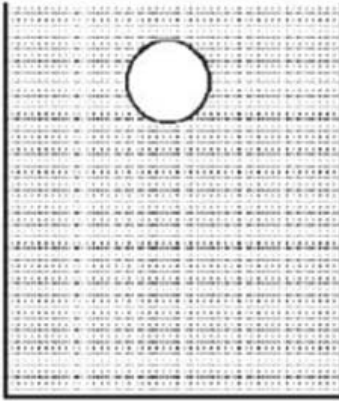
A) Momentum of water is zero, when ball reaches steady velocity.

B) Momentum of water is $1\,kg\,m/s$ in upward direction when ball reaches steady state.

C) Momentum of ball is $2\,kg\,m/s$ in downward direction when ball reaches steady state.

D) Momentum of [Ball + water] system is $2\,kg\,m/s$ in downward direction when ball reaches steady state.

11. Two identical cylindrical tanks are connected by a narrow tube with a cork at its middle (fig). The radius of tank is $R = 20.0\,cm$, the radius of the tube is $r = 1.0\,mm$ The length of the tube is $L = 1.5m$. Water $\left(\rho = 1000\,kg/m^3\right)$ is poured into one of the tanks to a height of $h = 50\,cm$, while the second tank is empty. At the instant $t = 0$, the cork is opened. [Both the tanks are open at top]
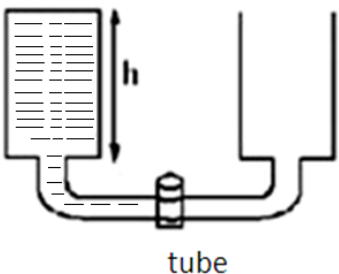
tube

$\left(\text{Viscosity of water}\,\eta = 1 \times 10^{-3}\,Pa - s\right)$

Given poiseuille's equation for volume flow rate of fluid in a tube $\dfrac{dV}{dt} = \dfrac{\Delta P \pi r^4}{8\eta L}$

$\Delta P \rightarrow$ pressure difference across ends of the tube

$r \rightarrow$ radius of tube

$L \rightarrow$ length of tube

A) The difference between the levels of the water in the tanks decreases to e times in time $1.6 \times 10^4 s$.

B) The difference between the levels of the water in the tanks decreases to e times in time $2.4 \times 10^4 s$.

C) Total mechanical energy of the fluid is conserved during the process

D) Water level in the two containers cannot become equal in a finite time

12.   Two vertical parallel rectangular glass plates are partially submerged in water. The separation between the plates is $d = 0.2\,mm$ and the width of each plate is $l = 10\,cm$. Assume that the water between the plates does not reach the upper edges of the plates and the contact angle is $\theta = 0°$. The surface tension of water is $T = 7 \times 10^{-2} N/m$ and the density of water is $\rho = 10^3 kg/m^3$. Then choose the CORRECT option(s). $\left(g = 10\,m/s^2 \right)$
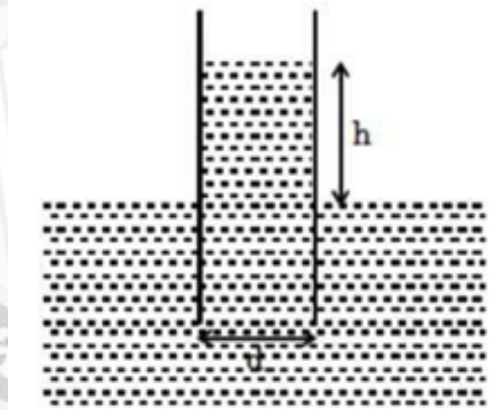
A) The water rises upto height $h = 7\,cm$ between the plates

B) The water rises upto height $h = 14\,cm$ between the plates

C) The force of mutual attraction between the plates is $2.45\,N$

**D)** The force of mutual attraction between the plates is $9.8\,N$

SECTION – III
(NUMERICAL VALUE TYPE)

• This section contains **SIX** (06) questions. The answer to each question is a **NUMERICAL VALUE.**
• For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. **If** the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.
• Answer to each question will be evaluated **according to the following marking scheme:**
*Full Marks*   :+4 **If** ONLY the correct numerical value is entered;
Zero Marks   :0 In all other cases

13.   A cylindrical pillar is made of two materials. The inner core, having radius r, has Young's modulus Y_1 and the outer layer (between radius r and R) has Young's modulus Y_2. A load of weight W is placed on the cylinder. Find the fraction of load supported by the outer layer. $\left[R = 3r, \dfrac{Y_1}{Y_2} = 2 \right]$
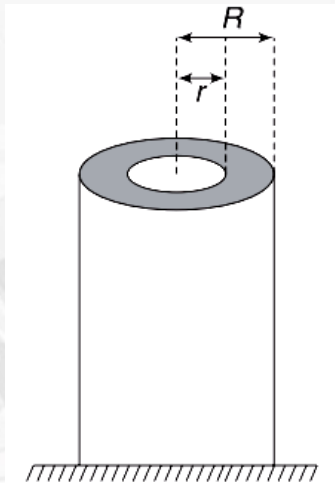

14.   The velocity distribution in a viscous flow over a plate is given by $u = 8y - 2y^2$ for $y \leq 2m$ where $u = $ velocity in m/s at a distance y from the plate. If the coefficient of dynamic viscosity is $1.5\,Pa.s$, determine the shear stress at $y = 1m$ (in SI units).

15.   A uniform glass tube of length $2m$ is closed at the lower end. It is completely filled with water and rigidly fixed at upper end. Now the tube is stretched downwards. Although the length of tube increases by $0.12\,cm$, the length of water column increases only by $0.08\,cm$. Assume water is incompressible. What is poisson's ratio σ for glass ? (Neglect surface tension effects)
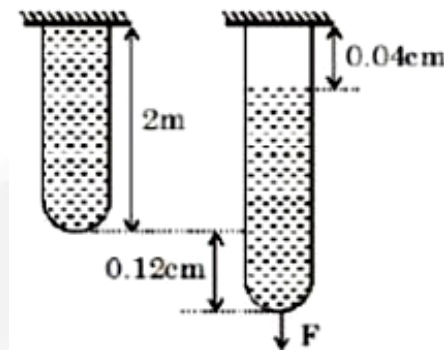
16. Figure shows a soap film formed between two square figures made of a uniform wire. The bigger square is held while keeping it in a horizontal plane and the smaller square is slowly allowed to drop vertically. It reaches an equilibrium state after dropping a height h. Let surface tension of soap $= T$. Mass per unit length of wire $= \lambda$.

Acceleration due to gravity $= g$. Given that $h = \dfrac{n\lambda ga}{\sqrt{T^2 - \dfrac{\lambda^2 g^2}{4}}}$; find the value n.
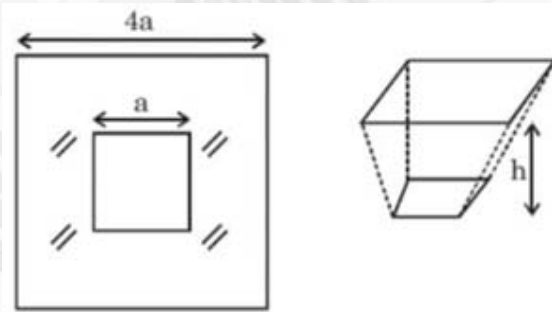
17. Eight identical droplets of water were falling in air with constant velocity $2\,cm/s$. The initial acceleration of each droplet was 'a_1' at the time when they start falling. At a time 't', these droplets coalesce to form a big drop due to pressure difference developed and just after the formation of combined drop, its acceleration is found 'a_2'. The ratio of $\dfrac{3a_1}{a_2}$ is

18. Capillary tube with very thin walls is suspended vertically in a cup containing water. Before the capillary is suspended, the cup was balanced against weights on a beam balance. When capillary is dipped to a small distance in the water, water rises in the capillary. Water completely wets the capillary walls. To restore the balance, we have to decrease the load on the other side by $0.14\pi g$. If the surface tension of water is $0.07\,N/m$, determine the radius $r(in\,mm)$ of the capillary.

CHEMISTRY   **Max Marks: 66**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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Zero Marks   : 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks   : -1 In all other cases

19. Bones glow, in dark because of slow combustion of white phosphorous in air. This is known as

    A) fluorescence   B) phosphorescence

    C) chemiluminescence   D) thermoluminiscence

20. The wrong statement about ozone is

    A) Ozone is pale blue in gaseous state, dark blue in liquid state and violet black in solid state.

    B) Ozone act as stronger oxidizing agent in acid solution than in neutral medium

    C) Ozone is stable in acidic solution and much more unstable in basic solutions.

    D) Ozone is polar molecule having some dipolemoment.

21. Correct order of S-S bond length in the following oxoanions is

    i) $S_2O_4^{2-}$ ii) $S_2O_5^{2-}$ iii) $S_2O_6^{2-}$

    A) i > ii> iii   B) i > iii > ii   C) iii > ii > i   D) iii > i > ii

22. N_2 is a stable molecule but N_4 molecule is unknown. P_4 is much more stable than molecular P_2. Which is the best explanation for this difference

    A) N_2 has valence electrons only in bonding and non bonding orbitals, while P_2 has some valence electrons in antibonding orbtials.

    B) The greater electronegativity of N compared to P stabilizes the molecules with lower molar masses

    C) The greater size of P compared to N result in decreased overlap in Pi bonds

    D) The preference of P to adopt smaller bond angles than N favours formation of tetrahedral P_4 molecules

23. An iodide ion may combine with one I_2 or two I_2 molecules to form I_3^- and I_5^- ions. Regarding these ions the correct statements is

A) Both I_3^- and I_5^- are linear and non polar

B) Both have the same number lone pairs of electrons on the central iodine atom

C) I_3^- is linear but I_5^- is angular

D) I_3^- is linear but I_5^- is square pyramidal

24. ICl_3 can form but $BrCl_3$ cannot form, because

A) Iodine is large enough to accommodate 3 chlorine atoms around itself

B) Bromine is not electronegative enough to react with chlorine

C) Iodine can have positive oxidation state but bromine cannot

D) Bromine is electronegative to react with chlorine

SECTION – II
(ONE OR MORE CORRECT ANSWER TYPE)

• This section contains **SIX** (06) questions.
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Partial Marks	: +3 If all the four options are correct but ONLY three options are chosen;
Partial Marks	: +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;
Partial Marks	: +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	: 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	: -2 In all other cases

25. Sulphur dioxide required for the manufacture of sulphuric acid is mainly obtained by burning iron pyrites; FeS_2. Regarding FeS_2 the correct statements are

A) The oxidation state of iron in FeS_2 is $+2$

B) The oxidation state of sulphur in the anion is -1

C) The structure of the anion in FeS_2 is analogous to peroxide ion

D) Similar to peroxide ion, the anion in FeS_2 can act as good oxidising agent

26. Regarding H_2O_2 and O_3 the correct statements are

A) Both are unstable but O_3 is less stable than hydrogen peroxide

B) O – O bond length is shorter in O_3 than in H_2O_2

C) Heat of formation of H_2O_2 is exothermic while the heat of formation of O_3 is endothermic

D) Both are polar but the dipolemoment of ozone is greater than hydrogen peroxide

27. The correct statements among the following is/are

A) Among the addition compounds formed by NO with halogens, $FNO, ClNO$ and $BrNO$, the $N-O$ bond length is shortest in FNO and longest in BrNO

B) Among the $FNO, ClNO$ and $BrNO$ the bond angle is lowest in FNO and largest in $BrNO$

C) Some metals are found in nature as their oxides whereas others (heavier metals such as lead mercury etc.) are found as sulphides

D) The bond angles in H_2O, HOF and OF_2 are in the order $H_2O > OF_2 > HOF$

28. Which of the following statements are correct?

A) When $AgCl$ react with ClF_3 chlorine gas is liberated along with the formation of AgF_2

B) Addition of excess chlorine water to KI solution, first gives brown solution which becomes colourless

C) PH_4I is the most stable of PH_4X halides with respect to decomposition to PH_3 and HX

D) ClO_2 is the major bleaching agent in the pulp industry.

29. Regarding HF the correct statements is/are

A) Among the hydrogen halide HF is the weakest acid

B) Acidic character of HF decreases with increase in concentration

C) In liquid $HF - HNO_3, H_2SO_4$ and HCl act as bases by accepting proton form HF

D) The fluoride ion acceptors such as BF_3, SbF_5, NbF_5 etc increase the acidic strength of HF

30. The correct statements among the following is/are

A) NO_3^- ion is stable but the corresponding PO_3^- ion is less stable

B) PO_4^{3-} ion is stable but the corresponding NO_4^{3-} is ion is unstable

C) NO_3^- ion is strong oxidizing agent but PO_4^{3-} cannot act as an oxidizing agent

D) PO_4^{3-} can act as reducing agent but NO_4^{3-} can act as strong oxidizing agent.

SECTION – III
(NUMERICAL VALUE TYPE)

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Zero Marks   : 0 In all other cases

31. Despite the structural differences with H_2SO_4 and selenic acid, telluric acid is a diprotic acid with $pka_1 = 7.68$ and $pka_2 = 11.29$. Telluric acid can be prepared by hydrolysis of tellurium hexafluoride

$$TeF_6 + 6H_2O \rightarrow Te(OH)_6 + 6HF$$

TeF_6 can be prepared by the reaction between elements

$$Te + 3F_2 \rightarrow TeF_6$$

A cube of tellurium (density 6g/cc) measuring 1.2 cm on edge is allowed to react with 2.34 L of fluorine gas at 1 atm and 27°C. What is the pH of the solution considering telluric acid only (Neglect HF and considered as volume of solution is 1 L). Assume 100% yield in all reactions.

(At Wt : Te = 128, F = 19, O = 16, H = 1) $(\log 3.17 = 0.5)$

32. A typical air bag contains approximately 50 g of sodium azide and some potassium nitrate to avoid explosion by burning of sodium. What is the amount (in g) of potassium nitrate required ?

33. Potassium chlorate $KClO_3$ is used in fire works and explosives. It can be prepared by bubbling chlorine into hot aqueous potassium hydroxide; $KCl(aq)$ and H_2O are the other products in the reaction. How many grams of $KClO_3$ can be obtained from $138\,L$ of Cl_2 whose pressure is $760\,mm\,Hg$ at $27°C$

(At wts : K = 39, $Cl = 35.5$, O = 16, H = 1)

34. The amount of sodium hypochlorite in a bleach solution can be determined by using a given volume of bleach to oxidize excess iodide ion to iodine, because the reaction goes to completion. The amount of iodine produced is then determined by titration with sodium thiosulphate $Na_2S_2O_3$, which is oxidized to sodium tetrathionte $Na_2S_4O_6$. Potassium iodide was added in excess to $5.00\,mL$ of bleach (density = 1.0 g/cc). This solution containing the iodine released in the reaction, was titrated with $0.1M\ Na_2S_2O_3$. If $40\,mL$ of hypo was required to reach the end point, what was the mass percentage of $NaClO$ in the bleach.

(At Wts : Na = 23, S = 32, O = 16, I = 127, $Cl = 35.5$)

35. SiF_4 react with $(CH_3)_4 NF$ to form an ionic compound in which coordination number of silicon is 6. What is the weight of the compound formed if 52 g of SiF_4 reacts with $(CH_3)_4 NF$.

(At. Wts : Si = 28, F = 19, C = 12, N = 14. H = 1)

36. Ammonia is manufactured in Haber's process by the direct reaction between nitrogen and hydrogen. When 280 kg N₂ react with 60 kg H₂ 300 kg ammonia is formed. What is the percent yield of ammonia.

MATHEMATICS   **Max Marks: 66**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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• For each question, choose the option corresponding to the correct answer.
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Zero Marks 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks -1 In all other cases

37. Two circles with radii R and $r(R > r)$ touch each other internally at A. ΔABC is an equilateral triangle with B on one circle and C on the other. Then the length of the side of the equilateral triangle ABC is

A) $\dfrac{2Rr\sqrt{3}}{\sqrt{R^2 - Rr + r^2}}$ B) $\dfrac{Rr\sqrt{3}}{\sqrt{R^2 - Rr + r^2}}$ C) $\dfrac{Rr\sqrt{3}}{\sqrt{R^2 + Rr + r^2}}$ D) $\dfrac{2Rr\sqrt{3}}{\sqrt{R^2 + Rr + r^2}}$

38. Consider a triangle Δ whose two sides lie on the x-axis and the line $x + y + 1 = 0$. If the orthocenter of Δ is $(1,1)$, then the equation of the circle passing through the vertices of the triangle Δ is

A) $x^2 + y^2 - 3x + y = 0$ B) $x^2 + y^2 + x + 3y = 0$

C) $x^2 + y^2 + 2y - 1 = 0$ D) $x^2 + y^2 + x + y = 0$

39. Rectangle $ABCD$ has $AB = 5$ and $BC = 4$, point E lies on AB so that $EB = 1$ point G lies on BC so that $CG = 1$ and point F lies on CD so that $DF = 2$, line segment AG and AC intersect EF at Q and P respectively then ratio $\dfrac{PQ}{EF}$ is

A) $\dfrac{\sqrt{13}}{16}$ B) $\dfrac{\sqrt{2}}{13}$ C) $\dfrac{9}{82}$ D) $\dfrac{10}{91}$

40. The locus of the mid-points of the perpendiculars drawn from points on the line $x + y + 5 = 0$ to the line $2x - y + 3 = 0$ is

A) $6x + 9y + 37 = 0$ B) $7x + 4y + 28 = 0$

C) $x - 2y - 2 = 0$ D) $4x + y + 13 = 0$

41. A line $y = mx + 1$ intersects the circle $(x-3)^2 + (y+2)^2 = 25$ at the points P and Q. If the midpoint of the line segment PQ has x-coordinate $-\dfrac{3}{5}$, then which one of the following options is correct ?

A) $4 \leq m \leq 6$ B) $-3 \leq m < -1$ C) $2 \leq m < 4$ D) $6 \leq m < 8$

42. Let C_1 be the circle of radius 1 with center at the origin. Let C_2 be the circle of radius r with center at the point $A = (4,1)$, where $1 < r < 3$. Two distinct common tangents PQ and ST of C_1 and C_2 are drawn. The tangent PQ touches C_1 at P and C_2 at Q. The tangent ST touches C_1 at S and C_2 at T. Mid points of the line segments PQ and ST are joined to form a line which meets the x-axis at a point B. If $AB = \sqrt{5}$, then the value of r^2 is

A) $\dfrac{9}{4}$ B) $\dfrac{15}{4}$ C) 2   D) 3

SECTION – II
(ONE OR MORE CORRECT ANSWER TYPE)

• This section contains **SIX** (06) questions.
• Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
• For each question, choose the option(s) corresponding to (all) the correct answer(s).
• Answer to each question will be evaluated **according to the following marking scheme**:

Full Marks	: +4 If only (all) the correct option(s) is(are) chosen;
Partial Marks	: +3 If all the four options are correct but ONLY three options are chosen;
Partial Marks	: +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;
Partial Marks	: +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	: 0 If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	: -2 In all other cases

43. $A(2,0)$ is a point on the circle $(x+2)^2 + (y-3)^2 = 25$, A line through point A making an angle of $45°$ with the tangent to the circle at A is drawn. Then the equation(s) of the circle(s) with the centre(s) on this line which are at a distance of $5\sqrt{2}$ units from point A and of radius 3 is/are

A) $(x-1)^2 + (y-7)^2 = 9$ B) $(x-3)^2 + (y+7)^2 = 9$

C) $(x-9)^2 + (y-1)^2 = 9$ D) $(x+9)^2 + (y+1)^2 = 9$

44. Consider a circle whose radius is 2 and centre is origin. Tangents are drawn from a point $P(\alpha, 2)$ which touches the circle at $A(a_1, a_2)$ and $B(b_1, b_2)$. Another pair of tangents are drawn from the point $Q(\beta, -2)$ which touches the circle at $A(a_1, a_2)$ and $C(c_1, c_2)$. Then which of the following is/are CORRECT ? $(\alpha, \beta > 0)$

A) $b_1 + b_2 + c_1 + c_2 = 0$ B) $\alpha\beta = 4$

C) If $\alpha = 4$, then $4a_2 + 3a_1 = 0$ D) If $\alpha = \beta$, then $a_2 = 0$

45. All points lying inside the triangle formed by the points $(1,3),(5,0)$ and $(-1,2)$ satisfy

A) $3x+2y \geq 0$ **B)** $2x+y-13 \geq 0$

C) $2x-3y-12 \leq 0$ **D)** $-2x+y \geq 0$

46. Let $X \subset R^2$ be a set satisfying the following properties:

i) If (x_1,y_1) and (x_2,y_2) are any two distinct elements of X then either $x_1 > x_2$ and $y_1 > y_2$ or $x_1 < x_2$ and $y_1 < y_2$.

ii) There are two elements (a_1,b_1) and (a_2,b_2) in X so that for any $(x,y) \in X, a_1 \leq x \leq a_2 \text{ and } b_1 \leq y \leq b_2$

iii) If (x_1,y_1) and (x_2,y_2) are two elements of X, then $\forall \lambda \in [0,1], (x_2 + \lambda(x_1-x_2), y_2 + \lambda(y_1-y_2)) \in X.$

A) All elements of X must be collinear points in R^2 plane

B) Not all elements of X are collinear points in R^2 plane

C) If $(x,y) \in X$, then for some $\mu \in [0,1]; x = a_2 + \mu(a_1-a_2)$ and $y = b_2 + \mu(b_1-b_2)$

D) If $(x,y) \in X$, then for some $\mu_1, \mu_2 \in [0,1]; x = a_2 + \mu_1(a_1-a_2)$ and $y = b_2 + \mu_2(b_1-b_2)$ where $\mu_1 \neq \mu_2$

47. Which of the following is/are correct with respect to angle bisectors of pair of lines $3x^2 - 4y^2 - xy - 12x + 16y = 0$

A) Angle bisector containing point $(2,1)$ is the obtuse angle bisector

B) Equation of acute angle bisector is $(3\sqrt{2}+5)x - (4\sqrt{2}-5)y - 20 = 0$

C) Equation of obtuse angle bisector is $(3\sqrt{2}+5)x - (4\sqrt{2}-5)y - 20 = 0$

D) Angle bisectors are perpendicular to each other

48. The circle $C_1 : x^2 + y^2 = 3$ with centre at O intersects the parabola $x^2 = 2y$ at the point P in the first quadrant. Let the tangent to the circle C_1 at P touches other two circles C_2 and C_3 at R_2 and R_3, respectively. Suppose C_2 and C_3 have equal radii $2\sqrt{3}$ and centres Q_2 and Q_3, respectively. If Q_2 and Q_3 lie on the Y-axis, then

A) $Q_2Q_3 = 12$ **B)** $R_2R_3 = 4\sqrt{6}$

C) area of the $\Delta OR_2R_3 \, is = 6\sqrt{2}$ **D)** area of the $\Delta PQ_2Q_3 \, is = 4\sqrt{2}$

SECTION – III
(NUMERICAL VALUE TYPE)

• This section contains **SIX (06)** questions. The answer to each question is a **NUMERICAL VALUE**.
• For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.
• Answer to each question will be evaluated **according to the following marking scheme:**
Full Marks   : +4 If ONLY the correct numerical value is entered;
Zero Marks   : 0 In all other cases

49. If the co-ordinates of orthocenter of the triangle formed by the straight lines

$$L_1 : y = m_1 x + \frac{2}{m_1}$$

$$L_2 : y = m_2 x + \frac{2}{m_2}$$

$$L_3 : y = m_3 x + \frac{2}{m_3}$$

As sides be (α, β) where m_1, m_2, m_3 are the roots of the cubic equation $x^3 - 9x^2 + 26x - 24 = 0$, then $4\beta + \alpha = $ _____

50. Let O be the centre of the circle $x^2 + y^2 = r^2$, where $r > \frac{\sqrt{5}}{2}$. Suppose PQ is a chord of this circle and the equation of the line passing through P and Q is $2x + 4y = 5$. If the centre of the circumcircle of the triangle OPQ lies on the line $x + 2y = 4$, then the value of r is ___

51. Tangents are drawn from the point $(4,3)$ to the circle $x^2 + y^2 = 9$. Then the area of the triangle formed by these tangents and the chord of contact is $\frac{64\Delta}{25}$ square units where Δ is equal to

52. C_1 and C_2 are two circles whose equations are given as $x^2 + y^2 = 25$ and $x^2 + y^2 + 10x + 6y + 1 = 0$. Now C_3 is a variable circle which cuts C_1 and C_2 orthogonally. Tangents are drawn from the centre of C_3 to C_1, if the locus of the mid point of the chord of contact of tangents is $ax + 3y + \frac{13}{b}\left(x^2 + y^2\right) = 0$, then $\frac{b}{a}$ is

53. Let $C_1 \equiv x^2 + y^2 - 169 = 0$ and $C_2 \equiv x^2 + y^2 - 24x - 32y + 111 = 0$. Let AB be their common chord. Maximum area of ΔABC if C lies on minor arc AB (Of either of the circle), is equal to $a\sqrt{30}\, unit\,(a \in N)$. Find the value of a.

54. Let A and B be any two points on y-axis and the line $y = 2x$ respectively. Also P and Q be the feet of perpendicular from A and B on the line $y = 2x$ and y-axis respectively. If AB passes through the points $(1,3)$, then the line PQ passes through fixed point (x_1, y_1) such that $\frac{y_1}{x_1}$ is