# FIITJEE RET – 4

## (2017 – 2019)(2ND YEAR_REGULAR)

## IIT-2015 (P2)_SET–A

## DATE: 02.07.2018

**Time: 3 hours** **Maximum Marks: 240**

**INSTRUCTIONS:**

**A. General**

1. This booklet is your Question Paper containing 60 questions.
2. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
3. Fill in the boxes provided for Name and Enrolment No.
4. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
5. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

**B. Filling in the OMR:**

6. The instructions for the OMR sheet are given on the OMR itself.

**C. Question paper format:**

7. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
8. **Section I** contains **8 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).
9. **Section II** contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
10. **Section III** contains **2 paragraphs** type questions. Each paragraph describes an experiment, a situation or a problem. Two multiple choice questions will be asked based on this paragraph. One or more than one option can be correct.

**D. Marking Scheme**

11. For each question in **Section I**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
12. For each question in **Section II**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–2 marks** will be awarded for incorrect answers in this section.
13. For each question in **Section III**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–2 marks** will be awarded for incorrect answers in this section.

**Don't write / mark your answers in this question booklet.**
**If you mark the answers in question booklet, you will not be allowed to continue the exam.**

**NAME:** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

**ENROLLMENT NO.:** ☐☐☐☐☐☐☐☐☐☐

# PAPER – II
# PART I: PHYSICS
## SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive
- For each question, darken the bubble corresponding to the correct integer in the ORS
- **Marking scheme:**
  - **+4** If the bubble corresponding to the answer is darkened
  - **0** In all other cases

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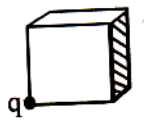
1. A ring of radius 0.1 m is made out of a thin metallic wire of area of cross –section $10^{-6}m^2$. The ring has a uniform charge of $\pi$ coulomb. The change in radius of ring when a charge of $10^{-8}c$ is placed at the centre of ring is $k\times10^{-3}m$. The 4k is equal to ( Young's modulus of metal is $2\times10^{11}\ N/m^2$)

2. A long non – conducting cylinder having volume charge density and varies as $\rho = kx^2$, where k is a constant. The electric field inside the cylinder is given as $\frac{kx^n}{a\varepsilon_0}$ then find n+a (where x is the distance from the axis of the cylinder )

3. The length of each side of cubical closed surface is $\ell$. If charge q is situated on one of the vertices of the cube, then the flux passing through shaded face of the cube is $\frac{q}{ab\varepsilon_0}$ then a + b = ?




4. A circular ring of radius R with uniform positive charge density $\lambda$ per unit length is fixed in the Y–Z plane with its centre at the origin O. A particle of mass m and positive charge q is projected from the point P $\left(\sqrt{3}R,0,0\right)$ on the positive X –axis directly towards O, with initial velocity v. The smallest value of the speed v such that the particle does not return to P is $\sqrt[n]{\frac{\lambda q}{a\varepsilon_0 m}}$ then na = ?

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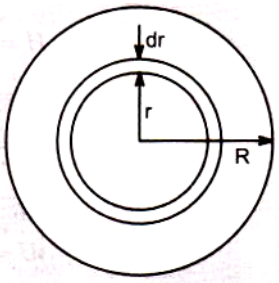
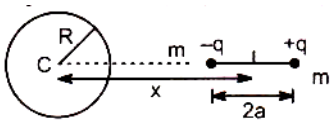
5. A spherical ball of radius R is uniformly charged with charge density $\rho$. The electrostatic energy of the sphere is equal to $\frac{AQ^2}{B\pi\varepsilon_0 R}$. Then Find $\left[\frac{B}{A}\right]$ here [ ] means integral part. Use $Q = \frac{4}{3}\pi R^3\rho$



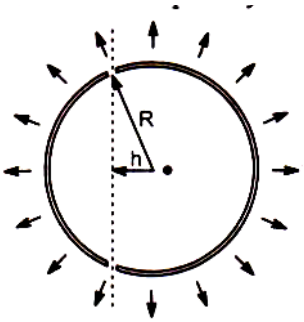

6. In fig shown an electric dipole lies at a distance x from the centre of axis of a charged ring of radius R with charge Q uniformly distributed over it



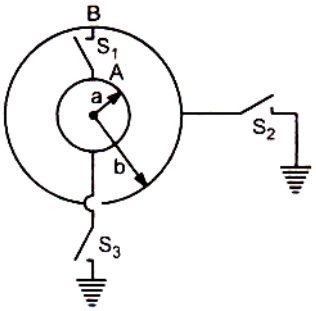

The net force acting on the dipole is $\frac{aQq}{A\pi\varepsilon_0}\left[\frac{R^2+Bx^2}{\left(R^2+x^2\right)^{5/2}}\right]$. Then

Find A + B = ?

7. Consider a metal sphere, of radius R that is cut in two along a plane whose minimum distance from the sphere's centre is h. Sphere is uniformly charged by a total electric charge Q. The force necessary to hold the two parts of the sphere together is $\frac{Q^2}{2^n\pi\varepsilon_0 R^4}\left[R^2-h^2\right]$. Find n




8. The figure shows a conducting sphere A radius 'a' is surrounded by a shell B of radius b (>a). Initially switches $S_1$, $S_2$ and $S_3$ are open and the sphere A carries a charge Q. First the switch $S_2$ is closed to connect the shell B with ground and then opened. Now the switch $S_3$ is closed so that the sphere A is grounded and then $S_2$ is opened. Finally the switch $S_3$ is closed to connect the spheres together .The total heat produced after closing the switch $S_1$ is given by $\frac{MQ^2a(b-a)}{N\pi\varepsilon_0 b^3}$. Then the value of $\left(\frac{N}{M}+1\right)$ is

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## SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- Each question has FOUR options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- **Marking scheme:**
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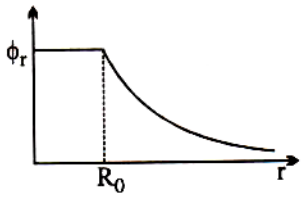
  - **0** If none of the bubbles is darkened
  - **–2** In all other cases

9. The electrostatic potential $(\phi_r)$ of a spherical symmetric system, kept at origin, is shown in the adjacent figure, and given as




$$\phi_r = \frac{q}{4\pi \in_0 r} \left(r \geq R_0\right)$$

$$\phi_r = \frac{q}{4\pi \in_0 R_0} \left(r \leq R_0\right)$$

Which of the following option(s) is/are correct ?

(A) For spherical region $r \leq R_0$, total electrostatic energy stored is zero.

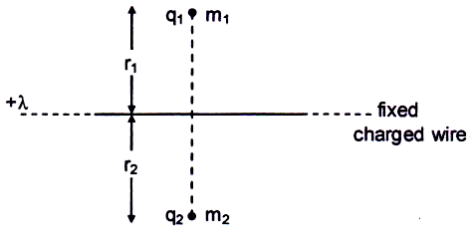
(B) Within $r = 2R_0$, total charge is q.

(C) There will be no charge any where except at $r = R_0$.

(D) Electric field is discontinuous at $r = R_0$.

10. When a positively charged sphere is brought near a metallic sphere, it is observed that a force of attraction exists between the two. It means that.
(A) the metallic sphere is necessarily negatively charged
(B) the metallic sphere my neutral
(C) the metallic sphere may be negatively charged
(D) none of the above

11. For the arrangement shown, the two point charges are in equilibrium. The infinite wire is fixed in the horizontal plane and the two point charges are placed one above and the other below the wire. Considering the gravitational effect of the earth, the nature of $q_1$ and $q_2$ can be




(A) $q_1 \to +ve,\ q_2 \to +ve$

(B) $q_1 \to +ve,\ q_2 \to -ve$

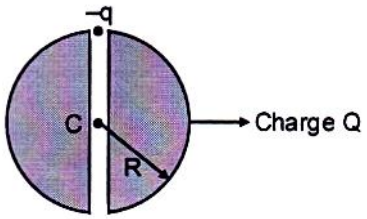
(C) $q_1 \to -ve,\ q_2 \to -ve$

(D) $q_1 \to -ve,\ q_2 \to +ve$

***space for rough work***

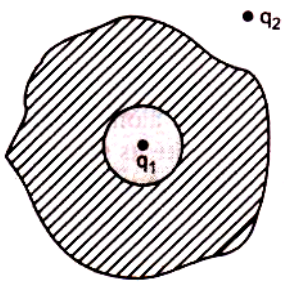
12. For Gauss's law, mark out the correct statement(s)
(A) if we displaced the enclosed charges (within a Gaussian surface) without crossing the boundary, then $\vec{E}$ and $\phi$ both remain same
(B) If we displace the enclosed charges without crossing the boundary, then $\vec{E}$ changes but $\phi$ remain the same
(C) If charge crosses the boundary, then both $\vec{E}$ and $\phi$ would change
(D) If charge crosses the boundary, then $\phi$ changes but $\vec{E}$ remains the same

13. In a uniformly charged dielectric sphere, a very thin tunnel has been made along the diameter as shown in figure below. A charge particle –q having mass m is released from rest at one end of the tunnel. For the situation described, mark out the correct statement(s). (neglect gravity)




(A) charge particle will perform SHM about center of the sphere as mean position
(B) time period of the particle is $2\pi\sqrt{\frac{2\pi\varepsilon_0 mR^3}{qQ}}$
(C) particle will perform oscillation but not SHM
(D) Speed of the particle while crossing mean position is $\sqrt{\frac{qQ}{4\pi\varepsilon_0 mR}}$

14. A point charge $q_1$ is placed in a cavity inside a conductor and another point charge $q_2$ is placed outside it as shown in fig. Which of the following statements are correct ?
(A) If $q_1$ is slightly shifted, the induced charge density on the inner surface of the cavity only changes
(B) If $q_1$ is slightly shifted, the induced charge density on the outer surface of the cavity only changes
(C) If $q_2$ is slightly shifted, the induced charge density on the inner surface of the cavity only changes
(D) If $q_2$ is slightly shifted, the induced charge density on the outer surface of the cavity only changes

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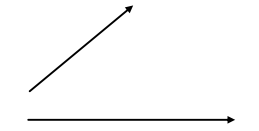
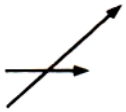
15. Each of the following figures shows electric field vectors at two places in an electric field. In which figure or figures can the illustrated field be created by a single point charge?



(A)

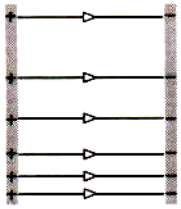
(B)

(C)



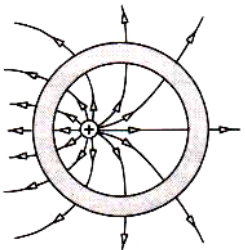
(D)

16. In the following figures, electric field lines of electrostatic fields are shown. Which of them are not correct representation ?



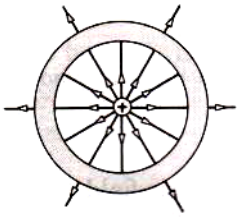
Two infinitely large charged layers

(A)



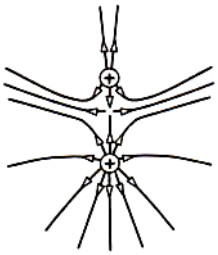
Point charge in a neutral conducting shell

(B)



Point charge in a neutral conducting shell

(C)



Two unequal point charges

(D)

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## SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
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  - **–2** In all other cases

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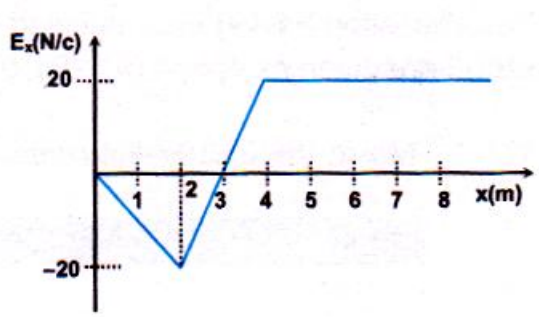
**Paragraph–1**

A graph of the x – component of the electric field as a function of x in a region of space is shown in the figure. The y and z – components of the electric field are zero in this region. The electric potential at the origin is 10 V




17. The electric potential at x = 2m is

(A) 10 V (B) 20 V (C) 30 V (D) 40 V

18. The greatest positive value of electric potential for points of the x – axis for which $0 \le x \le 6$ m is

A) 10 V (B) 20 V (C) 30 V (D) 40 V

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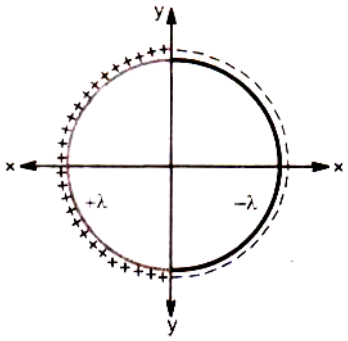
***space for rough work***

**Paragraph–2**

A thin ring of radius R metres is placed in x–y plane such that its centre lies on origin. The half ring in region x < 0 carries uniform linear charge density +λC/m and the remaining half ring in region x > 0 carries uniform linear charge density –λ C/m.




19. Then the direction of electric field at point P whose coordinates are $\left(0m,+\frac{R}{2}m\right)$ is

(A) Along positive x –direction (B) Along negative x –direction
(C) Along negative y –direction (D) None of these

20. The dipole moment of the ring in C–m is

(A) $-\left(2\pi R^2\lambda\right)\hat{i}$ (B) $\left(2\pi R^2\lambda\right)\hat{i}$ (C) $-\left(4R^2\lambda\right)\hat{i}$ (D) $\left(4R^2\lambda\right)\hat{i}$

# PART II: CHEMISTRY

## SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive
- For each question, darken the bubble corresponding to the correct integer in the ORS
- **Marking scheme:**
  - **+4** If the bubble corresponding to the answer is darkened
  - **0** In all other cases

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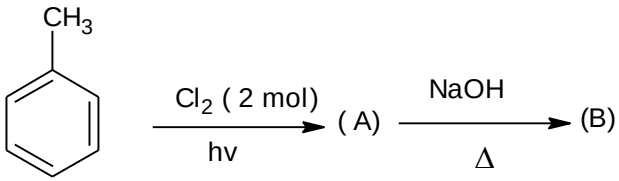
21.




The degree of unsaturation in (B) is

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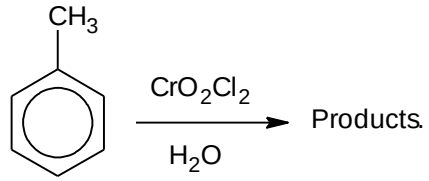
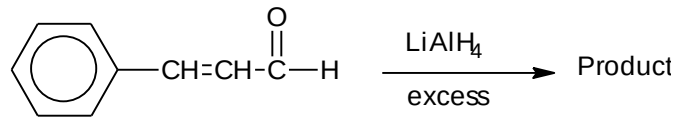
22. Consider all possible isomeric ketones, including steroisomer of MW = 100. All these isomers are independently reacted with $NaBH_4$. (Note : Stereoisomers are also reacted separately). The total number of ketones that give a racemic product(s)

23. $x\ H_3C-COCH_3 + y\ NaOH + z\ I_2 \longrightarrow$ products
Then (x + y + z) is :

24. How many of the following compounds shows positive iodoform test ?
$H_3C–CHO$, $HCHO$ , $H_3C–CH_2–COCH_2–CH_3$, $H_3C–COPh$, $CH_3–COOH$, $H_3C–COCH_2COOC_2H_5$, $CH_3–CH_2OH$, $H_3C–CH(OH)–CH_3$, $H_3C–CH(Cl)–CH_3$

25. 

The number of $\pi$ bonds in the product is equal to

26. 

The difference in the number of $\pi$ bonds between product and reactant.

27. The number of reagents we can select in preparation of benzaldehyde from benzyl alcohol
(i) Jones reagent (ii) $K_2Cr_2O_7$/conc. $H_2SO_4$ (iii) Collin's reagent
(iv) $MnO_2$ in Acetone (v) PDC
(vi) PCC (vii) $R–Li/H^+$ (viii) $NaIO_4/H^+$

28. Acetone when reacted with Ammonia derivative, yellow orange precipitate is formed. The number of $sp^2$ hybridised atoms in the precipitate is y. Then $\frac{y}{2}$ is

***space for rough work***

## SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
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29. When formaldehyde is treated with ammonia, the compound formed is :
(A) Urotropine (B) hexamethylene tetramine
(C) Bakelite (D) triethylene tetramine

30. Which of the following statements is correct ?
(A) Aldehydes and ketones contain polar carbonyl group
(B) Aldehydes and ketones undergo nucleophilic addition
(C) Aldehydes and ketones undergo electrophilic substitution
(D) Lower members of aldehydes and ketones are soluble in water due to hydrogen bonding.

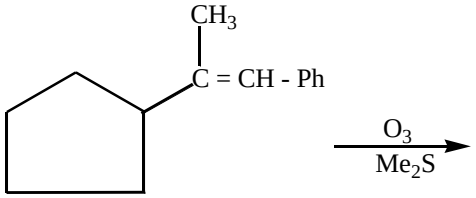
31. Cyclohexanol $\xrightarrow{PCC} A \xrightarrow{NH_2OH} B \xrightarrow{H^+} C$
Correct statement about 'C' is
(A) C is carboxylic acid (B) On hydrolysis C give amino acid
(C) A is cyclic ketone (D) C is cyclic amide having seven membered ring

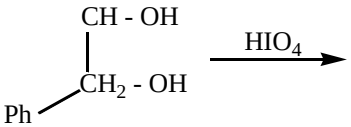
32. The reagents used to convert R–CN to R–CHO is/are :
(A) $NaBH_4$ (B) $SnCl_2/HCl$ (C) DIBAL–H (D) $CrO_3$

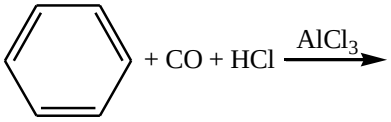
33. Which of the following compound major cannot be prepared by hydration of alkynes ?
(A) $H_3C–CHO$ (B) $H_3C–CH_2–CHO$
(C) $H_3C–COCH_3$ (D) HCHO

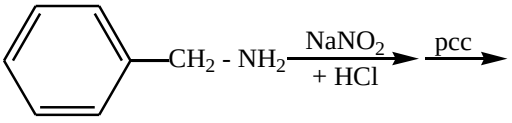
***space for rough work***

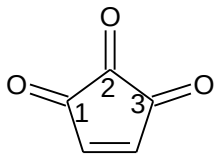
34. Which of the following reactions can produce benzaldehyde as major product?

(A) 


(B) 


(C) 


(D) 


35. 


Among the carbonyl groups 1, 2, 3 maked in this structure, the most reactive one towards nucleophilic addition reaction is

(A) 1 (B) 2 (C) 3 (D) none

36. Aldehyde is prepared by distillation of which of the following calcium salts

(A) $(RCOO)_2Ca$ (B) $(RCOO)_2Ca$ & $(HCOO)_2Ca$

(C) $(PhCOO)_2Ca$ and $(HCOO)_2Ca$ (D) $(HCOO)_2Ca$

## SECTION 3 (Maximum Marks: 16)

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***space for rough work***

**Paragraph–1**

Aldehydes & ketones undergo nucleophilic addition reactions which are goverened by the electrophilicity of the carbonyl carbon. The carbonyl group is polarized such that carbon is slightly negatively charged. Carbonyl compounds undergo a wide variety of reactions. Many of them are used fro synthesis of many useful organic compounds.

37. $Ph-CH=C(CH_3)COCH_3 \xrightarrow[H^+]{NaOCl} A+B$ ; A & B are

(A) Ph–CHO, $CHCl_3$ (B) $PhCH_2COCH_3$ , $CH_3COCl$

(C) $Ph-CH=C(CH_3)-CHCl_3$, $Cl_2$ (D) $Ph-CH=C(CH_3)-COOH$, $CHCl_3$

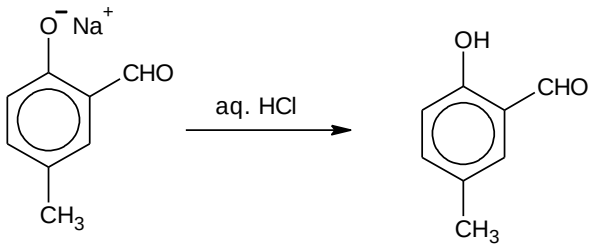
38. $Ph-CO-CH_3 \xrightarrow[H^{(+)}]{NH_2OH} A$ . A is

(A) Ph–CO–NH–$CH_3$ (B) $CH_3$–CO–NH–Ph

(C) Ph–CO–NH–Ph (D) $CH_3$–CO–NH–$CH_3$

**Paragraph–2**

Reimer Tiemann reaction introduces at aldehyde group on to the aromatic ring of phenol, ortho to the hydroxyl group. This involves Electropphilic aromatic substitution.




$(P)CH_3-Ph-OH \xrightarrow{Reagent}$ Intermediate

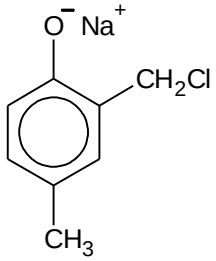
39. Which of the following reagents is used in the above reaction.

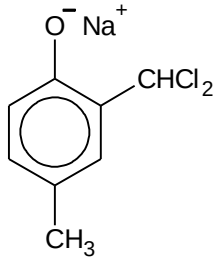
(A) aq. NaOH + $CH_3Cl$ (B) aq. NaOH + $CH_2Cl_2$

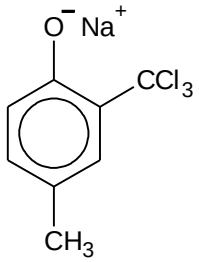
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + $CCl_4$

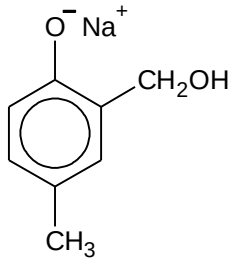
***space for rough work***

40. The structure of the intermediate is

(A) 


(B) 


(C) 


(D) 


# PART III: MATHEMATICS

## SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive
- For each question, darken the bubble corresponding to the correct integer in the ORS
- **Marking scheme:**
  - **+4** If the bubble corresponding to the answer is darkened
  - **0** In all other cases

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41. A circle $x^2 + y^2 + 4x - 2\sqrt{2}\,y + c = 0$ is the director circle of the circle $S_1$ and $S_1$ is the director circle of circle $S_2$, and so on. If the sum of radii of all these circles is 2, then the value of c is $k\sqrt{2}$, where the value of k is

42. Line segments AC and BD are diameters of the circle of radius one. If $\angle BDC = 60°$, the length of line segment AB is

43. If two perpendicular tangents can be drawn from the origin to the circle $x^2 - 6x + y^2 - 2py + 17 = 0$ then the value of |p| is

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***space for rough work***

44. The straight line $2x - 3y = 1$ divides the circular region $x^2 + y^2 \le 6$ into two parts. If $S = \left\{\left(2,\frac{3}{4}\right),\left(\frac{5}{2},\frac{3}{4}\right),\left(\frac{1}{4},\frac{1}{4}\right),\left(\frac{1}{8},\frac{1}{4}\right)\right\}$, then the number of point(s) in S lying inside the smaller part is

45. The coefficient of $x^9$ in the expansion of $(1 + x)(1 + x^2)(1 + x^3) ..... (1 + x^{100})$ is

46. The largest real value for x such that $\sum_{k=0}^{4}\left(\frac{3^{4-k}}{(4-k)!}\right)\left(\frac{x^k}{k!}\right) = \frac{32}{3}$ is

47. Let $1 + \sum_{r=1}^{10}\left(3^r \cdot {}^{10}C_r + r \cdot {}^{10}C_r\right) = 2^{10}\,(\alpha \,.\, 4^5 + \beta)$ where $\alpha, \beta \in N$ and $f(x) = x^2 - 2x - k^2 + 1$. If $\alpha, \beta$ lies between the roots of $f(x) = 0$, then find the smallest positive integral value of k.

48. The remainder, if $1 + 2 + 2^2 + 2^3 + ..... + 2^{1999}$ is divided by 5 is

## SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- Each question has FOUR options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- **Marking scheme:**
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is(are) darkened
  - **0** If none of the bubbles is darkened
  - **–2** In all other cases

49. $A\left(\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$ is a point on the circle $x^2 + y^2 = 1$ and B is another point on the circle such that arc length AB $= \frac{\pi}{2}$ units. Then, the coordinates of B can be

(A) $\left(\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$ (B) $\left(-\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$ (C) $\left(-\frac{1}{\sqrt{2}},-\frac{1}{\sqrt{2}}\right)$ (D) none of these

***space for rough work***

50. Point M moved on the circle $(x-4)^2 + (y-8)^2 = 20$. Then is broke away from it and moving along a tangent to the circle cut the x-axis at point (–2, 0). The coordinates of the point on the circle at which the moving point broke away is

(A) $\left(\frac{42}{5},\frac{36}{5}\right)$ (B) $\left(-\frac{2}{5},\frac{44}{5}\right)$ (C) (6, 4) (D) (2, 4)

51. A point $P\left(\sqrt{3},1\right)$ moves on the circle $x^2 + y^2 = 4$ and after covering a quarter of the circle leaves it tangentially. The equation of the line along which the point moves after leaving the circle is

(A) $y = \sqrt{3}x + 4$ (B) $\sqrt{3}\,y = x + 4$ (C) $y = \sqrt{3}\,x - 4$ (D) $\sqrt{3}\,y = x - 4$

52. The range of values of a such that angle $\theta$ between the pair of tangents drawn from (a, 0) to the circle $x^2 + y^2 = 1$ satisfies $\frac{\pi}{2} < \theta < \pi$ is

(A) (1, 2) (B) $\left(1,\sqrt{2}\right)$ (C) $\left(-\sqrt{2},-1\right)$ (D) (–2, –1)

53. Let P be any moving point on the circle $x^2 + y^2 - 2x = 1$. AB be the chord of contact of this point w.r.t the circle $x^2 + y^2 - 2x = 0$. The locus of the circumcentre of triangle CAB (C being the centre of the circle) is

(A) $2x^2 + 2y^2 - 4x + 1 = 0$ (B) $x^2 + y^2 - 4x + 2 = 0$
(C) $x^2 + y^2 - 4x + 1 = 0$ (D) $2x^2 + 2y^2 - 4x + 3 = 0$

54. The locus of the midpoints of the chords of the circle $x^2 + y^2 - ax - by = 0$ which subtend a right angle at $\left(\frac{a}{2},\frac{b}{2}\right)$ is

(A) $ax + by = 0$ (B) $ax + by = a^2 + b^2$
(C) $x^2 + y^2 - ax - by + \frac{a^2+b^2}{8} = 0$ (D) $x^2 + y^2 - ax - by - \frac{a^2+b^2}{8} = 0$

55. Let ABCD be a quadrilateral with area 18, with side AB parallel to the side CD, and AB = 2CD. Let AD be perpendicular to AB and CD. If a circle is drawn inside the quadrilateral ABCD touching all the sides, then its radius is

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

***space for rough work***

56. The circle $x^2 + y^2 = 4$ cuts the line joining the points A(1, 0) and B(3, 4) at two points, P and Q. Let $\frac{BP}{PA} = \alpha$ and $\frac{BQ}{QA} = \beta$. Then $\alpha$ and $\beta$ are the roots of the quadratic equation

(A) $3x^2 + 2x - 21 = 0$ (B) $3x^2 + 2x + 21 = 0$ (C) $2x^2 + 3x - 21 = 0$ (D) none of these

## SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- **Marking scheme:**
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is(are) darkened
  - **0** If none of the bubbles is darkened
  - **–2** In all other cases

### Paragraph–1

Tangents PA and PB are drawn to the circle $(x - 4)^2 + (y - 5)^2 = 4$ from the point P on the curve $y = \sin x$, where A and B lie on the circle. Consider the function $y = f(x)$ represented by the locus of the centre of the circumcircle of triangle PAB. Then answer the following questions.

57. The range of $y = f(x)$ is

(A) [–2, 1] (B) [–1, 4] (C) [0, 2] (D) [2, 3]

58. Which of the following is true ?

(A) $f(x) = 4$ has real roots (B) $f(x) = 1$ has real roots

(C) the range of $y = f^{-1}(x)$ is $\left[-\frac{\pi}{4} + 2, \frac{\pi}{4} + 2\right]$ (D) none of these

***space for rough work***

**Paragraph–2**

P is a variable point on the line L = 0. Tangents are drawn to the circle $x^2 + y^2 = 4$ from P to touch it at Q and R. The parallelogram PQSR is completed.

59. If $L \equiv 2x + y - 6 = 0$, then the locus of the circumcentre of $\Delta PQR$ is
(A) $2x - y = 4$ (B) $2x + y = 3$ (C) $x - 2y = 4$ (D) $x + 2y = 3$

60. If $P \equiv (6, 8)$, then the area of $\Delta QRS$ is
(A) $\frac{\sqrt[3]{6}}{25}$ sq. units (B) $\frac{\sqrt[3]{24}}{25}$ sq. units (C) $\frac{48\sqrt{6}}{25}$ sq. units (D) $\frac{192\sqrt{6}}{25}$ sq. units

***space for rough work***

# FIITJEE RET – 4

## (2017 – 2019)(2ND YEAR_REGULAR)

## IIT-2015 (P2)_SET–A

## DATE: 02.07.2018

## ANSWERS

**PHYSICS**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | **9** | 2. | **7** | 3. | **6** | 4. | **4** |
| 5. | **6** | 6. | **0** | 7. | **5** | 8. | **9** |
| 9. | **ABCD** | 10. | **BC** | 11. | **BC** | 12. | **BC** |
| 13. | **AD** | 14. | **AD** | 15. | **AC** | 16. | **ABC** |
| 17. | **C** | 18. | **D** | 19. | **A** | 20. | **C** |

**CHEMISTRY**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21. | **5** | 22. | **5** | 23. | **8** | 24. | **6** |
| 25. | **4** | 26. | **2** | 27. | **4** | 28. | **5** |
| 29. | **A, B** | 30. | **A, B, D** | 31. | **B, C, D** | 32. | **B, C** |
| 33. | **B, D** | 34. | **A, B, C,D** | 35. | **B** | 36. | **B, C, D** |
| 37. | **A,B** | 38. | **B** | 39. | **C** | 40. | **B** |

**MATHEMATICS**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 41. | **4** | 42. | **1** | 43. | **5** | 44. | **1** |
| 45. | **8** | 46. | **1** | 47. | **5** | 48. | **0** |
| 49. | **B** | 50. | **BC** | 51. | **BD** | 52. | **BC** |
| 53. | **A** | 54. | **C** | 55. | **B** | 56. | **A** |
| 57. | **D** | 58. | **C** | 59. | **B** | 60. | **D** |

# FIITJEE RET – 4

## (2017 – 2019)(2ND YEAR_REGULAR)

## IIT-2015 (P2)_SET–B

## DATE: 02.07.2018

**Time: 3 hours** **Maximum Marks: 240**

**INSTRUCTIONS:**

**A. General**

1. This booklet is your Question Paper containing 60 questions.
6. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
7. Fill in the boxes provided for Name and Enrolment No.
8. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
9. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

**B. Filling in the OMR:**

6. The instructions for the OMR sheet are given on the OMR itself.

**C. Question paper format:**

14. The question paper consists of **3 parts (Physics, Chemistry and Mathematics)**. Each part consists of **two sections**.
15. **Section I** contains **8 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).
16. **Section II** contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.
17. **Section III** contains **2 paragraphs** type questions. Each paragraph describes an experiment, a situation or a problem. Two multiple choice questions will be asked based on this paragraph. One or more than one option can be correct.

**D. Marking Scheme**

18. For each question in **Section I**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **No negative marks** will be awarded for incorrect answers in this section.
19. For each question in **Section II**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–2 marks** will be awarded for incorrect answers in this section.
20. For each question in **Section III**, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY**. In all other cases **zero (0) marks** will be awarded. **–2 marks** will be awarded for incorrect answers in this section.

**Don't write / mark your answers in this question booklet.**
**If you mark the answers in question booklet, you will not be allowed to continue the exam.**

**NAME:** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

**ENROLLMENT NO.:** ☐☐☐☐☐☐☐☐☐☐

# PAPER – II
# PART I: PHYSICS
## SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive
- For each question, darken the bubble corresponding to the correct integer in the ORS
- **Marking scheme:**
  - **+4** If the bubble corresponding to the answer is darkened
  - **0** In all other cases

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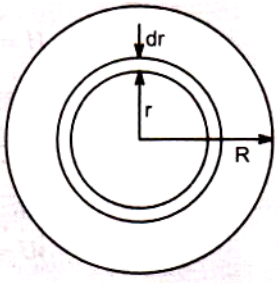
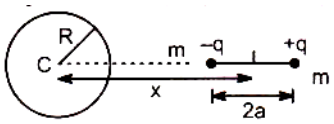
1. A spherical ball of radius R is uniformly charged with charge density $\rho$.




The electrostatic energy of the sphere is equal to $\frac{AQ^2}{B\pi\varepsilon_0 R}$. Then Find $\left[\frac{B}{A}\right]$

here [ ] means integral part. Use $Q = \frac{4}{3}\pi R^3\rho$

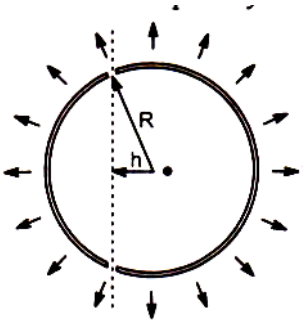
2. In fig shown an electric dipole lies at a distance x from the centre of axis of a charged ring of radius R with charge Q uniformly distributed over it




The net force acting on the dipole is $\frac{aQq}{A\pi\varepsilon_0}\left[\frac{R^2+Bx^2}{\left(R^2+x^2\right)^{5/2}}\right]$. Then

Find A + B = ?

3. Consider a metal sphere, of radius R that is cut in two along a plane whose minimum distance from the sphere's centre is h. Sphere is uniformly charged by a total electric charge Q. The force necessary to hold the two parts of the sphere together is $\frac{Q^2}{2^n\pi\varepsilon_0 R^4}\left[R^2-h^2\right]$. Find n

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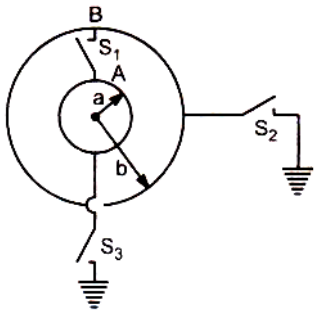
***space for rough work***

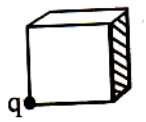
4. The figure shows a conducting sphere A radius 'a' is surrounded by a shell B of radius b (>a). Initially switches $S_1$, $S_2$ and $S_3$ are open and the sphere A carries a charge Q. First the switch $S_2$ is closed to connect the shell B with ground and then opened. Now the switch $S_3$ is closed so that the sphere A is grounded and then $S_2$ is opened. Finally the switch $S_3$ is closed to connect the spheres together .The total heat produced after closing the switch $S_1$ is given by $\frac{MQ^2a(b-a)}{N\pi\varepsilon_0 b^3}$. Then the value of $\left(\frac{N}{M}+1\right)$ is




5. A ring of radius 0.1 m is made out of a thin metallic wire of area of cross –section $10^{-6}m^2$. The ring has a uniform charge of $\pi$ coulomb. The change in radius of ring when a charge of $10^{-8}c$ is placed at the centre of ring is $k\times10^{-3}m$. The 4k is equal to ( Young's modulus of metal is $2\times10^{11}\ N/m^2$)

6. A long non – conducting cylinder having volume charge density and varies as $\rho = kx^2$, where k is a constant. The electric field inside the cylinder is given as $\frac{kx^n}{a\varepsilon_0}$ then find n+a (where x is the distance from the axis of the cylinder )

7. The length of each side of cubical closed surface is $\ell$. If charge q is situated on one of the vertices of the cube, then the flux passing through shaded face of the cube is $\frac{q}{ab\varepsilon_0}$ then a + b = ?



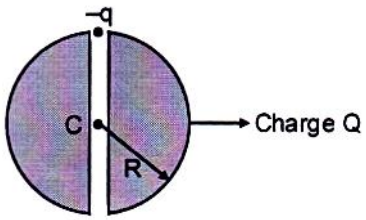

8. A circular ring of radius R with uniform positive charge density $\lambda$ per unit length is fixed in the Y–Z plane with its centre at the origin O. A particle of mass m and positive charge q is projected from the point P $\left(\sqrt{3}R,0,0\right)$ on the positive X –axis directly towards O, with initial velocity v. The smallest value of the speed v such that the particle does not return to P is $\sqrt[n]{\frac{\lambda q}{a\varepsilon_0 m}}$ then na = ?

***space for rough work***

## SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- Each question has FOUR options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- **Marking scheme:**
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is(are) darkened
  - **0** If none of the bubbles is darkened
  - **–2** In all other cases

9. In a uniformly charged dielectric sphere, a very thin tunnel has been made along the diameter as shown in figure below. A charge particle –q having mass m is released from rest at one end of the tunnel. For the situation described, mark out the correct statement(s). (neglect gravity)



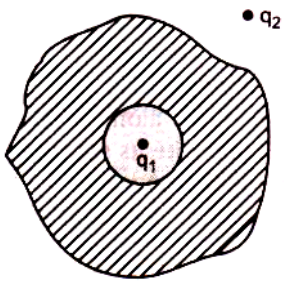

(A) charge particle will perform SHM about center of the sphere as mean position

(B) time period of the particle is $2\pi\sqrt{\frac{2\pi\varepsilon_0 mR^3}{qQ}}$

(C) particle will perform oscillation but not SHM

(D) Speed of the particle while crossing mean position is $\sqrt{\frac{qQ}{4\pi\varepsilon_0 mR}}$

10. A point charge $q_1$ is placed in a cavity inside a conductor and another point charge $q_2$ is placed outside it as shown in fig. Which of the following statements are correct ?




(A) If $q_1$ is slightly shifted, the induced charge density on the inner surface of the cavity only changes

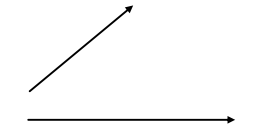
(B) If $q_1$ is slightly shifted, the induced charge density on the outer surface of the cavity only changes

(C) If $q_2$ is slightly shifted, the induced charge density on the inner surface of the cavity only changes

(D) If $q_2$ is slightly shifted, the induced charge density on the outer surface of the cavity only changes

***space for rough work***

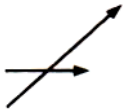
11. Each of the following figures shows electric field vectors at two places in an electric field. In which figure or figures can the illustrated field be created by a single point charge?



(A)

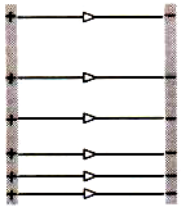
(B)

(C)



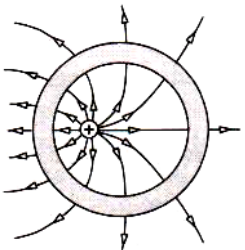
(D)

12. In the following figures, electric field lines of electrostatic fields are shown. Which of them are not correct representation ?



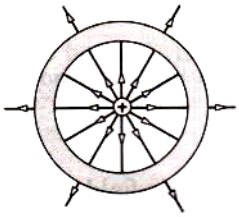
Two infinitely large charged layers

(A)



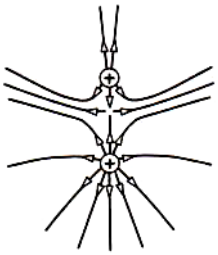
Point charge in a neutral conducting shell

(B)



Point charge in a neutral conducting shell

(C)

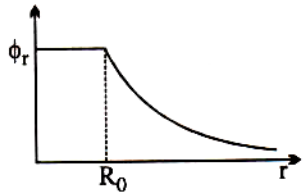


Two unequal point charges

(D)

***space for rough work***

13. The electrostatic potential $(\phi_r)$ of a spherical symmetric system, kept at origin, is shown in the adjacent figure, and given as




$$\phi_r = \frac{q}{4\pi \in_0 r} \left(r \geq R_0\right)$$

$$\phi_r = \frac{q}{4\pi \in_0 R_0} \left(r \leq R_0\right)$$

Which of the following option(s) is/are correct ?

(A) For spherical region $r \leq R_0$, total electrostatic energy stored is zero.

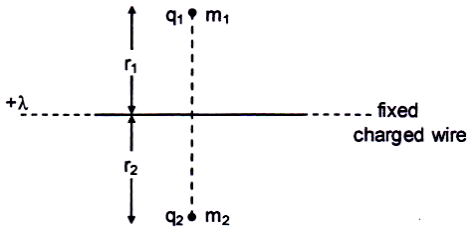
(B) Within $r = 2R_0$, total charge is q.

(C) There will be no charge any where except at $r = R_0$.

(D) Electric field is discontinuous at $r = R_0$.

14. When a positively charged sphere is brought near a metallic sphere, it is observed that a force of attraction exists between the two. It means that.
(A) the metallic sphere is necessarily negatively charged
(B) the metallic sphere my neutral
(C) the metallic sphere may be negatively charged
(D) none of the above

15. For the arrangement shown, the two point charges are in equilibrium. The infinite wire is fixed in the horizontal plane and the two point charges are placed one above and the other below the wire. Considering the gravitational effect of the earth, the nature of $q_1$ and $q_2$ can be




(A) $q_1 \rightarrow +ve,\ q_2 \rightarrow +ve$

(B) $q_1 \rightarrow +ve,\ q_2 \rightarrow -ve$

(C) $q_1 \rightarrow -ve,\ q_2 \rightarrow -ve$

(D) $q_1 \rightarrow -ve,\ q_2 \rightarrow +ve$

***space for rough work***

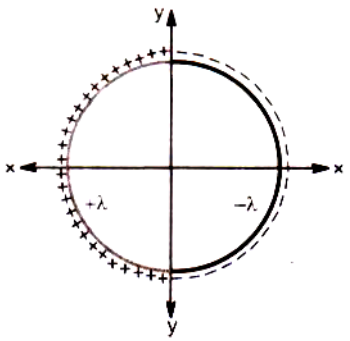
16. For Gauss's law, mark out the correct statement(s)
(A) if we displaced the enclosed charges (within a Gaussian surface) without crossing the boundary, then $\vec{E}$ and $\phi$ both remain same
(B) If we displace the enclosed charges without crossing the boundary, then $\vec{E}$ changes but $\phi$ remain the same
(C) If charge crosses the boundary, then both $\vec{E}$ and $\phi$ would change
(D) If charge crosses the boundary, then $\phi$ changes but $\vec{E}$ remains the same

## SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- **Marking scheme:**
  - **+4** If only the bubble(s) corresponding to all the correct option(s) is(are) darkened
  - **0** If none of the bubbles is darkened
  - **–2** In all other cases

### Paragraph–1

A thin ring of radius R metres is placed in x–y plane such that its centre lies on origin. The half ring in region x < 0 carries uniform linear charge density +λC/m and the remaining half ring in region x > 0 carries uniform linear charge density –λ C/m.



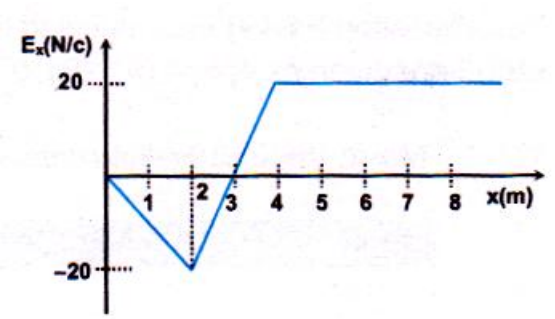

17. Then the direction of electric field at point P whose coordinates are $\left(0m, +\frac{R}{2}m\right)$ is
(A) Along positive x –direction
(B) Along negative x –direction
(C) Along negative y –direction
(D) None of these

18. The dipole moment of the ring in C–m is
(A) $-\left(2\pi R^2\lambda\right)\hat{i}$ (B) $\left(2\pi R^2\lambda\right)\hat{i}$ (C) $-\left(4R^2\lambda\right)\hat{i}$ (D) $\left(4R^2\lambda\right)\hat{i}$

***space for rough work***

**Paragraph–2**

A graph of the x – component of the electric field as a function of x in a region of space is shown in the figure. The y and z – components of the electric field are zero in this region. The electric potential at the origin is 10 V




19. The electric potential at x = 2m is

(A) 10 V (B) 20 V (C) 30 V (D) 40 V

20. The greatest positive value of electric potential for points of the x – axis for which $0 \le x \le 6$ m is

A) 10 V (B) 20 V (C) 30 V (D) 40 V

# PART II: CHEMISTRY

## SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive
- For each question, darken the bubble corresponding to the correct integer in the ORS
- **Marking scheme:**

**+4** If the bubble corresponding to the answer is darkened
**0** In all other cases

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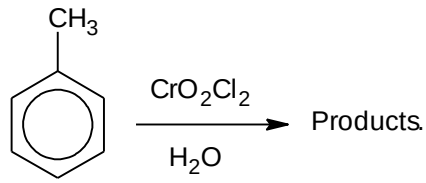
21.




The number of $\pi$ bonds in the product is equal to

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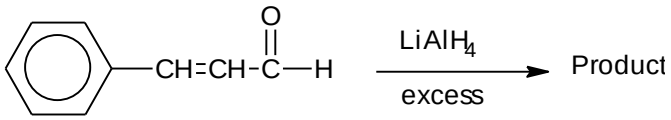
***space for rough work***

22.

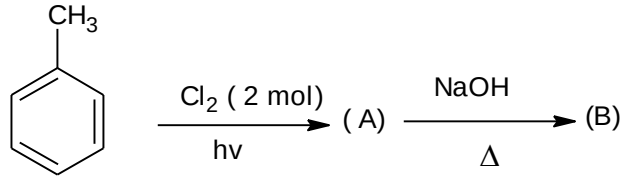



The difference in the number of $\pi$ bonds between product and reactant.

23. The number of reagents we can select in preparation of benzaldehyde from benzyl alcohol
(i) Jones reagent (ii) $K_2Cr_2O_7$/conc. $H_2SO_4$ (iii) Collin's reagent
(iv) $MnO_2$ in Acetone (v) PDC
(vi) PCC (vii) $R–Li/H^+$ (viii) $NaIO_4/H^+$

24. Acetone when reacted with Ammonia derivative, yellow orange precipitate is formed. The number of $sp^2$ hybridised atoms in the precipitate is y. Then $\frac{y}{2}$ is

25.




The degree of unsaturation in (B) is

26. Consider all possible isomeric ketones, including steroisomer of MW = 100. All these isomers are independently reacted with $NaBH_4$. (Note : Stereoisomers are also reacted separately). The total number of ketones that give a racemic product(s)

27. $x\ H_3C-COCH_3 + y\ NaOH + z\ I_2 \longrightarrow$ products
Then (x + y + z) is :

28. How many of the following compounds shows positive iodoform test ?
$H_3C–CHO$, $HCHO$ , $H_3C–CH_2–COCH_2–CH_3$, $H_3C–COPh$, $CH_3–COOH$, $H_3C–COCH_2COOC_2H_5$, $CH_3–CH_2OH$, $H_3C–CH(OH)–CH_3$, $H_3C–CH(Cl)–CH_3$

***space for rough work***

## SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- Each question has FOUR options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
- **Marking scheme:**
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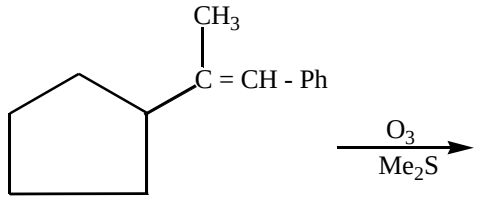
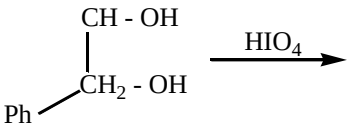
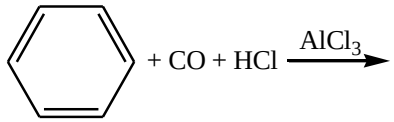
  - **–2** In all other cases

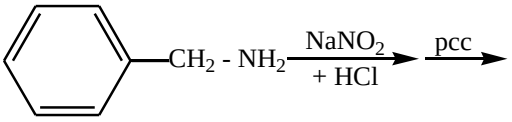
29. Which of the following compound major cannot be prepared by hydration of alkynes ?
(A) $H_3C–CHO$ (B) $H_3C–CH_2–CHO$
(C) $H_3C–COCH_3$ (D) HCHO

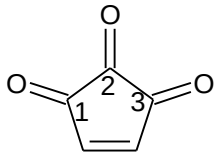
30. Which of the following reactions can produce benzaldehyde as major product?

(A) 


(B) 


(C) 


(D) 


31. 


Among the carbonyl groups 1, 2, 3 maked in this structure, the most reactive one towards nucleophilic addition reaction is
(A) 1 (B) 2 (C) 3 (D) none

***space for rough work***

32. Aldehyde is prepared by distillation of which of the following calcium salts
(A) $(RCOO)_2Ca$ (B) $(RCOO)_2Ca$ & $(HCOO)_2Ca$
(C) $(PhCOO)_2Ca$ and $(HCOO)_2Ca$ (D) $(HCOO)_2Ca$

33. When formaldehyde is treated with ammonia, the compound formed is :
(A) Urotropine (B) hexamethylene tetramine
(C) Bakelite (D) triethylene tetramine

34. Which of the following statements is correct ?
(A) Aldehydes and ketones contain polar carbonyl group
(B) Aldehydes and ketones undergo nucleophilic addition
(C) Aldehydes and ketones undergo electrophilic substitution
(D) Lower members of aldehydes and ketones are soluble in water due to hydrogen bonding.

35. Cyclohexanol $\xrightarrow{PCC} A \xrightarrow{NH_2OH} B \xrightarrow{H^+} C$
Correct statement about 'C' is
(A) C is carboxylic acid (B) On hydrolysis C give amino acid
(C) A is cyclic ketone (D) C is cyclic amide having seven membered ring

36. The reagents used to convert R–CN to R–CHO is/are :
(A) $NaBH_4$ (B) $SnCl_2/HCl$ (C) DIBAL–H (D) $CrO_3$

## SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** paragraphs
- Based on each paragraph, there will be **TWO** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct
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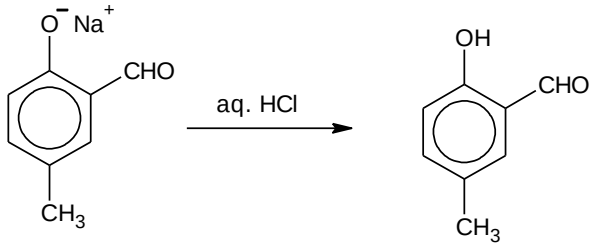
  - **–2** In all other cases

***space for rough work***

**Paragraph–1**

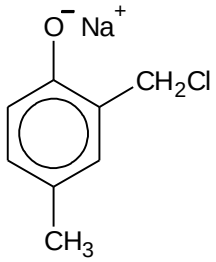
Reimer Tiemann reaction introduces at aldehyde group on to the aromatic ring of phenol, ortho to the hydroxyl group. This involves Electropphilic aromatic substitution.

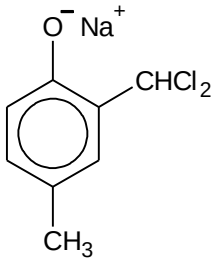


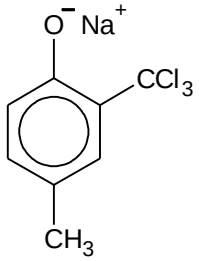

$(P)CH_3 - Ph - OH \xrightarrow{\text{Reagent}} \text{Intermediate}$

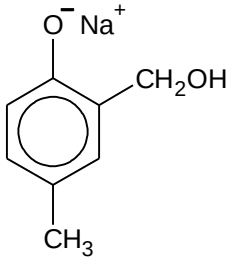
37. Which of the following reagents is used in the above reaction.
(A) aq. NaOH + $CH_3Cl$ (B) aq. NaOH + $CH_2Cl_2$
(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + $CCl_4$

38. The structure of the intermediate is

(A) 


(B) 


(C) 


(D) 


***space for rough work***

**Paragraph–2**

Aldehydes & ketones undergo nucleophilic addition reactions which are goverened by the electrophilicity of the carbonyl carbon. The carbonyl group is polarized such that carbon is slightly negatively charged. Carbonyl compounds undergo a wide variety of reactions. Many of them are used fro synthesis of many useful organic compounds.

39. $Ph-CH=C(CH_3)COCH_3 \xrightarrow[H^+]{NaOCl} A+B$ ; A & B are

(A) Ph–CHO, $CHCl_3$ (B) $PhCH_2COCH_3$ , $CH_3COCl$

(C) $Ph-CH=C(CH_3)-CHCl_3$, $Cl_2$ (D) $Ph-CH=C(CH_3)-COOH$, $CHCl_3$

40. $Ph-CO-CH_3 \xrightarrow[H^{(+)}]{NH_2OH} A$ . A is

(A) Ph–CO–NH–$CH_3$ (B) $CH_3$–CO–NH–Ph

(C) Ph–CO–NH–Ph (D) $CH_3$–CO–NH–$CH_3$

# PART III: MATHEMATICS

## SECTION 1 (Maximum Marks: 32)

- This section contains **EIGHT** questions
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from **0 to 9**, both inclusive
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  - **+4** If the bubble corresponding to the answer is darkened
  - **0** In all other cases

41. The coefficient of $x^9$ in the expansion of $(1 + x)(1 + x^2)(1 + x^3)$ ..... $(1 + x^{100})$ is

42. The largest real value for x such that $\sum_{k=0}^{4}\left(\frac{3^{4-k}}{(4-k)!}\right)\left(\frac{x^k}{k!}\right)=\frac{32}{3}$ is

***space for rough work***

43. Let $1 + \sum_{r=1}^{10}\left(3^r \cdot {}^{10}C_r + r \cdot {}^{10}C_r\right) = 2^{10}(\alpha \cdot 4^5 + \beta)$ where $\alpha, \beta \in N$ and $f(x) = x^2 - 2x - k^2 + 1$. If $\alpha, \beta$ lies between the roots of $f(x) = 0$, then find the smallest positive integral value of k.

44. The remainder, if $1 + 2 + 2^2 + 2^3 + ..... + 2^{1999}$ is divided by 5 is

45. A circle $x^2 + y^2 + 4x - 2\sqrt{2}y + c = 0$ is the director circle of the circle $S_1$ and $S_1$ is the director circle of circle $S_2$, and so on. If the sum of radii of all these circles is 2, then the value of c is $k\sqrt{2}$, where the value of k is

46. Line segments AC and BD are diameters of the circle of radius one. If $\angle BDC = 60°$, the length of line segment AB is

47. If two perpendicular tangents can be drawn from the origin to the circle $x^2 - 6x + y^2 - 2py + 17 = 0$ then the value of |p| is

48. The straight line $2x - 3y = 1$ divides the circular region $x^2 + y^2 \le 6$ into two parts. If $S = \left\{\left(2,\frac{3}{4}\right),\left(\frac{5}{2},\frac{3}{4}\right),\left(\frac{1}{4},\frac{1}{4}\right),\left(\frac{1}{8},\frac{1}{4}\right)\right\}$, then the number of point(s) in S lying inside the smaller part is

## SECTION 2 (Maximum Marks: 32)

- This section contains **EIGHT** questions
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  - **0** If none of the bubbles is darkened
  - **–2** In all other cases

49. Let P be any moving point on the circle $x^2 + y^2 - 2x = 1$. AB be the chord of contact of this point w.r.t the circle $x^2 + y^2 - 2x = 0$. The locus of the circumcentre of triangle CAB (C being the centre of the circle) is
(A) $2x^2 + 2y^2 - 4x + 1 = 0$ (B) $x^2 + y^2 - 4x + 2 = 0$
(C) $x^2 + y^2 - 4x + 1 = 0$ (D) $2x^2 + 2y^2 - 4x + 3 = 0$

***space for rough work***

50. The locus of the midpoints of the chords of the circle $x^2 + y^2 - ax - by = 0$ which subtend a right angle at $\left(\frac{a}{2}, \frac{b}{2}\right)$ is

(A) $ax + by = 0$ (B) $ax + by = a^2 + b^2$

(C) $x^2 + y^2 - ax - by + \frac{a^2 + b^2}{8} = 0$ (D) $x^2 + y^2 - ax - by - \frac{a^2 + b^2}{8} = 0$

51. Let ABCD be a quadrilateral with area 18, with side AB parallel to the side CD, and AB = 2CD. Let AD be perpendicular to AB and CD. If a circle is drawn inside the quadrilateral ABCD touching all the sides, then its radius is

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

52. The circle $x^2 + y^2 = 4$ cuts the line joining the points A(1, 0) and B(3, 4) at two points, P and Q. Let $\frac{BP}{PA} = \alpha$ and $\frac{BQ}{QA} = \beta$. Then $\alpha$ and $\beta$ are the roots of the quadratic equation

(A) $3x^2 + 2x - 21 = 0$ (B) $3x^2 + 2x + 21 = 0$ (C) $2x^2 + 3x - 21 = 0$ (D) none of these

53. $A\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ is a point on the circle $x^2 + y^2 = 1$ and B is another point on the circle such that arc length AB $= \frac{\pi}{2}$ units. Then, the coordinates of B can be

(A) $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ (B) $\left(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ (C) $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$ (D) none of these

54. Point M moved on the circle $(x - 4)^2 + (y - 8)^2 = 20$. Then is broke away from it and moving along a tangent to the circle cut the x-axis at point (–2, 0). The coordinates of the point on the circle at which the moving point broke away is

(A) $\left(\frac{42}{5}, \frac{36}{5}\right)$ (B) $\left(-\frac{2}{5}, \frac{44}{5}\right)$ (C) (6, 4) (D) (2, 4)

***space for rough work***

55. A point $P\left(\sqrt{3},1\right)$ moves on the circle $x^2 + y^2 = 4$ and after covering a quarter of the circle leaves it tangentially. The equation of the line along which the point moves after leaving the circle is
(A) $y = \sqrt{3}x + 4$ (B) $\sqrt{3}\,y = x + 4$ (C) $y = \sqrt{3}\,x - 4$ (D) $\sqrt{3}\,y = x - 4$

56. The range of values of a such that angle $\theta$ between the pair of tangents drawn from (a, 0) to the circle $x^2 + y^2 = 1$ satisfies $\frac{\pi}{2} < \theta < \pi$ is
(A) (1, 2) (B) $\left(1,\sqrt{2}\right)$ (C) $\left(-\sqrt{2},-1\right)$ (D) (–2, –1)

## SECTION 3 (Maximum Marks: 16)

- This section contains **TWO** paragraphs
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**Paragraph–1**

P is a variable point on the line L = 0. Tangents are drawn to the circle $x^2 + y^2 = 4$ from P to touch it at Q and R. The parallelogram PQSR is completed.

57. If $L \equiv 2x + y - 6 = 0$, then the locus of the circumcentre of $\Delta PQR$ is
(A) 2x – y = 4 (B) 2x + y = 3 (C) x – 2y = 4 (D) x + 2y = 3

58. If $P \equiv (6, 8)$, then the area of $\Delta QRS$ is
(A) $\frac{\sqrt[3]{6}}{25}$ sq. units (B) $\frac{\sqrt[3]{24}}{25}$ sq. units (C) $\frac{48\sqrt{6}}{25}$ sq. units (D) $\frac{192\sqrt{6}}{25}$ sq. units

***space for rough work***

**Paragraph–2**

Tangents PA and PB are drawn to the circle $(x-4)^2 + (y-5)^2 = 4$ from the point P on the curve $y = \sin x$, where A and B lie on the circle. Consider the function $y = f(x)$ represented by the locus of the centre of the circumcircle of triangle PAB. Then answer the following questions.

59. The range of $y = f(x)$ is
(A) $[-2, 1]$ (B) $[-1, 4]$ (C) $[0, 2]$ (D) $[2, 3]$

60. Which of the following is true ?
(A) $f(x) = 4$ has real roots (B) $f(x) = 1$ has real roots
(C) the range of $y = f^{-1}(x)$ is $\left[-\frac{\pi}{4}+2, \frac{\pi}{4}+2\right]$ (D) none of these

***pace for rough work***

# FIITJEE RET – 4

## (2017 – 2019)(2ND YEAR_REGULAR)

## IIT-2015 (P2)_SET–B

## DATE: 02.07.2018

## ANSWERS

**PHYSICS**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | **6** | 2. | **0** | 3. | **5** | 4. | **9** |
| 5. | **9** | 6. | **7** | 7. | **6** | 8. | **4** |
| 9. | **AD** | 10. | **AD** | 11. | **AC** | 12. | **ABC** |
| 13 | **ABCD** | 14. | **BC** | 15. | **BC** | 16. | **BC** |
| 17. | **A** | 18. | **C** | 19. | **C** | 20. | **D** |

**CHEMISTRY**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21. | **4** | 22. | **2** | 23. | **4** | 24. | **5** |
| 25. | **5** | 26. | **5** | 27. | **8** | 28. | **6** |
| 29. | **B, D** | 30. | **A, B, C,D** | 31. | **B** | 32. | **B, C, D** |
| 33. | **A, B** | 34. | **A, B, D** | 35. | **B, C, D** | 36. | **B, C** |
| 37. | **C** | 38. | **B** | 39. | **A,B** | 40. | **B** |

**MATHEMATICS**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 41. | **8** | 42. | **1** | 43. | **5** | 44. | **0** |
| 45. | **4** | 46. | **1** | 47. | **5** | 48. | **1** |
| 49. | **A** | 50. | **C** | 51. | **B** | 52. | **A** |
| 53. | **B** | 54. | **BC** | 55. | **BD** | 56. | **BC** |
| 57. | **B** | 58. | **D** | 59. | **D** | 60. | **C** |