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GRAND TEST

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Time: 2.00 PM to 5.00 PM **Max Marks:198**

Syllabus

Physics	**:**	**Total Syllabus**
Chemistry	**:**	**Total Syllabus**
Maths	**:**	**Total Syllabus**

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PAPER-II
JEE-ADVANCED

Time: 3:00 **IMPORTANT INSTRUCTIONS** **Max Marks: 198**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 8)	Questions with Single Correct Choice	3	-1	8	24
Sec – II(Q.N : 9 – 15)	Questions with Comprehension Type (3 Comprehensions : 2+2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 16 – 20)	Questions with Multiple Correct Choice	4	0	6	24
Total				**20**	**66**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 28)	Questions with Single Correct Choice	3	-1	8	24
Sec – II(Q.N : 29 – 34)	Questions with Comprehension Type (3 Comprehensions : 2+2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 35 – 40)	Questions with Multiple Correct Choice	4	0	6	24
Total				**20**	**66**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : (41 – 48)	Questions with Single Correct Choice	3	-1	8	24
Sec – II(Q.N : (49 – 54)	Questions with Comprehension Type (3 Comprehensions : 2+2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 55 – 60)	Questions with Multiple Correct Choice	4	0	6	24
Total				**20**	**66**

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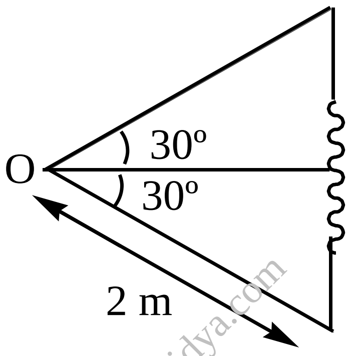
PHYSICS **Max Marks : 66**

SECTION I

Single Correct Answer Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Two identical rods each of length 2 m and having same mass are connected from end to end by means of a spring of spring constant $\left(3+2\sqrt{2}\right)N/m$. The other two ends of the rods are riveted to ground at O and are on a smooth horizontal surface. These two rods are free to rotate about the rivet on the horizontal surface. When the spring is in natural length the angle between the two rods is 60º. From this position each rod is pulled away from each other by an angle of 15º and released. Then the force on the rivet when they come back to their initial position in Newton is



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a) $\frac{3\sqrt{3}}{2}$ b) $\frac{3\sqrt{3}}{4}$ c) $\frac{3}{2\sqrt{3}}$ d) $\frac{3}{4\sqrt{3}}$

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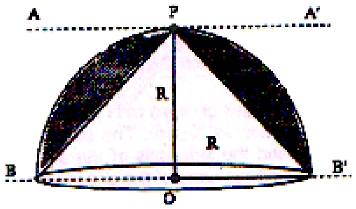
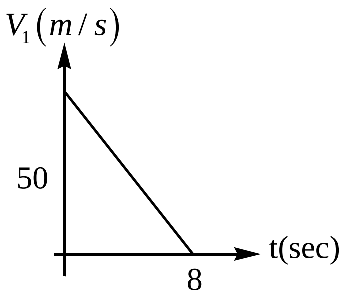
2. From a solid hemisphere of radius 'R' a cone of base radius 'R' and height 'R' is removed as shown in the figure. The moment of inertia of the remaining body about an axis BB' in the plane of the base and passing through the centre 'O' is I_0. I_1 is the moment of inertia about AA' which is parallel to BB' and I_2 is moment of inertia about an axis perpendicular to BB', and passing through 'O', then



a) $I_1 = I_0$ b) $I_2 = 2I_0$ c) $I_1 = \frac{I_0}{2}$ d) $I_2 = 3I_0$

3. Two trains are moving in opposite direction on same track. When their separation was 600 m their drivers notice the mistake and starts slowing down to avoid collision. Graphs of their velocities as function of time is as shown, find separation between the drivers when first train stops.



(first train)

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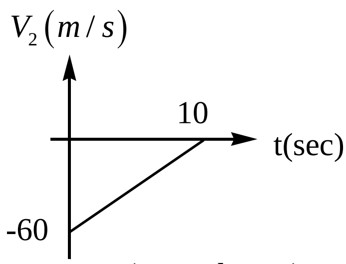

(second train)

a) 100 m b) 160 m c) 112 m d) 124 m

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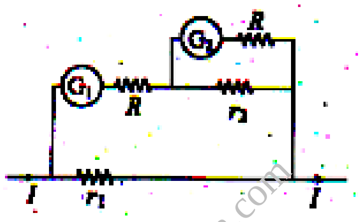
4. There are three charges Q_1 columb, Q_2 columb and Q_3 columb. Q_2 and Q_3 are fixed at positive (0, 0) and (30, 0) respectively. Now Q_1 moves in circular path in x-y plane of radius 40 m with help of external agent starting from (0, 40) about origin then work done by external agent is [till Q_1 crosses x axis (40, 0), given co-ordinates are in centimeters :

a) $\frac{Q_1 Q_3}{4\pi \in_0}$ joule b) $\frac{Q_1 Q_3}{2\pi \in_0}$ joule c) $\frac{2Q_1 Q_3}{\pi \in_0}$ joule d) $\frac{2Q_1 (Q_2 + Q_3)}{\pi \in_0}$ joule

5. The diagram shows two galvanometers G_1 and G_2. When current I = 1A both G_1 and G_2 shows full scale deflection. It is given that G_1 shows full scale deflection for 10mA and G_2 shows full scale deflection for 1 mA. The values of r_1 and r_2 are(G_1 and G_2 are of negligible resistance)



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a) $r_1 = \frac{R}{9}$ and $r_2 = \frac{R}{90}$ b) $r_1 = \frac{R}{90}$ and $r_2 = \frac{R}{9}$

c) $r_1 = \frac{2R}{9}$ and $r_2 = \frac{2R}{90}$ d) $r_1 = \frac{4R}{9}$ and $r_2 = \frac{4R}{90}$

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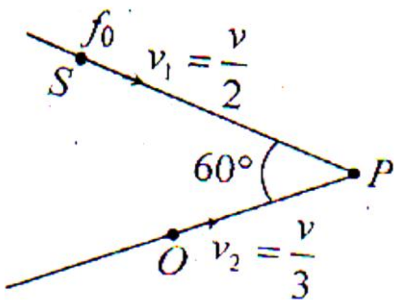
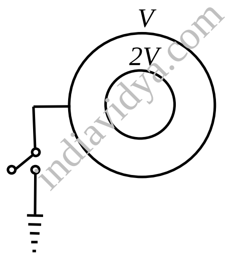
6. A source of sound and an observer are moving along two straight lines inclined at 60^0 with speeds $\frac{v}{2}$ and $\frac{v}{3}$ respectively where v is speed of sound in air. The frequency of the sound heard by the observer when he reaches at point P(Assume that observer reaches P before source) is



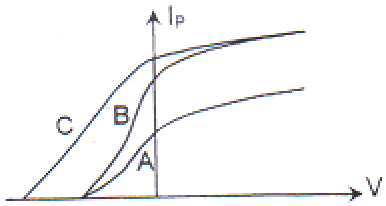
a) $\frac{f_0}{3}$ b) $\frac{5f_0}{3}$ c) $\frac{3f_0}{5}$ d) $\frac{f_0}{4}$

7. The diagram shows two concentric shells at the potentials as shown. The radius of the outer shell is R and the radius of the inner shell is R/2. What is the amount of heat generated on closing the switch ?



a) $2\pi\varepsilon_0 R(V)^2$ b) $4\pi\varepsilon_0 R(V)^2$ c) $8\pi\varepsilon_0 R(V)^2$ d) $\pi\varepsilon_0 R(V)^2$

8. In a photo electric experiment, anode potential is plotted against plate current.



a) A, B and C will have same frequency photon beam

b) A and B will have same intensity beam and C will have different

c) B and C will have same intensity and frequency

d) B and C will have same intensity but different frequency

SECTION II
Paragraph Type

This section contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

Passage-1 :

There is a detective submarine installed inside sea after 26/11 incident to detect terrorists. It is moving with constant speed v_0 along a straight line and it sends a wave which travels with speed $v_\omega = 1100 m/s$ in water. Initially waves are getting reflected from a fixed island and the frequency detected by the submarine is found to be 20% more than the original frequency. When a terrorist ship moving towards the submarine with constant speed v_s comes in between the submarine and the island, frequency of

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waves reflected from the ship is 80% more than the original frequency. (Density of sea water is 10^3 kg/m^3.)

9. Value of v_0 will be :

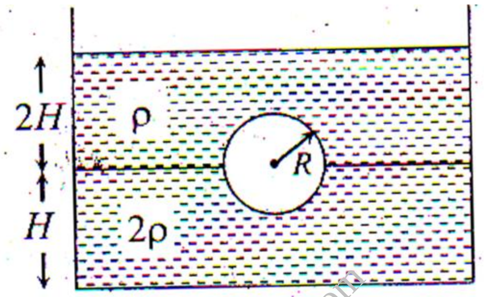
a) 50 m/s b) 100 m/s c) 10 m/s d) 25 m/s

10. Speed of enemy ship v_s is :

a) 220 m/s b) 110 m/s c) 200 m/s d) None

Passage – 2

A spherical ball of radius R is floating at the interface of two liquids with densities ρ and 2ρ. The volumes of the ball immersed in two liquids are equal. Answer the following questions :



11. Find the force exerted by the liquid with density 2ρ on the ball

a) $\pi R^2 \rho g\left(H+\frac{2R}{3}\right)$ b) $\frac{2}{3}\pi R^2 \rho g$ c) $\frac{4}{3}\pi R^2 \rho g$ d) $2\pi R^2 \rho g\left(H+\frac{2R}{3}\right)$

12. If a hole is drilled at the bottom of the vessel then volume of the ball immersed in liquid with density ρ will

a) remain same b) decrease

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c) increase d) decrease first then increases

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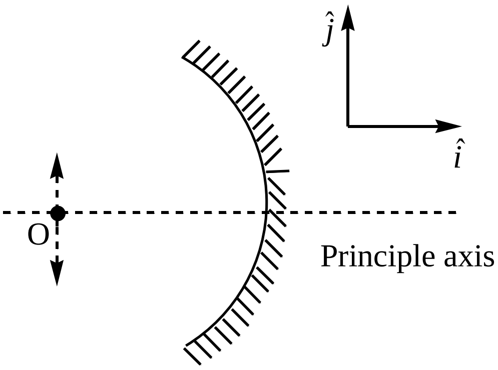
Passage – 3

A point object is placed at a distance 5R/3 from the pole of a concave mirror. R is the radius of curvature of mirror. Point object oscillates with amplitude of 1 mm perpendicular to the principle axis.



13. The amplitude of image is

a) 3/7 mm b) 2/7 mm c) 4/3 mm d) 11/7 mm

14. Position of image when object is at O

a) 5/7 R b) –5/7 R c) 4/7 R d) –4/7R

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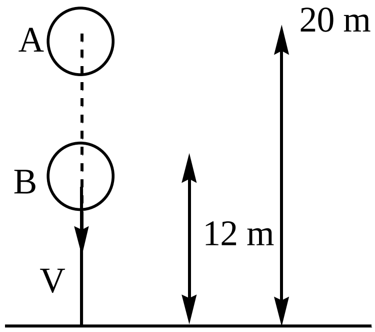
SECTION III
Multiple Correct Answer(s) Type

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

15. Two balls of same mass are thrown downwards at the same time with initial velocities $V_A = 0$ and $V_B = 0$ and $V_B = V$ m/s from the positions shown in figure. All the collisions are elastic in nature. The centers of the balls A and B are in the same vertical line, then choose the correct option(s)



a) minimum value of v for which ball A reaches its initial point of release in one collision is $\sqrt{160}$

b) Minimum value of v for which ball A reaches its initial point of release is zero

c) for $|v| < \sqrt{160}\, m/s$ ball A reaches its initial point of release after even number of collisions with ball B

d) for $|v| < \sqrt{160}\, m/s$ ball A reaches its initial point of release after odd number of collisions with ball B

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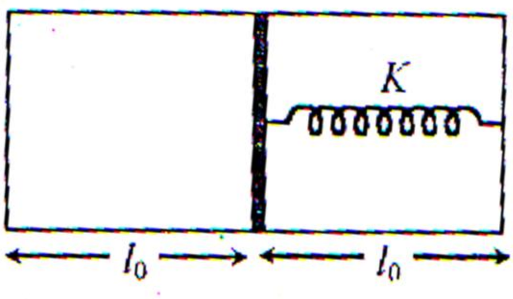
16. A diathemic piston of mass M, cross section area A separate the volume inside a horizontal adiabatic cylinder of length $2l_0$ in two equal parts. Each chamber contains an ideal gas and pressure on each side is P. The piston can move without friction and is attached with a spring of spring constant K as shown. Initially the spring is non-deformed. The piston is given a small displacement x towards left. Then



a) The pressure in left chamber increases

b) The pressure in right chamber decreases

c) The piston oscillates with time period $2\pi\sqrt{\dfrac{Ml_0}{2PA+l_0K}}$

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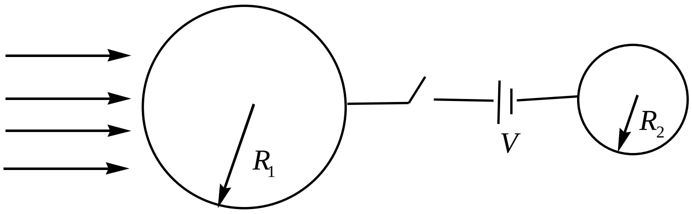
d) The piston oscillates with time period $2\pi\sqrt{\dfrac{Ml_0}{PA+l_0K}}$

17. Two conducting uncharged spheres of radius R_1 and R_2 ($R_1 > R_3$) are connected to a battery with a switch as shown. Light rays of frequency f are incident on the bigger sphere and simultaneously the switch is closed work function of bigger sphere is ϕ . After some time the charge on bigger sphere becomes q_1, and on smaller sphere becomes $-q_2$ remains constant there after. Then



a) $\frac{q_1}{4\pi\varepsilon_0 R_1} + \frac{q_2}{4\pi\varepsilon_0 R_2} = V$

b) The number of electrons emitted by larger sphere is $\frac{q_1 - q_2}{e}$ when e is the charge of an electron

c) $\frac{eq_1}{4\pi\varepsilon_0 R_1} = hf - \phi$

d) The number of electrons emitted by larger sphere is independent of the potential of the battery

18. A uniform square plate of mass m and edge a initially at rest starts rotating about one of the edge under the action of a constant torque τ . Then at the end of the 5^{th} sec after start

a) angular momentum is equal to 5τ

b) kinetic energy is equal to $\frac{75\tau^2}{ma^2}$

c) angular momentum is equal to 2.5τ

d) kinetic energy is equal to $\frac{75\tau^2}{2ma^2}$

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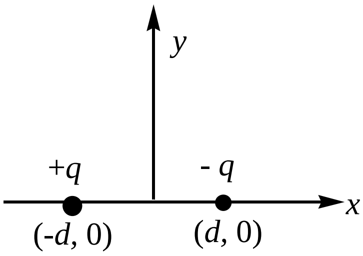
19. Two charges +q and –q are fixed closely on x-axis as shown. Consider a region in y-z plane $a^2 \le y^2 + z^2 \le b^2$. Choose the correct statement(s). (a>>>d).



a) Electric field anywhere in the given region is directed towards +ve x-axis

b) work done by the electric field in bringing a +ve test charge from $\left(0, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right)$ to $\left(0, \frac{a}{\sqrt{2}}, \frac{-a}{\sqrt{2}}\right)$ is zero

c) Electric potential throughout the given region is zero

d) Flux crossing this surface is $\frac{dq}{\epsilon_0}\left(\frac{1}{a} - \frac{1}{b}\right)$

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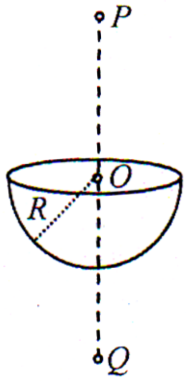
20. Consider a hemispherical body of uniform mass density ρ and radius R as shown. P and Q are two points such that OP = OQ = 2R as shown. Choose the correct statement(s).



a) Magnitude of gravitational field intensity at P and Q are same

b) Gravitational field intensity at P and Q are unlike parallel

c) Magnitude of gravitational field intensity at Q is $\frac{\pi G\rho R}{6}$

d) If E_0 is the magnitude of gravitational field intensity at Q then at P magnitude of gravitational field intensity is $\frac{\pi G\rho R}{3}$

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CHEMISTRY: **Max.Marks : 66**

SECTION I
Single Correct Answer Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

21. Edge length of unit cell of Li*Cl* with rock salt type lattice is 5.14A°. If Li^+ ions precisely fits into the octahedral voids of closed packed structure of Cl^- ions, find ionic radius of Cl^- in A°?

(A) $\frac{5.14}{2\sqrt{2}}$ (B) $\frac{5.14}{\sqrt{2}}$ (C) $\frac{\sqrt{2}}{5.14}$ (D) $\frac{2\sqrt{2}}{5.14}$

22. Which of the following statement(s) are CORRECT?

P: At constant temperature, the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas

Q: Lowering of vapour pressure increases with increase in temperature.

R: Lowering of vapour pressure is directly proportional to mole fraction of solute. Mole fraction of solute depends upon temperature.

S: Relative lowering of vapour pressure is independent of temperature.

(A) PQRS (B) PQS only (C) QR only (D) PS only

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23. Which of the following statements is true for desilverisation of lead by parke's process

a) Molten zinc is miscible with molten lead

b) Zinc is recovered from Zn – Pb mixture by distillation

c) Lead is lighter than zinc

d) Silver is more soluble in molten zinc than molten lead

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24. Which of the following method can't be used for preparation of phosphorus:

a) Retort process

b) Electrolytic reduction of hot phosphorite using carbon electrodes in presence of SiO_2

c) Electrolysis of Ca_3P_2

d) All the above

25. $AlBr_3$ in solid state exist as

a) monomer b) dimer c) Polymer d) $Al^{+3}[AlBr_4]^-$

26. Which among the following compounds will give mixture of two ketones on hydration with $HOH / H_2SO_4 / HgSO_4$?

a) $CH_3—CH_2—C \equiv C—CH_3$ b) $CH_3—C \equiv C—CH_3$

c) $C_2H_5—C \equiv C—C_2H_5$ d) All of these

27. Benzene reacts with fuming sulphuric acid to give

a) Sodium benzene sulphonate b) benzene sulphonic acid

c) Sodium benzoate d) all the above

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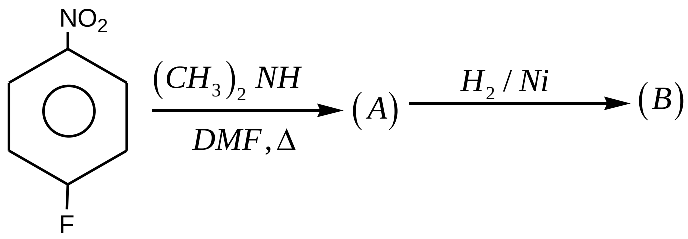
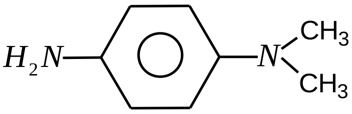
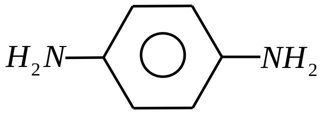
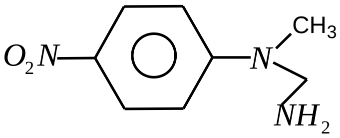
28.

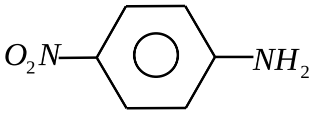


. (B) is

a) 

b) 

c) 

d) 

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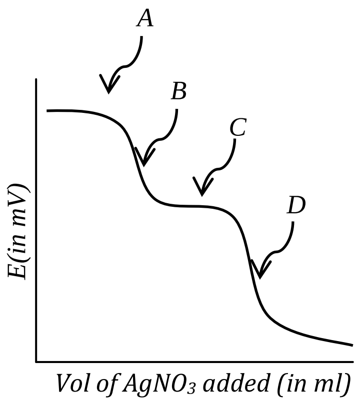
SECTION II

Paragraph Type

This section contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

Passage-1

The graph shows change in the electrode potential measured during addition of $AgNO_3$ solution to a solution containing KI and KCl of unknown equal concentration using a suitable electrode.



29. In the experiment, what is true regarding the quantities of iodide and chloride ions in solution at point A?

(A) I^- is in large excess and Cl^- is unchanged from the start of the reaction

(B) Cl^- is in large excess and I^- is unchanged from the start of the reaction

(C) I^- is in small and Cl^- is unchanged from the start of the reaction

(D) Cl^- is in small and I^- is unchanged from the start of the reaction

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30. How would the graph changes if KBr were present in the mixture, in addition to KI and KC*l*.

(A) A third end point would appear before point A

(B) A third end point would appear between point B and point D

(C) A third end point would appear after point D

(D) A third end point would appear but its location cannot be determined with the given information

Passage – II

An acid (A) in pale – blue in solution. The sodium salt of the acid does not give any reaction with $BaCl_2$ solution, but gives white crystalline precipitate (B) with $AgNO_3$ solution. The acid(A) reacts with urea to liberate two gases C & D.

31. The anhydride of acid 'A' is _____

a) N_2O_3 b) NO_2 c) N_2O_5 d) N_2O

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32. The gases C & D respectively are

a) NO_2 & N_2O b) N_2 & CO_2 c) N_2 & CO d) N_2O & CO_2

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Passage III

Alexander Williamson prepared diethyl ether by a simple method, now called as Williamson's ether Synthesis. In this method an alkyl halide is treated with sodium alkoxied prepared from sodium and alcohol.

$$R-O^{-}+R'-X\rightarrow R-O-R'+X^{-}$$

This reaction is used in the synthesis of symmetrical and unsymmetrical ethers.

It may be noted that for preparing unsymmetrical ethers, the halide used should preferably be primary because secondary and tertiary alkyl halides may form alkenes as major product due to elimination process.

$$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Br+\underset{\text{Sodium ethoxide}}{Na^{+}O^{-}-C_2H_5}\rightarrow \underset{\text{2-methyl propene}}{CH_3-\overset{CH_3}{C}=CH_2}+C_2H_5OH+NaBr$$

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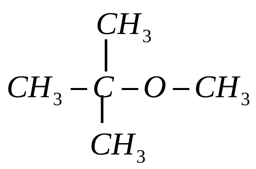
Aryl ethers or phenolic ethers can be prepared by using sodium phenoxide and alkyl halides. However,aryl halides and sodium alkoxide cannot be used for prepared phenolic ethers because aryl halides are less reactive towards nucleophilic substitution reactions.

33. Arrange the following halides in decreasing order of reactivity towards Williamson's ether Synthesis.

$CH_3 - \underset{\underset{Cl}{|}}{CH} - CH_3$ (u) $\quad CH_2 = CH - CH_2Cl$ (v) $\quad CH_3 - CH_2 - Cl$ (w) $\quad CH_3 - Cl$ (x)

a) $x > v > u > w$ b) $v > x > u > w$ c) $w > x > v > u$ d) $x > v > w > u$

34. Methyl tertiary butyl ether (MTBE) is added in gasoline to improve its octane number.



which of the following is the best method for synthesis of the above ether?

a) $(CH_3)_2C = CH_2 + CH_3OH \longrightarrow$

b) $(CH_3)_3CBr + CH_3ONa \longrightarrow$

c) $(CH_3)_3C - O^- - Na^+ + CH_3I \longrightarrow$

d) All of these reactions

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SECTION III

Multiple Correct Answer(s) Type

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

35. Choose correct statement(s) among the following:

(a) Attractive intermolecular forces becomes dominant over repulsive forces when $T_{\exp} < T_i$

(b) Gases shows ideal behavior if $T_{\exp} = T_B$

(c) For ideal gases, Joule Thomson's coefficient μ_{JT} becomes zero at any temperature.

(d) In case of real gases, μ_{JT} becomes zero if $T_{\exp} = T_i$

[$T_{\exp}$ =experimental temp. T_i = Inversion temp. T_B = Boyle temp.]

36. Which of the following represents "hydrolysis" process?

(a) $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

(b) $NH_4^+ + 2H_2O \rightleftharpoons NH_4OH + H_3O^+$

(c) $HCO_3^- + H_2O \rightleftharpoons H_2CO_3 + OH^-$

(d) $HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$

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37. The dibasic acid(s) is/are _____

a) chromic acid

b) permanganic acid

c) phosphorous acid

d) Peroxy di sulphuric acid

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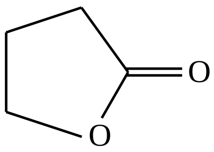
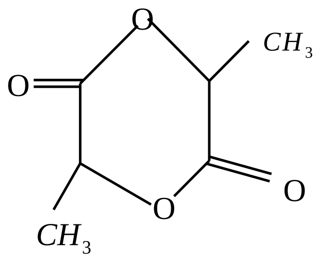
38. The metal(s) which are soluble in liquid NH_3 .....

a) Na b) Ca c) Sr d) Be

39. Which is/are true statements?

a) $\underset{\text{OH}}{\underset{|}{CH_2}} - CH_2 - COOH$ on heating is converted into $CH_2 = CHCOOH$

b) $\underset{NH_2}{\underset{|}{CH_2}} - CH_2 - CH_2 - COOH$ on heating is converted to 

c) $CH_3 - \underset{\text{OH}}{\underset{|}{CH}} - COOH$ on heating form 

d) $\underset{NH_2}{\underset{|}{H_2C}} - COOH$ form Zwitter ion which move towards cathode at $P^H = 4$

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40. Which of the following is not correct regarding sucrose?

a) Acid catalysed hydrolysis of sucrose yields 1 mole of D-glucose and 1 mole of L-fructose.

b) It gives negative test with Benedict’s solution.

c) It doesn’t from osazone derivative

d) It undergoes mutarotation.

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MATHEMATICS: **Max.Marks : 66**

SECTION I

Single Correct Answer Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

41. Let f(x) be a differentiable non-decreasing function such that

$\int_0^x (f(t))^3 dt = \frac{1}{x^2}\left(\int_0^x f(t)\,dt\right)^3 \forall x \in R-\{0\}$ and $f(1)=1$. If $\int_0^x f(t)\,dt = g(x)$ then $\frac{xg'(x)}{g(x)}$ is

a) always equal to 1
b) always equal to -2
c) may be 1 or -2
d) not independent of x

42. The number of real solutions of the equation $2x^4-3x^2-2x\sin x+3=0$ is

a) 1
b) 2
c) 3
d) 0

43. The value of $\int_0^2 \left[x^2-x+1\right] dx$ (where [.] denotes the greatest integer function) is

a) $\frac{6-\sqrt{5}}{2}$
b) $\frac{8-\sqrt{5}}{2}$
c) $\frac{5-\sqrt{5}}{2}$
d) $\frac{7-\sqrt{5}}{2}$

44. A, B, C are vertices of a triangle with right angle at A and P (-4, 0) ; Q (0, 6) are two given points. If the ratio of distances from each vertex to P, to that of Q is 2 : 3, then the centroid of DABC lies on a circle with radius equal to

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a) $\frac{4\sqrt{13}}{5}$ units
b) 4 units
c) $\frac{8\sqrt{13}}{5}$ units
d) 8 units

45. If $k.3^{\tan x}+k.3^{-\tan x}-4=0$ has real solutions, where $0\le x\le \pi, x\ne \frac{\pi}{2}$, then k belongs to

a) $[-2,2]$
b) $[-2,0]$
c) $(0,2]$
d) $(0,\infty)$

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46. An isosceles triangle ABC is inscribed in the circle whose equation is $x^2 + y^2 = 9$ with vertex at $A(3,0)$ and with base angles B and C each equal to 75^0. Then the product of the ordinates of B and C is

a) $-\frac{9}{4}$ b) $\frac{9}{4}$ c) $\frac{3}{4}$ d) 1

47. The equation of tangent drawn from a point of $z_1\left(\frac{1}{\sqrt{2}}\right)$ on the locus of point $\frac{z-(3+4i)}{\sqrt{2}z-(1+i)}$ is ______________ where z is any point on $|z|=1$

a) $\arg\left(z-2-\frac{i}{4}\right)=-\tan^{-1}\frac{1}{6}$ b) $\arg(z-2+i)=-\tan^{-1}\frac{1}{6}$

c) $\arg(z-2-i)=\tan^{-1}\frac{1}{6}$ d) does not exists

48. Let $f(x)=x\sin x$ be an invertible function. Then the area bounded by functions $y=f(x)$ and $y=g(x)$ is ___________ where $g(x)$ is inverse of function $f(x)$.

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

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SECTION II
Paragraph Type

This section contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

Passage-1

Suppose a set X contain different 4×4 arrays with each entry as 1 or -1 and having the property that the sum of the entries in each column is 0 and the sum of entries in each row is 0

49. If a set $P\subseteq X$ be chosen at random, find probability that it contains different 4×4 arrays whose first two columns share same two numbers in each row:

a) $\frac{2}{5}$ b) $\frac{8}{15}$ c) $\frac{4}{15}$ d) $\frac{1}{15}$

50. If a set $Q\subseteq X$ be chosen at random, find probability that it contains different 4×4 arrays whose first two columns share no two numbers same in each row:

a) $\frac{2}{5}$ b) $\frac{8}{15}$ c) $\frac{4}{15}$ d) $\frac{1}{15}$

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Passage-2

Let two planes $P_1 : 2x - y + z = 2$ and $P_2 : x + 2y - z = 3$ are given.

51. The equation of the plane through the intersection of P_1 and P_2 and the point $(3, 2, 1)$ is

a) $3x - y + 2z - 9 = 0$

b) $x - 3y + 2z + 1 = 0$

c) $2x - 3y + z - 1 = 0$

d) $4x - 3y + 2z - 8 = 0$

52. Equation of the plane which passes through the point $(-1, 3, 2)$ and is perpendicular to each of the planes P_1 and P_2 is

a) $x + 3y - 5z + 2 = 0$

b) $x + 3y + 5z - 18 = 0$

c) $x - 3y - 5z + 20 = 0$

d) $x - 3y + 5z = 0$

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Passage-3

If a function (continuous and twice differentiable) is always concave upward in an interval, then its graph lies always below the segment joining extremities of the graph in that interval and vice-versa.

53. If $\sin x + x \geq |k| x^2, \forall x \in \left[0, \frac{\pi}{2}\right]$, then the greatest value of k is

a) $\frac{-2(2+\pi)}{\pi^2}$

b) $\frac{2(2+\pi)}{\pi^2}$

c) can't be determined finitely

d) zero

54. Let $f(x), f'(x)$ and $f''(x)$ are all positive $\forall x \in [0,7]$. If $f^{-1}(x)$ exists, then $3f^{-1}(4) - f^{-1}(2) - 2f^{-1}(5)$ is

a) always positive

b) always negative

c) non-negative

d) non-positive

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SECTION III
Multiple Correct Answer(s) Type

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE are correct.**

55. Vertex of parabola (s) having common chord of the circles $(x-1)^2 + (y-2)^2 = 5$ and $(x-3)^2 + (y-4)^2 = 25$ as directrix and centre of either of the two circles as the focus, is/are

a) $\left(-\frac{1}{2}, \frac{1}{2}\right)$ b) $\left(\frac{1}{4}, \frac{5}{4}\right)$ c) $\left(\frac{5}{4}, \frac{9}{4}\right)$ d) (5, 6)

56. If $(1 + x + x^2)^n = a_0 + a_1x + a_2x^2 + \ldots\ldots + a_{2n}x^{2n}$, then the value of $a_0 + a_3 + a_6 + \ldots\ldots$ is

a) $a_1 + a_4 + a_7 + \ldots\ldots$ b) $a_2 + a_5 + a_8 + \ldots.$ c) 3^{n-1} d) 3^n

57. If a, b and c are three terms of an A.P. such that $a \neq b$, then $\frac{b-c}{a-b}$ may be equal to

a) $\sqrt{2}$ b) $\sqrt{3}$ c) 1 d) 3

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58. Let the complex numbers z_1 and z_2 satisfy the equations $|Z_1 - 1| = 1, |Z_2 + 4| = 2.$ Then value of $|Z_1 - Z_2|$ can be

a) 8 b) 5 c) 4 d) 2

59. Which of the following belongs to the range set of $\cot^{-1}(x^2 - 4x + 5)$?

a) $2/3$ b) $3/4$ c) $5/6$ d) $7/8$

60. If 3 different numbers are chosen together at random from {1, 2, 3, ………, 20}, then the probability that

a) they form A.P. = $\frac{3}{38}$

b) their sum is even = $\frac{1}{2}$

c) their product is odd = $\frac{2}{19}$

d) they form A.P with odd common difference = $\frac{5}{114}$

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Paper-2_Key & Solutions

KEY SHEET

PHYSICS

1)	A	2)	A	3)	C	4)	C	5)	B	6)	B
7)	A	8)	D	9)	B	10)	A or D	11)	D	12)	A
13)	A	14)	B	15)	ABC	16)	ABC	17)	ABC or B	18)	AD
19)	ABCD	20)	B								

CHEMISTRY

21)	A	22)	B	23)	D	24)	C	25)	B	26)	A
27)	B	28)	A	29)	C	30)	B or D	31)	A	32)	B
33)	A	34)	C	35)	ABCD	36)	BC	37)	ACD	38)	ABC
39)	ACD or AC	40)	AD								

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MATHEMATICS

41)	A	42)	D	43)	C	44)	A	45)	C	46)	A
47)	D	48)	B	49)	D	50)	A	51)	B	52)	C
53)	B	54)	A	55)	BC	56)	ABC	57)	CD	58)	ABCD
59)	AB	60)	ABCD								

Solutions

PHYSICS

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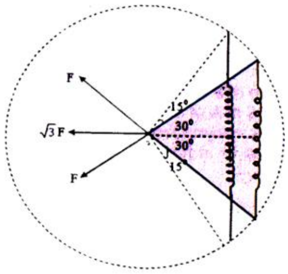
1. a) $\frac{1}{2}k\left(\sqrt{2I}-I\right)^2=\frac{1}{2}2\left(\frac{mI^2}{3}\right)\omega^2$



$k\left(\sqrt{2I}-I\right)^2=\frac{2m}{3}\omega^2$ ....(1)

F_{on} each rod by hinge = $m\frac{1}{2}\omega^2$

$\therefore F_{on}$ hinge = $\sqrt{3}\left(\frac{ml}{2}\omega^2\right)\to 2$

on solving F_{on} hinge = $\frac{3\sqrt{3}}{2}N$

2. a) Mass of hemi sphere $= M\rho 2/3\pi r^3$

Mass of cone = $M^1=\rho\times 1/3\pi R^3=\frac{M}{2}$

$$Y_{com}=\frac{(M)(3R/8)-\left(\frac{M}{2}\right)\left(\frac{R}{4}\right)}{M-\frac{M}{2}}=\frac{R}{2}$$

$I_{BB'}=I_{cm}+M\left(R/2\right)^2=I_0$

$I_{AA'}=I_{cm}+M\left(R/2\right)^2=I_0$

By symmetry $I_2 = I_0$

3. c

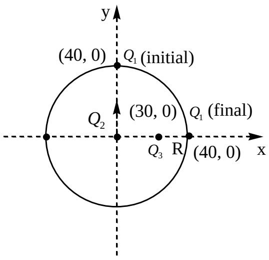
$V_1=-\frac{50}{8}t+50, a_1=-\frac{25}{4}m/s^2$

$V_2=\frac{60}{10}t-60, a_2=6m/s^2$

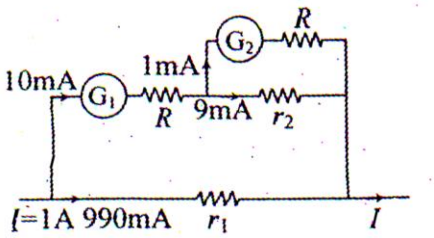
First train will stop after 8 sec. Now use concept of relative motion

4. c

$W_{ext}=Q_1\left(V_R-V_P\right)$



5. B



$$1A \times \frac{r_1}{\frac{Rr_2}{R+r_2}+R+r_1} = 10mA \quad \text{.......(1)}$$

and $10mA \times \frac{r_2}{R+r_2} = 1mA$ ....(2)

From (2) $r_2 = \frac{R}{9}$, 10R + R = 990r_1, $r_1 = \frac{R}{90}$

6. B

$$f = f_0\left(\frac{v-\frac{v}{3}\cos 60^0}{v-\frac{v}{2}}\right) = f_0\left(\frac{v-\frac{v}{6}}{\frac{v}{2}}\right) = f_0\left(\frac{\frac{5v}{6}}{\frac{v}{2}}\right) = \frac{5f_0}{3}$$

7. a

The energy stored between the shell remains unchanged so heat generated is

$H = \frac{1}{2}4\pi\varepsilon_0 R(V)^2$ (Energy between outer shell and infinity)

$= 2\pi\varepsilon_0 RV^2$

8. d

Passage – 1 (9 – 10)

9. b

In case when the wave reflected back from the fixed island

$$f = f_0\left(\frac{v+v_0}{v-v_0}\right) = 12.\ f_0$$

$\therefore v_0 = 100\ m/s$

10. a

In case when the wave reflected back from the enemy ship

$$f = f_0\left(\frac{v+v_2}{v-v_0}\right)\left(\frac{v+v_0}{v-v_s}\right) = 1.8\ f_0$$

By putting the values

v_s = 220 m/s

Passage – 2 (11 – 12)

11. d

$$\pi R^2 2H\rho g + \frac{2}{3}\pi R^3 2\rho g = F$$

$$2\pi R^2 H\rho g + \frac{4\pi R^3 \rho g}{3} = F$$

$$2\pi R^2 \rho g\left(H + \frac{2R}{3}\right) = F$$

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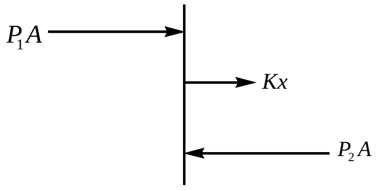
12. A
Pressure difference between two points in the liquid depends upon the relative separation between those points

Passage – 3 (13 – 14)

13. a
14. b
15. abc
16. abc
The FBD of the piston is
Restoring force = $(P_2 - P_1) A + Kx$



$-Ma = (P_2 - P_1) A + Kx$
Also $P_1A(l_0 - x) = PAl_0$

$$P_1 = \frac{Pl_0}{l_0 - x} \qquad \text{.........(i)}$$

$$P_2A(l_0 + x) = PAl_0$$

$$P_2 = \frac{Pl_0}{l_0 + x} \qquad \text{.........(ii)}$$

From (i) and (ii) $a = \left[\frac{2Pl_0A}{l_0^2 - x^2} + K\right]\frac{x}{M}$

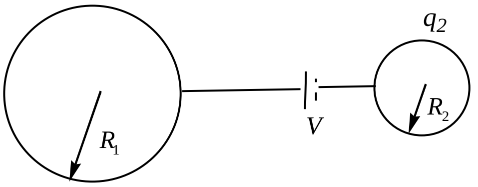
Since $x << l_0$

$$a = -\left[\frac{2Pl_0A}{l_0^2} + K\right]\frac{x}{M}$$

$$\therefore T = 2\pi\sqrt{\frac{Ml_0}{2PA + Kl_0}}$$

17. abcd

$$\frac{q_1}{4\pi\varepsilon_0 R_1} - \left(-\frac{q_2}{4\pi\varepsilon_0 R_2}\right) = V$$



Also number of electrons emitted = $\frac{q_1 - q_2}{e}$

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18. ad

Change in angular momentum = angular impulse

$L = 5\tau$

$I = \frac{ma^2}{3}$

$K = \frac{L^2}{2I} = \frac{75\tau^2}{2ma^2}$

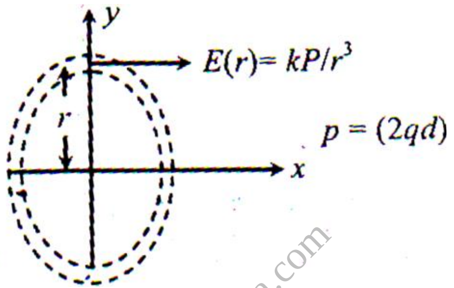
19. abcd

For the considered region given charge distribution will act as a diole system. Therefore electric field anywhere is the region is directed towards +ve x-axis.

Due to symmetry we can conclude that electric potential anywhere in y-z plane will be zero

So the work done from bringing a positive test change from $\left(0, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right)$ *to* $\left(a, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right)$ is zero

Electric flux crossing



$\phi = \int_{r=a}^{b} E(r)(2\pi r dr) = (kP)(2\pi)\int_{b} \frac{dr}{r^2} a$

$= \frac{1}{4\pi \in_0}(2qd)(2\pi)\left(\frac{-1}{r}\right)_a^b = \frac{qd}{\in_0}\left(\frac{1}{a} - \frac{1}{b}\right)$

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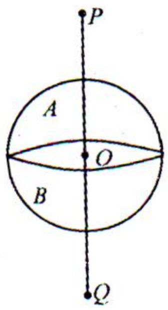
20. BD

Let us assume the complete sphere. The upper hemisphere is denoted by 4 and the lower by B. Combined field intensity at P or Q is

$E = \frac{GM}{(2R)^2} = \frac{G}{4R^2}\frac{4}{3}\pi R^3 \rho = \frac{\pi G \rho R}{3}$



It is obvious that intensity at P and Q will be unlike parallel.

It is clear that is magnitude of intensity at Q due to only the hemisphere B is E_0 then at P it will be $\frac{\pi}{3} G\rho R - E_0$

CHEMISTRY :

21. If Li^+ ions fit exactly into octahedral void of LiC*l*, $2r_{Li^+}+2_{Cl^-}=5.14 \Rightarrow r_{Li^+}+_{Cl^-}=2.57$

Cl^- ions occupies corners of the face as well as center of face

Let distance between the centers of two chlorides ions be "a" and

distance between Li^+ and Cl^- be "b" $\Rightarrow$ b = 2.57

\ radius of Cl^- $= \dfrac{5.14}{2\sqrt{2}}$

22. Mole fraction of solute is independent of temperature.

23. Conceptual

24. Factual

25. Factual

26.

$$CH_3-CH_2-C\equiv C-CH_3 \xrightarrow{H_2O/H_2SO_4/HgSO_4} H_3C-H_2C-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$$

$$+$$

$$H_3C-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$$

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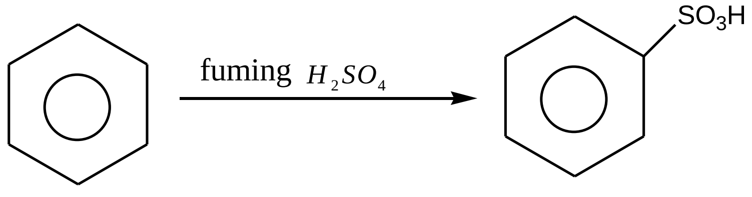
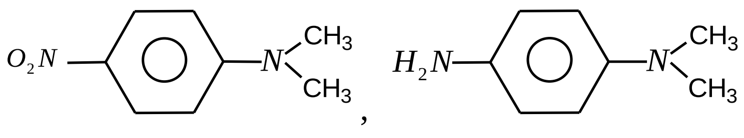
27.



28.



(A) (B)

29. $(K_{sp})_{AgI} < (K_{sp})_{AgCl}$

30. $(K_{sp})_{AgI} < (K_{sp})_{AgBr} < (K_{sp})_{AgCl}$

Passage (31 – 32)

A is HNO_2 : $NaNO_2 + AgNO_3 \rightarrow AgNO_2 \downarrow$

White ppt

$HNO_2 + urea \rightarrow CO_2 + N_2$

Passage (33 – 34)

34. $(CH_3)_3C-O^{(-)}.Na^+ + CH_3I \longrightarrow (CH_3)_3-O-CH_3$

35.

36.

37.

38. $H_2CrO_4 : H_3PO_3 \;\; H_2S_2O_8$.

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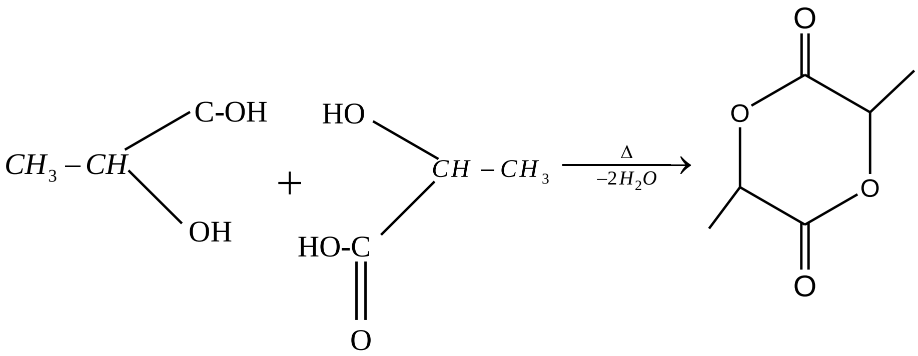
39. a) $\underset{\text{OH}}{CH_2}-CH_2-COOH \xrightarrow{\Delta} CH_2=CH-COOH$

c) 

d) $H_2N \;\; CH_2 \;\; COOH \rightleftharpoons H_3\bar{N} \;\; CH_2 \;\; COO$

40.

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MATHEMATICS:

41. $\int_0^x (f(t))^3\,dt = \frac{1}{x^2}\left(\int_0^x f(t)dt\right)^3$

$\therefore (f(x))^3 = \frac{1}{x^2}.3\left(\int_0^x f(t)dt\right)^2 .f(x) - \frac{2}{x^3}.\left(\int_0^x f(t)dt\right)^3$

$\Rightarrow \left(\frac{xg'(x)}{g(x)}\right)^3 - 3\left(\frac{xg'(x)}{g(x)}\right) + 2 = 0$

$\Rightarrow \frac{xg'(x)}{g(x)} = 1\, or\, -2$

If $\frac{xg'(x)}{g(x)} = 1 \Rightarrow f(x) = 1$

While if $\frac{xg'(x)}{g(x)} = -2 \Rightarrow f(x) = \frac{1}{x^3}$ (decreasing function)

42. $x^4 - \frac{3}{2}x^2 + \frac{3}{2} = x\sin x$

$f(x) = x^4 - \frac{3}{2}x^2 + \frac{3}{2}$

$f'(x) = 4x^3 - 3x = 0$

$x = 0, \pm\frac{\sqrt{3}}{2}$

$\Rightarrow$ There is no solution of equation

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43. $\int_0^2 \left[x^2 - x + 1\right]dx = \int_0^2 \left(\left(x - \frac{1}{2}\right)^2 + \frac{3}{4}\right)dx$

$= \int_0^1 0dx + \int_1^{\frac{\sqrt{5}+1}{2}} dx + 2\int_{\frac{\sqrt{5}+1}{2}}^2 dx = 0 + \left(\frac{\sqrt{5}+1}{2} - 1\right) + 2\left(2 - \frac{\sqrt{5}+1}{2}\right)$

$= \frac{5-\sqrt{5}}{2}.$

44. $P = (-4, 0) \qquad Q = (0, 6)$

Let $A = (x, y)$

$\frac{PA}{QA} = \frac{2}{3} \qquad \Rightarrow \quad 9PA^2 = 4QA^2$

$9\left[(x+4)^2 + y^2\right] = 4\left[x^2 + (y-6)^2\right]$

$5x^2 + 5y^2 + 72x + 48y = 0$ is equation of circum circle of ΔABC

Circumcentre of $\Delta ABC = S = \left(-\frac{36}{5}, -\frac{24}{5}\right)$ and A is orthocenter

$SG : GA = 1 : 2 \Rightarrow SG = \frac{1}{3}SA = \frac{1}{3}\sqrt{\left(\frac{36}{5}\right)^2 + \left(\frac{24}{5}\right)^2} = \frac{4\sqrt{13}}{5}$ units

45. Put $y = 3^{\tan x}$

y is always positive

$ky + \frac{k}{y} - 4 = 0$

$ky^2 - 4y + k = 0$

y is real $\Rightarrow 16 - 4k^2 > 0$

$\Rightarrow k \in [-2, 2]$

But sum of the roots $= \frac{4}{k}$ is positive because y is positive

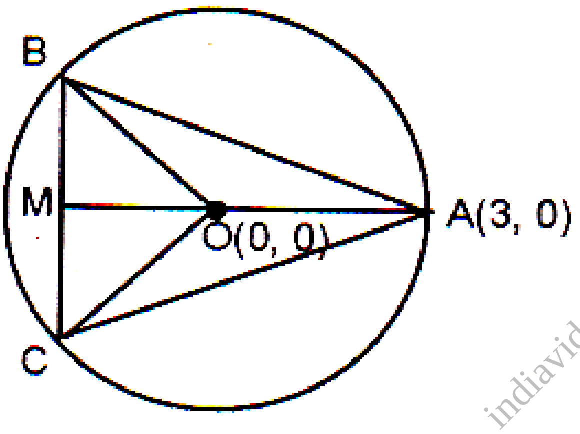
$\Rightarrow k$ is positive

$\Rightarrow k \in (0, 2]$.

46. Since $\angle B = \angle C = 75^0$

$\angle BAC = 30^0, \angle BOC = 60^0$

ΔOBC is equilateral BC=OB=3



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M is the midpoint of BC

$OM = \sqrt{9 - \frac{9}{4}} = \frac{3\sqrt{3}}{2}$

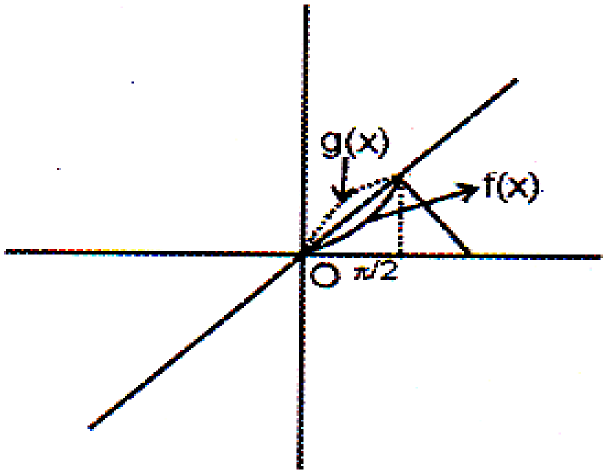
Equation of BC is $x = -\frac{3\sqrt{3}}{2}$

Solving with $x^2 + y^2 = 9$,we get the points $\left(-\frac{3\sqrt{3}}{2}, \pm\frac{3}{2}\right)$

$\therefore$ Product of the ordinates of B and C $= \frac{3}{2}\left(-\frac{3}{2}\right) = -\frac{9}{4}$.

47. Locus is perpendicular bisector of line segment joining $\frac{1}{\sqrt{2}}$ and $\frac{7}{2} + \frac{i}{2}$.

48.



$$\int_0^{\pi/2} x\sin x dx = [-x\cos x + \sin x]_0^{\pi/2} = 1$$

Area of shaded region is $2\left(\frac{\pi^2}{8}-1\right)$

49-50. The first two columns share no two numbers same in each row in ${}^4C_2 \times {}^4C_2 = 36$ ways.

The first two columns share one number same in each of two rows in ${}^4C_1 \times {}^3C_2 \times 2 \times 2 = 48$ ways.

The first two columns share two numbers same in each row in ${}^4C_2 = 6$ ways

$\therefore$ Total number of different arrays $= 36+48+6 = 90$.

51. The equation of any plane through the intersection of P_1 and P_2 is

$$P_1 + \lambda P_2 = 0$$

$\Rightarrow (2x - y + z - 2) + \lambda(x + 2y - z - 3) = 0$.........$(i)$

Since, it passes through $(3,2,1)$,then

$$(6-2+1-2)+\lambda(3+4-1-3) = 0$$

$$\therefore \lambda = -1$$

From eq.(1),

$$x - 3y + 2z + 1 = 0$$

Which is the required plane.

52. The equation of any plane through $(-1,3,2)$ is $a(x+1)+b(y-3)+c(z-2) = 0$..........(i)

If this plane (i) is perpendicular to P_1 ,then

$$2a - b + c = 0 ....(ii)$$

And if the plane (i) is perpendicular to P_2 ,then

$$a + 2b - c = 0 ....(iii)$$

From eq.(ii) and (iii),we get

$$\frac{a}{-1} = \frac{b}{3} = \frac{c}{5}$$

Substituting these proportionate values of a,b,c in eq.(ii),we get the required equation as

$$-(x+1)+3(y-3)+5(z-2) = 0$$

Or $x - 3y - 5z + 20 = 0$

53. $f(x)=\sin x+x,\ f'(x)=\cos x+1,\ f''(x)=-\sin x$

f is concave downward for $x\in\left[0,\frac{\pi}{2}\right]$

Irrespective of $k, g(x)=|k|x^2$ is concave upward.

So, If $g\left(\frac{\pi}{2}\right)\le f\left(\frac{\pi}{2}\right)$, then $f(x)\ge g(x)$

$\Rightarrow 1+\frac{\pi}{2}\ge|k|\frac{\pi^2}{4}\Rightarrow k\in\left[-\frac{(2\pi+4)}{\pi^2},\frac{(2\pi+4)}{\pi^2}\right]$.

54. $f''(x)>0\Rightarrow f$ is concave upward.

$\Rightarrow f^{-1}$ is concave downwards.

Consider point dividing the join of this segment in ratio 2:1 is given as

$\left(4,\frac{2f^{-1}(5)+f^{-1}(2)}{3}\right)$, Where upon a point $\left(4, f^{-1}(4)\right)$ on graph of $f^{-1}(x)$ is always above it

$\Rightarrow 3f^{-1}(4)-f^{-1}(2)-2f^{-1}(5)>0$.

55. BC

$\because$ The common chord to the circles will be x + y = 0

$\Rightarrow$ Equation of Axis of the parabolas will be x – y + 1 = 0

As vertex is the mid point of focus and point of intersection of Axis and directrix of the parabola ; hence required points will be $\left(\frac{1}{4},\frac{5}{4}\right)$ *and* $\left(\frac{5}{4},\frac{9}{4}\right)$

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56. ABC

Putting x = ω in the equation, $0=a_0+a_1\omega+a_2\omega^2+a_3+.....$ ....(i)

Putting x = ω^2 in the equation, $0=a_0+a_1\omega^2+a_2\omega+a_3+......$ ....(ii)

Putting x = 1 in the equation, $3^n = a_0 + a_1 + a_2 + a_3 + ...$ ....(iii)

adding (i), (ii) and (iii), $3^n = 3(a_0 + a_3 + a_6 + ...)$ ....(a)

$a_0 + a_3 + a_6 + ... = 3^{n-1}$ (option C)

subtracting (ii) from (i),

$0=\left(\omega-\omega^2\right)\left(a_1-a_2+a_4-a_5+......\right)$

Since $\omega-\omega^2\ne 0,\ a_1+a_4+a_7+.....=a_2+a_5+a_8+.....$ ....(iv)

Also from (3) – (a), $a_1 + a_2 + a_4 + a_5 + ... = 3^n - 3^{n-1} = 2.3^{n-1}$ ....(v)

From (iv) and (v), $a_1 + a_4 + a_7 + ... = a_2 + a_5 + a_8 + ... = 3^{n-1} = a_0 + a_3 + a_6 + ...$

57. a, b, c are three terms of A.P

$\Rightarrow b = a + \alpha(d)$ and $c = a + \beta(d)$ where $\alpha, \beta \in N$ and d is c.d of A.P.

Then $\frac{b-c}{a-b}=\frac{(\alpha-\beta)d}{-\alpha d}=\left(-1+\frac{\beta}{\alpha}\right)$ which is rational

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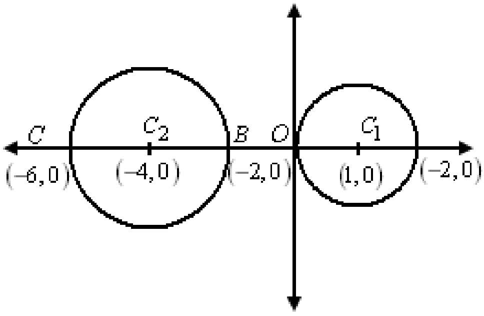
58. Method–I:Using Geometry



$|Z_1 - 1| = 1 \Rightarrow z_1$ lies on a circle with centre 1+0i and radius unity

$|Z_2 + 4| = 2 \Rightarrow z_2$ lies on a circle with centre–4+0i and radius2 units

$|z_1 - z_2|$represents the distance between z_1 andz_2

$\therefore$ Max. value of $|z_1 - z_2|$= Max. distance between two any two points on the two given circles [lies along their common normal.

Hence, Max. value of $|z_1 - z_2|$ is AC = CO + OA = 8

Min value is clearly 2

59. We have $0 \le (x-2)^2 < \infty$

$\Rightarrow 1 \le (x^2 - 4x + 5) < \infty$

$\Rightarrow 0 < \cot^{-1}(x^2 - 4x + 5) \le \pi/4$

Range = $\left(0, \pi/4\right]$

Clearly $2/3 < \pi/4$ and $3/4 < \pi/4$ are true

Also $5/6 < \pi/4$ and $7/8 < \pi/4$ are false

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60. $n(s) = {}^{20}C_3$

Number of A.P's with c.d's 1, 2, 3, ……., 9

are respectively 18, 16, 14, ………, 2

Total no. of A.P's = 2 + 4 + 6 + …….. + 18 = 2(1 + 2 + 3 + …….. + 9) = 90

No. of A.P's with odd c.d. = 18 + 14 + 10 + 6 + 2 = 50

Sum = even $\Rightarrow$ (3 nos. are even) or (1 even, 2 odd)

No. of fav. Case = ${}^{10}C_3 + \left({}^{10}C_1 \times {}^{10}C_2\right) = 120 + 450 = 570$

Prob. (product is odd) = $\left(\dfrac{{}^{10}C_3}{{}^{20}C_3}\right) = \dfrac{2}{19}$