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**Margdarshan**  
for JEE (Main & Advanced), NTSE, KVPY, Olympiad  
A Division of SHYAM SAI CLASSES PVT. LTD.



HINDUSTAN MARGDARSHAN SCHOLARSHIP TEST-2017-18  
SAMPLE PAPER  
FOR  
CLASS 12<sup>th</sup> (Appearing), [Engg.]

**INSTRUCTIONS**

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.  
You are not allowed to leave the examination hall before the end of the test.

**[A] General :**

1. Attempt ALL the questions. Answer have to be marked on the **OMR** sheets
2. This question paper contains **90 questions**.
3. The question paper consists of **THREE Parts Physics, Chemistry & Mathematics**
4. Blank spaces are provided at the bottom of each page for rough work. No additional sheets will be provided for rough work.
5. Blank paper, clipboard, log tabs, silde rules, calculators, cellular phones, pagers and electronic gadgets in any form are **NOT** allowed.
6. Do not Tamper / mutilate the **OMR sheet** or this booklet.
7. Do not break the seals of the question-paper booklet before instructed to do so by the invigilator.
8. **SUBMIT** the OMR sheet to the invigilator after completing the test & take away the test paper with you.

**[B] Filling of OMR Sheet :**

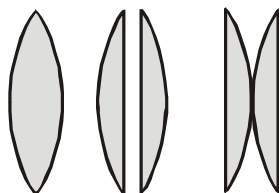
9. In all the parts, each question will have 4 choices out of which **only one choice is correct**
10. Use only Black/Blue ball point pen for filling the OMR sheet.
11. On the OMR sheet, darken the appropriate bubble for each character of your name, Registration No., Phone No. etc.

**[C] Marking Scheme :**

12. For each right answer you will be **awarded 4 marks** if you darken the bubble corresponding to the correct answer and **zero marks** if no bubble is darkened. In case of bubbling of incorrect answer, **minus one (-1)** mark will be awarded.

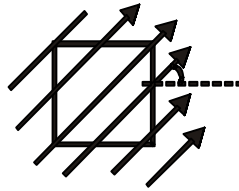
## PHYSICS

1. A boy stands straight in front of a mirror at a distance of 30 cm away from it. He sees his erect image whose height is  $\frac{1}{5}$ th of his real height. The mirror he is using is :-  
 (A) plane mirror            (B) convex mirror            (C) concave mirror            (D) convex lens
2. A concave mirror is used to form an image of the sun on a white screen. If the lower half of the mirror were covered with an opaque card, the effect on the image on the screen would be-  
 (A) Negligible  
 (B) To make the image less bright than before  
 (C) To make the upper half of the image disappear  
 (D) To make the lower half of the image disappear
3. An object placed 10 cm in front of a lens has an image 20 cm behind the lens. What is the power of the lens (in dioptre) ?  
 (A) 1.5                            (B) 3.0                            (C) - 5.0                            (D) +15.0
4. A convex lens of focal length 20 cm is cut into two equal parts so as to obtain two parts so as to obtain two plano-convex lenses as shown in figure. The two parts are then put in contact as shown in figure. What is the focal length of the combination ?



- (A) zero                            (B) 5 cm                            (C) 10 cm                            (D) 20 cm
5. A convex lens of focal length 40 cm, a concave lens of focal length 40 cm and a concave lens of focal length 15 cm are placed in contact. The power of this combination is :-  
 (A) + 1.5 D                            (B) - 1.5 D                            (C) + 6.67 D                            (D) - 6.67 D
  6. A short linear object of length  $b$  lies along the axis of a concave mirror of focal length  $f$ , at a distance  $u$  from the mirror. The size of the image is ?  
 (A)  $b\left(\frac{u-f}{f}\right)^{1/2}$                             (B)  $b\left(\frac{f}{f-u}\right)$                             (C)  $b\left(\frac{u-f}{f}\right)^2$                             (D)  $b\left(\frac{f}{u-f}\right)^2$
  7. Two charged metal spheres of radii  $R$  and  $2R$  are temporarily placed in contact and then separated. Which of the following has the greater value at surface for smaller sphere :-  
 (a) Charge                            (b) Charge density                            (c) Potential                            (d) Electric field  
 (A) b, d                            (B) a,b,d                            (C) b, c, d                            (D) Only b

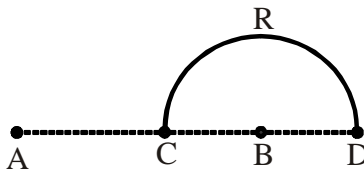
8. A square surface of side  $L$  meter in the plane of the paper is placed in a uniform electric field  $E$  (volt/m) acting along the same plane at an angle  $\theta$  with the horizontal side of the square as shown in figure. The electric flux linked to the surface, in units of volt-m, is :-



- (A) Zero                      (B)  $EL^2$                       (C)  $EL^2 \cos \theta$                       (D)  $EL^2 \sin \theta$
9. Three concentric spherical shells have radii  $a$ ,  $b$  and  $c$  ( $a < b < c$ ) and have surface charge densities  $\sigma$ ,  $-\sigma$  and  $\sigma$  respectively. If  $V_A$ ,  $V_B$  and  $V_C$  denote the potentials of the three shells, then, for  $c = a + b$ , we have
- (A)  $V_C = V_B = V_A$                       (B)  $V_C = V_A^{-1} V_B$                       (C)  $V_C = V_B^{-1} V_A$                       (D)  $V_C^{-1} V_B^{-1} V_A$
10. Two positive ions, each carrying a charge  $q$ , are separated by a distance  $d$ . If  $F$  is the force of repulsion between the ions, the number of electrons missing from each ion will be ( $e$  being the charge on an electron) :-

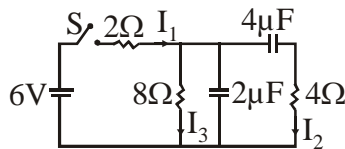
(A)  $\frac{4\pi \epsilon_0 Fd^2}{q^2}$                       (B)  $\frac{4\pi \epsilon_0 Fd^2}{e^2}$                       (C)  $\sqrt{\frac{4\pi \epsilon_0 Fe^2}{d^2}}$                       (D)  $\sqrt{\frac{4\pi \epsilon_0 Fd^2}{e^2}}$

11. Charges  $+q$  and  $-q$  are placed at points A and B respectively which are at distance  $2L$  apart, C is the midpoint between A and B. The work done in moving a charge  $+Q$  along the semicircle CRD is :-



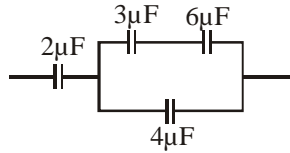
(A)  $-\frac{qQ}{6\pi \epsilon_0 L}$                       (B)  $\frac{qQ}{4\pi \epsilon_0 L}$                       (C)  $\frac{qQ}{2\pi \epsilon_0 L}$                       (D)  $\frac{qQ}{6\pi \epsilon_0 L}$

12. Three capacitors each of capacitance  $C$  and of breakdown voltage  $V$  are joined in series. The capacitance and breakdown voltage of the combination will be :-
- (A)  $3C, 3V$                       (B)  $C/3, V/3$                       (C)  $3C, V/3$                       (D)  $C/3, 3V$
13. In the circuit shown in the figure, the switch  $S$  is initially open and the capacitor is initially uncharged.  $I_1$ ,  $I_2$  and  $I_3$  represent the current in the resistance  $2\Omega$ ,  $4\Omega$  and  $8\Omega$  respectively.



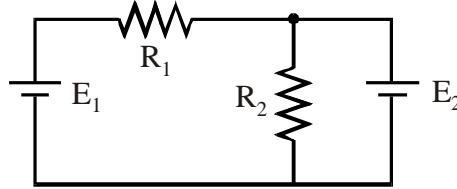
- (A) just after the switch  $S$  is closed,  $I_1 = 3A$ ,  $I_2 = 3A$  and  $I_3 = 0$   
 (B) just after the switch  $S$  is closed,  $I_1 = 3A$ ,  $I_2 = 0$  and  $I_3 = 0$   
 (C) long time after the switch  $S$  is closed,  $I_1 = 0.6A$ ,  $I_2 = 0$  and  $I_3 = 0$   
 (D) long time after the switch  $S$  is closed,  $I_1 = I_2 = I_3 = 0.6A$ .

14. Charge on capacitor  $2 \mu\text{F}$  is (potential on capacitor  $3 \mu\text{F}$  is  $6\text{V}$ ) :-



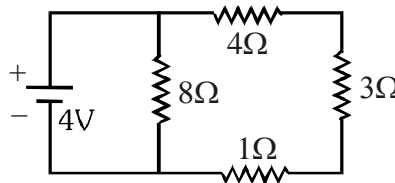
- (A)  $18 \mu\text{C}$                       (B)  $36 \mu\text{C}$                       (C)  $54 \mu\text{C}$                       (D)  $6 \mu\text{C}$

15. Two resistors  $R_1$  and  $R_2$  are joined as in fig. What is the current in  $R_1$  :-



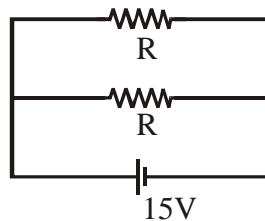
- (A)  $\frac{(E_1 - E_2)}{R_1}$                       (B)  $\frac{(E_1 - E_2)}{R_1 + R_2}$                       (C)  $\frac{E_1}{R_1 + R_2}$                       (D) None

16. An electric circuit is shown in the following diagram. The value of current which flows in the resistance of  $8 \Omega$  is



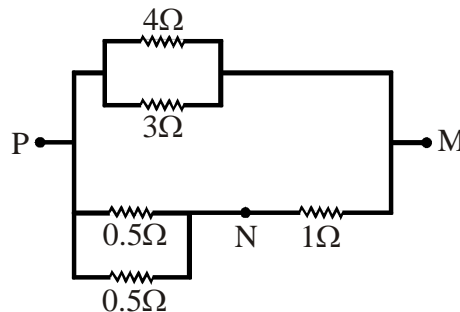
- (A) 2A                      (B) 1A                      (C) 0.5A                      (D) 0.25A

17. Find R, if power dissipated in the circuit is 150 watt :-



- (A)  $2 \Omega$                       (B)  $6 \Omega$                       (C)  $7 \Omega$                       (D)  $3 \Omega$

18. In the circuit shown, the current through the  $4 \Omega$  resistor is 1 amp when the points P and M are connected to a d.c. voltage source. The potential difference between the points M and N is :-

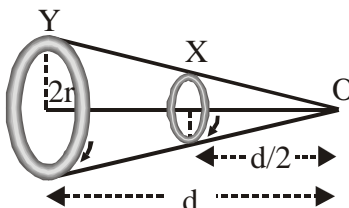


- (A) 0.5 volt                      (B) 3.2 volt                      (C) 1.5 volt                      (D) 1.0 volt

19. Two cells, having the same e.m.f., are connected in series through an external resistance R. Cell have internal resistances  $r_1$  and  $r_2$  ( $r_1 > r_2$ ) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is :-

- (A)  $r_1 - r_2$                       (B)  $\frac{r_1 + r_2}{2}$                       (C)  $\frac{r_1 - r_2}{2}$                       (D)  $r_1 + r_2$

20. Two circular coils X and Y, having equal number of turns, carry equal currents in the same sense and subtend same solid angle at point O. If the smaller coil, X is midway between O and Y, then if we represent the magnetic induction due to bigger coil Y at O as  $B_Y$  and that due to smaller coil X at O as  $B_X$ , then :-



- (A)  $\frac{B_Y}{B_X} = 1$                       (B)  $\frac{B_Y}{B_X} = 2$                       (C)  $\frac{B_Y}{B_X} = \frac{1}{2}$                       (D)  $\frac{B_Y}{B_X} = \frac{1}{4}$

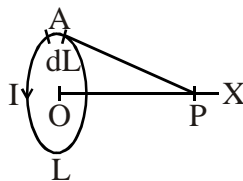
21. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be :

- (A) 4s                      (B) 1s                      (C) 2s                      (D) 3s

22. The permeability of a paramagnetic substance is :-

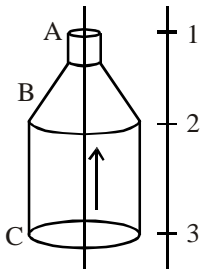
- (A) Slightly more than vacuum                      (B) Slightly less than vacuum  
(C) Much more than vacuum                      (D) None of the above

23. L is a circular loop carrying a current. P is a point on its axis OX. dL is an element of length on the loop at a point A on it. The magnetic field at P :

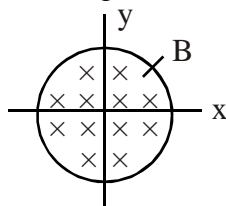


- (1) Due to L is direction along OX                      (2) Due to dL is directed along OX  
(3) Due to dL is perpendicular to OX                      (4) Due to dL is perpendicular to AP  
(A) 1, 4                      (B) 1, 2                      (C) 1, 3                      (D) Only 1

24. A long, straight, hollow conductor (tube) carrying a current has two sections A and C of unequal cross-sections joined by conical section B. 1, 2 and 3 are points on a line parallel to the axis of the conductor. The magnetic fields at 1, 2 and 3 have magnitudes  $B_1$ ,  $B_2$  and  $B_3$ :



- (A)  $B_1 = B_2 = B_3$       (B)  $B_1 = B_2 \neq B_3$       (C)  $B_1 < B_2 < B_3$   
 (D)  $B_2$  cannot be found unless the dimensions of the section B are known
25. A charged particle moves undeflected in a region of crossed electric and magnetic fields. If the electric field is switched off, the particle has an initial acceleration  $a$ . If the magnetic field is switched off, instead of the electric field, the particle will have an initial acceleration :-  
 (A) Equal to 0      (B)  $> a$       (C) Equal to  $a$       (D)  $< a$
26. A conducting circular loop is placed in a uniform magnetic field,  $B = 0.025$  T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of  $1 \text{ mm s}^{-1}$ . The induced e.m.f. when the radius is 2 cm, is :-  
 (A)  $2 \mu\text{V}$       (B)  $2\pi \mu\text{V}$       (C)  $\pi \mu\text{V}$       (D)  $\pi/2 \mu\text{V}$
27. A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is  $4 \times 10^{-3}$  Wb. The self-inductance of the solenoid is :-  
 (A) 1.0 henry      (B) 4.0 henry      (C) 2.5 henry      (D) 2.0 henry
28. Self-inductances of two coils connected in series are 0.01 and 0.03 H. If the windings in the coils are in opposite sense and  $M = 0.01$  H, then the resultant self-inductance will be :-  
 (A) 2H      (B) 0.2 H      (C) 0.02 H      (D) Zero
29. A loop is kept so that its centre lies at the origin of the coordinate system. A magnetic field has the induction  $B$  along  $z$ -axis as shown in the figure :

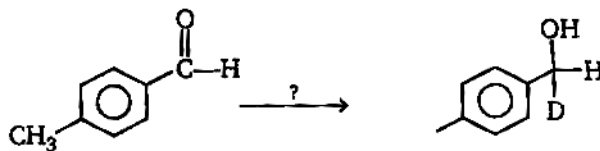


- (A) An e.m.f. and current will be induced in the loop if it rotates about the  $z$ -axis  
 (B) No e.m.f. is induced and no current flows if the loop is a fiber when it rotates about  $y$ -axis  
 (C) e.m.f. is induced and induced current flows in the loop if the loop is made of copper and is rotated about  $y$ -axis  
 (D) If the loop moves about  $z$ -axis with constant velocity current flows in it
30. Two coils of inductances  $L_1$  and  $L_2$  are linked such that their mutual inductance is  $M$  :-  
 (A)  $M = L_1 + L_2$       (B)  $M = \frac{1}{2}(L_1 + L_2)$   
 (C) The maximum value of  $M$  is  $(L_1 + L_2)$       (D) The maximum value of  $M$  is  $\sqrt{L_1 L_2}$

## CHEMISTRY

31. For the first order reaction, half life is 14 sec. The time required for the initial concentration to reduce to  $1/8^{\text{th}}$  of its value is  
(A) 28 s (B) 42 s (C)  $(14)^2$  s (D) 14 s
32. The rate constant for the reaction  $2\text{N}_2\text{O}_5 \longrightarrow 4\text{NO}_2 + \text{O}_2$  is  $2 \times 10^{-5} \text{ sec}^{-1}$ . If the rate is  $1.2 \times 10^{-5} \text{ mol lit}^{-1} \text{ sec}^{-1}$ , then concentration of  $\text{N}_2\text{O}_5$  in mole  $\text{L}^{-1}$  is  
(A) 1.4 (B) 1.2 (C) 0.04 (D) 0.6
33. In the first order reaction the concentration of the reactants is reduced to 25% in one hour. The half life period for the reaction  
(A) 2 hrs (B) 4 hrs (C) 1/2 hrs (D) 1/4 hrs
34. If the coordination no. of an element in its crystal lattice is 8, then packing is  
(A) fcc (B) hcp (C) bcc (D) none of the above
35. In a hexagonal closest packing in two layers one above the other, the coordination number of each sphere will be  
(A) 4 (B) 6 (C) 8 (D) 9
36. The maximum proportion of available volume that can be filled by hard spheres in diamond is  
(A) 0.52 (B) 0.34 (C) 0.32 (D) 0.68
37. The number of molecules in a unit cell of fluorite is  
(A) 2 (B) 4 (C) 6 (D) 8
38. Silicon doped with arsenic is  
(A) p – type Semiconductor (B) n – type Semiconductor  
(C) Like a metallic conductor (D) an insulator
39. A solid has a structure in which W atoms are located at the corners of cubic lattice, O atoms at the centre of edges and Na atom at the centre of the cube. The formula of the compound is  
(A)  $\text{NaWO}_2$  (B)  $\text{NaWO}_3$  (C)  $\text{Na}_2\text{WO}_3$  (D)  $\text{NaWO}_4$
40. The rate of reaction  $\text{A} + \text{B} + \text{C} \longrightarrow \text{products}$  is given by rate =  $k[\text{A}]^{1/2}[\text{B}]^{1/3}[\text{C}]$ .  
The order of reaction is  
(A) 1 (B) 3 (C) 5/6 (D) 11/6
41. What is the amount of chlorine evolved when 2 ampere of current is passed for 30 minutes in an aqueous solution of NaCl ?  
(A) 66 g (B) 1.32 g (C) 33 g (D) 99 g
42. The specific conductance of a salt of 0.01 M concentration is  $1.06 \times 10^{-4}$ . Molar conductance of the same solution will be :  
(A)  $1.061 \times 10^{-4}$  (B) 1.061 (C) 10.61 (D) 106.1
43. What is the number of coulombs required for the conversion of one mole of  $\text{MnO}_4^-$  to one mole of  $\text{Mn}^{2+}$  ?  
(A)  $5 \times 96500$  (B)  $3 \times 96500$  (C) 96500 (D) 9650
44.  $6.02 \times 10^{20}$  molecules of urea are present in 100 ml of its solution. The concentration of urea solution is :  
(A) 0.001 M (B) 0.01 M (C) 0.02 M (D) 0.1 M.
45. Which one of the following aqueous solutions will exhibit highest boiling point ?  
(A) 0.01 M  $\text{Na}_2\text{SO}_4$  (B) 0.01 M  $\text{KNO}_3$  (C) 0.015 M urea (D) 0.015 M glucose

46. Which of the following reagents is best used for the conversion shown below ?



(A) 1.  $\text{NaBH}_4$  / 2.  $\text{D}_3\text{O}^+$

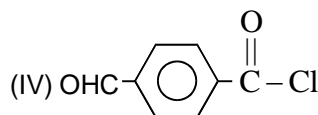
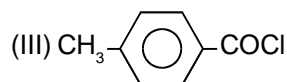
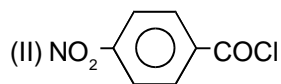
(B) 1.  $\text{NaBD}_4$  / 2.  $\text{H}_3\text{O}^+$

(C) 1.  $\text{LiAlH}_4$  / 2.  $\text{D}_3\text{O}^+$

(D) 1.  $\text{H}_2/\text{Pt}$  / 2.  $\text{D}_3\text{O}^+$

47. Arrange following compounds in decreasing order of reactivity for hydrolysis reaction :

(I)  $\text{C}_6\text{H}_5\text{COCl}$



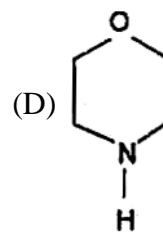
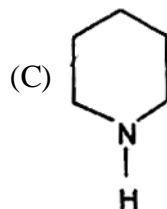
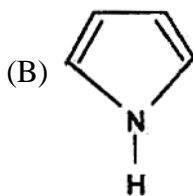
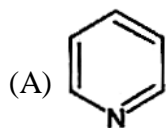
(A) II > IV > I > III

(B) II > IV > III > I

(C) I > II > III > IV

(D) IV > III > II > I

48. The most basic among the following compound is



49. In the reaction  $\xrightarrow{\text{HBr}}$  the products are :

(A) and  $\text{H}_2$

(B) and  $\text{CH}_3\text{Br}$

(C) and  $\text{CH}_3\text{OH}$

(D) and  $\text{CH}_3\text{Br}$

50. Order of nucleophilicity in polar aprotic solvent ?

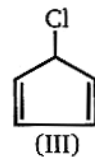
(A)  $\text{I}^\ominus > \text{Br}^\ominus > \text{Cl}^\ominus > \text{F}^\ominus$

(B)  $\text{F}^\ominus > \text{Cl}^\ominus > \text{Br}^\ominus > \text{I}^\ominus$

(C)  $\text{I}^\ominus > \text{Cl}^\ominus > \text{Br}^\ominus > \text{F}^\ominus$

(D)  $\text{F}^\ominus > \text{I}^\ominus > \text{Br}^\ominus > \text{Cl}^\ominus$

51. Order of rate of reaction with  $\text{AgNO}_3$  or rate of  $\text{S}_{\text{N}}1$



(A) I > III > II

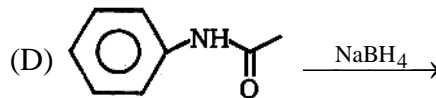
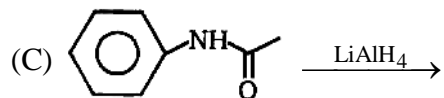
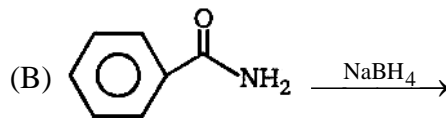
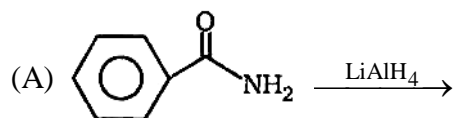
(B) II > III > I

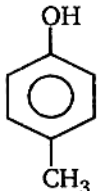
(C) I > II > III

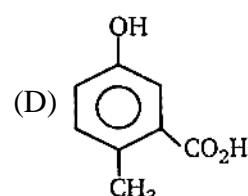
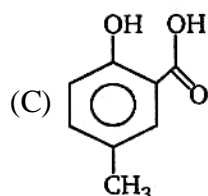
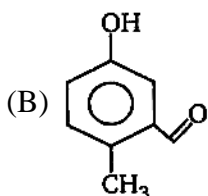
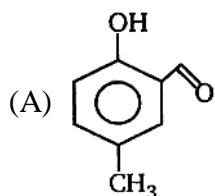
(D) III > I > II



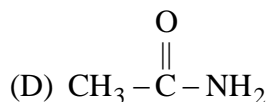
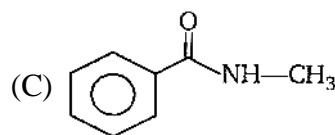
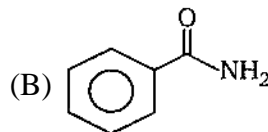
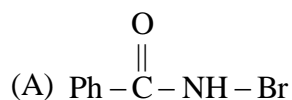
52. Find out a reaction in which product obtained gives positive isocyanide test



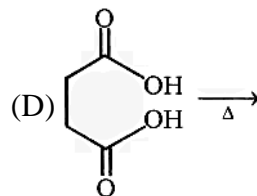
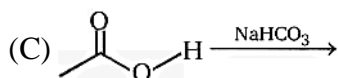
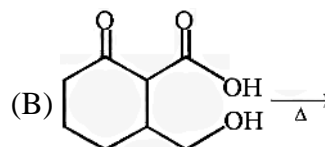
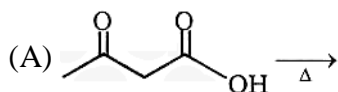
53.  +  $\text{CHCl}_3 + \text{NaOH} \xrightarrow{2\text{H}^{\oplus}}$  (A) Product (A) is

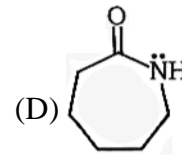
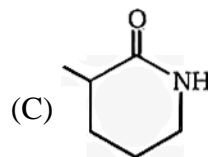
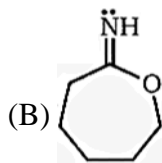
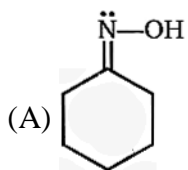
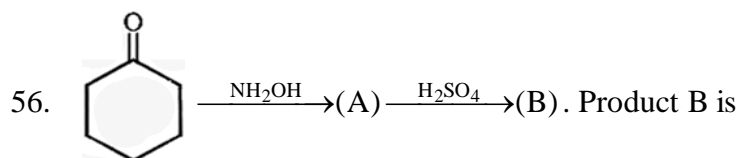


54. Which of the following will not undergo Hoffmann bromamide reaction ?

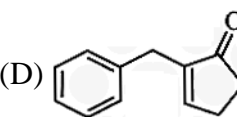
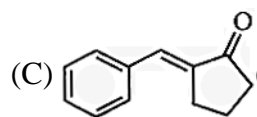
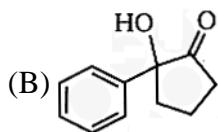
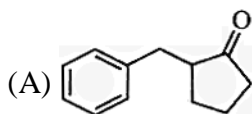
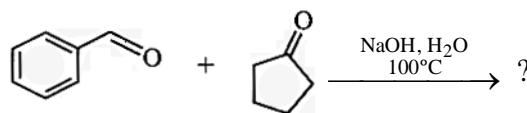


55. In which of the following reaction  $\text{CO}_2$  (carbonyl oxide) is not released ?





57. What is the major product of the following reaction ?



58. The IUPAC name of the Wilkinson's catalyst  $[\text{RhCl}(\text{PPh}_3)_3]$  is

(A) Chlorotris (triphenylphosphine) rhodium (I)

(B) Chlorotris (triphenylphosphine) rhodium (IV)

(C) Chlorotris (triphenylphosphine) rhodium (0)

(D) Chlorotris (triphenylphosphine) rhodium (VI)

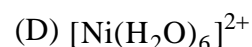
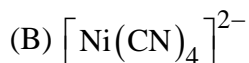
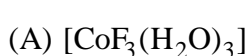
59. The geometry of  $[\text{Ni}(\text{CO})_4]$  and  $[\text{NiCl}_2(\text{PPh}_3)_2]$  are

(A) both square planar

(B) tetrahedral and square planar respectively

(C) both are tetrahedral (D) square planar and tetrahedral respectively

60. The species with spin only magnetic moment of  $\sqrt{24}$  BM is



## MATHEMATICS

61. A kite is 300 m high and there are 500 m of cord out. If the wind moves the kite horizontally at the rate of 5 km/hr. directly away from the person who is flying it, find the rate at which the cord is being paid?

(A) 4 (B) 8  
(C) 3 (D) cannot be determined

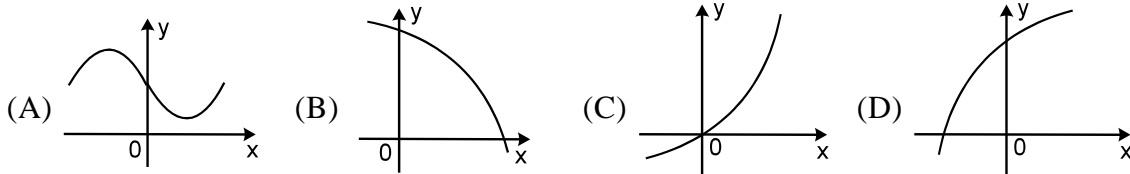
62. If  $f(x) = a \ln |x| + bx^2 + x$  has its extremum values at  $x = -1$  and  $x = 2$ , then  
(A)  $a = 2, b = -1$  (B)  $a = 2, b = -1/2$  (C)  $a = -2, b = 1/2$  (D) none of these

63.

The greatest, the least values of the function,  $f(x) = 2 - \sqrt{1+2x+x^2}$ ,  $x \in [-2, 1]$  are respectively

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

64. The curve  $y = f(x)$  which satisfies the condition  $f'(x) > 0$  and  $f''(x) < 0$  for all real  $x$ , is:



65. **STATEMENT-1 :** If  $f(x)$  is increasing function with concavity upwards, then concavity of  $f^{-1}(x)$  is also upwards.

**STATEMENT-2 :** If  $f(x)$  is decreasing function with concavity upwards, then concavity of  $f^{-1}(x)$  is also upwards.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

66. If  $f(x)$  satisfies the requirements of Lagrange's mean value theorem on  $[0, 2]$  and if  $f(0) = 0$

and  $f'(x) \leq \frac{1}{2} \forall x \in [0, 2]$ , then

(A)  $|f(x)| \leq 2$

(B)  $f(x) \leq 1$

(C)  $f(x) = 2x$

(D)  $f(x) = 3$  for at least one  $x$  in  $[0, 2]$

67. Number of tangents drawn from the point  $(-1/2, 0)$  to the curve  $y = e^{\{x\}}$ . (Here  $\{ \}$  denotes fractional part function).

(A) 2

(B) 1

(C) 3

(D) 4

68. On the curve  $x^3 = 12y$ . The interval in which abscissa changes at a faster rate than its ordinate

(A)  $(-3, 0)$

(B)  $(-\infty, -2) \cup (2, \infty)$

(C)  $(-2, 2)$

(D)  $(-3, 3)$

69. If  $f(x) = 1 + 2x^2 + 4x^4 + 6x^6 + \dots + 100x^{100}$  is a polynomial in a real variable  $x$ , then  $f(x)$  has:  
 (A) neither a maximum nor a minimum (B) only one maximum  
 (C) only one minimum (D) one maximum and one minimum
70. If  $\int_0^{100} f(x) dx = a$ , then  $\sum_{r=1}^{100} \left( \int_0^1 f(r-1+x) dx \right) =$   
 (A)  $100a$  (B)  $a$  (C)  $0$  (D)  $10a$
71.  $\lim_{t \rightarrow \left(\frac{\pi}{2}\right)^-} \int_0^t \tan \theta \sqrt{\cos \theta} \ln(\cos \theta) d\theta$  is equal to :  
 (A)  $-4$  (B)  $4$  (C)  $-2$  (D) Does not exist
72. The tangent to the graph of the function  $y = f(x)$  at the point with abscissa  $x = 1$  form an angle of  $\pi/6$  and at the point  $x = 2$ , an angle of  $\pi/3$  and at the point  $x = 3$ , an angle of  $\pi/4$  with positive  $x$ -axis. The value of  $\int_1^3 f'(x)f''(x)dx + \int_2^3 f''(x)dx$  ( $f''(x)$  is supposed to be continuous) is :  
 (A)  $\frac{4\sqrt{3}-1}{3\sqrt{3}}$  (B)  $\frac{3\sqrt{3}-1}{2}$  (C)  $\frac{4-\sqrt{3}}{3}$  (D)  $\frac{4}{3}-\sqrt{3}$
73. The order of the differential equation whose general solution is given by  
 $y = (C_1 + C_2) \sin(x + C_3) - C_4 e^{x+C_5}$  is  
 (A) 5 (B) 4 (C) 2 (D) 3
74. The differential equation whose solution is  $(x - h)^2 + (y - k)^2 = a^2$  is ( $a$  is a constant)  
 (A)  $\left[ 1 + \left( \frac{dy}{dx} \right)^2 \right]^3 = a^2 \frac{d^2y}{dx^2}$  (B)  $\left[ 1 + \left( \frac{dy}{dx} \right)^2 \right]^3 = a^2 \left( \frac{d^2y}{dx^2} \right)^2$   
 (C)  $\left[ 1 + \left( \frac{dy}{dx} \right)^2 \right]^3 = a^2 \left( \frac{d^2y}{dx^2} \right)^2$  (D)  $\left[ 1 + \left( \frac{dy}{dx} \right)^2 \right]^2 = a^2 \left( \frac{d^2y}{dx^2} \right)^3$
75. Solution of differential equation  $x(xdx - ydy) = 4\sqrt{x^2 - y^2} (xdy - ydx)$  is  
 (A)  $\sqrt{x^2 - y^2} = Ae^{4 \sin^{-1}\left(\frac{x}{y}\right)}$  (B)  $\sqrt{x^2 + y^2} = Ae^{4 \cos^{-1}x}$   
 (C)  $\sqrt{x^2 - y^2} = Ae^{4 \tan^{-1}\left(\frac{y}{x}\right)}$  (D)  $\sqrt{x^2 - y^2} = Ae^{4 \sin^{-1}\left(\frac{y}{x}\right)}$
76. If the function  $g(x) = \begin{cases} k\sqrt{x+1} & , 0 \leq x \leq 3 \\ mx+2 & , 3 < x \leq 5 \end{cases}$  is differentiable, then the value of  $k+m$  is;  
 (A) 2 (B)  $\frac{16}{5}$  (C)  $\frac{10}{3}$  (D) 4

77. Consider the function,  $f(x) = |x - 2| + |x - 5|$ ,  $x \in \mathbb{R}$ .
- Statement-1 :**  $f'(4) = 0$
- Statement-2 :**  $f$  is continuous in  $[2, 5]$ , differentiable in  $(2, 5)$  and  $f(2) = f(5)$ .
- (A) Statement-1 is false, Statement-2 is true.  
 (B) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for Statement-1.  
 (C) Statement-1 is true, statement-2 is true; statement-2 is **not** a correct explanation for Statement-1.  
 (D) Statement-1 is true, statement-2 is false.
78. If  $q^2 - 4pr = 0$ ,  $p > 0$ , then the domain of the function  $f(x) = \log(p x^3 + (p + q)x^2 + (q + r)x + r)$  is:
- (A)  $\mathbb{R} - \left\{ -\frac{q}{2p} \right\}$                       (B)  $\mathbb{R} - \left[ (-\infty, -1] \cup \left\{ -\frac{q}{2p} \right\} \right]$
- (C)  $\mathbb{R} - \left[ (-\infty, -1) \cap \left\{ -\frac{q}{2p} \right\} \right]$                       (D)  $\mathbb{R}$
79. Let  $f$  be a real valued function defined by  $f(x) = \frac{e^x - e^{-|x|}}{e^x + e^{|x|}}$ , then the range of  $f(x)$  is :
- (A)  $\mathbb{R}$                       (B)  $[0, 1]$                       (C)  $[0, 1)$                       (D)  $\left[ 0, \frac{1}{2} \right)$
80. If  $f(x) = 2[x] + \cos x$ , then  $f: \mathbb{R} \rightarrow \mathbb{R}$  is: (where  $[.]$  denotes greatest integer function)
- (A) one-one and onto                      (B) one-one and into  
 (C) many-one and into                      (D) many-one and onto
81. The complete solution set of the inequality  $[\cot^{-1}x]^2 - 6[\cot^{-1}x] + 9 \leq 0$ , where  $[.]$  denotes greatest integer function, is
- (A)  $(-\infty, \cot 3]$                       (B)  $[\cot 3, \cot 2]$                       (C)  $[\cot 3, \infty)$                       (D)  $(-\infty, \cot 2]$
82. OABCDE is a regular hexagon of side 2 units in the XY-plane in the  $I^{\text{st}}$  quadrant. O being the origin and OA taken along the X-axis. A point P is taken on a line parallel to Z-axis through the centre of the hexagon at a distance of 3 units from O in the positive Z direction. Then vector  $\overrightarrow{AP}$  is:
- (A)  $-\hat{i} + 3\hat{j} + \sqrt{5}\hat{k}$                       (B)  $\hat{i} - \sqrt{3}\hat{j} + 5\hat{k}$                       (C)  $-\hat{i} + \sqrt{3}\hat{j} + \sqrt{5}\hat{k}$                       (D)  $\hat{i} + \sqrt{3}\hat{j} + \sqrt{5}\hat{k}$
83. Points X and Y are taken on the sides QR and RS, respectively of a parallelogram PQRS, so that  $QX = 4XR$  and  $RY = 4YS$ . The line XY cuts the line PR at Z. Find the ratio  $PZ : ZR$ .
- (A) 4 : 21                      (B) 3 : 4                      (C) 21 : 4                      (D) 4 : 3
84. If  $\vec{a} \times \vec{b} = \vec{c}$ ,  $\vec{b} \times \vec{c} = \vec{a}$ , then find value of  $|\vec{3a} + 4\vec{b} + 12\vec{c}|$  if  $\vec{a}, \vec{b}, \vec{c}$  are vectors of same magnitude.
- (A) 11                      (B) 12                      (C) 13                      (D) 14

85. If 3 non zero vectors  $\vec{a}, \vec{b}, \vec{c}$  are such that  $\vec{a} \times \vec{b} = 2(\vec{a} \times \vec{c}), |\vec{a}| = |\vec{c}| = 1; |\vec{b}| = 4$  the angle between  $\vec{b}$  and  $\vec{c}$  is  $\cos^{-1} \frac{1}{4}$  then  $\vec{b} = \ell \vec{c} + \mu \vec{a}$  where  $|\ell| + |\mu|$  is -  
 (A) 6 (B) 5 (C) 4 (D) 0
86. Equation of the angle bisector of the angle between the lines  $\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{1}$  &  $\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{-1}$  is :  
 (A)  $\frac{x-1}{2} = \frac{y-2}{2}; z - 3 = 0$  (B)  $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$   
 (C)  $x - 1 = 0; \frac{y-2}{1} = \frac{z-3}{1}$  (D)  $\frac{x-1}{2} = \frac{y-2}{3}; z - 3 = 0$
87. The value of  $[(\vec{a} + 2\vec{b} - \vec{c}) (\vec{a} - \vec{b}) (\vec{a} - \vec{b} - \vec{c})]$  is equal to the box product:  
 (A)  $[\vec{a} \vec{b} \vec{c}]$  (B)  $2[\vec{a} \vec{b} \vec{c}]$  (C)  $3[\vec{a} \vec{b} \vec{c}]$  (D)  $4[\vec{a} \vec{b} \vec{c}]$
88. Let  $\vec{a}, \vec{b}, \vec{c}$  are three non-coplanar vectors such that  $\vec{r}_1 = \vec{a} - \vec{b} + \vec{c}, \vec{r}_2 = \vec{b} + \vec{c} - \vec{a}, \vec{r}_3 = \vec{c} + \vec{a} + \vec{b}, \vec{r} = 2\vec{a} - 3\vec{b} + 4\vec{c}$ . If  $\vec{r} = \lambda_1 \vec{r}_1 + \lambda_2 \vec{r}_2 + \lambda_3 \vec{r}_3$ , then the values of  $\lambda_1, \lambda_2$  and  $\lambda_3$  respectively are  
 (A) 7, 1, -4 (B) 7/2, 1, -1/2 (C) 5/2, 1, 1/2 (D) -1/2, 1, 7/2
89. The reflection of the point (2, -1, 3) in the plane  $3x - 2y - z = 9$  is :  
 (A)  $(\frac{26}{7}, \frac{15}{7}, \frac{17}{7})$  (B)  $(\frac{26}{7}, \frac{-15}{7}, \frac{17}{7})$  (C)  $(\frac{15}{7}, \frac{26}{7}, \frac{-17}{7})$  (D)  $(\frac{26}{7}, \frac{17}{7}, \frac{-15}{7})$
90. The distance of the point (-1, -5, -10) from the point of intersection of the line,  $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$  and the plane,  $x - y + z = 5$ , is :  
 (A) 10 (B) 11 (C) 12 (D) 13

## ANSWER KEY

### PHYSICS

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

### CHEMISTRY

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

### MATHEMATICS

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