QUESTION PAPER

Mathematics

1. $\int \frac{(5x^8+7x^6)}{(x^2+1+2x^7)^2}dx$ is equal to

(A) $\frac{x}{(x^2+1+2x^7)}+C$

(B) $\frac{x^7}{(x^2+1+2x^7)}+C$

(C) $\frac{x^6}{(x^2+1+2x^7)}+C$

(D) $\frac{x^2}{(x^2+1+2x^7)}+C$

2. The number of positive integral value of α for which roots of equation $6x^2-11x+\alpha=0$ are rational, is

(A) 3

(B) 2

(C) 1

(D) 4

3. The coefficient of t^4 in $\left(\frac{1-t^6}{1-t}\right)$ is

(A) 18

(B) 12

(C) 9

(D) 15

4. If $\sum_{i=1}^{n}(x_i \times 1)^2 = 9n$ and $\sum_{i-1}^{n}(x_i-1)^2 = 5n$, then standard deviation of these 'n' observations (x_i) is

(A) $2\sqrt{3}$

(B) $\sqrt{3}$

(C) $\sqrt{5}$

(D) $3\sqrt{2}$

5. Number of natural number's less than 7000 using digit 0,1,3,7,9 (repetition allowed) is

(A) 375

(B) 275

(C) 274

(D) 374

6. An urn contains 5 red and 2 green balls, one ball is chosen from urn, if it is red then a green ball is put back into Box, and if is green then a red ball is put in to box (previous ball was not put in that box), now a second ball is drawn from the urn. The probability that it is red ball is

(A) $\frac{32}{49}$

(B) $\frac{17}{49}$

(C) $\frac{15}{49}$

(D) $\frac{36}{49}$

7. Sum of first 15 term of series $1+6+\frac{9(1^2+2^2+3^2)}{7}+\frac{12(1^2+2^2+3^2+4^2)}{9}+\ldots$ is

(A) 7620

(B) 7280

(C) 7820

(D) 7067

8. Let Z_0 is the root of equation $x^2+x+1=0$ and $Z=3+6i(Z_0)^{81}-3i(Z_0)^{93}$ then arg (Z) is equal to

(A) $\frac{\pi}{4}$

(B) $\frac{\pi}{3}$

(C) π

(D) $\frac{\pi}{6}$

9. Let $\vec{a} = \hat{\imath} + j + \sqrt{2}\hat{k}, \vec{b} = b_1\hat{\imath} + b_2\hat{\jmath} + \sqrt{2}\hat{k}, \vec{c} = 5\hat{\imath} + \hat{\jmath} + \sqrt{2}\hat{k}$. Given $\vec{a} + \vec{b}$ is perpendicular to $\vec{c}$ and projection vector of $\vec{b}$ on $\vec{a}$ is $\vec{a}$, then find $|\vec{b}|$ is equal to

(A) 6

(B) $\sqrt{22}$

(C) $\sqrt{32}$

(D) 11

10. $\int_0^{\pi/3} \frac{\tan x}{\sqrt{2k \sec x}} dx = 1 - \frac{1}{\sqrt{2}}$, then value of k is

(A) 2

(B) 1

(C) $\frac{1}{2}$

(D) $\frac{1}{4}$

11. Number of solutions of equation $\sin x - \sin 2x + \sin 3x = 0$ in $0 \leq x < \frac{\pi}{2}$, is

(A) 2

(B) 3

(C) 4

(D) 5

12. Find area enclosed by curve $0 \leq y \leq x|x| + 1$ between $-1 \leq x \leq 1$ is

(A) 2

(B) $\frac{4}{3}$

(C) $\frac{1}{3}$

(D) 3

13. The value of $\lim_{x \to 0^-} \frac{x([x]+|x|)\sin[x]}{|x|}$ is

(A) $-\sin 1$

(B) $\sin 1$

(C) 0

(D) 1

14. Let $y = y(x)$ is solution of $\frac{dy}{dx} = f(x)$ where $f(xy) = f(x).f(y)\ \forall x, y \in R$ and $f(0) \neq 0$ and $y(0) = \frac{1}{2}$, then $y\left(\frac{1}{4}\right) + y\left(\frac{3}{4}\right)$ is equal to

(A) 1

(B) 2

(C) 3

(D) 4

15. If $A(4, -4)$ and $B(9, 6)$ lies on $y^2 = 4x$ and point C on arc AOB (O is origin) such that area of ΔACB is maximum then point C is

(A) $\left(\frac{1}{4}, 1\right)$

(B) $\left(1, \frac{1}{4}\right)$

(C) $\left(1, \frac{1}{2}\right)$

(D) $\left(\frac{1}{2}, 1\right)$

16. If the circles $x^2 + y^2 - 16x - 20y + 164 = r^2$ and $(x-4)^2 + (y-7)^2 = 36$ intersect at two points then

(A) $1 < r < 11$

(B) $r = 11$

(C) $r > 11$

(D) $0 < r < 1$

17. The eccentricity of hyperbola passing though (4, 2) whose centre is $(0, 0)$, length of transverse axis is 4 and transverse axis along x axis is

(A) 2

(B) $\sqrt{3}$

(C) $\frac{\sqrt{3}}{2}$

(D) $\frac{2}{\sqrt{3}}$

18. If $x = 3\tan t$ and $y = 3\sec t$ then find $\frac{d^2y}{dx^2}$ at $t = \frac{\pi}{4}$

(A) 3

(B) $\frac{1}{6\sqrt{2}}$

(C) 1

(D) $\frac{1}{6}$

19. Let $A\{x: x \in R^{-}\}, f: A \to R$ is defined as $f(x) = \frac{2x}{x-1}$ then $f(x)$ is

(A) Surjective but nor injective

(B) Injective but nor surjective

(C) Neither injective nor surjective

(D) Injective

20. Let a, b, c are $7^{th}, 11^{th}$ and 13^{th} terms of a non constant A.P. If a, b, c are also is G.P then find $\frac{a}{c}$ is

(A) 1

(B) 2

(C) 3

(D) 4

21. If S is a set of triangles whose one vertex is the origin and other two vertices are integral coordinates and lie on the coordinate axis. If area of all such triangles is 50 square units, then number of elements in set S is equal to

(A) 9

(B) 18

(C) 36

(D) 40

22. If the roots of equation $x^2 - mx + 4 = 0$ are distinct and lies in $[1, 5]$, then range of 'm' is

(A) $(3, 4)$

(B) $(4, 5)$

(C) $(-5, -4)$

(D) $(-3, 4)$

23. If $x = \sin^{-1}(\sin 10)$ and $y = \cos^{-1}(\cos 10)$, then the value of $(y - x)$ is

(A) π

(B) 7π

(C) 0

(D) 10

24. Matrix $A = \begin{bmatrix} e^t & e^{-t}(\sin t - 2\cos t) & e^{-t}(-2\sin t - \cos t) \\ e^t & -e^{-t}(2\sin t + \cos t) & e^{-t}(\sin t - 2\cos t) \\ e^t & e^{-t}\cos t & e^{-t}\sin t \end{bmatrix}$ is invertible

(A) Only if $t = \frac{\pi}{2}$

(B) Only if $t = \pi$

(C) for all $t \in R$

(D) for all $t \notin R$

25. Two lines in 3-D are $x = ay + b, z = cy + d$ and $x = a'z + b'$, $y = c'\ z + d'$. If these lines are perpendicular to each other, then which of the following condition is true?

(A) $aa' + c + c' = 0$

(B) $cc' + a''a' = 0$

(C) $aa' + cc' = 0$

(D) $aa' + cc' + 1 = 0$

26. Let equation of two sides of a triangle are $4x + 5y = 20$ and $3x - 2y + 6 = 0$. If orthocenter of triangle is (1, 1) then the equation of third side of triangle is

(A) $y + 10 = \frac{-13}{61}\left(x + \frac{35}{2}\right)$

(B) $y + 10 = \frac{-13}{61}\left(x - \frac{35}{2}\right)$

(C) $y + 10 = \frac{13}{61}\left(x - \frac{35}{2}\right)$

(D) $y - 10 = \frac{13}{61}\left(x - \frac{35}{2}\right)$

27. If $|f(x) - f(y)| \leq 2|x - y|^{3/2}\ \forall\ x, y \in R$ and $f(0) = 1$ then value of $\int_0^1 f^2(x)dx$ is equal to

(A) 1

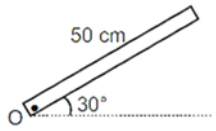
(B) 2

(C) $\sqrt{2}$

(D) 4

Physics

1. A uniform rod of length $50\,cm$ is released in the vertical plane from the position shown in figure. The rod is hinged smoothly at O. The angular speed of rod when it becomes horizontal is:



(A) $30\ rad/s$

(B) $\sqrt{30}\ rad/s$

(C) $40\ rad/s$

(D) $\sqrt{32}\ rad/s$

2. A particle is moving such that its position is given by

$x = A\cos\omega t$

$y = A\sin\omega t$

$z = A\,\omega t$

Speed of particle will be

(A) ωA

(B) $\sqrt{2}\,\omega A$

(C) $\frac{\omega A}{2}$

(D) Zero

3. A transformer is operating at 90% efficiency. The voltage across primary coil and secondary coil is $2300\,V$ and $230\,V$ respectively. The number of turns in primary coil is 2400 and current in primary coil is $5A$.

What is the current in secondary coil:

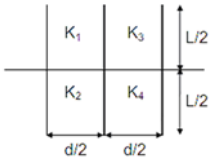
(A) $45\ A$

(B) $30\ A$

(C) $50\ A$

(D) $52\ A$

4.



What is the equivalent dielectric constant of a single dielectric that can replace k_1, k_2, k_3 and k_4

(A) $\frac{(K_1+K_2)(K_3+K_1)}{K_1+K_2+K_3+K_4}$

(B) $\frac{(K_1+K_4)(K_2+K_3)}{K_1+K_3+K_4+K_2}$

(C) $\frac{(K_2+K_4)(K_1+K_3)}{K_1+K_2+K_3+K_4}$

(D) $\frac{K_1K_2+K_3K_4}{K_1+K_2+K_3+K_4}$

5. A charge $\sqrt{10}\,\mu C$ is placed at $(1,0)$ and another charge $-25\mu C$ is placed at $(4,0)$. Find Electric field vector at point $(0,3)$.

(A) $63\hat{\imath} - 27\hat{\jmath}$

(B) $-63\hat{\imath} + 27\hat{\jmath}$

(C) $27\hat{\imath} - 63\hat{\jmath}$

(D) $-27\hat{\imath} + 126\hat{\jmath}$

6. E_1 is energy required to take a satellite up to height h from surface of earth. E_2 is kinetic energy required to perform circular motion at that height if $E_1 = E_2$ then h will be [Radius of earth $6.4 \times 10^3 km$]

(A) $6.4 \times 10^3\ km$

(B) $1.6 \times 10^4\ km$

(C) $3.2 \times 10^3\ km$

(D) $1.6 \times 10^3\ km$

7. A light with magnetic field wave $B = B_0[\sin(3.14 \times 10^7 ct) + \sin(6.28 \times 10^7 ct)]$. Incident on metallic surface with $\phi = 4.7\ eV$. The maximum kinetic energy of photo electron is:

(A) $7\ eV$

(B) $7.7\ eV$

(C) $6.5\ eV$

(D) $8\ eV$

8. Volume charge density varies according to $\rho(r) = \frac{A}{r^2} e^{\frac{2r}{a}}$ where r is distance from center find radius in which total charge Q is enclosed.

(A) $\frac{a}{2} ln\left(\frac{2\pi aA}{2\pi aA - Q}\right)$

(B) $a\, ln\left(\frac{\pi aA}{2\pi aA - Q}\right)$

(C) $\frac{a}{4} ln\left(\frac{\pi aA}{\pi aA - Q}\right)$

(D) None of these

9. Two carnot engine are connected in series and output work of both engine is same. If temperature of source of 1^{st} engine is $600\ K$ and temperature of sink of 2^{nd} engine is $400\ K$. The temperature of junction will be

(A) $300\ K$

(B) $400\ K$

(C) $500\ K$

(D) $600\ K$

10. Displacement of an object of mass $2\ kg$ varies as $s = 3t^2 + 5$. Find work done by man from $t = 0$ to $t = 5$ sec.

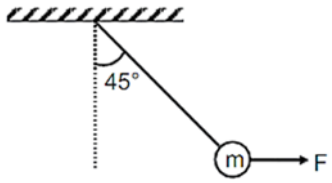
(A) $100\ J$

(B) $200\ J$

(C) $500\ J$

(D) $900\ J$

11. An object is connected to rigid support through a light string. The value of F so that block remains in equilibrium. $[m = 10\ kg]$



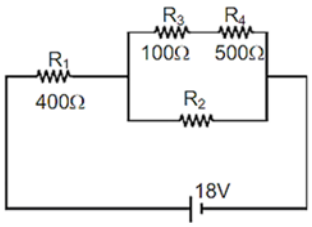
(A) $100\ N$

(B) $50\ N$

(C) $50\sqrt{2}$

(D) $100\sqrt{2}$

12. If voltage across 500Ω is $5V$. Then R_2 is



(A) $400\ \Omega$

(B) $200\ \Omega$

(C) $300\ \Omega$

(D) $500\ \Omega$

13. There are two plane mirrors placed at some angle θ with each other. A ray incident an first mirror travelling parallel to second mirror and it travels parallel to the first mirror after two successive reflections. Find angle θ between the mirrors.

(A) $\theta = 90^o$

(B) $\theta = 60^o$

(C) 120^o

(D) 30^o

14. A and B participate in a race with acceleration a_1 and a_2 respectively. A reaches t times earlier than B at finish line and there velocities at finish line are v_1 and v_2 respectively. If difference between their velocities is v then find the value of v

(A) $\frac{a_1+a_2}{2}t$

(B) $\sqrt{a_1 a_2}t$

(C) $\frac{a_1 a_2}{a_1+a_2}t$

(D) $\frac{2a_1 a_2}{a_1+a_2}t$

15. A particle is performing S.H.M between $x = -A$ and $x = +A$. The position of particle where K.E. equals to P.E.

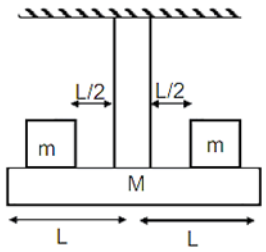
(A) $x = 0$

(B) $x = +A$

(C) $x = +\frac{A}{\sqrt{2}}$

(D) $x = \frac{\sqrt{3}}{2}A$

16. A rod of mass M and length $2L$ is performing SHM as Torsional pendulum in horizontal plane. Two blocks each of mass m are put at distance $\frac{L}{2}$ from centre. The frequency after putting blocks of mass m is 20% of initial frequency. Then ratio of $\frac{m}{M}$ will be:



(A) 12

(B) 14

(C) 16

(D) 18

17. 15 gm N_2 is present in a closed container at 300 K. The amount of heat supplied to the system so that V_{rms} becomes double is:

(A) 8 kJ

(B) 10 kJ

(C) 12 kJ

(D) 14 kJ

18. $d = 0.5\,mm \quad \lambda = 5000\,A^o \quad -30 \leq \theta \leq 30^o$

In a young's Double slit experiment the separation between the slits $d = 0.5\,mm$ and the wavelength used is $\lambda = 800\,nm$. Find the total number of maxima that lies between on two lines drawn symmetrically from the point right in the middle of the two slits.

(A) 624

(B) 625

(C) 621

(D) 640

19. A musician is playing an open flute of length 50 cm at its second harmonic. A car is running towards the musician with speed 10 km/h. Find frequency observed by the man if speed of sound in air is 330 m/s.

(A) 660 Hz

(B) 662 Hz

(C) 665 Hz

(D) 664 Hz

20. Two wires of same length are bent in the form of a circle and square respectively. If same current passes in both of then, find the ratio of magnetic fields at their centres

(A) $\frac{\pi^2}{8\sqrt{2}}$

(B) $\frac{\pi^2}{2\sqrt{2}}$

(C) $\frac{\pi^2}{4\sqrt{2}}$

(D) $\frac{\pi^2}{16\sqrt{2}}$

21. Resistor is coloured as green – orange – yellow – gold, its resistance will be

(A) $53 \times 10^4 \pm 10\%$

(B) $54 \times 10^4 \pm 10\%$

(C) $42 \times 10^4 \pm 10\%$

(D) $53 \times 10^4 \pm 5\%$

22. A charge of magnitude $1.6 \times 10^{-19} C$ is moving in circle of radius 5 cm in a uniform magnetic field $0.5T$. After applying $E = 0.15\ V/m$ charge starts moving in a straight line mass of charge will be.

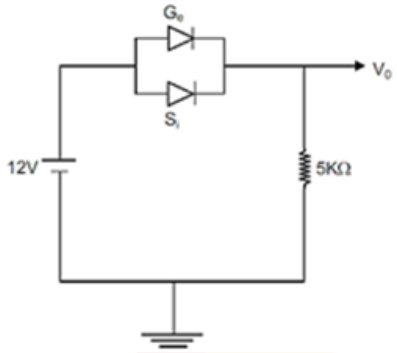
(A) $\frac{2}{3} \times 10^{-20} kg$

(B) $\frac{4}{3} \times 10^{-20} kg$

(C) $\frac{6}{3} \times 10^{-20} kg$

(D) $\frac{1}{3} \times 10^{-20} kg$

23. As shown in the diagram we get some value of voltage V_0. Now direction of Ge diode becomes reverse, then we get some other value of voltage V_0, Find the difference of voltage V_0, in both the cases.



(A) $0.3\ V$

(B) $0.4\ V$

(C) $0.7\ V$

(D) $1.0\ V$

24. There is screw gauge having main scale division as well as pitch of circular scale is $0.5\ mm$. Circular scale has 100 divisions. If no object is placed then $'0'$ of main scale is not visible and 3 division lies below reference main scale If wire is placed in between jaws, reading on main scale is $5.5\ mm$ and 48^{th} division matches with reference on main scale. The diameter of wire is

(A) $7.235\ mm$

(B) $6.225\ mm$

(C) $5.634\ mm$

(D) $6.125\ mm$

25. If gravitational constant (G), planks constant (h) and speed of light (c) considered as fundamental physical quantities then find dimensional formula of time

(A) $\left[G^{\frac{1}{2}}\ h^{\frac{1}{2}}\ c^{\frac{-5}{2}}\right]$

(B) $\left[G^{1}\ h^{2}\ c^{\frac{-5}{2}}\right]$

(C) $\left[G^{\frac{1}{2}}\ h^{\frac{1}{2}}\ c^{-2}\right]$

(D) $\left[G^{2}\ h^{\frac{1}{2}}\ c^{-2}\right]$

Chemistry

1. Which of the following will form a stable nitride?
(A) Li
(B) K
(C) Rb
(D) Cs

2. In which of the following cases, does the bond order increases, and the magnetic behavior changes from paramagnetic to diamagnetic?
(A) $O_2 \rightarrow O_2^+$
(B) $NO \rightarrow NO^+$
(C) $O_2 \rightarrow O_2^-$
(D) $N_2 \rightarrow N_2^+$

3. M^{3+} ion show blue, green, red colour with ligands $L_1, L_2,$ and L_3 respectively. Arrange the ligands in order of their strength.
(A) $L_1 > L_2 > L_3$
(B) $L_2 > L_3 > L_1$
(C) $L_3 > L_2 > L_1$
(D) $L_3 > L_1 > L_2$

4. Which of the following transition elements will have least enthalpy of atomization?
(A) V
(B) Cu
(C) Zn
(D) Fe

5. By which ion arsenic sulphide coagulated maximum?
(A) $AgCl$
(B) $NaCl$
(C) $AlCl_3$
(D) $Na_3(PO_4)$

6. Why H_3PO_2 is a strong reducing agent?
(A) One $P-H$ bond
(B) Two $P-H$ bond
(C) One $O-H$ bond
(D) Two $-OH$ bond

7. Cu crystallises in FCC lattice with unit cell edge length XÅ Calculate its density (Given molecular mass of $Cu = 63.5\ gm/mole$)

(A) $\frac{421.716}{x^3} gm/cm^3$

(B) $\frac{215}{x^3} gm/cm^3$

(C) $\frac{267}{x^3} gm/cm^3$

(D) $\frac{351.76}{x^3} gm/cm^3$

8. $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$. If at 300 K temperature $E^o_{cell} = 2V$ then find out the equilibrium constant. (Giving $R = 8j\ mol^{-1}K^{-1}$ and $F = 96500\ C$).

(A) e^{160}

(B) e^{-160}

(C) e^{320}

(D) e^{-320}

9. For a reaction $2A + B \rightarrow C$ the initial rate of reaction is $0.3M$/sec on doubling the concentration of both A & B rate becomes 2.4 M/sec. On doubling A alone rate becomes 0.6 M/sec, then order or reaction is:

(A) w.r.t. A is 2

(B) w.r.t. B is 2

(C) Total order of reaction is 4

(D) Order of B is 1

10. Find the mass of H_2O formed if combustion of 445 gm $C_{57}H_{110}O_6$ takes place.

(A) 490 gm

(B) 495 gm

(C) 890 gm

(D) 690 gm

11. Equilibrium constant of reaction $A_2 + B_2 \rightleftharpoons 2AB$ is K_1, and for $6AB \rightleftharpoons 3A_2 + 3B_2$ is K_2. Then which of the following is correct?

(A) $K_2 = 3K_1^3$

(B) $K_2 = \frac{1}{K_1^3}$

(C) $K_2 = \frac{K_1^3}{3}$

(D) $K_2 = \frac{3}{K_1^3}$

12. Which compound can cause temporary Hardness in water?

(A) $NaCl$

(B) $CaCl_2$

(C) $AlCl_3$

(D) $Ca(HCO_3)_2$

13. Which compound have maximum Crystal Field Splitting Energy ($CFSE$)?

(A) $[Co(CN)_6]^{-3}$

(B) $[Co(H_2O)(NH_3)_5]^{+3}$

(C) $[Co(H_2O)_5Cl]Cl_2$

(D) $[Co(H_2O)_4Cl_2]Cl$

14. 62 gm ethylene glycol present in 250 gm water, and $\Delta T_f = +10^oC$. Then how many gram of water will exist as ice? $\left((K_f)_{H_2O} = 1.86\right)$

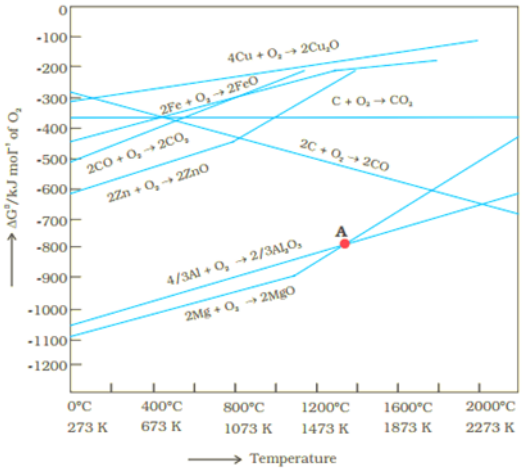
(A) 64

(B) 48

(C) 32

(D) 40

15. Ellingham diagram given



Which reaction is feasible?

(A) We can extract Cu from Cu_2O by carbon reduction.

(B) We can extract Zn from ZnO by coke at 500^oC

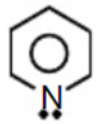
(C) Zn can be extracted by ZnO by using Al at 500^oC

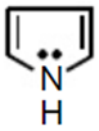
(D) Al can be extracted from Al_2O_3 by coke

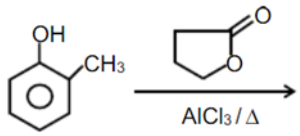
16. Which of the following compounds is not aromatic?

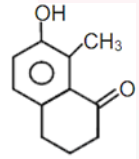
(A) 

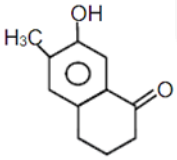
(B) 

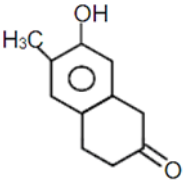
(C) 

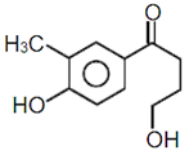
(D) 

17. 

(A) 

(B) 

(C) 

(D) 

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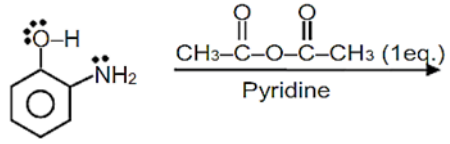
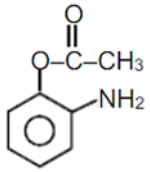
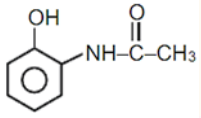
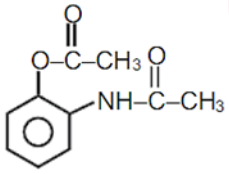
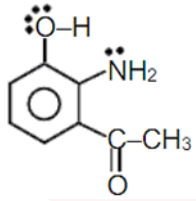


(A) 

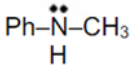
(B) 

(C) 

(D) 

19. What will be order of basicity of the following compounds?

(i) $MeNH_2$

(ii) 

(iii) Me_2NH

(iv) Me_3N

(A) (iii) > (i) > (iv) > (ii)

(B) (i) > (iii) > (ii) > (iv)

(C) (ii) > (iii) > (i) > (iv)

(D) (iv) > (i) > (iii) > (ii)

20. The pH of rain water is:

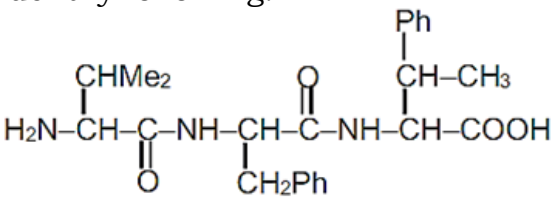
(A) 7.2

(B) 8.7

(C) 5.6

(D) 6.5

21. Identify following:



(A) Val – Phe - Thr

(B) Phe – Val - Thr

(C) Thr – Phe - Val

(D) Phe – Thr - Val

22. Methemoglobinemia disease occurs due to high quantity of the following in water?

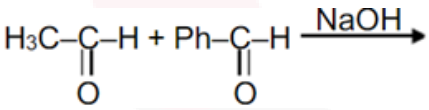
(A) Greater than 50 ppm of Pb

(B) Greater than 50 ppm of Cl^-

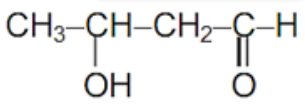
(C) Greater than 50 ppm of S^{2-}

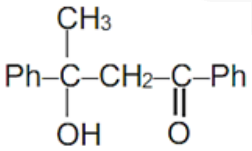
(D) Greater than 50 ppm of NO_3^-

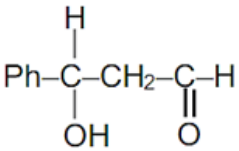
23.

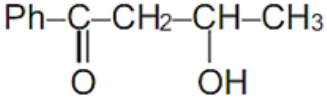


Major product of the reaction is:

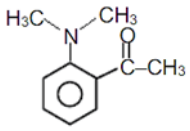
(A) 

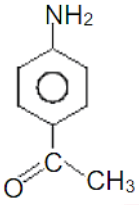
(B) 

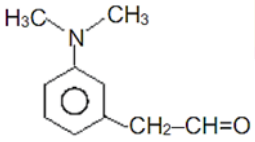
(C) 

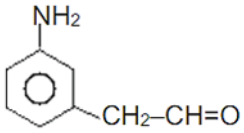
(D) 

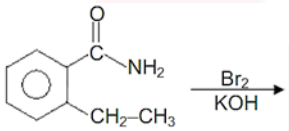
24. Identify the compound from the given options which gives positive test 2, 4, -DNP, positive iodoform test and does not form azo dye.

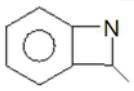
(A) 

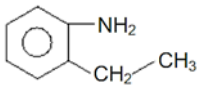
(B) 

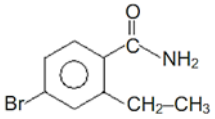
(C) 

(D) 

25. 

(A) 

(B) 

(C) 

(D)