JEE MAIN

20 JULY 2021 QUESTION PAPER

(EVENING SHIFT)

shiksha

JEE MAIN-2021 | DATE : 20 JULY 2021 (SHIFT-2) PAPER

PHYSICS

1. A particle is making simple harmonic motion along the X- axis. If at a distances x_1 and x_2 from the mean position the velocities of the particle are v_1 and v_2 respectively. The time period of its oscillation is given as:

(1) $T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2 + v_2^2}}$ (2) $T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2 - v_2^2}}$

(3) $T = 2\pi\sqrt{\frac{x_2^2 + x_1^2}{v_1^2 + v_2^2}}$ (4) $T = 2\pi\sqrt{\frac{x_2^2 + x_1^2}{v_1^2 - v_2^2}}$

2. Consider a binary star system of star A and star B with masses m_A and m_B revolving in a circular orbit of radii r_A and r_B, respectively. If T_A and T_B are the time period of star A and star B, respectively, then:

(1) $\frac{T_A}{T_B} = \left(\frac{r_A}{r_B}\right)^{\frac{3}{2}}$ (2) $T_A > T_B$ (if $r_A > r_B$)

(3) $T_A = T_B$ (4) $T_A > T_B$ (if $m_A > m_B$)

3. In an electromagnetic wave the electric field vector and magnetic field vector are given as $\vec{E} = E_0\hat{i}$ and $\vec{B} = B_0\hat{k}$ respectively. The direction of propagation of electromagnetic wave is along:

(1) $\left(\hat{k}\right)$ (2) $\left(-\hat{j}\right)$

(3) $\left(-\hat{k}\right)$ (4) $\hat{j}$

4. If the kinetic energy of a moving body becomes four times its initial kinetic energy, then the percentage change in its momentum will be:

(1) 100% (2) 200% (3) 400% (4) 300%

5. The length of a metal wire is l_1, when the tension in it is T_1 and is l_2 when the tension is T_2. The natural length of the wire is:

(1) $\frac{l_1 + l_2}{2}$ (2) $\frac{l_1T_2 - l_2T_1}{T_2 - T_1}$ (3) $\frac{l_1T_2 + l_2T_1}{T_2 + T_1}$ (4) $\sqrt{l_1l_2}$

6. For a series LCR circuit with $R = 100\,\Omega$, L = 0.5 mH and C = 0.1 pF connected across 200V –50 Hz AC supply, the phase between current and supplied voltage and the nature of the circuit is:

(1) 0°, resonance circuit (2) 0°, resistive circuit

(3) $\approx$ 90°, predominantly inductive circuit (4) $\approx$ 90°, predominantly capacitive circuit

7. A satellite is launched into a circular orbit of radius R around earth, while a second satellite is launched into a circular orbit of radius 1.02R. The percentage difference in the time periods of the two satellites is:

(1) 1.5 (2) 3.0 (3) 0.7 (4) 2.0

8. Two small drops of mercury each of radius R coalesce to form a single large drop. The ratio of total surface energy before and after the change is:

(1) $1:2^{\frac{1}{3}}$ (2) 2 : 1 (3) $2^{\frac{1}{3}}:1$ (4) 1 : 2

9. A body at rest is moved along a horizontal straight line by a machine delivering a constant power. The distance moved by the body in time 't' is proportional to:

(1) $t^{\frac{3}{2}}$ (2) $t^{\frac{1}{2}}$ (3) $t^{\frac{3}{4}}$ (4) $t^{\frac{1}{4}}$

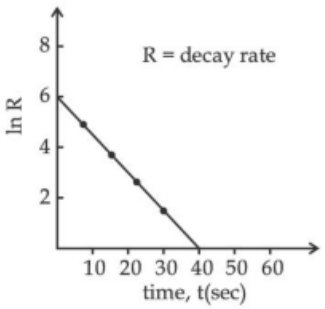
10. An electron having de – Broglie wavelength λ is incident on a target in a X – ray tube. Cut – off wavelength of emitted X – ray is:

(1) 0 (2) $\frac{hc}{mc}$ (3) $\frac{2m^2c^2\lambda^2}{h^2}$ (4) $\frac{2m\lambda^2}{h}$

11. At an angle of 30° to the magnetic meridian, the apparent dip is 45°. Find the true dip:

(1) $\tan^{-1}\frac{1}{\sqrt{3}}$ (2) $\tan^{-1}\sqrt{3}$ (3) $\tan^{-1}\frac{2}{\sqrt{3}}$ (4) $\tan^{-1}\frac{2}{\sqrt{3}}$

12. For a certain radioactive process the graph between In R and t(sec) is obtained as shown in the figure. The the value of half life for the unknown radioactive material is approximately:



(1) 6.93 sec (2) 4.62 sec (3) 9.15 sec (4) 2.62 sec

13. A boy reaches the airport and finds that the escalator is not working. He walks up the stationary escalator in time t_1. If the remains stationary on a moving escalator then the escalator takes him up in time t_2. The time taken by him to walk up on the moving escalator will be :

(1) $t_2 + t_1$ (2) $t_1 + t_2$ (3) $\frac{t_1t_2}{t_2 - t_1}$ (4) $\frac{t_1t_2}{t_2 + t_1}$

14. A body rolls down an inclined plane without slipping. The kinetic energy of rotation is 50% of its translational kinetic energy. The body is:

(1) Solid sphere (2) Hollow cylinder (3) Ring (4) Solid cylinder

15. The magnetic susceptibility of a material of a rod is 499. Permeability in vacuum is $4\pi - 10^{-7}$ H/m. Absolute permeability of the material of the rod is:

(1) $\pi \times 10^{-4}$ H/m. (2) $2\pi \times 10^{-4}$ H/m. (3) $3\pi \times 10^{-4}$ H/m. (4) $4\pi \times 10^{-4}$ H/m.

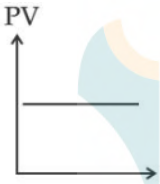
16. The correct relation between the degrees of freedom *f* and the ratio of specific heat γ is:

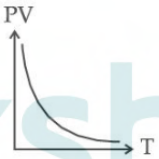
(1) $f = \frac{2}{\gamma + 1}$ (2) $f = \frac{1}{\gamma + 1}$ (3) $f = \frac{2}{\gamma - 1}$ (4) $f = \frac{\gamma + 1}{2}$

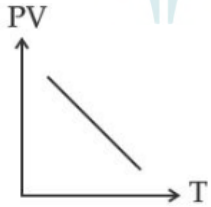
17. With what speed should a galaxy move outward, with respect to earth so that the sodium-D line at wavelength 5890 Å is observed at 5896 Å ?

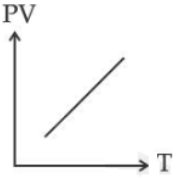
(1) 296 km/sec (2) 322 km/sec (3) 336 km/sec (4) 306 km/sec

18. Which of the following graphs represent the behavior of an ideal gas? Symbols have their usual meaning.

(1) 

(2) 

(3) 

(4) 

19. If time (t), velocity (v), and angular momentum (l) are taken as the fundamental units. Then the dimension of mass (m) in terms of t, v, and l is:

(1) $\left[t^{-2}v^{-1}l^{1}\right]$ (2) $\left[t^{-1}v^{1}l^{-2}\right]$ (3) $\left[t^{1}v^{2}l^{-1}\right]$ (4) $\left[t^{-1}v^{-2}l^{1}\right]$

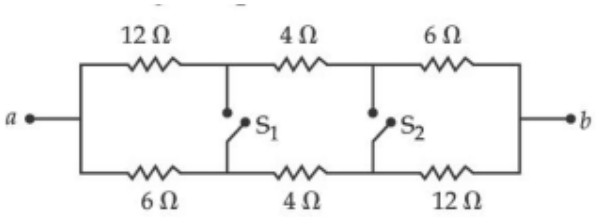
20. The vectors $\vec{P}$ and $\vec{Q}$ have equal magnitudes of $\vec{P}+\vec{Q}$ is n times the magnitude of $\vec{P}-\vec{Q}$, then angle between $\vec{P}$ and $\vec{Q}$ is:

(1) $\cos^{-1}\left(\frac{n-1}{n+1}\right)$ (2) $\sin^{-1}\left(\frac{n-1}{n+1}\right)$ (3) $\cos^{-1}\left(\frac{n^2-1}{n^2+1}\right)$ (4) $\sin^{-1}\left(\frac{n^2-1}{n^2+1}\right)$

1. A radioactive substance decays to $\left(\frac{1}{16}\right)^{th}$ of its initial activity in 80 days. The half life of the radioactive substance expressed in days is …….

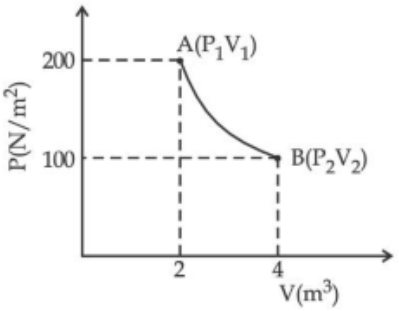
2. A series LCR circuit of R = Ω, L = 20mH and C = 0.5 μF is connected across an AC supply of 250 V, having variable frequency. The power dissipated at resonance condition is _____× 10^2 W.

3. In the given figure switches S_1 and S_2 are in open condition. The resistance across ab when the switches S_1 and S_2 are closed is …… Ω.



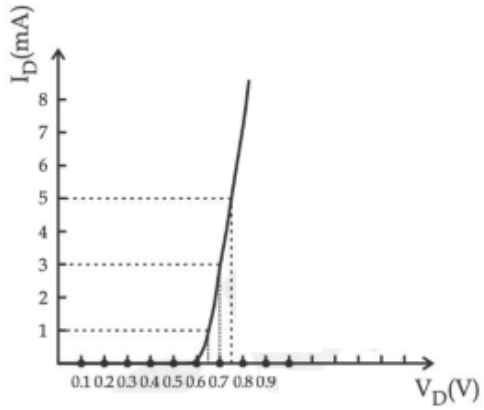
4. A certain metallic surface is illuminated by monochromatic radiation of wavelength λ.The stopping potential for photoelectric current of this radiation is $3V_0$. If the same surface is illuminated with a radiation of wavelength 2λ, the stopping potential is V_0. The thershold wavelength of this surface for photoelectric effect is ……...λ.

5. One mole of an ideal gas at 27°C is taken from A to B as shown in the given PV indicator diagram. The work done by the system be …… ×10^{-1} J.
[Given : R = 8.3 J/mole K, In2 = 0.6931] (Round off to the nearest integer)



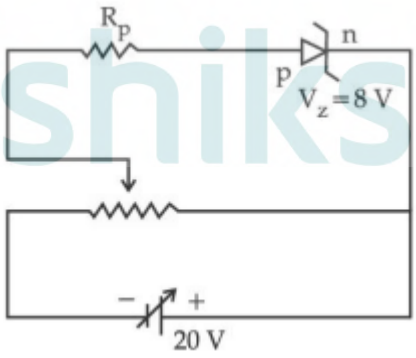
6. A body rotating with an angular speed of 600 rpm is uniformly accelerated to 1800 rpm in 10 sec. The number of rotations made in the process is

7. For the forward biased diode characteristics shown in the figure, the dynamic resistance at I_D= 3 mA will be ----------Ω.



8. A body of mass 'm' is launched up on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of friction between the body and plane is $\frac{\sqrt{x}}{5}$ if the time of ascent is half of the time of descent. The value of *x* is _____.

9. A zener diode having zener voltage 8V and power dissipation rating of 0.5W is connected across a potential divider arranged with maximum potential drop across zener diode is as shown in the diagram. The value of protective resistance R_P is ……. Ω.



10. Two bodies a right and a solid cylinder of same material are rolling down without slipping an inclined plane. The radii of the bodies are same. The ratio of velocity of the centre of mass of the bottom of the inclined plane of the ring to that of the cylinder is $\frac{\sqrt{x}}{2}$. Then, the value of *x* is …….

CHEMISTRY

1. The single largest industrial application of dihydrogen is :

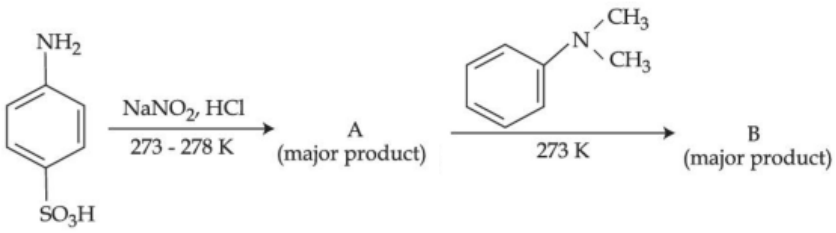
(1) In the synthesis of nitric acid (2) Manufacture of metal hydrides

(3) Rocket fuel in space research (4) In the synthesis of ammonia

2. Spin only magnetic moment of an octahedral complex of Fe^{2+} in the presence of a strong field ligand in BM is:

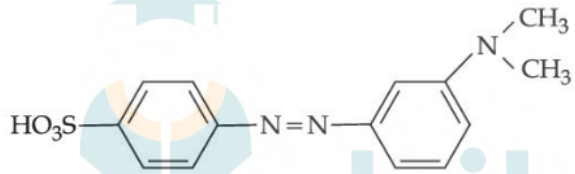
(1) 0 (2) 4.89 (3) 2.82 (4) 3.46

3.

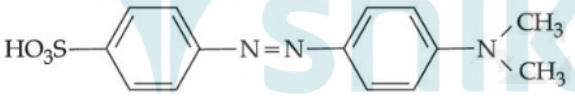


Consider the above reaction, compound B is:

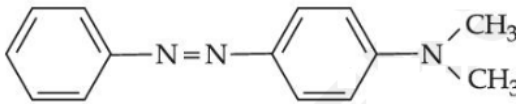
(1)



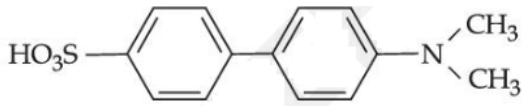
(2)



(3)



(4)



4. Cu^{2+} salt reacts with potassium iodide to give:

(1) Cu_2I_2 (2) CuI (3) $Cu(I_3)_2$ (4) Cu_2I_3

5. A solution is 0.1 M in Cl^- and 0.001 M in CrO_4^{2-} . Solid $AgNO_3$ is gradually added to it. Assuming that the addition does not change in volume and K_{SP} (AgCl) = 1.7×10^{-10} M^2 and $K_{SP}(Ag_2CrO_4) = 1.9 \times 10^{-12}$ M^3. Select correct statement from the following:

(1) AgCl will preipitate first as the amount of Ag^+ needed to precipitate is low.

(2) Ag_2CrO_4 precipitates first because the amount of Ag^+ needed is low.

(3) AgCl precipitates first because its K_{SP} is hight.

(4) Ag_2CrO_4 precipitates first as its K_{SP} is low.

6. Bakelite is a cross – linked polymer of formaldehyde and:

(1) Dacron (2) Buna - S

(3) Novolac (4) PHBV

7. Benzene on nitration gives nitrobenzene in presence of HNO_3 and H_2SO_4 mixture, where:

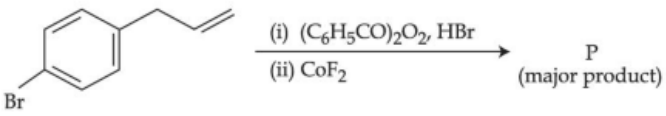
(1) both H_2SO_4 and HNO_3 act as an acids

(2) both H_2SO_4 and HNO_3 act as a bases

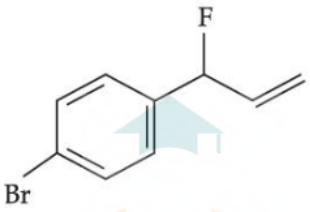
(3) HNO_3 acts as an acid and H_2SO_4 acts as a base

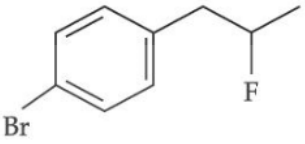
(4) HNO_3 acts as a base and H_2SO_4 acts as an acid

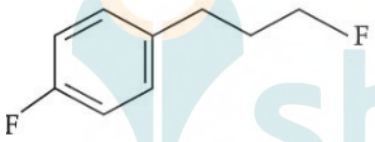
8.

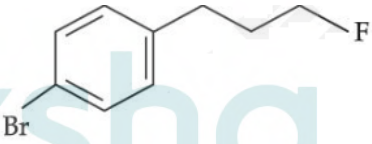


Major product P of above reaction, is:

(1) 

(2) 

(3) 

(4) 

9. Which one of the following species **doesn't** have a magnetic moment of 1.73 BM, (spin only value) ?

(1) CUI (2) $[Cu(NH_3)_4]Cl_2$

(3) O_2^+ (4) O_2^-

10. In Carius method, halogen containing organic compound is heated with funning nitric acid in the presence of:

(1) $CuSO_4$ (2) HNO_3

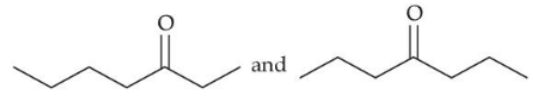
(3) $BaSO_4$ (4) $AgNO_3$

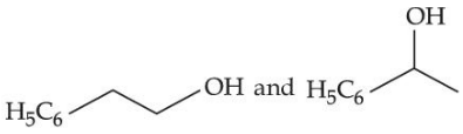
11. The hybridisations of the atomic orbitals of nitrogen in NO_2^-, NO_2^+ and NO_4^+ respectively are:

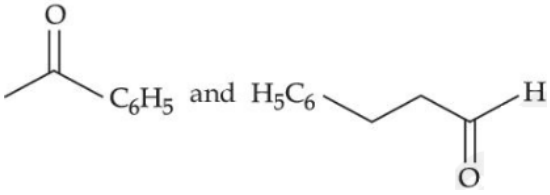
(1) sp^3, sp and sp^2 (2) sp^2 , sp and sp^3

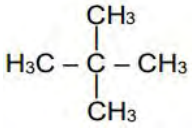
(3) sp^3, sp^2 and sp (4) sp, sp^2 and sp^3

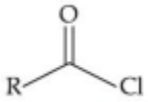
12. Which one of the following pairs of isomers is an example of metamerism?

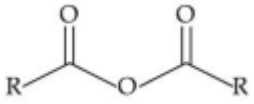
(1) 

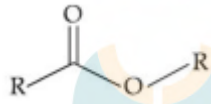
(2) 

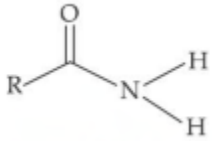
(3) 

(4) $CH_3CH_2CH_2CH_2CH_3$ and 

13. (A) 

(B) 

(C) 

(D) 

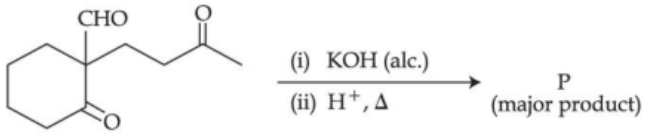
The correct order of their reactivity towards hydrolysis at room temperature is:

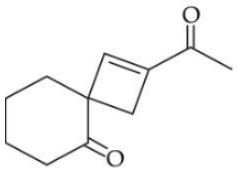
(1) (D) > (A) > (B) > (C)
(2) (A) > (B) > (C) > (D)
(3) (A) > (C) > (B) > (D)
(4) (D) > (B) > (A) > (C)

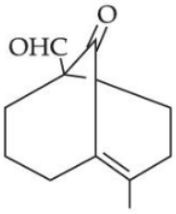
14. Which one of the following statements is **not** true about enzymes?

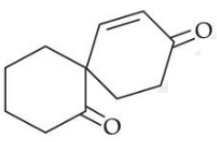
(1) Almost all enzymes are proteins.
(2) Enzymes work as catalysts by lowering the activation energy of a biochemical reaction.
(3) Enzymes are non – specific for a reaction and substrate.
(4) The action of enzymes is temperature and pH specific.

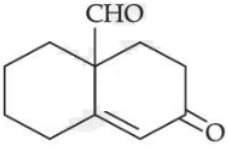
15. The major product (P) in the following reaction is:



(1) 

(2) 

(3) 

(4) 

16. Metallic soldium does not react normally with :

(1) But-2-yne (2) tert -butyl alcohol

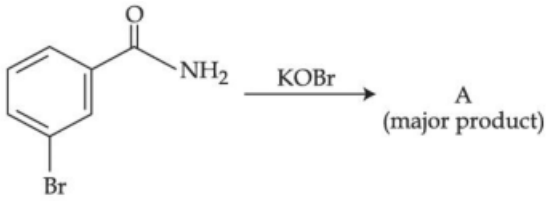
(3) gaseous ammonia (4) Ethyne

17. Outermost electronic configuration of a group 13 element, E, is $4s^2$, $4p^1$. The electronic configuration of an element of p- block period – five placed diagonally to element , E is:

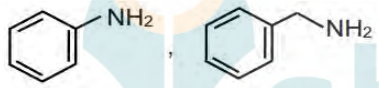
(1) $[Xe]5d^{10}6s^26p^2$ (2) $[Xe]3d^{10}4s^24p^2$

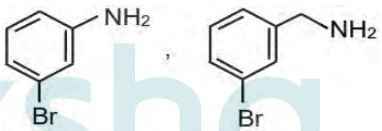
(3) $[Kr]3d^{10}4s^24p^2$ (4) $[Kr]4d^{10}5s^25p^2$

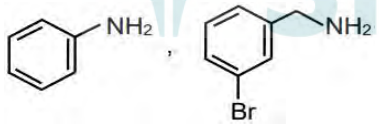
18.

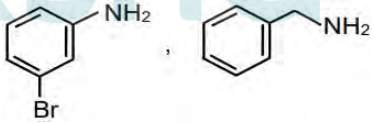


In the above reactions, product A and product B respectively are:

(1) 

(2) 

(3) 

(4) 

19. Which one of the following gases is reported to retard photosyntheis?

(1) CFCs (2) CO (3) NO_2 (4) CO_2

20. Consider two chemical reactions (A) and (B) that take place during metallurgical process:

(A) $ZnCO_{3(S)} \xrightarrow{\Delta} ZnO_{(S)} + CO_{2(g)}$ (B) $2ZnS_{(S)} + 3O_{2(g)} \xrightarrow{\Delta} ZnO_{(S)} + 2SO_{2(g)}$

The correct options of names given to them respectively is:

(1) Both (A) and (B) are producing same product so both are calcination

(2) (A) is roasting and (B) is calcination

(3) (A) is calcination and (B) is roasting

(4) Both (A) and (B) are producing same product so both are roasting.

1. 100 ml of 0.0018 % (w/v) solution of Cl^- ion was minimum concentration Cl^- required to precipitate a negative sol in one h. The coagulating value of Cl^- ion is _____. (Nearest integer)

2. The vapour pressure of A and B at 25°C are 90 mm Hg and 15 mm Hg respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.6, then the mole fraction of B in the vapour phase is $x \times 10^{-1}$. The value of x is _____. (Nearest integer)

3. Diamond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is_____.

4. 4g equimolar mixture of NaOH and Na_2CO_3 contains x g of NaOH and y g of Na_2CO_3. The value of x is _____ g.

5. For a given chemical reaction A $\rightarrow$ B at 300 K the free energy change is -49.4 kJ mol^{-1} and the enthalpy of reaction is 51.4 kJ mol^{-1}. The entropy change of the reaction is _____JK^{-1} mol^{-1}.

6. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

In the above first order reaction the concentration of PCl_5 reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300K. The rate constant for the reaction at 300 K is $x \times 10^{-2}$ min^{-1}. The value of x is _____. [Given log 5 = 0.69989]

7. Potassium chlorate is prepared by electrolysis of KCl in basic solution as shown by following equation.

$$6OH^- + Cl^- \rightarrow ClO_3^- + 3H_2O + 6e^-$$

A current of x A has to be passed for 10 h to produce 10.0 g of potassium chlorate. The value of x is _____ . (Nearest integer)

(Molar mass of $KClO_3$ = 122.6g mol^{-1}, F = 96500 C)

8. The wavelength of electrons accelerated from rest through a potential difference of 40 kV is $x - 10^{-12}$ m. The value of x is _____. (Nearest integer)

Given: Mass of electron = 9.1×10^{-31} kg

Charge on an electron = 1.6×10^{-19} C

Planck's constant = 6.63×10^{-34} Js

9. When 0.15 g of an organic compound was analyzed using Carius method for estimation of bromine, 0.2397 g of AgBr was obtained. The percentage of bromine in the organic compound is _____. (Nearest integer)

$$\begin{bmatrix} \text{Atomic mass:} \\ \text{Silver} = 108 \\ \text{Bromine} = 80 \end{bmatrix}$$

10. An aqueous solution of $NiCl_2$ was heated with excess sodium cyanide in presence of strong oxidizing agent to from $[Ni(CN)_6]^{2-}$. The total change in number of unpaired electrons on metal centre is _____.

MATHEMATICS

1. For the natural number m, n, if $(1-y)^m (1+y)^n = 1+a_1y+a_2y^2 + \ldots..+a_{m+n}y^{m+n}$ and $a_1 = a_2 = 10$, then the value of (m + n) is equal to:

(1) 100 (2) 80 (3) 88 (4) 64

2. Let $y = y(x)$ satisfies the equation $\frac{dy}{dx} = |A| = 0$, for all x > 0, where $x > A = \begin{bmatrix} y & \sin x & 1 \\ 0 & -1 & 1 \\ 2 & 0 & \frac{1}{x} \end{bmatrix}$.

If $y(\pi) = \pi + 2$, then the value of $y\left(\frac{\pi}{2}\right)$ is:

(1) $\frac{3\pi}{2} - \frac{1}{\pi}$ (2) $\frac{\pi}{2} + \frac{4}{\pi}$ (3) $\frac{\pi}{2} - \frac{1}{\pi}$ (4) $\frac{\pi}{2} - \frac{4}{\pi}$

3. Let r_1 and r_2 be the radii of the largest and smallest circles, respectively, which pass through the point (–4,1) and having their centres on the circumference of the circle $x^2 + y^2 + 2x + 4y - 4 = 0$. If $\frac{r_1}{r_2} = a + b\sqrt{2}$, then a+ b is equal to:

(1) 5 (2) 7 (3) 3 (4) 11

4. Let $f : R - \left\{\frac{\alpha}{6}\right\} \to R$ be defined by $f(x) = \frac{5x+3}{6x-\alpha}$. Then the value of α for which $(fof)(x) = x$, for all $x \in R - \left\{\frac{\alpha}{6}\right\}$, is:

(1) 6 (2) 8

(3) 5 (4) No such α exists

5. If $f : R \to R$ is given by $f(x) = x + 1$, then the value of

$\lim\limits_{b\to\infty} \frac{1}{n}\left[f(0) + f\left(\frac{5}{n}\right) + f\left(\frac{10}{n}\right) + \ldots.. + f\left(\frac{5(n-1)}{n}\right)\right]$, is:

(1) $\frac{1}{2}$ (2) $\frac{3}{2}$

(3) $\frac{7}{2}$ (4) $\frac{5}{3}$

6. Let in a right angled triangle, the smallest angle θ. If triangle formed by taking the reciprocal of its sides is also a right angled triangle, then $\sin\theta$ is equal to:

(1) $\frac{\sqrt{5}+1}{4}$ (2) $\frac{\sqrt{2}-1}{2}$

(3) $\frac{\sqrt{5}-1}{2}$ (4) $\frac{\sqrt{5}-1}{4}$

7. Let $g^{(t)}=\int_{\pi/2}^{\pi/2}\cos\left(\frac{\pi}{4}t+f(x)\right)dx$, where $f(x)=\log_e\left(x+\sqrt{x^2+1}\right), x\in R$. Then which one of following is correct?

(1) $g(1)=g(0)$ (2) $g(1)+g(0=0)$

(3) $g(1)+\sqrt{2}g(0)$ (4) $\sqrt{2}g(1)=g(0)$

8. If sum of the first 21 terms of series $\log_{9^{\frac{1}{2}}}x+\log_{9^{\frac{1}{3}}}x+\log_{9^{\frac{1}{4}}}x+....,$ where $x > 0$ is 504, then x is equal to :

(1) 9 (2) 243 (3) 7 (4) 81

9. The value of $k\in R$, for which the following system of linear equation

$3x-y+4z=3,$

$x+2y-3z=-2,$

$6x+5y+kz=-3,$

Has infinitely many solutions, is:

(1) 5 (2) 3 (3) –5 (4) –3

10. Let A,B and C be three events such that the probability that exactly one of A and B occurs is (1-k), the probability that exactly one of B and C occurs is (1 –2k), the probability that exactly one of C and A occurs is (1 –K) and the probability of all A, B and C occur simultaneously is k^2, where $0 < k < 1$. Then the probability that at least one of A, B and C occur is:

(1) exactly equal to $\frac{1}{2}$ (2) greater than $\frac{1}{4}$ but less than $\frac{1}{2}$

(3) greater than $\frac{1}{8}$ but less than $\frac{1}{4}$ (4) greater than $\frac{1}{2}$

11. Let P be a variable point on the parabola $y = 4x^2 + 1$. Then, the locus of the mid- point of the point P and the foot of the perpendicular drawn from the point P to the line y =x is:

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

(3) $2(x-3y)^2+(3x-y)+2=0$ (4) $(3x-y)^2+2(x-3y)+2=0$

12. If the mean and variance of six observations 7,10, 11, 15 a, b are 10 and $\frac{20}{3}$, respectively, then value of $|a-b|$ is equal to:

(1) 1 (2) 11 (3) 1 (4) 9

13. The sum of all the local minimum values of the twice differentiable function f : R $\rightarrow$ R defined by $f(x)=x^3-3x^2-\frac{3f''(2)}{2}x+f''(1)$ is:

(1) 0 (2) 5 (3) –22 (4) –27

14. If [X] denotes the greatest integer less than or equal to x, then the value of the integral $\int_{-\pi/2}^{\pi/2}\left[[x]-\sin x\right]dx$ is equal to:

(1) $-\pi$ (2) 0 (3) π (4) 1

15. Consider the following three statements:

(A) If 3 + 3 = 7 then 4 + 3 = 8.

(B) If 5 + 3 = 8 then earth is flat.

(C) If both (A) and (B) are true then 5 + 6 =17.

Then, which of the following statements is correct?

(1) (A) is true while (B) and (C) are false (2) (A) and (C) are true while (B) is false

(3) (A) and (B) are false while (C) is true (4) (A) is false, but (B) and (C) are true

16. The lines x = ay –1 =z –2 and x = 3y –2 = bz –2, (ab $\neq$ 0) are coplanar, if:

(1) b =1 , $a \in R-\{0\}$ (2) a = 2, b =2 (3) a =1, $b \in R-\{0\}$ (4) a =2, b =3

17. Consider the line L given by the equation $\frac{x-3}{2}=\frac{y-1}{1}=\frac{z-2}{1}$. Let Q be the mirror image of the point (2,3 –1) with respect to L. Let a plane P be such that it passes through Q, and the line L is perpendicular to P. Then which of the following points is one the plane P?

(1) (–1, 1, 2) (2) (1,1,2) (3) (1,.1,1) (4) (1,2,2)

18. If the real part of the complex number $(1-\cos\theta+2i\sin\theta)^{-1}$ is $\frac{1}{5}$ for $\theta\in(0,\pi)$, then the value of the integral $\int_0^0 \sin x dx$ is equal to :

(1) 1 (2) 0 (3) –1 (4) 2

19. The value of $\left(2\tan^{-1}\left(\frac{3}{5}\right)+\sin^{-1}\left(\frac{5}{13}\right)\right)$ is equal to:

(1) $\frac{151}{63}$ (2) $\frac{220}{21}$ (3) $\frac{-181}{69}$ (4) $\frac{-291}{76}$

20. In a triangle ABC, if $|\vec{BC}|=3, |\vec{CA}|=5$ and $|\vec{BA}|=7$, then the projection of the vector $\vec{BA}$ on $\vec{BC}$ is equal to:

(1) $\frac{19}{2}$ (2) $\frac{13}{2}$ (3) $\frac{11}{2}$ (4) $\frac{15}{2}$

1. The number of solutions of the equation $\log_{(x+1)}(2x^2+7x+5)+\log_{(2x+5)}(x+1)^{2-4}=0$, x > 0, is _____.

2. If the point on the curve $y^2 = 6x$, nearest to the point $\left(3,\frac{3}{2}\right)$ is (α,β) then $2(\alpha+\beta)$ is equal to _____.

3. If $\lim\limits_{x\to 0}\frac{\alpha.e^x-\beta\log_e(1+x)+\gamma x^2e^{-x}}{x\sin^2 x}=10$, $\alpha,\beta,\gamma\in R$, then the value of $\alpha+\beta+\gamma$ is_____.

4. For p > 0, a vector $\vec{v}_2=2\hat{i}+(p+1)\hat{j}$ is obtained by rotating the vector $\vec{v}_1=\sqrt{3}p\hat{i}+\hat{j}$ by an angle θ about origin in counter clockwise direction. If $\tan\theta=\left(\frac{\alpha\sqrt{3}-2}{4\sqrt{3}+3}\right)$, then the value of α is equal to___.

5. Let a curve y = y (x) be given by the solution of differential equation

$$\cos\left(\frac{1}{2}\cos^{-1}\left(e^{-x}\right)\right)dx=\sqrt{e^{2x}-1}dy$$

If it intersects y – axis at y = –1, and the intersection point point of the curve with x – axis is (α,θ), then e^{α} is equal to_____.

6. Let a function g: [0,4] $\to$ R be defined as $g(x)=\begin{cases}\max\limits_{0\le t\le x}\left\{t^3-6t^2+9t-3\right\}, & 0\le x\le 3\\ 4-x, & 3<x\le 4\end{cases}$

then the number of points in the interval (0,4) where g(x) is NOT differentiable, is_____.

7. For $k\in N$, let $\frac{1}{\alpha(\alpha+1)(\alpha+2).....(\alpha+20)}=\sum_{k=0}^{20}\frac{A_K}{\alpha+k}$, where a > 0. Then the value of $100\left(\frac{A_{14}+A_{15}}{A_{13}}\right)^2$ is equal to_____.

8. Let $\{a_n\}_{n=1}^{\infty}$ be a sequence such that a_1 =1, a_2 =1 and a_{n+2} =2a_{n+1} +a_n for all n $\geq$ 1. Then the value of $47\sum_{n=1}^{\infty}\frac{a_n}{2^{3n}}$ is equal to_____.

9. Let $A=\{a_{ij}\}$ be a 3 × matrix, where

$$a_{ij}=\begin{cases}(-1)^{j-i} \text{ if } i<j,\\ 2 \quad \text{if } o=j,\\ (-1)^{i+j} \text{ if } i>j,\end{cases}$$

then det(3 Adj($2A^{-1}$)) is equal to_____.

10. Consider a triangle having vertices A (–2,3), B (1,9) and C (3,8). If a line L passing through the circum – center of triangle ABC, bisects line BC, and intersects y – axis at point $\left(0.\frac{\alpha}{2}\right)$, then the value of real number α is _____.