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JEE MAIN SAMPLE PAPER

Paper 1 for B.Tech

SET C

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Physics

Q1. A sonometer wire of length 1.5 m is made of steel. The tension in it produces an elastic strain of 1 %. What is the fundamental frequency of steel if density and elasticity of steel are 7.7×10^3 kg/m^3 and $2.2 \times 1011 N/m^2$ respectively?
1. 178.2 Hz
2. 200.5 Hz
3. 770 Hz
4. 188.5 Hz

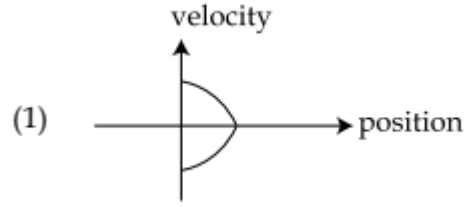
Correct. 1

Q2. Two short bar magnets of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid - point O of the line joining their centres is close to (Horizontal component of earth's magnetic induction is 3.6×10^{-5} Wb/m^2)
1. 2.56×10^{-4} Wb/m^2
2. 3.50×10^{-4} Wb/m^2
3. 5.80×10^{-4} Wb/m^2
4. 3.6×10^{-5} Wb/m^2

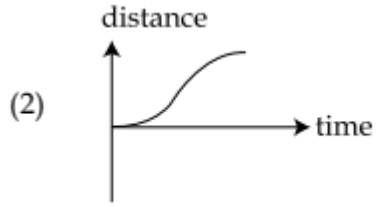
Correct. 1

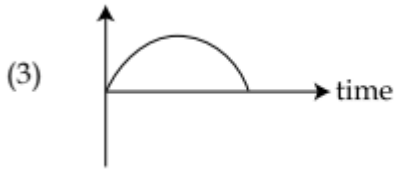
Q3. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up.

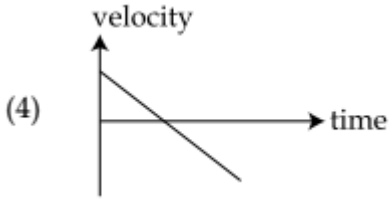
1.



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2. 

3. 

4. 

Correct. 2

Q4. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively. Let Λ_n be the wavelength of the emitted photon in the transition from the n^{th} state to the ground state. For large n, (A, B are constants)

1. $A_n = A + B / \lambda^2_n$
2. $A_n = A+B \lambda_n$
3. $A^2_n = A + B \lambda^2_n$
4. $A^2_n = \lambda$

Correct. 1

Q5. A telephonic communication service is working at carrier frequency of 10 GHz. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5 kHz ?

1. 2×10^3
2. 2×10^4
3. 2×10^5
4. 2×10^6

Correct. 3

Q6. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to :

1. $\sqrt{\frac{hc^5}{G}}$
2. $\sqrt{\frac{Gh}{c^3}}$

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3. $\sqrt{\frac{Gh}{c^5}}$
4. $\sqrt{\frac{c^3}{Gh}}$

Correct. 3

Q7. The pitch and the number of divisions, on the circular scale, for a given screw gauge are 0.5 mm and 100 respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line. The readings of the main scale and the circular scale, for a thin sheet, are 5.5 mm and 48 respectively, the thickness of this sheet is :
1. 5.950 mm
2. 5.755 mm
3. 5.725 mm
4. 5.740 mm

Correct. 3

Q8. A musician using an open flute of length 50 cm produces second harmonic sound waves. A person runs towards the musician from another end of a hall at a speed of 10 km/h. If the wave speed is 330 m/s, the frequency heard by the running person shall be close to :
1. 500 Hz
2. 753 Hz
3. 666 Hz
4. 333 Hz

Correct. 3

Q9. A 15 g mass of nitrogen gas is enclosed in a vessel at a temperature 27°C. Amount of heat transferred to the gas, so that rms velocity of molecules is doubled, is about : (Take R=8.3J/K mole)
1. 14 kJ
2. 10 kJ
3. 0.9 kJ
4. 6 kJ

Correct. 2

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Q10. In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed 'v' more than that of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then 'v' is equal to:

1. $\frac{a_1+a_2}{2}t$
2. $\sqrt{a_1a_2}t$
3. $\sqrt{2a_1a_2}t$
4. $\frac{2a_1a_2}{a_1+a_2}t$

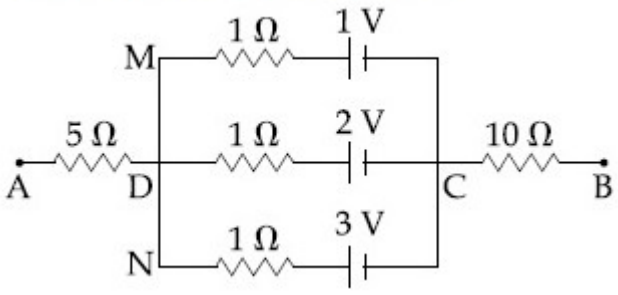
Correct. 2

Q11. The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of a simple pendulum on the Earth is 2 s. The period of oscillation of the same pendulum on the planet would be:

1. $2\sqrt{3}s$
2. $\frac{\sqrt{3}}{2}s$
3. $\frac{3}{2}s$
4. $\frac{2}{\sqrt{3}}s$

Correct. 1

Q12. In the circuit shown, the potential difference between A and B is :



1. 3 V
2. 1 V
3. 6 V
4. 2 V

Correct. 4

Q13. A homogeneous solid cylindrical roller of radius R and mass M is pulled on a cricket pitch by a horizontal force. Assuming rolling without slipping, angular acceleration of the cylinder is :

1. $\frac{2F}{3mR}$

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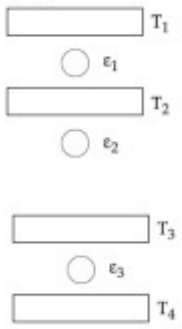
2. $\frac{F}{2mR}$
3. $\frac{F}{3mR}$
4. $\frac{3F}{2mR}$

Correct. 1

Q14. A plano convex lens of refractive index μ_1 and focal length $f_1$is kept in contact with another plano concave lens of refractive index klip and focal length f2. If the radius of curvature of their spherical faces is R each and $f_1 = 2f_2$, then μ_1 and μ_2 are related as
1. $2\mu_2 - \mu_1 = 1$
2. $3\mu_2 - 2\mu_1 = 1$
3. $\mu_1 + \mu_2 = 3$
4. $2\mu_1 - \mu_2 = 1$

Correct. 4

Q15. Three Carnot engines operate in series between a heat source at a temperature T, and a heat sink at temperature T4 (see figure). There are two other reservoirs at temperature T, and T3, as shown, with T2 > T2 > T2 > T4. The three engines are equally efficient if



1. $T_2 = \left(T_1^3 T_4\right)^{1/4}; T_3 = \left(T_1 T_4^3\right)^{1/4}$
2. $T_2 = \left(T_1^2 T_4\right)^{1/3}; T_3 = \left(T_1 T_4^2\right)^{1/3}$
3. $T_2 = \left(T_1 T_4^2\right)^{1/3}; T_3 = \left(T_1^2 T_4\right)^{1/3}$
4. $T_2 = \left(T_1 T_4\right)^{1/2}; T_3 = \left(T_1^2 T_4\right)^{1/3}$

Correct. 2

Q16. An ideal gas is enclosed in a cylinder at pressure of 2 atm and temperature, 300 K. The mean time between two successive collisions is 6×10^{-8}s. If the pressure is doubled and temperature is increased to 500 K, the mean time between two successive collisions will be
close to:

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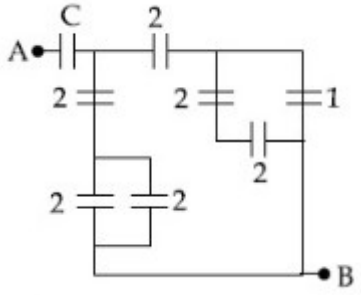
1. 4×10^{-8}s
2. 3×10^{-6}s
3. 0.5×10^{-8}s
4. $2 \times 10^{-7} s$

Correct. 1

Q17. A load of mass M kg is suspended from a steel wire of length 2 m and radius 1.0 mm in Searle's apparatus experiment. The increase in length produced in the wire is 4.0 mm. Now the load is fully immersed in a liquid of relative density 2 . The relative density of the material of load is 8. The new value of increase in length of the steel wire is :
1. 4.0 mm
2. zero
3. 5.0 mm
4. 3.0 mm

Correct. 4

Q18. In the circuit shown, find C if the effective capacitance of the whole circuit is to be 0.5 uF. All values in the circuit are in uF.



1. $\frac{6}{5} \mu$F
2. 4 μF
3. $\frac{7}{11} \mu$F
4. $\frac{7}{10} \mu$F

Correct. 3

Q19. A paramagnetic material has atoms/. Its magnetic susceptibility at temperature 350 K is 2.8 x . Its susceptibility at 300 K is :
1. 3.267 x
2. 3.672 x
3. 2.672 x
4. 3.726 X

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Correct. 1

Q20. In a radioactive decay chain, the initial nucleus is $^{232}_{90}\mathrm{Th}$. At the end there are 6 α-particles and 4 β-particles which are emitted. If the end nucleus is $^{A}_{Z}\mathrm{X}$, A and Z are given by :

1. A= 202; Z=80
2. A= 200; Z=81
3. A= 208; Z=80
4. A= 208 ; Z=82

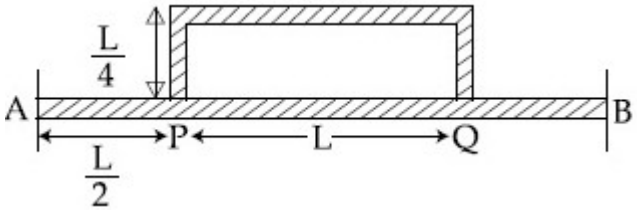
Correct. 4

Q21. Surface of certain metal is first illuminated with light of wavelength λ_1 = 350 nm and then, by light of wavelength λ_2 = 540 nm. It is found that the maximum speed of the photo electrons in the two cases differ by a factor of 2 . The work function of the metal (in eV) is close to :
(Energy of photon = $\frac{1240}{\lambda(\text{ in nm})}\text{eV}$)

1. 5.6
2. 2.5
3. 1.4
4. 1.8

Correct. 4

Q22. Temperature difference of 120°C is maintained between two ends of a uniform rod AB of length 2L. Another bent rod PQ, 3L of same cross-sectionas AB and length 3L/2, is connected across AB (See figure). In steady state, temperature difference between P and Q will be close to :



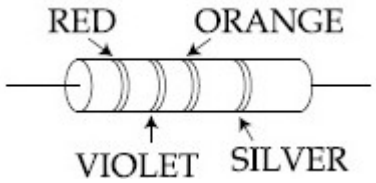
1. 35 °C
2. 45 °C
3. 60°C
4. 75 °C

Correct. 2

Q23. A resistance is shown in the figure. Its value and tolerance are given respectively

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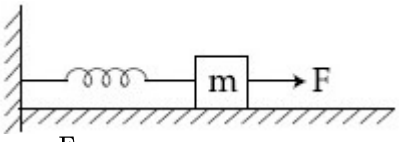
by :



1. 27 kΩ, 20%
2. 270 Ω, 10%
3. 270 Ω,5%
4. 27 kΩ, 10%

Correct. 4

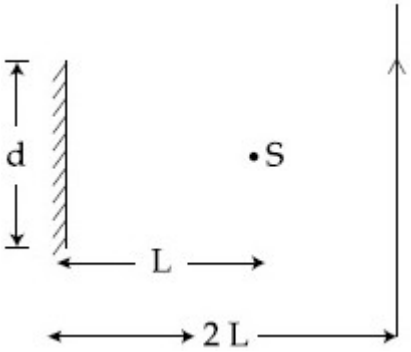
Q24. A block of mass m, lying on a smooth horizontal surface, is attached to a spring (of negligible mass) of spring constant k. The other end of the spring is fixed, as shown in the figure. The block is initially at rest in its equilibrium position. If now the block is pulled with a constant force F, the maximum speed of the block is :



1. $\frac{\mathrm{F}}{\sqrt{\mathrm{mk}}}$
2. $\frac{F}{\pi\sqrt{mk}}$
3. $\frac{\pi \mathrm{F}}{\sqrt{\mathrm{mk}}}$
4. $\frac{2\mathrm{f}}{\sqrt{\mathrm{mk}}}$

Correct. 1

Q25. A point source of light, S is placed at a distance L in front of the centre of plane mirror of width d which is hanging vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror, at a distance 2L as shown below. The distance over which the man can see the image of the light source in the mirror is :



1. 3d
2. 2d
3. d

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4. d/2

Correct. 1

Chemistry

Q1. The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion is required to make teeth enamel harder by converting [$3Ca_3(PO_4)_2.Ca(OH)_2$] to :
1. [CaF_2]
2. [$3(CaF_2).Ca(OH)_2$]
3. [$3Ca_3(PO_4)_2.CaF_2$]
4. [$3\{Ca(OH)_2\}.CaF_2$]

Correct. 3

Q2. Which of the following are Lewis acids ?
1. PH_3 and BCl_3
2. $AlCl_3$ and $SiCl_4$
3. PH_3 and $SiCl_4$
4. BCl_3 and $AlCl_3$

Correct. 4

Q3. A metal crystallises in a face centred cubic structure. If the edge length of its unit cell is 'a', the closest approach between two atoms in metallic crystal will be :
1. $\sqrt{2}$ a
2. a/$\sqrt{2}$
3. 2a
4. 2$\sqrt{2}$a

Correct. 2

Q4. The products obtained when chlorine gas reacts with cold and dilute aqueous NaOH are :
1. Cl^- and ClO^-
2. Cl^- and ClO_2^-
3. ClO^- and ClO^-_3
4. ClO_2^- and ClO_3^-

Correct. 1

Q5. The correct match between Item 1 and Item II is :
Item I (A) Benzaldehyde (B) Alumina (C) Acetonitrile
Item II (P) Mobile phase (Q) Adsorbent (R) Adsorbate Options

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1. (A) $\rightarrow$(Q); (B)$\rightarrow$(P); (C)$\rightarrow$ (R)
2. (A) $\rightarrow$(R); (B)$\rightarrow$(Q): (C)$\rightarrow$(P)
3. (A) $\rightarrow$(P); (B)$\rightarrow$(R); (C)$\rightarrow$ (Q)
4. (A) $\rightarrow$(Q); (B)$\rightarrow$(R); (C) $\rightarrow$(P)

Correct. 2

Q6. For the following reaction, the mass of water produced from 445g of $\text{C}_{57}\text{H}_{110}\text{O}_6$ is
$2\text{C}_{57}\text{H}_{110}\text{O}_6(\text{s}) + 163\text{O}_2(\text{g}) \rightarrow 114\text{CO}_2(\text{g}) + 110\text{H}_2\text{O}(\text{l})$
1. 490 g
2. 495 g
3. 445 g
4. 890 g

Correct. 2

Q7. The de Broglie wavelength (λ) associated with a photoelectron varies with the frequency (v) of the incident radiation as, [v_0 is threshold frequency]:
1. $\lambda \propto \frac{1}{(v-v_0)}$
2. $\lambda \propto \frac{1}{(v-v_0)^{\frac{1}{4}}}$
3. $\lambda \propto \frac{1}{(v-v_0)^{\frac{1}{2}}}$
4. $\lambda \propto \frac{1}{(v-v_0)^{\frac{3}{2}}}$

Correct. 3

Q8. The reaction, MgO(s) +C(s) >Mg(s) +CO(g), for which $\Delta_{\text{r}}\text{H}^\circ = +491.1 \quad \text{kJ} \quad \text{mol}^{-1}$ and $\Delta_r S^\circ = 198.0\text{JK}^{-1}\text{mol}^{-1}$, is not feasible at 298 K. Temperature above which reaction will be feasible is :
1. 2380.5 K
2. 2480.3 K
3. 2040.5 K
4. 1890.0 K

Correct. 2

Q9. The higher concentration of which gas in air can cause stiffness of flower buds ?

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1. CO_2
2. CO
3. SO_2
4. NO_2

Correct. 3

Q10. The values of K_p/K_c for the following reactions at 300 K are, respectively : (At 300 K, $RT = 262 dm^3 atm mol^{-1}$)

$N_2(g) + O_2(g) = 2NO(g)$
$N_2O_4(g) = 2NO_2(g)$
$N_2(g) + 3H_2(g) = 2NH_3(g)$

1. $262 dm^3 atm mol^{-1}$
   $606.0 dm^6 atm^2 mol^{-2}$
2. $1,1 \times 10^{-2} dm^{-3} atm^{-1} mol$
   $606 dm^6 atm^2 mol^{-2}$
3. $1, 262 dm^3$ atm mol^{-1} ,
   $606.0 dm^6 atm^2 mol^{-2}$
4. $1, 262 dm^3 atm mol^{-1}$.
   $1.65 \times 10^{-3} dm^{-6} atm^{-2} mol^2$

Correct. 4

Q11. Which premitive unit cell has unequal edge lengths ($a \neq b \neq c$) and all axial angles different from 90° ?
1. Monoclinic
2. Hexagonal
3. Triclinic
4. Tetragonal

Correct. 3

Q12. Hall-Heroult's process is given by:
1. $ZnO + C \quad \text{Coke, } 1673K \rightarrow Zn + CO$
2. $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$
3. $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$

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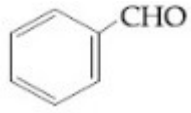
4. $Cu^{2+}(aq) + H_2(g) \rightarrow Cu(s) + 2H^+(aq)$

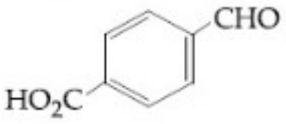
Correct. 2

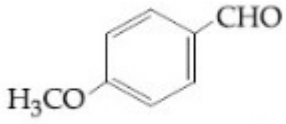
Q13. Which of the following is not an example of heterogeneous catalytic reaction ?
1. Ostwald's process
2. Hydrogenation of vegetable oils
3. Haber's process
4. Combustion of coal

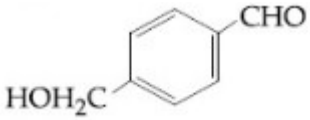
Correct. 4

Q14. The aldehydes which will not form Grignard product with one equivalent Grignard reagents are:

(A) 

(B) 

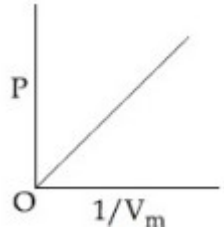
(C) 

(D) 

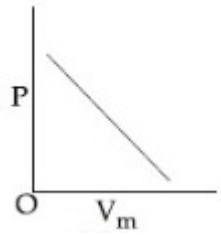
1. (C), (D)
2. (B), (D)
3. (B), (C), (D)
4. (B), (C)

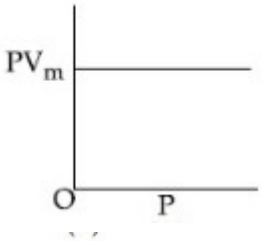
Correct. 2

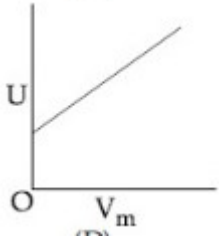
Q15. The combination of plots which does not represent isothermal expansion of an ideal gas is :

(A) 

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(B) 

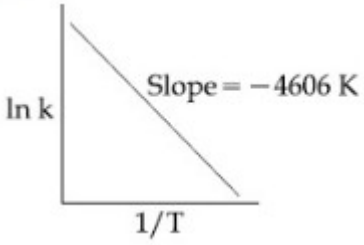
(C) 

(D) 

1. (B) and (D)
2. (A) and (D)
3. (B) and (C)
4. (A) and (C)

Correct. 1

Q16. For a reaction, consider the plot of In k versus 1/T given in the figure. If the rate constant of this reaction at 400 K is $10^{-5}s^{-1}$, then the rate constant at 500 K is :



1. $10^{-4}s^{-1}$
2. 4 x $10^{-4}s^{-1}$
3. $10^{-6}s^{-1}$
4. $2 \times 10^{-4}s^{-1}$

Correct. 1

Q17. For emission line of atomic hydrogen from n_i = 8 to n_f= n, the plot of wave number $(\overline{v})$ against $\left(\frac{1}{n^2}\right)$ will be (The Rydberg constant, R_H is in wave number unit)

1. Linear with intercept - R_H

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2. Non linear
3. Linear with slope R_H
4. Linear with slope - R_H

Correct. 4

Q18. The following results were obtained during kinetic studies of the reaction
2A+B Products

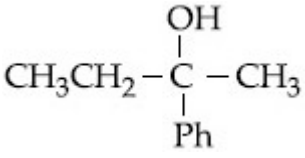
Experiment	[A] (in mol L^{-1})	[B] (in mol L^{-1})	Initial Rate of reaction (in mol L^{-1} min^{-1})
I	0.10	0.20	6.93×10^{-3}
II	0.10	0.25	6.93×10^{-3}
III	0.20	0.30	1.386×10^{-2}

The time (in minutes) required to consume half of A is:
1. 5
2. 1
3. 10
4. 100

Correct. 1

Q19. The highest value of the calculated spin-only magnetic moment (in BM) among all the transition metal complexes is :
1. 5.92
2. 6.93
3. 4.90
4. 3.87

Correct. 1

Q20. 

Cannot be prepared by:
1. $PhCOCH_3 + CH_3CH_2MgX$
2. $HCHO + PHCH(CH_3)CH_2MgX$
3. $PHCOCH_2CH_3 + CH_3MgX$
4. $CH_3CH_2COCH_3 + PhMgX$

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Correct. 2

Q21. Water samples with BOD values of 4 ppm and 18 ppm, respectively, are:
1. Clean and Highly polluted
2. Highly polluted and Highly polluted
3. Highly polluted and Clean
4. Clean and Clean

Correct. 1

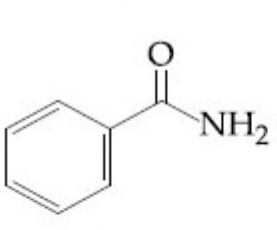
Q22. In a chemical reaction,

$$A+2B \overset{K}{\rightleftharpoons} 2C+D$$

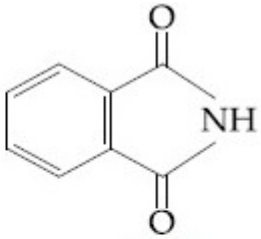
the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant(K) for the aforesaid chemical reaction is:
1. 1
2. ¼
3. 4
4. 16

Correct. 3

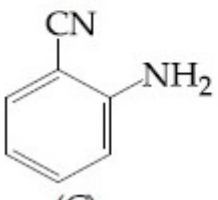
Q23. The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is :



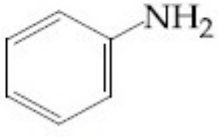
(A)



(B)



(C)



(D)

1. (B) < (A) < (D) < (C)
2. (A) < (C) < (D) < (B)
3. (B) < (A) < (C) < (D)

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4. (A) < (B) < (C) < (D)

Correct. 3

Q24. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$ is :
1. Cr^{2+} and Mn^{2+}
2. V^{2+} and Co^{2+}
3. V^{2+} and Fe^{2+}
4. Co^{2+} and Fe^{2+}

Correct. 2

Q25. Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is :
1. 2A
2. 3A
3. A
4. 4A

Correct. 2

Maths

Q1. A ray of light along $x + \sqrt{3}y = \sqrt{3}$ gets reflected upon reaching x-axis, the equation of the reflected rays is
1. $\sqrt{3}y = x-\sqrt{3}$
2. $y = \sqrt{3}x - \sqrt{3}$
3. $\sqrt{3}y = x-1$
4. $y = x+\sqrt{3}$

Correct. 1

Q2. All the students of a class performed poorly in Mathematics. The teacher decided to give grace marks of 10 to each of the students. Which of the following statistical measures will not change even after the grace marks were given ?
1. median
2. mode
3. variance
4. mean

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Correct. 3

Q3. If $\int f(x)\,dx = \Psi(x)$, then $\int x^5 f(x^3)\,dx$ is equal to

1. $(1/3)x^3\Psi(x^3) - 3\int x^3\Psi(x^3)\,dx + C$
2. $(1/3)x^3\Psi(x^3) - \int x^2\Psi(x^3)\,dx + C$
3. $(1/3)[x^3\Psi(x^3) - \int x^3\Psi(x^3)\,dx] + C$
4. $(1/3)[x^3\Psi(x^3) - \int x^2\Psi(x^3)\,dx] + C$

Correct. 2

Q4. If $\begin{vmatrix} x-4 & 2x & 2x \\ 2x & x-4 & 2x \\ 2x & 2x & x-4 \end{vmatrix} = (A + Bx)(x - A)^2$, then the ordered pair (A, B) is equal to :

1. (−4, −5)
2. (−4, 3)
3. (−4, 5)
4. (4, 5)

Correct. 3

Q5. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. The number of such arrangements is :

1. at least 1000
2. less than 500
3. at least 500 but less than 750
4. at least 750 but less than 1000

Correct. 1

Q6. Let $f(x)=x^2+1/x^2$ and $g(x)=x-1/x$, $x \in R-\{-1,0,1\}$. If $h(x)=f(x)/g(x)$, then the local minimum value of h(x) is:

1. 3
2. -3
3. $-2\sqrt{2}$
4. $2\sqrt{2}$

Correct. 4

Q7. If S is the set of distinct values of 'b' for which the following system of linear equations $x+y+z=1$ $x+ay+z=1$ $ax+by+z=0$ has no solution, then S is :

1. an infinite set
2. a finite set containing two or more elements
3. a singleton
4. an empty set

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Correct. 3

Q8. The value of $({}^{21}C_1 - {}^{10}C_1) + ({}^{21}C_2 - {}^{10}C_2) + ({}^{21}C_3 - {}^{10}C_3) + ({}^{21}C_4 - {}^{10}C_4) + \ldots\ldots\ldots + ({}^{21}C_{10} - {}^{10}C_{10})$ is :

1. $2^{21} - 2^{10}$
2. $2^{20} - 2^{9}$
3. $2^{20} - 2^{10}$
4. $2^{21} - 2^{11}$

Correct. 3

Q9. Let $I_n = \int \tan^n x\, dx$, (n>1). If $I_4 + I_6 = a\tan^5 x + bx^5 + C$, where C is a constant of integration, then the ordered pair (a,b) is equal to:

1. (1/5,0)
2. (1/5,-1)
3. (-1/5,0)
4. (-1/5,1)

Correct. 1

Q10. If $(2+\sin x)dy/dx + (y+1)\cos x = 0$ and $y(0) = 1$, then $y(\pi/2)$ is equals to:

1. -2/3
2. -1/3
3. 4/3
4. 1/3

Correct. 4

Q11. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{b} = \hat{i} + \hat{j}$. Let $\vec{c}$ be a vector such that $|\vec{c} - \vec{a}| = 3$, $|(\vec{a} \times \vec{b}) \times \vec{c}| = 3$ and the angle between $\vec{c}$ and $\vec{a} \times \vec{b}$ be 30°. Then $\vec{a} \cdot \vec{c}$ is equal to :

1. 2
2. 5
3. 1/8
4. 25/8

Correct. 1

Q12. If $5(\tan^2 x - \cos^2 x) = 2\cos 2x + 9$, then the value of $\cos 4x$ is:

1. 1/3
2. 2/9

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3. -7/9
4. -3/5

Correct. 3

Q13. If the fractional part of the number $\frac{2^{403}}{15}$ is k/15, then k is equal to :
1. 6
2. 8
3. 14
4. 4

Correct. 2

Q14. Let A = { $\theta \in \left(-\frac{\pi}{2}, \pi\right) : \frac{3+2i\sin\theta}{1-2i\sin\theta}$ is purely imaginary } .Then the sum of the elements in A is:
1. 3π/4
2. 2π/3
3. π
4. 5π/6

Correct. 2

Q15. For any $\theta \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$, the expression $3(\sin\theta - \cos\theta)^4 + 6(\sin\theta + \cos\theta)^2 + 4\sin^6\theta$ equals:
1. $13 - 4\cos^2\theta + 6\sin^2\theta\cos^2\theta$
2. $13 - 4\cos^6\theta$
3. $13 - 4\cos^4\theta + 2\sin^2\theta\cos^2\theta$
4. $13 - 4\cos^2\theta + 6\cos^4\theta$

Correct. 2

Q16. The expression $\sim (\sim p \rightarrow q)$ is logically equivalent to :
1. $p \wedge q$
2. $\sim p \wedge q$
3. $\sim p \wedge \sim q$
4. $p \wedge \sim q$

Correct. 3

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Q17. If a circle of radius R passes through the origin O and intersects the coordinate axes at A and B, then the locus of the foot of perpendicular from O on AB is :

1. $\left(x^2+y^2\right)^3=4R^2x^2y^2$
2. $\left(x^2+y^2\right)^2=4Rx^2y^2$
3. $\left(x^2+y^2\right)(x+y)=R^2xy$
4. $\left(x^2+y^2\right)^2=4R^2x^2y^2$

Correct. 1

Q18. Consider the quadratic equation $(c-5)x^2-2cx+(c-4)=0, c=5$. Let S be the set of all integral values of c for which one root of the equation lies in the interval (0, 2) and its other root lies in the interval (2,3). Then the number of elements in Sis:

1. 18
2. 12
3. 11
4. 10

Correct. 3

Q19. All x satisfying the inequality $\left(\cot^{-1}x\right)^2-7\left(\cot^{-1}x\right)+10>0$, lie in the interval :

1. $(-\infty,\cot 5)\cup(\cot 4,\cot 2)$
2. $(\cot 2,\infty)$
3. $(-\infty,\cot 5)\cup(\cot 2,\infty)$
4. $(\cot 5,\cot 4)$

Correct. 2

Q20. The integral $\int_{\pi/6}^{\pi/4}\frac{\mathrm{d}x}{\sin 2x\left(\tan^5x+\cot^5x\right)}$ equals :

1. $\frac{1}{10}\left(\frac{\pi}{4}-\tan^{-1}\left(\frac{1}{9\sqrt{3}}\right)\right)$
2. $\frac{\pi}{40}$
3. $\frac{1}{5}\left(\frac{\pi}{4}-\tan^{-1}\left(\frac{1}{3\sqrt{3}}\right)\right)$
4. $\frac{1}{20}\tan^{-1}\left(\frac{1}{9\sqrt{3}}\right)$

Correct. 1

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Q21. Let a function $f:(0,\infty)\to(0,\infty)$ be defined by $f(x)=\left|1-\frac{1}{x}\right|$. Then f is :
1. injective only
2. both injective as well as surjective
3. not injective but it is surjective
4. neither injective nor surjective

Correct. 4

Q22. A bag contains 30 white balls and 10 red balls. 16 balls are drawn one by one randomly from the bag with replacement. If X be the number of white balls drawn, then $\left(\frac{\text{mean of } X}{\text{standard deviation of } X}\right)$ is equal to:
1. 4
2. $3\sqrt{2}$
3. $4\sqrt{3}$
4. $\frac{4\sqrt{3}}{3}$

Correct. 3

Q23. Let z_0 be a root of the quadratic equation, $x^2+x+1=0$. If $z=3+6iz_0^{81}-3iz_0^{93}$ then arg z is equal to :
1. π/4
2. π/6
3. π/3
4. 0

Correct. 1

Q24. If both the roots of the quadratic equation $x^2-mx+4=0$ are real and distinct and they lie in the interval [1, 5] , then m lies in the interval :
1. (4,5)
2. (5,6)
3. (-5,-4)
4. (3,4)

Correct. 1

Q25. The number of natural numbers less than 7,000 which can be formed by using the digits 0, 1, 3, 7, 9 (repitition of digits allowed) is equal to :
1. 375

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2. 374
3. 250
4. 372

Correct. 2

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