FINAL JEE–MAIN EXAMINATION – APRIL, 2023

(Held On Saturday 08th April, 2023) **TIME : 3 : 00 PM to 6 : 00 PM**

MATHEMATICS — TEST PAPER WITH ANSWER

SECTION-A

1. Let the mean and variance of 12 observations be $\frac{9}{2}$ and 4 respectively. Later on, it was observed that two observations were considered as 9 and 10 instead of 7 and 14 respectively. If the correct variance is $\frac{m}{n}$, where m and n are co-prime, then m+n is equal to

(1) 316
(2) 314
(3) 317
(4) 315

Official Ans. by NTA (3)

2. Let a_n be the n^{th} term of the series $5 + 8 + 14 + 23 + 35 + 50 + \ldots$ and $S_n = \sum_{k=1}^{n} a_k$. Then $S_{30} - a_{40}$ is equal to

(1) 11310
(2) 11280
(3) 11290
(4) 11260

Official Ans. by NTA (3)

3. Let P be the plane passing through the line $\frac{x-1}{1} = \frac{y-2}{-3} = \frac{z+5}{7}$ and the point (2, 4, –3). If the image of the point (–1, 3, 4) in the plane P is (α, β, γ), then $\alpha + \beta + \gamma$ is equal to

(1) 12
(2) 11
(3) 9
(4) 10

Official Ans. by NTA (4)

4. Let $A = \theta \in (0, 2\pi) : \frac{1+2i\sin\theta}{1-i\sin\theta}$ is purely imaginary . Then the sum of the elements in A is

(1) π
(2) 2π
(3) 4π
(4) 3π

Official Ans. by NTA (3)

5. The absolute difference of the coefficients of x^{10} and x^7 in the expansion of $\left(2x^2 + \frac{1}{2x}\right)^{11}$ is equal to

(1) $12^3 - 12$
(2) $11^3 - 11$
(3) $10^3 - 10$
(4) $13^3 - 13$

Official Ans. by NTA (1)

6. If the number of words, with or without meaning, which can be made using all the letters of the word MATHEMATICS in which C and S do not come together, is (6!)k, then k is equal to

(1) 1890
(2) 945
(3) 2835
(4) 5670

Official Ans. by NTA (4)

7. Let S be the set of all values of $\theta \in [-\pi, \pi]$ for which the system of linear equations

$x + y + \sqrt{3}z = 0$
$-x + (\tan\theta)y + \sqrt{7}z = 0$
$x + y + (\tan\theta)z = 0$

has non-trivial solution. Then $\frac{120}{\pi}\sum_{\theta \in S}\theta$ is equal to

(1) 40
(2) 10
(3) 20
(4) 30

Official Ans. by NTA (3)

8. If the probability that the random variable X takes values x is given by $P(X = x) = k(x + 1)3^{-x}$, x = 0, 1, 2, 3… , where k is a constant, then P (X ≥ 2) is equal to

(1) $\frac{7}{27}$

(2) $\frac{11}{18}$

(3) $\frac{7}{18}$

(4) $\frac{20}{27}$

Official Ans. by NTA (1)

9. The value of $36(4\cos^2 9° - 1)(4\cos^2 27° - 1)(4\cos^2 81° - 1)(4\cos^2 243° - 1)$ is

(1) 54

(2) 18

(3) 27

(4) 36

Official Ans. by NTA (4)

10. The integral $\int\left(\left(\frac{x}{2}\right)^x + \left(\frac{2}{x}\right)^x\right)\log_2 x\,dx$ is equal to

(1) $\left(\frac{x}{2}\right)^x + \left(\frac{2}{x}\right)^x + C$

(2) $\left(\frac{x}{2}\right)^x - \left(\frac{2}{x}\right)^x + C$

(3) $\left(\frac{x}{2}\right)^x \log_2\left(\frac{x}{2}\right) + C$

(4) $\left(\frac{x}{2}\right)^x \log_2\left(\frac{2}{x}\right) + C$

Official Ans. by NTA (2)

11. The area of the quadrilateral ABCD with vertices A(2, 1, 1), B(1, 2, 5), C (–2, –3, 5) and D (1, –6, –7) is equal to

(1) 48

(2) $8\sqrt{38}$

(3) 54

(4) $9\sqrt{38}$

Official Ans. by NTA (2)

12. For a, b ∈ Z and $|a - b| \le 10$, let the angle between the plane P: ax + y – z = b and the line l : x – 1 = a –y = z + 1 be $\cos^{-1}\left(\frac{1}{3}\right)$. If the distance of the point (6, –6, 4) from the plane P is $3\sqrt{6}$, then $a^4 + b^2$ is equal to

(1) 25

(2) 85

(3) 48

(4) 32

Official Ans. by NTA (4)

13. $25^{190} - 19^{190} - 8^{190} + 2^{190}$ is divisible by

(1) 34 but not by 14

(2) both 14 and 34

(3) neither 14 nor 34

(4) 14 but not by 34

Official Ans. by NTA (1)

14. Let the vectors $\vec{u}_1 = \hat{i} + \hat{j} + a\hat{k}, \vec{u}_2 = \hat{i} + b\hat{j} + \hat{k}$ and $\vec{u}_3 = c\hat{i} + \hat{j} + \hat{k}$ be coplanar. If the vectors $\vec{v}_1 = (a+b)\hat{i} + c\hat{j} + c\hat{k}$, $\vec{v}_2 = a\hat{i} + (b+c)\hat{j} + a\hat{k}$ and $\vec{v}_3 = b\hat{i} + b\hat{j} + (c+a)\hat{k}$ are also coplanar, then 6 (a + b + c) is equal to

(1) 0

(2) 6

(3) 12

(4) 4

Official Ans. by NTA (3)

15. Let O be the origin and OP and OQ be the tangents to the circle $x^2 + y^2 - 6x + 4y + 8 = 0$ at the point P and Q on it. If the circumcircle of the triangle OPQ passes through the point $\left(\alpha, \frac{1}{2}\right)$, then a value of α is

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

(2) $\frac{5}{2}$

(3) 1

(4) $-\frac{1}{2}$

Official Ans. by NTA (2)

16. The negation of $p \wedge (\sim q) \vee (\sim p)$ is equivalent to

(1) $p \wedge q$

(2) $p \wedge (\sim q)$

(3) $p \wedge (q \wedge (\sim p))$

(4) $p \vee (q \vee (\sim p))$

Official Ans. by NTA (1)

17. If $\alpha > \beta > 0$ are the roots of the equation $ax^2 + bx + 1 = 0$, and

$$\lim_{x \to \frac{1}{\alpha}} \left(\frac{1 - \cos\left(x^2 + bx + a\right)}{2\left(1 - \alpha x\right)^2} \right)^{\frac{1}{2}} = \frac{1}{k}\left(\frac{1}{\beta} - \frac{1}{\alpha}\right)$$,then k is equal to

(1) 2β

(2) 2α

(3) α

(4) β

Official Ans. by NTA (2)

18. If $A = \begin{bmatrix} 1 & 5 \\ \lambda & 10 \end{bmatrix}$, $A^{-1} = \alpha A + \beta I$ and $\alpha + \beta = -2$, then $4\alpha^2 + \beta^2 + \lambda^2$ is equal to:

(1) 12

(2) 10

(3) 19

(4) 14

Official Ans. by NTA (4)

19. Let A(0,1), B(1, 1) and C(1, 0) be the mid – points of the sides of a triangle with incentre at the point D. If the focus of the parabola $y^2 = 4ax$ passing through D is $\left(\alpha + \beta\sqrt{2}, 0\right)$, where α and β are rational numbers, then $\frac{\alpha}{\beta^2}$ is equal to

(1) 6

(2) 8

(3) 12

(4) $\frac{9}{2}$

Official Ans. by NTA (2)

20. Let A = {1, 2, 3, 4, 5, 6, 7}.Then the relation R = $\{(x,y) \in A \times A : x + y = 7\}$is

(1) transitive but neither symmetric nor reflexive

(2) reflexive but neither symmetric nor transitive

(3) an equivalence relation

(4) symmetric but neither reflexive nor transitive

Official Ans. by NTA (4)

SECTION-B

21. Let [t] denote the greatest integer function. If $\int_0^{2.4} \left[x^2\right] dx = \alpha + \beta\sqrt{2} + \gamma\sqrt{3} + \delta\sqrt{5}$, then $\alpha + \beta + \gamma + \delta$ is equal to ____

Official Ans. by NTA (6)

22. Let k and m be positive real numbers such that the function $f(x) = \begin{cases} 3x^2 + k\sqrt{x+1}, & 0 < x < 1 \\ mx^2 + k^2, & x \geq 1 \end{cases}$ is differentiable for all x > 0. Then $\frac{8f'(8)}{f'\left(\frac{1}{8}\right)}$ is equal to

____

Official Ans. by NTA (309)

23. Let $0 < z < y < x$ be three real numbers such that $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$ are in an arithmetic progression and x, $\sqrt{2}y$, z are in a geometric progression. If $xy + yz + zx = \frac{3}{\sqrt{2}}xyz$, then $3(x + y + z)^2$ is equal to____

Official Ans. by NTA (150)

24. If domain of the function $\log_e\left(\frac{6x^2+5x+1}{2x-1}\right)+\cos^{-1}\left(\frac{2x^2-3x+4}{3x-5}\right)$ is $(\alpha, \beta) \cup (\gamma, \delta]$, then $18(\alpha^2 + \beta^2 + \gamma^2 + \delta^2)$ is equal to ____

Official Ans. by NTA (20)

25. Let m and n be the numbers of real roots of the quadratic equations $x^2 - 12x + [x] + 31 = 0$ and $x^2 - 5|x + 2| - 4 = 0$ respectively, where [x] denotes the greatest integer $\le x$. Then $m^2 + mn + n^2$ is equal to ____.

Official Ans. by NTA (9)

26. The ordinates of the points P and Q on the parabola with focus (3, 0) and directrix x = –3 are in the ratio 3 : 1. If R(α, β) is the point of intersection of the tangents to the parabola at P and Q, then $\frac{\beta^2}{\alpha}$ is equal to____:

Official Ans. by NTA (16)

27. Let the solution curve x = x(y), $0 < y < \frac{\pi}{2}$, of the differential equation $(\log_e(\cos y))^2 \cos y\, dx - (1 + 3x \log_e(\cos y))\sin y\, dy = 0$ satisfy $x\left(\frac{\pi}{3}\right) = \frac{1}{2\log_e 2}$. If $x\left(\frac{\pi}{6}\right) = \frac{1}{\log_e m - \log_e n}$, where m and n are co-prime, then mn is equal to

Official Ans. by NTA (12)

28. Let P_1 be the plane $3x - y - 7z = 11$ and P_2 be the plane passing through the points (2, –1, 0), (2, 0, –1), and (5, 1, 1). If the foot of the perpendicular drawn from the point (7, 4, –1)on the line of intersection of the planes P_1 and P_2 is (α, β, γ), then $\alpha + \beta + \gamma$ is equal to ____.

Official Ans. by NTA (11)

29. Let R = {a, b, c, d, e} and S = {1, 2, 3, 4}. Total number of onto function f : R $\rightarrow$ S such that f(a) $\neq$ 1, is equal to _____.

Official Ans. by NTA (384)

30. Let the area enclosed by the lines x + y = 2, y = 0, x = 0 and the curve $f(x) = \min\left\{x^2 + \frac{3}{4}, 1 + [x]\right\}$ where [x] denotes the greatest integer $\le$ x, be A. Then the value of 12A is _____

Official Ans. by NTA (17)

PHYSICS

TEST PAPER WITH SOLUTION

SECTION-A

31. Electric potential at a point 'P' due to a point charge of 5×10^{-9} C is 50 V. The distance of 'P' from the point charge is:

(Assume, $\frac{1}{4\pi\varepsilon_0}=9\times10^{+9}\,Nm^2C^{-2}$)

(1) 3 cm (2) 9 cm

(3) 90 cm (4) 0.9 cm

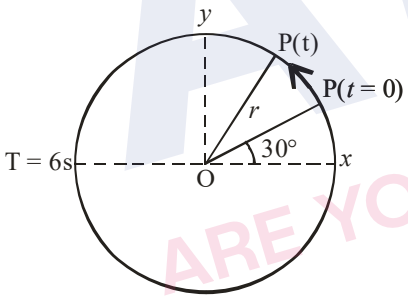
Official Ans. by NTA (3)

Sol. $V_P=\frac{KQ}{r}$

$50=\frac{9\times10^9\times5\times10^{-9}}{r}$

$r=\frac{45}{50}=\frac{9}{10}=0.9m=90cm$

32. For particle P revolving round the centre O with radius of circular path r and angular velocity ω, as shown in below figure, the projection of OP on the x-axis at time t is



(1) $x(t)=r\cos\left(\omega t+\frac{\pi}{6}\right)$

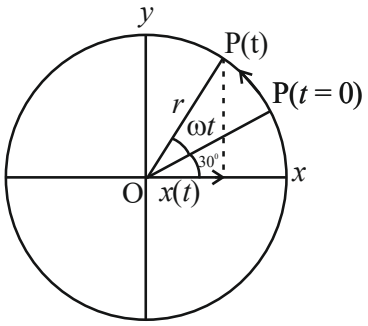
(2) $x(t)=r\cos(\omega t)$

(3) $x(t)=r\sin\left(\omega t+\frac{\pi}{6}\right)$

(4) $x(t)=r\cos\left(\omega t-\frac{\pi}{6}\omega\right)$

Official Ans. by NTA (1)

Sol.



$x(t) = r\cos(\omega t + 30°)$

$x(t) = r\cos(\omega t + \pi/6)$

33. Match List I with List II

LIST-I		LIST-II	
A.	Torque	I.	$ML^{-2}T^{-2}$
B.	Stress	II.	$ML^{2}T^{-2}$
C.	Pressure gradient	III.	$ML^{-1}T^{-1}$
D.	Coefficient of viscosity	IV.	$ML^{-1}T^{-2}$

Choose the correct answer from the options given below:

(1) A-III, B-IV, C-I, D-II

(2) A-IV, B-II, C-III, D-I

(3) A-II, B-IV, C-I, D-III

(4) A-II, B-I, C-IV, D-III

Official Ans. by NTA (3)

Sol. **A.** Torque $\Rightarrow \vec{\tau}=\vec{r}\times\vec{F}$

$[\tau]=[L][MLT^{-2}]$

$\Rightarrow ML^2T^{-2}$

B. $\text{Stress}=\frac{F}{A}\Rightarrow\frac{MLT^{-2}}{L^2}$

$[\text{stress}] = ML^{-1}T^{-2}$

C. Pressure gradient $=\frac{\Delta P}{\Delta X}$

$\Rightarrow\frac{[F/A]}{[L]}\Rightarrow\frac{MLT^{-2}}{L^3}$

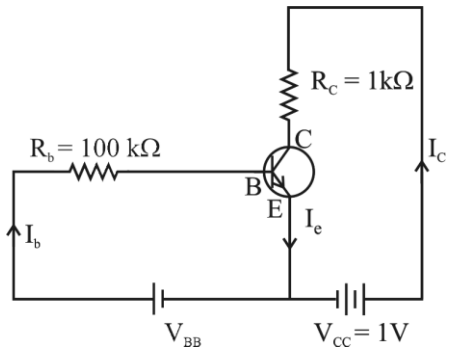
$\Rightarrow ML^{-2}T^{-2}$

D. Coefficient of viscosity $\Rightarrow F = 6\pi\eta rv$

$MLT^{-2} = [\eta]\,L^2T^{-1}$

$[\eta] = ML^{-1}T^{-1}$

34. For a given transistor amplifier circuit in CE configuration V_{CC} = 1 V, R_c = 1 kΩ, R_b = 100 kΩ and β = 100. Value of base current I_b is

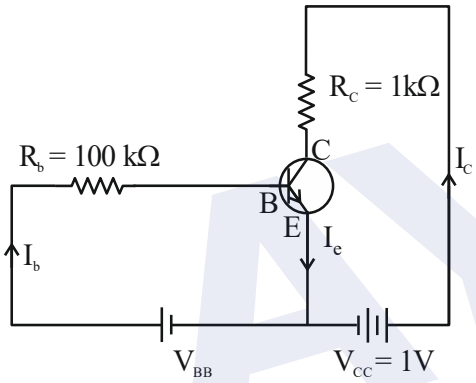


(1) I_b = 1.0 μA (2) I_b = 0.10 μA

(3) I_b = 100 μA (4) I_b = 10 μA

Official Ans. by NTA (4)

Sol.



Considering the transistor in saturation mode

$V_{CE} = 0$

Using KVL

$-I_cR_c + V_{CC} = 0$

$$I_c = \frac{V_{CC}}{R_C} = \frac{1}{1\times10^3}$$

$I_c = 10^{-3}$A

$$\beta = \frac{I_c}{I_b}$$

$$I_b = \frac{10^{-3}}{100} \Rightarrow 10^{-5}\text{A} \Rightarrow I_b = 10\ \mu\text{A}$$

35. The trajectory of projectile, projected from the ground is given by $y = x - \frac{x^2}{20}$. Where x and y are measured in meter. The maximum height attained by the projectile will be.

(1) 5 m (2) $10\sqrt{2}$m

(3) 200 m (4) 10 m

Official Ans. by NTA (1)

Sol. $y = x - \frac{x^2}{20}$

For maximum height,

$$\frac{dy}{dx} = 0 \Rightarrow 1 - \frac{2x}{20} = 0$$

x = 10

$$\text{So, } y_{max} = 10 - \frac{100}{20} = 5\text{m}$$

36. A radio-active material is reduced to 1/8 of its original amount in 3 days. If 8×10^{-3} kg of the material is left after 5 days. The initial amount of the material is

(1) 64 g (2) 40 g

(3) 32 g (4) 256 g

Official Ans. by NTA (4)

Sol. $N = N_0\left(\frac{1}{2}\right)^n$

$$\frac{N_0}{8} = N_0\left(\frac{1}{2}\right)^n$$

n = 3

3 half lives = 3 days

1 half life = 1 day

5 days = 5 half life

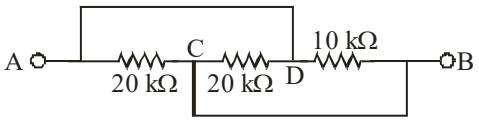
$$N = N_0\left(\frac{1}{2}\right)^n$$

$$8 \times 10^{-3} = N_0\left(\frac{1}{2}\right)^5$$

$N_0 = 256 \times 10^{-3}$ kg

N_0 = 256 g

37. The equivalent resistance between A and B as shown in figure is:

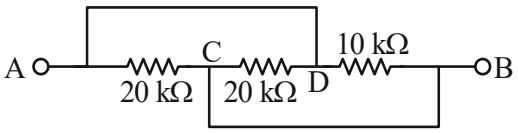


(1) 5 kΩ (2) 30 kΩ

(3) 10 kΩ (4) 20 kΩ

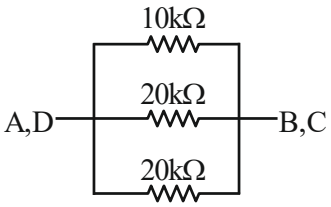
Official Ans. by NTA (1)

Sol.



$V_A = V_D$

$V_C = V_B$



All resistors are in parallel. So,

$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{20} + \frac{1}{20}$$

$R_{eq} = 5\ k\Omega$.

38. A hydraulic automobile lift is designed to lift vehicles of mass 5000 kg. The area of cross section of the cylinder carrying the load is 250 cm^2. The maximum pressure the smaller piston would have to bear is [Assume g = 10 m/s^2] :

(1) $200 \times 10^{+6}$ Pa (2) $20 \times 10^{+6}$ Pa

(3) $2 \times 10^{+6}$ Pa (4) $2 \times 10^{+5}$ Pa

Official Ans. by NTA (3)

Sol. Force = mg = 5000 g

Area of cross section = 250 cm^2 = 250×10^{-4} m^2

$$\text{maximum pressure} = \frac{\text{Force}}{\text{area of cross section}}$$

$$= \frac{5000g}{250\times10^{-4}} = \frac{20\times g}{10^{-4}} = 2\times10^{6}\,\text{Pa}$$

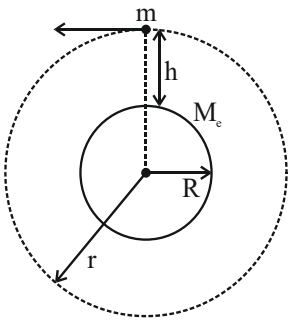
39. The orbital angular momentum of a satellite is L, when it is revolving in a circular orbit at height h from earth surface. If the distance of satellite from the earth centre is increased by eight times to its initial value, then the new angular momentum will be-

(1) 8 L (2) 4 L

(3) 9 L (4) 3 L

Official Ans. by NTA (4)

Sol.



$L = mvr$

$$v = \sqrt{\frac{GM_e}{r}}$$

$$L = m\sqrt{\frac{GM_e}{r}}\cdot r$$

$$L \propto r^{\frac{1}{2}}$$

Now distance from centre is increased by 8 times.

So new distance from centre = r + 8r = 9r

Now angular momentum $L' \propto (9r)^{1/2}$

$$\frac{L}{L'} = \frac{r^{1/2}}{(9r)^{1/2}} = \frac{1}{3}$$

L'= 3 L

40. The temperature at which the kinetic energy of oxygen molecules becomes double than its value at 27°C is

(1) 1227° C (2) 927°C

(3) 327°C (4) 627°C

Official Ans. by NTA (3)

Sol. Kinetic energy = $\frac{f}{2}kT$, T is absolute temperature.

If K_1 is kinetic energy at 27°C.

K_2 is kinetic energy at new temperature T.

$$\frac{K_1}{K_2} = \frac{T_1}{T_2} \Rightarrow \frac{1}{2} = \frac{300}{T}$$

T = 600 K

T = 327°C

41. The acceleration due to gravity at height h above the earth if h <<R (radius of earth) is given by

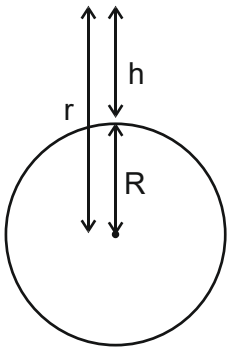
(1) $g' = g\left(1 - \frac{2h}{R}\right)$ (2) $g' = g\left(1 - \frac{2h^2}{R^2}\right)$

(3) $g' = g\left(1 - \frac{h}{2R}\right)$ (4) $g' = g\left(1 - \frac{h^2}{2R^2}\right)$

Official Ans. by NTA (1)

Sol. For point outside the surface of earth

$$g = \frac{GM}{r^2}$$



r = distance from center of earth

$$\Rightarrow g(h) = \frac{GM}{(R+h)^2} \Rightarrow g(h) = \frac{GM}{R^2\left(1+\frac{h}{R}\right)^2}$$

$$\Rightarrow g(h) = \frac{GM}{R^2}\left(1+\frac{h}{R}\right)^{-2}$$

If $h <<< R$, $\left(1+\frac{h}{R}\right)^{-2} \approx 1-\frac{2h}{R}$

$$\Rightarrow g(h) = \frac{GM}{R^2}\left(1-\frac{2h}{R}\right)$$

$$\Rightarrow g(h) = g_{surface}\left(1-\frac{2h}{R}\right), \frac{GM}{R^2} = g_{surface}$$

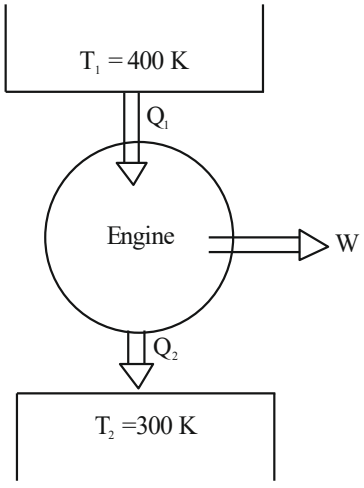
42. Work done by a Carnot engine operating between temperatures 127°C and 27°C is 2 kJ. The amount of heat transferred to the engine by the reservoir is:

(1) 4kJ (2) 2 kJ

(3) 8kJ (4) 2.67 kJ

Official Ans. by NTA (3)

Sol.



Efficiency of carnot engine

$$\eta = 1-\frac{T_2}{T_1} = \frac{W}{Q_1}$$

$$\Rightarrow \frac{W}{Q_1} = 1-\frac{300}{400} = \frac{1}{4}$$

$$\Rightarrow \frac{2kJ}{Q_1} = \frac{1}{4}$$

$$\Rightarrow Q_1 = 8 \text{ kJ}$$

43. Given below are two statements:

Statement I: Area under velocity- time graph gives the distance travelled by the body in a given time.

Statement II: Area under acceleration- time graph is equal to the change in velocity- in the given time.

In the light of given statements, choose the correct answer from the options given below.

(1) Both Statement I and Statement II are true.

(2) Statement I is correct but Statement II is false.

(3) Statement I is incorrect but Statement II is true.

(4) Both Statement I and Statement II are False.

Official Ans. by NTA (1)

Sol. Area under velocity time graph gives displacement of body in given time.

Area under acceleration time graph gives change in velocity in the given time.

So Statement I false

Statement II True

44. The waves emitted when a metal target is bombarded with high energy electrons are

(1) Microwaves (2) X-rays

(3) Infrared rays (4) Radio Waves

Official Ans. by NTA (2)

Sol. X rays are emitted when target metal is bombarded with high energy electron.

45. The width of fringe is 2 mm on the screen in a double slits experiment for the light of wavelength of 400 nm. The width of the fringe for the light of wavelength 600 nm will be:

(1) 4 mm (2) 1.33 mm

(3) 3 mm (4) 2 mm

Official Ans. by NTA (3)

Sol. Fringe width $(\beta) = \frac{D\lambda}{d}$

$\Rightarrow \frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1}$

$\Rightarrow \frac{\beta_2}{2mm} = \frac{600nm}{400nm} = \frac{3}{2}$

$\Rightarrow \boxed{\beta_2 = 3mm}$

46. Given below are two statements; one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: Electromagnets are made of soft iron.

Reason R: Soft iron has high permeability and low retentivity.

In the light of above, statements, choose the most appropriate answer from the options given below.

(1) A is not correct but R is correct

(2) Both A and R are correct and R is the correct explanation of A

(3) Both A and R are correct but R is NOT the correct explanation of A

(4) A is correct but R is not correct

Official Ans. by NTA (2)

Sol. Electromagnets are made of soft iron because it has high permeability and low retentivity.

So, Both A and R are correct and R is the correct explanation of A

47. In photo electric effect

A. The photocurrent is proportional to the intensity of the incident radiation.

B. Maximum Kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.

C. Max. K.E with which photoelectrons are emitted depends on the frequency of incident light.

D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.

E. Max. K.E of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below:

(1) A and C only (2) A and E only

(3) B and C only (4) A and B only

Official Ans. by NTA (1)

Sol. Intensity of light $\propto$ number of photons $\propto$ no of photo electrons $\propto$ photo current

So, A is correct

$KE_{max} = h\nu - \phi$

KE_{max} depends on frequency

So, C is correct

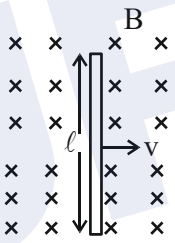
So, A and C are correct

48. An emf of 0.08 V is induced in a metal rod of length 10 cm held normal to a uniform magnetic field of 0.4 T, when moves with a velocity of:

(1) 2 ms^{-1} (2) 3.2 ms^{-1}

(3) 0.5 ms^{-1} (4) 20 ms^{-1}

Sol. Official Ans. by NTA (1)



Induced emf = Bℓv

$\Rightarrow 0.08 = 0.4\left(\frac{10}{100}\right)v$

$\Rightarrow v = \left(\frac{0.08 \times 10}{0.4}\right)$ $\Rightarrow v = 2m/s$

49. A bullet of mass 0.1 kg moving horizontally with speed 400 ms^{-1} hits a wooden block of mass 3.9 kg kept on a horizontal rough surface. The bullet gets embedded into the block and moves 20 m before coming to rest. The coefficient of friction between the block and the surface is_____.

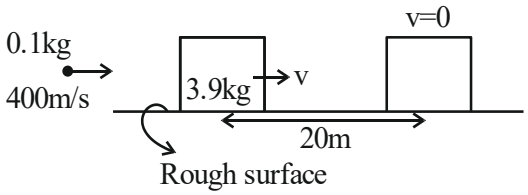
(Given g= 10 ms^2)

(1) 0.50 (2) 0.90

(3) 0.65 (4) 0.25

Official Ans. by NTA (4)

Sol.



$P_i = P_f$ (Collision)

$\Rightarrow (0.1)(400) = (0.1+3.9)v$

$\Rightarrow v = \frac{0.1\times 400}{4} = 10 m/s$

$a = \frac{\mu mg}{m} = \mu g$

Apply equation of motion,

$v^2 = u^2 + 2as$

$\Rightarrow 0 = (10)^2 - 2\mu g \times 20$

$\Rightarrow 40\mu g = 100$

$\Rightarrow \mu = \frac{100}{2\times 10\times 20} = \frac{1}{4}$

50. The power radiated from a linear antenna of length l is proportional to

(Given, λ = Wavelength of wave):

(1) $\frac{l}{\lambda}$ (2) $\frac{l}{\lambda^2}$ (3) $\frac{l^2}{\lambda}$ (4) $\left(\frac{l}{\lambda}\right)^2$

Official Ans. by NTA (4)

Sol. Power radiated form a linear antenna of length

$l \propto \left(\frac{l}{\lambda}\right)^2$

SECTION-B

51. A series combination of resistor of resistance 100 Ω, inductor of inductance 1 H and capacitor of capacitance 6.25 μF is connected to an ac source. The quality factor of the circuit will be _____.

Official Ans. by NTA 4

Sol. Quality factor $= \frac{X_L}{R} = \frac{\omega L}{R}$

$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{1\times 6.25\times 10^{-6}}} = \frac{10^3}{2.5} = 400/sec$

Q-factor $= \frac{400\times 1}{100} = 4$

52. A guitar string of length 90 cm vibrates with a fundamental frequency of 120 Hz. The length of the string producing a fundamental frequency of 180 Hz will be _____ cm.

Official Ans. by NTA 60

Sol. $f = \frac{nv}{2\ell}$, for fundamental mode n = 1

$f = \frac{v}{2\ell}$

$f \propto \frac{1}{\ell}$

$\frac{f_1}{f_2} = \frac{\ell_2}{\ell_1}$

$\frac{120}{180} = \frac{\ell_2}{90}$

$\ell_2 = 60cm$

53. The ratio of wavelength of spectral lines H_α and H_β in the Balmer series is $\frac{x}{20}$. The value of x is _____

Official Ans. by NTA 27

Sol. $\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ for H-atom

For balmer series, n_1=2

$\frac{1}{\lambda} = R\left[\frac{1}{4} - \frac{1}{n_2^2}\right]$

For H_α, $n_2 = 3$

& H_β, $n_2 = 4$

$\frac{1}{\lambda_{H_\alpha}} = R\left[\frac{1}{4} - \frac{1}{9}\right] = \frac{5R}{36}$

$\frac{1}{\lambda_{H_\beta}} = R\left[\frac{1}{4} - \frac{1}{16}\right] = \frac{3R}{16}$

$\frac{\frac{1}{\lambda_{H_\alpha}}}{\frac{1}{\lambda_{H_\beta}}} = \frac{\frac{5R}{36}}{\frac{3R}{16}}$

$\frac{\lambda_{H_\alpha}}{\lambda_{H_\beta}} = \frac{27}{20} = \frac{x}{20}$

$x = 27$

54. The number density of free electrons in copper is nearly $8 \times 10^{28}\ m^{-3}$. A copper wire has its area of cross section $= 2 \times 10^{-6}\ m^2$ and is carrying a current of 3.2 A. The drift speed of the electrons is _____ $\times 10^{-6}\ ms^{-1}$.

Official Ans. by NTA 125

Sol. $n = 8\times10^{28}\ m^{-3}$

Area $= 2\times10^{-6}\ m^2$

$I = 3.2\ A$

$I = neAv_d$

$$V_d = \frac{I}{neA} = 125\times10^{-6}\,m/s$$

55. A steel rod of length 1 m and cross sectional area $10^{-4}\ m^2$ is heated from 0°C to 200°C without being allowed to extend or bend. The compressive tension produced in the rod is _____ $\times 10^4$ N. (Given Young's modulus of steel $= 2 \times 10^{11}\ Nm^{-2}$, coefficient of linear expansion $= 10^{-5}K^{-1}$.

Official Ans. by NTA 4

Sol. Stress = Y × strain

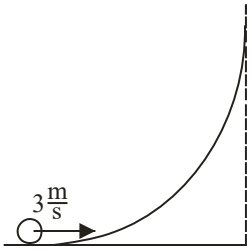
$$\text{Stress} = Y \times \frac{\Delta\ell}{\ell}$$

$$= Y \times \frac{\ell\alpha\Delta T}{\ell} = Y\alpha\Delta T$$

Compressive Tension = Stress × Area of cross section

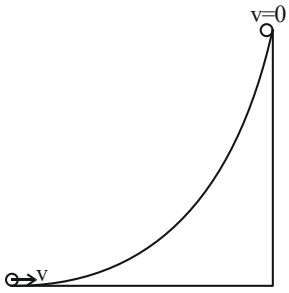
$= YA\alpha\Delta T = 4 \times 10^4$ N

56. A hollow spherical ball of uniform density rolls up a curved surface with an initial velocity 3 m/s (as shown in figure). Maximum height with respect to the initial position covered by it will be _____ cm.



Official Ans. by NTA 75

Sol.



At highest point $KE_f = 0$

Initial KE = Translational KE + Rotational KE

$$= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

In case of rolling $v = R\omega$

$$= \frac{1}{2}mv^2 + \frac{1}{2}\times\frac{2}{3}mR^2\times\frac{v^2}{R^2}$$

$$= \frac{5}{6}mv^2$$

Apply energy conservation

$$KE_i + PE_i = KE_f + PE_f$$

$$\frac{5}{6}mv^2 = mgh$$

$$h = \frac{5}{6\times10}\times9m = \frac{15}{20}m = 75cm$$

57. A body of mass 5 kg is moving with a momentum of 10 kg ms^{-1}. Now a force of 2 N acts on the body in the direction of its motion for 5 s. The increase in the Kinetic energy of the body is _____ J.

Official Ans. by NTA (30)

Sol. Given

$M = 5$ kg

$P_i = 10$ kg m/s (initial momentum)

Impulse $= F\Delta t = \Delta P = P_f - P_i$

$2 \times 5 = P_f - 10$

$P_f = 20$ kg m/s (final momentum)

Increase in $KE = KE_f - KE_i$

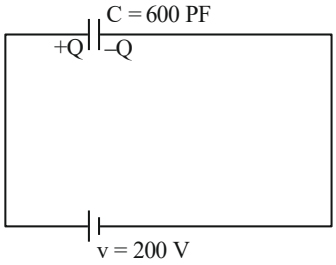
$$= \frac{P_f^2}{2m} - \frac{P_i^2}{2m}$$

$$= \frac{400}{2\times5} - \frac{100}{2\times5} = 40 - 10 = 30J$$

58. A 600 pF capacitor is charged by 200V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. Electrostatic energy lost in the process is _____ μJ.

Official Ans. by NTA (6)

Sol.

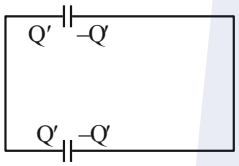


$Q = CV = 600 \times 10^{-12} \times 200 = 12 \times 10^{-8} C$

Initial energy $= \frac{1}{2}CV^2$

$= \frac{1}{2} \times 600 \times 10^{-12} \times (200)^2 = 12\mu J$

When connected to another uncharged capacitor



Charge will be equally distributed on identical capacitor

$Q' = \frac{Q}{2} = 6 \times 10^{-8}$

Final energy $= 2 \times \frac{Q'^2}{2C} = \frac{Q'^2}{C}$

$\frac{(6 \times 10^{-8})^2}{600 \times 10^{-12}} = 6\mu J$

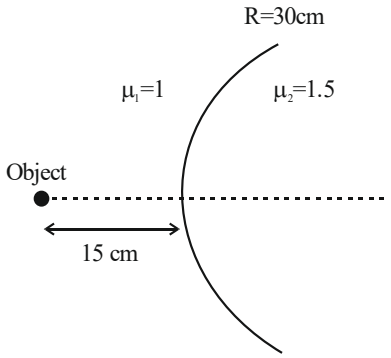
Energy lost = Initial energy – Final energy

= (12–6) μJ = 6μJ

59. Two transparent media having refractive indices 1.0 and 1.5 are separated by a spherical refracting surface of radius of curvature 30 cm. The centre of curvature of surface is towards denser medium and a point object is placed on the principle axis in rarer medium at a distance of 15 cm from the pole of the surface. The distance of image from the pole of the surface is _____ cm.

Official Ans. by NTA 30

Sol.



$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\frac{1.5}{v} - \frac{1}{-15} = \frac{1.5-1}{30} = \frac{1}{60}$

$\frac{1.5}{v} + \frac{1}{15} = \frac{1}{60}$

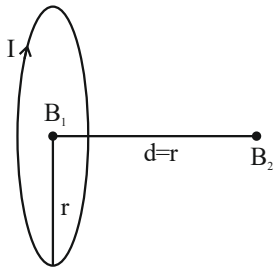
$\frac{1.5}{v} = \frac{1}{60} - \frac{1}{15} = \frac{-1}{20}$

$\frac{1.5}{v} = -\frac{1}{20} \Rightarrow v = -30cm$

60. The ratio of magnetic field at the centre of a current carrying coil of radius r to the magnetic field at distance r from the centre of coil on its axis is $\sqrt{x} : 1$. The value of x is _____

Official Ans. by NTA 8

Sol.



Magnetic field at centre $(B_1) = \frac{\mu_0 I}{2r}$

Magnetic field on axis $= \frac{\mu_0 I r^2}{2(r^2 + d^2)^{3/2}}$

Value of d = r (given)

$B_2 = \frac{\mu_0 I}{4\sqrt{2}r}$

$\frac{B_1}{B_2} = \frac{\mu_0 I}{2r} \times \frac{4\sqrt{2}r}{\mu_0 I} = \frac{2\sqrt{2}}{1} = \frac{\sqrt{8}}{1}$

x = 8

CHEMISTRY | TEST PAPER WITH SOLUTION

SECTION-A

61. Which of the following have same number of significant figures ?

(A) 0.00253

(B) 1.0003

(C) 15.0

(D) 163

Choose the correct answer from the options given below

(1) A, B and C only

(2) C and D only

(3) A, C and D only

(4) B and C only

Official Ans. by NTA (3)

Sol. All non zero digits are significant.

0.00253

Significant figures = 3(2, 5, 3)

1.0003

Zeros between non-zero digit are significant.

Thus, 1.0003 has 5 significant figures.

15.0

Significant number = 3

163

Significant number = 3

Options (3) – A, C and D

62. Which of these reactions is not a part of breakdown of ozone in stratosphere ?

(1) $\dot{Cl}O(g) + O(g) \longrightarrow \dot{Cl}(g) + O_2(g)$

(2) $\dot{Cl}(g) + O_3(g) \longrightarrow \dot{Cl}O(g) + O_2(g)$

(3) $2\ \dot{Cl}O \longrightarrow ClO_2(g) + \dot{Cl}(g)$

(4) $CF_2Cl_2(g) \xrightarrow{uv} \dot{Cl}(g) + \dot{C}F_2Cl(g)$

Official Ans. by NTA (3)

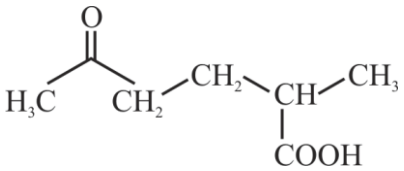
Sol. Ozone destruction

$CF_2Cl_2 \xrightarrow{hv} Cl^{\bullet} + C^{\bullet}F_2Cl(g)$

$Cl^{\bullet} + O_3 \rightarrow ClO^{\bullet} + O_2$

$ClO^{\bullet} + O^{\bullet} \rightarrow Cl^{\bullet} + O_2$

63. The correct IUPAC nomenclature for the following compound is



(1) 5–Formyl–2–methylhexanoic acid

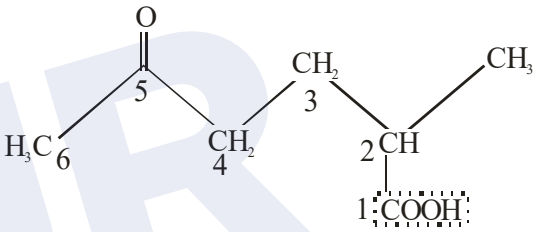
(2) 2–Methyl–5–oxohexanoic acid

(3) 2–Formyl–5–methylhexan–6–oic acid

(4) 5–Methyl–2–oxohexan–6–oic acid

Official Ans. by NTA (2)

Sol.



IUPAC NAME

2–Methyl–5–oxohexanoic acid

64. Arrange the following gases in increasing order of van der Waals constant 'a'

A. Ar

B. CH_4

C. H_2O

D. C_6H_6

Choose the correct option from the following :-

(1) B, C, D and A

(2) C, D, B and A

(3) A, B, C and D

(4) D, C, B and A

Official Ans. by NTA (3)

Sol. Vanderwaal constant – 'a'

(i) Ar = 1.34

(ii) CH_4 = 2.25

(iii) H_2O = 5.46

(iv) C_6H_6 = 18.57

'a' symbolises force of attraction and directly proportional to surface area

65. Given below are two statements :-

Statement I :- Methyl orange is a weak acid.

Statement II :- The benzenoid form of methyl orange is more intense/deeply coloured than the quinonoid form.

In the light of the above statement, choose the most appropriate answer from the options given below :-

(1) Statement I is correct but Statement II is incorrect.

(2) Statement I is incorrect but statement II is correct.

(3) Both Statement I and Statement II are incorrect.

(4) Both statement I and Statement II are correct.

Official Ans. by NTA (3)

Sol. Methyl orange is weak base .

Benzenoid structure $\rightleftharpoons$ Quinonoid structure

(yellow coloured) (Red coloured)

(more intense)

Statement I – FALSE

Statement II – FALSE

66. Given below are two statements :-

Statement I :- In redox titration, the indicators used are sensitive to change in pH of the solution.

Statement II :- In acid-base titration, the indicators used are sensitive to change in oxidation potential.

In the light of the above statements, choose the most appropriate answer from the options given below

(1) Both statement I and statement II are correct.

(2) Statement I is incorrect but Statement II is correct.

(3) Statement I is correct but Statement II is incorrect.

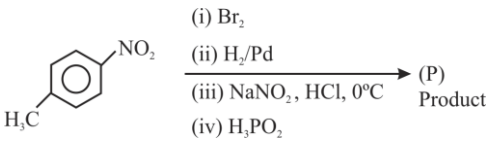
(4) Both statement I and statement II are incorrect.

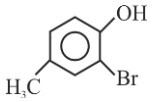
Official Ans. by NTA (4)

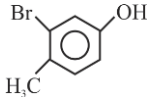
Sol. In redox titration, indicators are sensitive to oxidation potential and in acid base titration, indicators are sensitive to change in pH of solution

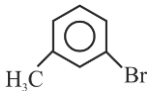
Both statement are false.

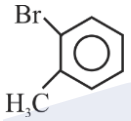
67. The product (P) formed from the following multistep reaction is :-



(1) 

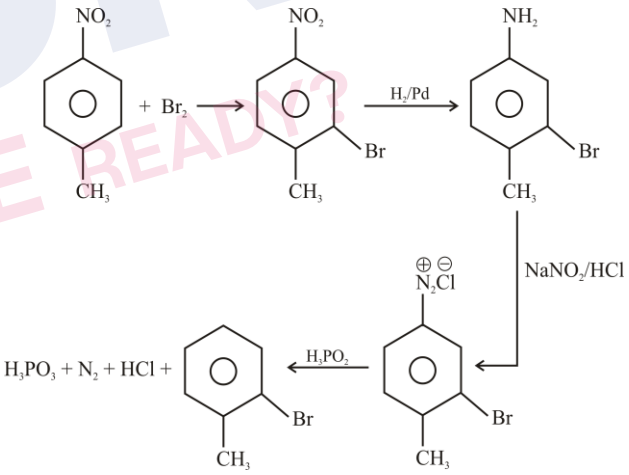
(2) 

(3) 

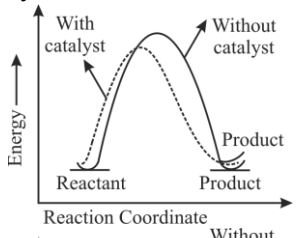
(4) 

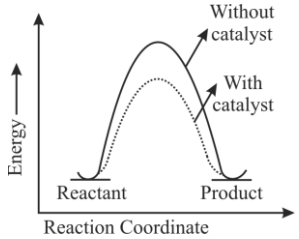
Official Ans. by NTA (4)

Sol.

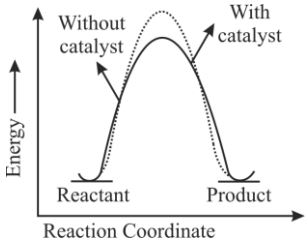


68. The correct reaction profile diagram for a positive catalyst reaction.

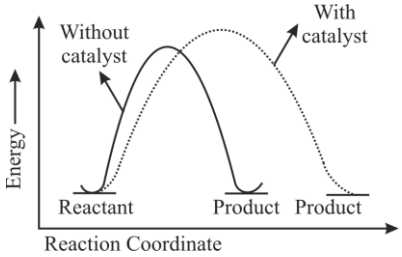
(1) 

(2) 

(3)



(4)



Official Ans. by NTA (2)

Sol. By using positive catalyst :

(i) ΔH does not change

(ii) Activation energy decreases

69. Which of the following can reduce decomposition of H_2O_2 on exposure to light

(1) Alkali

(2) Urea

(3) Dust

(4) Glass containers

Official Ans. by NTA (2)

Sol. Urea acts as a stabilizer in the decomposition of H_2O_2

70. The statement/s which are true about antagonists from the following is/are :-

A. They bind to the receptor site.

B. Get transferred inside the cell for their action.

C. Inhibit the natural communication of the body.

D. Mimic the natural messenger.

Choose the correct answer from the options given below :-

(1) B only

(2) A, C and D

(3) A and B

(4) A and C

Official Ans. by NTA (4)

Sol. Drugs that bind to the receptor site and inhibit its natural function are called antagonists

71. Match List I with List II :-

	List I Coordination Complex		List II Number of unpaired electrons
A.	$[Cr(CN)_6]^{3-}$	I.	0
B.	$[Fe(H_2O)_6]^{2+}$	II.	3
C.	$[Co(NH_3)_6]^{3+}$	III.	2
D.	$[Ni(NH_3)_6]^{2+}$	IV.	4

Choose the correct answer from the options given below :-

(1) A – II, B – IV, C – I, D – III

(2) A – IV, B – III, C – II, D – I

(3) A – III, B – IV, C – I, D – II

(4) A – II, B – I, C – IV, D – III

Official Ans. by NTA (1)

Sol. For option (A)

Cr^{+3} : $3d^3$

$CN^- \rightarrow$ SFL

$\Rightarrow$ No. of unpaired electrons = 3

For option (B)

Fe^{+2} : $3d^6$

H_2O : WFL

No. of unpaired electrons = 4

For option (C)

Co^{+3} : $3d^6$

NH_3 : SFL

No. of unpaired electrons = 0

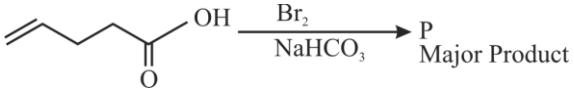
For option (D)

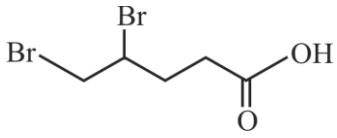
Ni^{+2} : $3d^8$

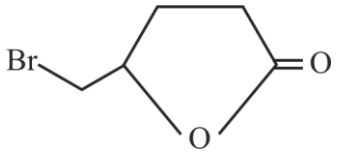
NH_3 : SFL

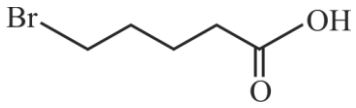
No. of unpaired electrons = 2

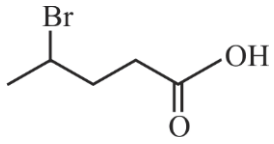
72. Major product 'P' formed in the following reaction is :-



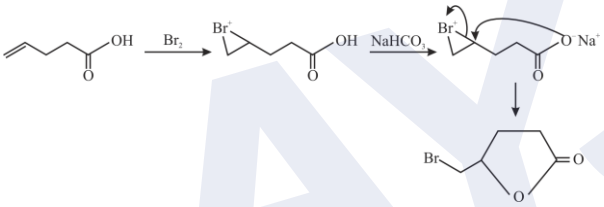
(1)


(2)


(3)


(4)


Official Ans. by NTA (2)

Sol.


73. In Hall – Heroult process, the following is used for reducing Al_2O_3 :-
(1) Graphite
(2) Magnesium
(3) Na_3AlF_6
(4) CaF_2
Official Ans. by NTA (1)

Sol. In case of Hall's process, reduction of Al_2O_3 to Al can be done using graphite.

74. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**
Assertion A :- Sodium is about 30 times as abundant as potassium in the oceans.
Reason R :- Potassium is bigger in size than sodium.
In the light of above statements, choose the correct answer from the options given below

(1) Both A and R are true and R is the correct explanation of A.
(2) A is true but R is false.
(3) A is false but R is true
(4) Both A and R are true but R is NOT the correct explanation of A.
Official Ans. by NTA (1)

Sol. Due to bigger size of potassium, it forms more efficient lattices as compared to sodium with silicates.
The abundance of sodium in ocean is more due to the more soluble nature of salt of sodium as compared to potassium salts.

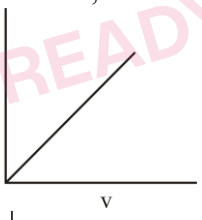
75. Math List I with List II
Choose the correct answer from the options given below :

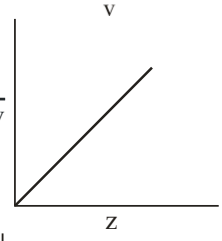
	List I Natural amino acid		**List II One letter code**
A.	Glutamic acid	I.	Q
B.	Glutamine	II.	W
C.	Tyrosine	III.	E
D.	Tryptophan	IV.	Y

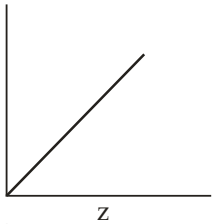
(1) A-II, B-I, C-IV, D-III
(2) A-IV, B-III, C-I, D-II
(3) A-III, B-I, C-IV, D-II
(4) A-III, B-IV, C-I, D-II
Official Ans. by NTA (3)

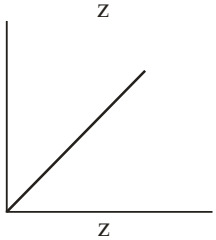
Sol. According to List I and List II option (3) is correct.

76. Henry Moseley studied characteristic X-ray spectra of elements. The graph which represents his observation correctly is : (Given v = frequency of X-ray emitted; Z = atomic number)

(1) 

(2) 

(3) 

(4) 

Official Ans. by NTA (2)

Sol. $\sqrt{v} \alpha Z$

77. The descending order of acidity for the following carboxylic acid is :

A. CH_3COOH

B. $F_3C–COOH$

C. $ClCH_2–COOH$

D. $FCH_2–COOH$

E. $BrCH_2–COOH$

Choose the correct answer from the options given below :

(1) D > B > A > E > C

(2) E > D > B > A > C

(3) B > C > D > E > A

(4) B > D > C > E > A

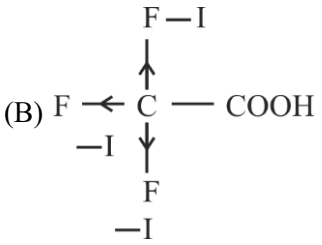
Official Ans. by NTA (4)

Sol. $\text{Acidic Strength } \alpha \frac{1}{+I \text{ effect}}$

$\boxed{\text{Acidic Strength } \alpha -I \text{ effect}}$

$\boxed{F > Cl > Br}$ –I effect order

(A) $CH_3 \rightarrow COOH$ (+I)

(B) 

$\Rightarrow$ 3, –I group

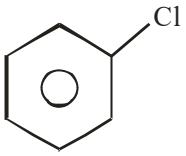
(C) $Cl \leftarrow CH_2 \rightarrow COOH$ (–I)

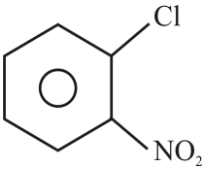
(D) $F \leftarrow CH_2 \rightarrow COOH$ (–I)

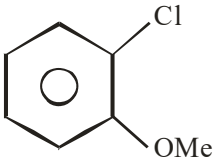
(E) $Br \leftarrow CH_2 \rightarrow COOH$ (–I)

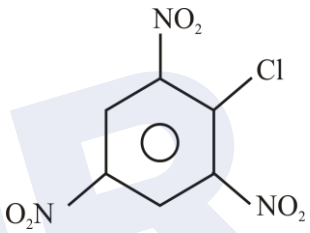
So Option (4) B > D > C > E > A

78. The correct order of reactivity of following haloarenes towards nucleophilic substitution with aqueous NaoH is :

A. 

B. 

C. 

D. 

Choose the correct answer from the options given below :

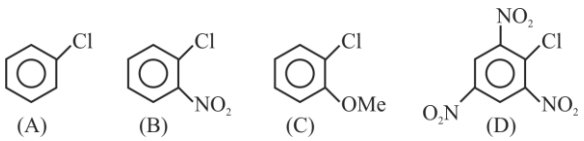
(1) A > B > D > C

(2) C > A > D > B

(3) D > C > B > A

(4) D > B > A > C

Official Ans. by NTA (4)

Sol. 

$\boxed{D > B > A > C}$

Option (4) is correct.

(– M) group increases reactivity where as (+M) group decreases reactivity of Halobenzene towards Nucleophilic substitution reaction.

79. For a good quality cement, the ratio of lime to the total of the oxides of Si, Al and Fe should be as close as to :

(1) 4

(2) 2

(3) 3

(4) 1

Official Ans. by NTA (2)

Sol. $\frac{\%\ CaO}{\%\ SiO_2 + \%Al_2O_3 + \%Fe_2O_3} = 1.9 - 2.1$

Option (2) is correct.

80. A compound 'X' when treated with phthalic anhydride in presence of concentrated H_2SO_4 yields 'Y'. 'Y' is used as an acid/base indicator. 'X' and 'Y' are respectively:

(1) Carbolic acid, Phenolphthalein

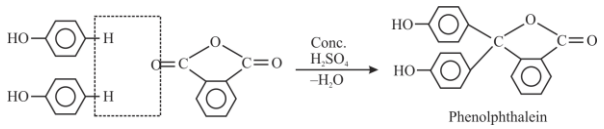
(2) Anisole, methyl orange

(3) Salicylaldehyde, Phenolphthalein

(4) Toludine, Phenolphthalein

Official Ans. by NTA (1)

Sol



Phenolphthalein

SECTION-B

81. The solubility product of $BaSO_4$ is 1×10^{-10} at 298K. The solubility of $BaSO_4$ in 0.1 M K_2SO_4(aq) solution is _____ $\times 10^{-9}$ g L^{-1} (nearest integer).

Given : Molar mass of $BaSO_4$ is 233 g mol^{-1}

Official Ans. by NTA (233)

Sol. $K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$

0.1 M 0.2M 0.1M

$BaSO_4 \rightleftharpoons Ba^{+2} + SO_4^{2-}$

a–S S S + 0.1 $\approx$ 0.1

$K_{SP} = S \times 10^{-1}$

$\Rightarrow 1 \times 10^{-10} = S \times 10^{-1}$

$\Rightarrow S = 10^{-9}$ mol L^{-1}

So, $S = 10^{-9} \times 233$ g L^{-1}

So, Answer : 233

82. Coagulating value of electrolytes $AlCl_3$ and NaCl for As_2S_3 are 0.09 and 50.04 respectively. The coagulating power of $AlCl_3$ is x times the coagulating power of NaCl. The value of x is _____:

Official Ans. by NTA (556)

Sol. $\underset{(C.V)}{\text{Coagulating Value}} \propto \frac{1}{\underset{(C.P)}{\text{Coagulating Power}}}$

$$\Rightarrow \frac{(C.V)_{AlCl_3}}{(C.V)_{NaCl}} = \frac{(C.P)_{NaCl}}{(C.P)_{AlCl_3}}$$

$$\Rightarrow \frac{0.09}{50.04} = \frac{(C.P)_{NaCl}}{(C.P)_{AlCl_3}}$$

$$\Rightarrow (C.P)_{AlCl_3} = 556(C.P)_{NaCl}$$

So, Answer = 556

83. The number of atomic orbitals from the following having 5 radial nodes is _____.

7s, 7p, 6s, 8p, 8d

Official Ans. by NTA (3)

Sol. Radial node = $n - \ell - 1$

7s $\Rightarrow$ R.N = 7 – 0 – 1 = 6

7p $\Rightarrow$ R.N = 7 – 1 – 1 = 5

6s $\Rightarrow$ R.N = 6 – 0 – 1 = 5

8p $\Rightarrow$ R.N = 8 – 1 – 1 = 6

8d $\Rightarrow$ R.N = 8 – 2 – 1 = 5

So, Answer is 3

84. For complete combustion of ethene.

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ the amount of heat produced as measured in bomb calorimeter is 1406 kJ mol^{-1} at 300K. The minimum value of $T\Delta S$ needed to reach equilibrium is (–) _____kJ. (Nearest integer)

Given : R = 8.3 JK^{-1} mol^{-1}

Official Ans. by NTA (1411)

Sol. $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(\ell)$

$\Delta U = -1406$ KJ mol^{-1}, T = 300 K

$\Delta H = \Delta U + \Delta n_g RT$

$\Delta H = -1406 + (-2) \times 8.3 \times 300 = -1406 - 4.98$

$= -1410.98$ KJ $mol^{-1} \approx -1411$

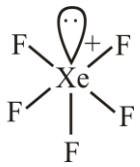
$\Delta H = T\Delta S = -1411$ KJ mol^{-1}

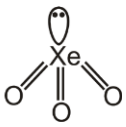
85. The number of species from the following carrying a single lone pair on central atom Xenon is ____:

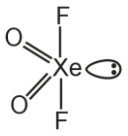
XeF_5^+, XeO_3, XeO_2F_2, XeF_5^-, XeO_3F_2, $XeOF_4$, XeF_4

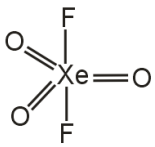
Official Ans. by NTA (4)

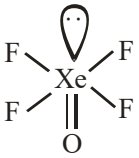
Sol.

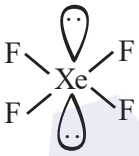
XeF_5^+ 

XeO_3 

XeO_2F_2 

XeO_3F_2 

$XeOF_4$ 

XeF_4 

So, Answer is 4

86. If the boiling points of two solvents X and Y (having same molecular weights) are in the ratio 2 : 1 and their enthalpy of vaporizations are in the ratio 1 : 2, then the boiling point elevation constant of X is m times the boiling point elevation constant of Y. The value of m is ____ (Nearest integer)

Official Ans. by NTA (8)

Sol. $\frac{(T_B)_x}{(T_B)_y}=\frac{2}{1}\quad \frac{(\Delta H)_x}{(\Delta H)_y}=\frac{1}{2}$

$$\frac{(\Delta T_B)_x}{(\Delta T_B)_y}=m=\frac{(K_B)_x\times \text{molality}}{(K_B)_y\times \text{molality}}$$

$$=\frac{(T.B)_x^2}{(T.B)_y^2}\times\frac{\Delta H_y}{(\Delta H)_x}=(2)^2\times 2=8$$

87. The sum of oxidation state of the metals in $Fe(CO)_5$, VO^{2+} and WO_3 is _____ :

Official Ans. by NTA (10)

Sol. $\overset{(0)}{Fe}(CO)_5 \quad \overset{(+4)}{V}O^{2+} \quad \overset{(+6)}{W}O_3$

So, Sum of oxidation state = 0 + 4 + 6 = 10

88. The observed magnetic moment of the complex $[Mn(\underline{N}CS)_6]^{x-}$ is 6.06 BM. The numerical value of x is _____ :

Official Ans. by NTA (4)

Sol. $[Mn(NCS)_6]^{x-}$

Number of unpaired electron = 5

So, Mn must be in +2 oxidation state (Mn^{+2})

$\Rightarrow 2 + (-6) = -x$

$\Rightarrow -4 = -x$

$\Rightarrow x = 4$

89. The number of incorrect statements from the following is _____

A. The electrical work that a reaction can perform at constant pressure and temperature is equal to the reaction Gibbs energy.

B. E^0_{cell} is dependent on the pressure

C. $\frac{dE^0cell}{dT}=\frac{\Delta_rS^0}{nF}$

D. A cell is operating reversibly if the cell potential is exactly balanced by an opposing source of potential difference.

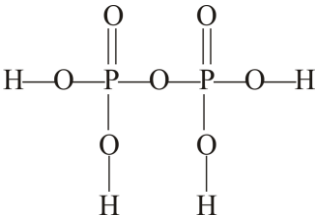
Official Ans. by NTA (1)

Sol. Option B is incorrect

So, Answer is 1

90. The ratio of sigma and π bonds present in pyrophosphoric acid is _____ :

Official Ans. by NTA (6)

Sol. 

$\frac{\sigma}{\pi}=\frac{12}{2}=6$

So, Answer is 6