ANSWERKEY

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	**1**	**4**	**4**	**1**	**1**	**3**	**1**	**2**	**2**	**1**	**1**	**1**	**2**	**3**	**1**	**1**	**4**	**3**	**4**	**4**
Q.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A.	**3**	**4**	**1**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**1**	**4**	**2**	**2**
Q.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A.	**3**	**1**	**3**	**4**	**2**	**3**	**3**	**4**	**4**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**2**	**4**	**3**	**4**
Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	**2**	**2**	**4**	**3**	**2**	**2**	**3**	**1**	**1**	**3**	**3**	**1**	**2**	**2**	**4**	**4**	**1**	**4**	**2**	**3**
Q.	81	82	83	84	85	86	87	88	89	90										
A.	**1**	**4**	**3**	**4**	**1**	**3**	**4**	**2**	**2**	**3**										

SOLUTION

1. $ax^2 + bx + 6 \le 0 \;\forall\; x \in R$ if $a < 0$

$ax^2 + bx + 6 \ge 0 \;\forall\; x \in R$ if $a > 0$

But $f(0) = 6 > 0$

$\Rightarrow f(x) = ax^2 + bx + 6 \ge, 0 \;\forall\; x \in R$

$\Rightarrow f(3) = 9a + 3b + 6 \ge 0$

$3a + b \ge -2$

2. $(x^2 + y^2)(x + y)(x - y) = 3789108$ is a even number so x, y either both are odd or both are even so LHS is always divisible by 8 but RHS is not divisible by 8 so No solution

3. $4x^2 - 2ax - 2cx + 2x + ac - b = 0$

$2x(2x - a) - c(2x - a) + 2x - b = 0$

$f(x) = (2x - a)(2x - c) + (2x - b) = 0$

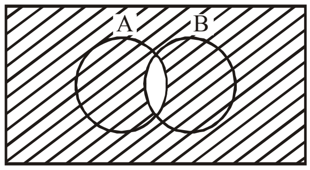
$f\left(\frac{a}{2}\right) = a - b \qquad f\left(\frac{c}{2}\right) = c - b$

$f\left(\frac{a}{2}\right)f\left(\frac{c}{2}\right) = (a-b)(c-b) < 0$

$\because (a > b > c)$

So exactly one root lie in $\left(\frac{c}{2}, \frac{a}{2}\right)$

4.



$= \cup - (A \cap B)$

$\Rightarrow \overline{(A \cap B)} = \bar{A} \cup \bar{B}$

5. $n(A \times B) = 21$

$S = {}^{21}C_{10} + {}^{21}C_{11} + \ldots\ldots\ldots\ldots + {}^{21}C_{21}$

$S = {}^{21}C_0 + {}^{21}C_1 + \ldots\ldots\ldots\ldots + {}^{21}C_{11}$

$2S = 2^{21}$

$S = 2^{20}$

7. Eq. of focal chord is $y = m(x - 4)$.......(1)

(1) is tangent to $(x - 6)^2 + y^2 = 2$

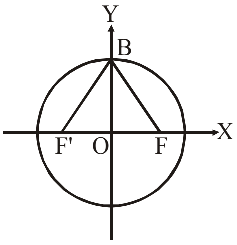
$\therefore \left|\frac{2m}{\sqrt{1+m^2}}\right| = \sqrt{2}$

$\Rightarrow 4m^2 = 2 + 2m^2$

$\Rightarrow 2m^2 = 2$

$\Rightarrow m = \pm 1.$

8. Circle is a director circle of hyperbola.

9. 

$B \equiv (0, b)$, $F \equiv (ae, 0)$, $F' \equiv (-ae, 0)$

$\angle FBF' = \dfrac{\pi}{2}$

$\Rightarrow OB = OF$

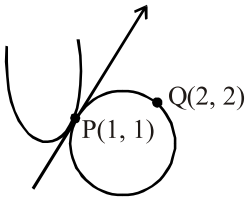
$\Rightarrow b = ae$

$\Rightarrow \dfrac{b^2}{a^2} = e^2$

$\Rightarrow 1 - e^2 = e^2$

$\Rightarrow e^2 = \dfrac{1}{2}$

$\Rightarrow e = \dfrac{1}{\sqrt{2}}$.

12. 

Eq. of tangent to parabola $y = x^2$ at $P(1, 1)$ is

$2x - y - 1 = 0$

Eq. of circle is

$(x - 1)^2 + (y - 1)^2 + \lambda(2x - y - 1) = 0$ ....(i)

Circle passes through $Q(2, 2)$

$\therefore (2 - 1)^2 + (2 - 1)^2 + \lambda(4 - 2 - 1) = 0$

$\Rightarrow \lambda = -2$

Put $\lambda = -2$ in (i)

$x^2 + y^2 - 6x + 4 = 0$

13. $A = 2 \times 4\text{cosec}^2\theta = 8\text{cosec}^2\theta$

$\Rightarrow A_{min} = 8$

14. $\tan\theta/2 = b/a$

$\Rightarrow \cos\theta/2 = \dfrac{a}{\sqrt{a^2 + b^2}}$

$\Rightarrow \cos\theta/2 = \dfrac{1}{\sqrt{1+\dfrac{b^2}{a^2}}} = \dfrac{1}{\sqrt{e^2}} = \dfrac{1}{e}$

15. Required plane is

$[r-(2\hat{i}+\hat{j}-3\hat{k})].(2\hat{i}+\hat{j}-3\hat{k})=0$

16. $\hat{a}+\hat{b}=\left(\dfrac{7i-4j-4k}{9}\right)+\left(\dfrac{2\hat{i}-\hat{j}+2\hat{k}}{3}\right)$

$=\dfrac{(7i-4j-4k)+(-6i-3j-6k)}{9} = \dfrac{i-7j+2k}{9}$

$\therefore$ Vector mag. $3\sqrt{6}=\dfrac{3\sqrt{6}(i-7j+2k)}{\sqrt{54}}$

17. $\hat{a}.\hat{b}=0$: $\hat{b}.\hat{c}=\hat{a}.\hat{c}=\dfrac{1}{2}$

therefore $[\hat{a}\ \hat{b}\ \hat{c}]^2 = \dfrac{1}{2}$

18. $\dfrac{1}{6}[\vec{a}\,\vec{b}\,\vec{c}]=3$ (Given)

$[\vec{a}\,\vec{b}\,\vec{c}]=18$

Vol. of parallelopiped= $[\vec{a}+\vec{b}\quad \vec{b}+\vec{c}\quad \vec{c}+a]$

$=2[\vec{a}\ \vec{b}\ \vec{c}] = 2 \times 18 = 36$

19. $p_1 = \vec{r}.(\hat{i}+2\hat{j}-2\hat{k}) = 3$

$\Rightarrow \quad x + 2y - 2z = 3$ ....(i)

$P_2 : 2x + 2y - 4z = 5$

$\Rightarrow \quad x + 2y - 2z = \dfrac{5}{2}$ ....(ii)

Distance between (i) & (ii) is equal to

$$\dfrac{\left|\dfrac{5}{2}-3\right|}{\sqrt{1^2+2^2+2^2}} = \dfrac{1}{6}$$

20. Statement 1 : $R_1 \to a\ R_1\ b \Leftrightarrow a + b$ is an even integer then R_1 is equivalence relation.

$R_2 \to a\ R_2\ b \Leftrightarrow a - b$ is an even integer then R_2 is equivalence relation.

$R_3 \to aR_3\ b \Leftrightarrow a < b$ then R3 is not equivalence relation.

23. $\tan 2\beta = \tan\{(\alpha + \beta) - (\alpha - \beta)\}$

$= \dfrac{\tan(\alpha+\beta)-\tan(\alpha-\beta)}{1+\tan(\alpha+\beta)\tan(\alpha-\beta)} = -\dfrac{1}{7}$

$\Rightarrow 0 < 2\beta < 90°$ $(\because \tan 2\beta > 0)$

$\therefore \cos 2\beta = \dfrac{7}{5\sqrt{2}}$

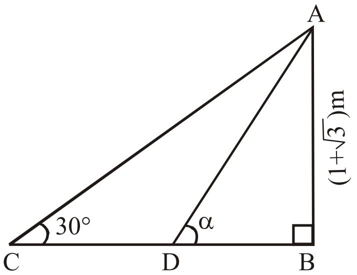
24. $4\sin^2\theta\cos^2\theta = 2(1-\sin^2\theta)$

$\Rightarrow (2\sin^2\theta - 1)\cos^2\theta = 0$

$\Rightarrow \sin^2\theta = 1/2$ or $\cos^2\theta = 0$

$\Rightarrow \theta = \pi/4$ or $\theta = \pi/2$

25. Let AB is a tower of height $(1+\sqrt{3})$ m ; BC and BD are its shadows. When the sun's elevation are 30° and α (say) respectively and CD = 2m.



$\therefore$ In triangle ABC,

$2 + BD = (1+\sqrt{3})\cot 30°$

or $\quad 2 + BD = (1+\sqrt{3})\sqrt{3}$

or $\quad BD = (\sqrt{3}+3) - 2 = \sqrt{3}+1$

Now, in triangle ABD

$\tan\alpha = \dfrac{AB}{BD} = \dfrac{1+\sqrt{3}}{\sqrt{3}+1} = 1 = \tan 45°$

$\therefore \alpha = 45°$

26. Petrol bought in first year $= \dfrac{4000}{7.50}$ litres

Petrol bought in second year $\dfrac{4000}{8}$ litres

Petrol bought in third year $= \dfrac{4000}{8.50}$ litres

Total money = Rs. 12000.

$\therefore$ Average cost per litre

$$\frac{12000}{\dfrac{4000}{7.50}+\dfrac{4000}{8}+\dfrac{4000}{8.50}} = \text{Rs. } 7.98$$

27. $N = \Sigma f_i = k[{}^nC_0 + {}^nC_1 + \ldots {}^nC_n]$

$= k(1+1)^n = k2^n$

$\Sigma f_i x_i = k[1.{}^nC_1 + 2.{}^nC_2 + \ldots n\,{}^nC_n]$

$= kn\left[1+(n-1)+\dfrac{(n-1)(n-2)}{2!}+\ldots+1\right]$

$= kn(1+1)^{n-1} = kn^{2-1}$

Thus $\bar{x} = \dfrac{1}{2^n}(n2^{n-1}) = \dfrac{n}{2}$

28. $p \to (q \to p) \equiv \sim p \vee (q \to p)$

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

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

$\equiv (\sim q) \vee T = T$

$\therefore p \to (q \to p)$ is a tautology.

Also $\quad p \to (p \vee q) \equiv \sim p \vee (p \vee q)$

$\equiv (\sim p \vee p) \vee q \equiv T \vee q = T$

$\therefore p \to (p \vee q)$ is also a tautology.

Thus, $p \to (q \to p)$ is equivalent to $p \to (p \vee q)$

29. $p \to (q \to r) \equiv \sim p \vee (q \to r)$

$\equiv \sim p \vee (\sim q \vee r)$

$\equiv [(\sim p) \vee (\sim q)] \vee r$

$\equiv \sim (p \wedge q) \vee r$

$\equiv p \wedge q \to r$

$\therefore$ given statement is a tautology.

30. $\cos\theta\cos 2\theta \ldots \cos 2^{n-1}\theta$

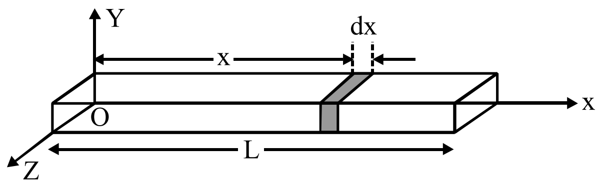
$= \dfrac{1}{2\sin\theta}\left[2\sin\theta\cos\theta\cos 2\theta \ldots \cos 2^{n-1}\theta\right]$

$= \dfrac{1}{2^n\sin\theta}\left(\sin 2^n\theta\right) = \dfrac{1}{2^n\sin\theta}\sin(\pi+\theta)$

$\dfrac{1}{2^n\sin\theta}(-\sin\theta) = -\dfrac{1}{2^n}$

So Statement-2 is true which implies statement-1 is also true.

31. As the rod is along x-axis, for all points on it y and z will be zero, so. $Y_{CM} = 0$ and $Z_{CM} = 0$



i.e., the centre of mass will lie on the rod. Now, consider an element of rod of length dx at a distance x from the origin, then

$dm = \lambda\, dx = (A + Bx)\, dx$

So, $\quad X_{CM} = \dfrac{\int_0^L x\,dm}{\int_0^L dm} = \dfrac{\int_0^L x(A+Bx)dx}{\int_0^L (A+Bx)dx}$

$= \dfrac{\dfrac{AL^2}{2}+\dfrac{BL^3}{3}}{AL+\dfrac{BL^2}{2}} = \dfrac{L(3A+2BL)}{3(2A+BL)}$

[Note : In the above problem]

(i) If the rod is of uniform density, then λ = constant = A and B = 0

Hence, $X_{CM} = L/2$

(ii) If the density of rod varies linearly with x, i.e., $\lambda = Bx$ and A = 0 then $X_{CM} = 2L/3$

32. $\vec{v}_{com} = \dfrac{m_1\vec{v}_1 + m_2\vec{v}_2}{m_1 + m_2} = \dfrac{\vec{v}_1 + \vec{v}_2}{2} = (\hat{i} + \hat{j})$ m/s

Similarly,

$$\vec{a}_{com} = \frac{\vec{a}_1 + \vec{a}_2}{2} = \frac{3}{2}(\hat{i} + \hat{j})\,m/s^2$$

Since, $\vec{v}_{com}$ is parallel to $\vec{a}_{com}$ the path will be a straight line.

33. Because the planes of two rings are mutually $\perp$ and the centres are coincident, hence an axis, which is passing through the centre of one of the rings and $\perp$ to its plane, will be along the diameter of other ring. Hence, moment of inertia of the system.

$$= I_{CM} + I_{diameter} = mr^2 + \frac{mr^2}{2} = \frac{3}{2}\,mr^2$$

34. According to theorem of perpendicular axis :

I_{EF} = MI of system about one rod as axis + MI of system about second rod as axis.

$$= \frac{ML^2}{12} + \frac{ML^2}{12} = \frac{ML^2}{6}$$

35. M = Mass of the square plate before cutting the holes Mass of one hole,

$$m = \left(\frac{M}{16R^2}\right)\pi R^2 = \frac{\pi M}{16}$$

$\therefore$ Moment of inertia of the remaining portion,

$I = I_{square} - 4I_{hole}$

$$= \frac{M}{12}\,(16R^2 + 16R^2) - 4\left[\frac{mR^2}{2} + m(2R^2)\right]$$

$$= \frac{8}{3}\,MR^2 - 10\,mR^2$$

$$= \left(\frac{8}{3} - \frac{10\pi}{16}\right)MR^2$$

36. We know that ; $\vec{L} = I\vec{\omega}$

$$\therefore \quad \frac{d\vec{L}}{dt} = I\frac{d\vec{\omega}}{dt} = I\vec{\alpha}$$

or $\dfrac{d\vec{L}}{dt} = \vec{\tau}$ $\quad (\because\ \vec{\tau} = I\vec{\alpha})$

If $\vec{\tau} = 0$, then $\dfrac{d\vec{L}}{dt} = 0$

i.e., $\vec{L}$ = constant vector

[**Note :** Angular momentum of a system (may be particle or body) remains constant if resultant torque acting on it is zero. This principle is called law of conservation of angular momentum which is just analogous to law of conservation of linear momentum in translational motion.

37. In circular motion, there are two types of accelerations which may act on the particle :

(a) centripetal acceleration $\rightarrow$ directed radially

(b) angular acceleration $\rightarrow$ directed tangentially

38. $$\frac{K_T}{K} = \frac{\frac{1}{2}mv^2}{\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2}$$

$$= \frac{\frac{1}{2}mv^2}{\frac{1}{2}mv^2 + \frac{1}{2}\times\frac{2}{5}mr^2\times v^2/r^2}$$

$$(\because\ I = \frac{2}{5}\,mr^2 \text{ and } v = r\omega)$$

$$\therefore \frac{K_T}{K} = \frac{I}{1+\frac{2}{5}} = \frac{5}{7} \quad \text{or } 5:7$$

40. $I_1\omega_1 = I_2\omega_2$

As, $I_1 > I_2$

so, $\omega_1 < \omega_2$

Hence, $\dfrac{1}{2}I_1\omega_1^2 < \dfrac{I_2\omega_2^2}{2}$

or $E_1 < E_2$

41. As the body rolls the inclined plane, it loses potential energy. However, in rolling it acquires both linear and angular speeds and hence, gain in kinetic energy of translation and that of rotation. So by conservation of mechanical energy,

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

But as in rolling, v = Rω

$$\therefore \quad Mgh = \frac{1}{2}Mv^2\left[1+\frac{I}{MR^2}\right]$$

Let $\quad 1 + \frac{I}{MR^2} = \beta$

Let $\quad Mgh = \frac{1}{2}\beta Mv^2$

Hence, $\quad v = \sqrt{\frac{2gh}{\beta}}$

42. Equation of motion,

$Mg\sin\theta - f = Ma$ ......(i)

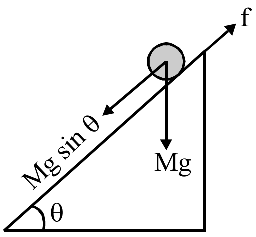
Also, $fR = t = I\alpha = Mk^2\frac{a}{R}$ ....(ii)

But $\quad a = \dfrac{g\sin\theta}{1+\frac{k^2}{R^2}}$ ......(iii)

Putting value of a in eqn. (ii)

$$f = \left(\frac{Mk^2}{R^2}\right)\frac{g\sin\theta}{1+\frac{k^2}{R^2}}$$

For cylinder :



$$Mk^2 = I = \frac{1}{2}MR^2$$

$$\therefore k^2 = \frac{1}{2}R^2$$

$$\therefore f = \frac{M\left(\frac{1}{2}\right)g\sin\theta}{\left(1+\frac{1}{2}\right)} = \frac{1}{3}Mg\sin\theta$$

In case of static friction,

$$f_s = \mu N = \mu Mg\cos\theta$$

$$\frac{1}{3}Mg\sin\theta = \mu Mg\cos\theta$$

$$\therefore \quad \mu = \frac{1}{3}\tan\theta$$

43. Using conservatioin of angular momentum

$$MR^2\omega = (M + 2m)R^2\omega'$$

$$\therefore \quad \omega' = \frac{\omega M}{M+2m}$$

44. Since Y, F and L are same for wires of same material, therefore $l \propto \frac{1}{d^2}$. It means smaller the diameter, higher will be the elongation for given load, therefore it represents the thinest wire.

45. **Given :** $\frac{\Delta V}{V} = 1\% = \frac{1}{100}$

Bulk modulus,

$$B = \frac{P}{\Delta V/V} = \frac{pV}{\Delta V}$$

or $\quad p = \frac{B\,\Delta V}{V}$

$$= 7.5 \times 10^{10} \times \frac{1}{100} = 7.5 \times 10^{8}\ Nm^{-2}$$

46. Let L be the length of wire.

If the length of a wire is doubled, the longitudinal strain will be

$$\frac{\Delta L}{L} = \frac{2L-L}{L} = \frac{L}{L} = 1$$

Young's modulus, $Y = \frac{Stress}{Strain}$

$\therefore \quad Y = Stress \quad (\because \text{strain} = 1)$

48. $$\frac{\Delta V}{V} = \frac{\Delta(\pi r^2 L)}{\pi r^2 L}$$

$$= \frac{\pi r^2\Delta L + \pi L 2r\cdot\Delta r}{\pi r^2 L}$$

$$= \frac{\Delta L}{L} + 2\cdot\frac{\Delta r}{r} \quad ......(i)$$

We know that Poisson's ratio is,

$$s = -\frac{(\Delta r/r)}{(\Delta L/L)} \text{ or } \frac{\Delta r}{r} = -\sigma\cdot\frac{\Delta L}{L}$$

Given, $\quad \frac{\Delta L}{L} = 2\times10^{-3}$

$$\therefore \quad \frac{\Delta r}{r} = -0.5\times2\times10^{-3} = -1\times10^{-3}$$

Hence, from eqn. (i),

$$\frac{\Delta V}{V} = 2\times10^{-3} - 2\times10^{-3} = 0$$

∴ % increase in volume = 0%

49. Both assertion and reason are true and reason is the correct explanation of assertion.

According to principle of conservation of angular momentum, I ω = constant

$$MK^2\left(\frac{2\pi}{T}\right) = \text{constant} \quad \text{or} \quad \frac{K^2}{T} = \text{constant}$$

(where K is radius of gyration and $w = 2\pi/T$.)

When K becomes 1/2, K^2 becomes (1/4)th. Therefore, T becomes (1/4)th of initial value,

i.e., $\frac{24}{4} = 6$ hours.

50. Both assertion and reason are true but reason is not the correct explanation of assertion.

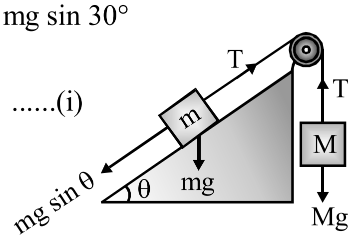
Rolling occurs only on account of friction which is a tangential force capable of providing torque when the inclined plane is perfectly smooth, it will simply slip under the effect of its own weight.

Once the perfect rolling begins, force of friction becomes zero. Hence, work done aginst friction is zero.

55. Here

$T = mg \sin\theta = mg \sin 30°$

$T = \frac{mg}{2}$ ......(i)



We know that velocity of transverse wave

$$v = \sqrt{\frac{T}{\mu}} \Rightarrow T = v^2\mu \qquad ......(ii)$$

From eq. (1) & (ii)

$$m = \frac{2v^2\mu}{g} = \frac{2\times(100)^2\times 9.8\times 10^{-3}}{9.8} = 20 \text{ kg}$$

63. NCERT Class-XI, Part-1, Page no. 221

68. In this reaction gaseous moleculer count

$MgCO_3 \rightarrow MgO_{(s)} + CO_{2(g)}$

$K_p = P_{CO_2}$.

69. NCERT XI, part 1 Page # 193.

$2AB \rightleftharpoons A_2 + B_2$

$$K_c = \frac{[A_2][B_2]}{[AB]^2}$$

For reaction $AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$

$$K_c' \frac{[A_2]^{1/2}[B_2]^{1/2}}{[AB]}; K_c' = \sqrt{K_c} = \sqrt{49} = 7$$

70. NCERT XI Part 1, Page # 204

ΔH is positive so reaction move forward by increase in temperature & value of Δn = 3 – 2 = +1 is positive so it forward with decrease in pressure.

83. Tritium is radioactive and emits low energy $\beta^{\ominus}$ particles ($t_{1/2}$ = 13.33 yrs)

केवल ट्रीटियम ही रेडियोएक्टिव होता है, जो कि $\beta^{\ominus}$ कणों का उत्सर्जन करता है। ($t_{1/2}$ = 13.33 yrs)

85. Highest hydration enthalpy which accounts for its high negative $E^{\ominus}$ value and its high reducing power.

उच्च जलयोजन एन्थैल्पी के कारण $E^{\ominus}$ (इलेक्ट्रॉड विभव) का मान बढ़ जाता है। इसलिए अपचयन सामर्थ्य भी बढ़ जाएगा।

86. $2Be(NO_3)_2 \xrightarrow{\Delta} 2BeO + 4NO_2 + O_2$

87. CrO_4^{2-}, MnO_4^{2-}, MnO_4^{3-}

88. This is due to the increasing stability of the lower species to which they are reduced.

जिस आयन का अपचयन आसानी से होता है वह अच्छा ऑक्सीकारक होता है।

89. $F^{\ominus} < O^{2-} < N^{3-}$ are isoelectronic species.

$F^{\ominus} < O^{2-} < N^{3-}$ समइलेक्ट्रॉनिक स्पीशीज है।

90. Atomic weight = 39

Element is K_{19}

परमाणु भार = 39

तत्व = K_{19}

${}_{19}K^{39} \Rightarrow A = 39$

$Z = 19$

$N = 39 - 19$

$= 20$

${}_{18}Ar^{38} \Rightarrow A = 38$

$Z = 18$

$N = 38 - 18 = 20$