

**INDIAN ASSOCIATION OF PHYSICS TEACHERS  
NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE  
(NSEJS – 2023)**

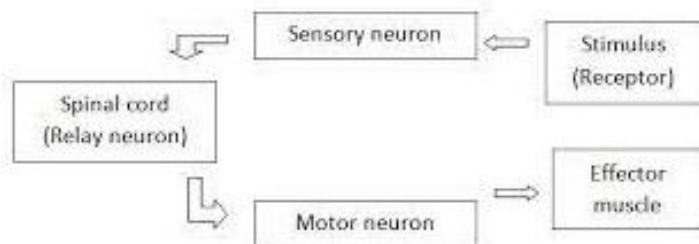
**Answer key**

1.	D	2.	A	3.	C	4.	D	5.	B
6.	D	7.	B	8.	B	9.	B	10.	C
11.	B	12.	B	13.	C	14.	B	15.	C
16.	B	17.	D	18.	A	19.	D	20.	C
21.	B	22.	B	23.	C	24.	B	25.	B
26.	D	27.	B	28.	D	29.	D	30.	D
31.	B	32.	D	33.	B	34.	C	35.	A
36.	B	37.	D	38.	D	39.	B	40.	B
41.	A	42.	C	43.	B	44.	B	45.	D
46.	C	47.	C	48.	C	49.	A, B, C	50.	B, D
51.	A, B	52.	A, B	53.	B, C	54.	A, D	55.	A, B, C
56.	A, C, D	57.	A, B, C, D	58.	A, B, C	59.	A, B, C	60.	B, C, D

## Solution

1. **D**  
 1. Mitral valve is located between the left atrium & the left ventricle.

2. **A**  
 2.



3. **C**  
 3. Pomato & brimato are the examples of cytoplasmic hybrids.

4. **D**  
 4. Trachea, vasa deferentia, epididymis contains the pseudo stratified epithelial.

5. **B**  
 5. The woman is non-taster. This means she has genotype  $tt$ . The man is a PTC taster which means his genotype could be either  $TT$  or  $Tt$ . Since, they are having a non-taster child, this means the child has  $tt$  genotype and  $t$  allele is inherited from both the parents. So, the man has to be heterozygous, *i.e.*,  $Tt$  genotype. Thus, the cross can be represented as shown in the figure.



	T	t	
t	Tt Taster	tt Non taster	
t	Tt Taster	tt Non taster	

F1

Hence, the probability that their third child will be born a nontaster = No. of children as nontaster/ Total number of children  
 $= 2/4$   
 $= 0.5$   
 So, the correct answer is '0.5'.

6. **D**  
 6. Cortisol & corticosterone are secreted from zona fasciculata & zona reticularis.

7. **B**  
 7. Presbyopia is caused by a decrease in the force of contraction of the ciliary muscle with age.

8. **B**  
8. Angoumois grain moth, *Sitotroga cerealella* moths are dirty yellow and brown with narrow pointed wings completely folded over back at rest in a slopping manner, infests paddy, or wheat.
9. **B**  
9. For forming 300 seeds we required 300 meiotic division for egg and 75 meiotic division for the pollen grain. So, 375 meiotic divisions are required to produce desired fruit.
10. **C**  
10. In Plantae, *Equisetum* has peculiar feature of Carinal canals & Vallecular canals.
11. **B**  
11. Acrocentric – A chromosome where the centromere is not central and instead located near the end of the chromosome. Humans usually have five pairs of acrocentric autosomes 13, 14, 15, 21 & 22. The Y chromosome is also acrocentric.
12. **B**  
12. The torus and margo are characteristic features of bordered pit-pairs in gymnosperms, such as Coniferales, Ginkgo, and Gnetales. In other vascular plants, the torus is rare. The pit membrane is separated into two parts: a thick impermeable torus at the center of the pit membrane, and the permeable margo surrounding it. The torus regulates the functions of the bordered pit, and the margo is a cell wall- derived porous membrane that supports the torus. The margo is composed of bundles of microfibrils that radiate from the torus.
13. **C**  
13. Diagram 1 represents – Biparaous cyme  
Diagram 3 represents – Multiparous cyme
14. **B**  
14. Growth factor gene is not essentially required for mammalian embryogenesis.
15. **C**  
15. *Aloe* belongs to CAM plant
16. **B**  
16. *Dendrophthoe falcata* is one of the hemiparasitic plant that belongs to the mistletoes family Loranthaceae. It is the most common of all the mistletoes that occur in India.
17. **D**  
17.  $(\text{Kinetic energy})_A = (\text{Kinetic energy})_B$   

$$\Rightarrow \frac{1}{2}m_A v_A^2 = \frac{1}{2}m_B v_B^2$$

$$\frac{v_A^2}{v_B^2} = \frac{m_B}{m_A}$$
Given  $m_B = 4\text{kg}$   
 $m_A = 1\text{kg}$   

$$\frac{V_A}{V_B} = \sqrt{\frac{4}{1}} = \frac{2}{1}$$

$$\Rightarrow \frac{p_A}{p_B} = \frac{m_A V_A}{m_B V_B} = \frac{1 \times 2}{4 \times 1} = \frac{1}{2}$$

$$\Rightarrow S_1 \text{ is false, } S_2 \text{ is true}$$
18. **A**  
18. Resistance (R) =  $\frac{\rho l \times l}{A \times l}$   

$$R = \frac{\rho l^2}{V}$$

(we know volume  $(V) = \frac{m(\text{mass})}{d(\text{density})}$ )

$$R = \frac{\rho l^2 d}{m}$$

$$\Rightarrow l = \sqrt{\frac{Rm}{\rho d}}$$

$$\Rightarrow l = \sqrt{\frac{0.065 \times 20.95 \times 10^{-3}}{1.7 \times 10^{-8} \times 8900}}$$

$$\Rightarrow l = \sqrt{0.009 \times 10^3}$$

$$\Rightarrow l = 3\text{m}$$

19. **D**

$$v \propto \sqrt{T}$$

$$\frac{v_{T_1}}{v_{T_2}} = \sqrt{\frac{T_1}{T_2}}$$

Given at  $T_1 = 0^\circ\text{C} = 273\text{K}$ ,  $v_{T_1} = 332\text{m/s}$

At  $T_2 = T\text{K}$ ,  $v_{T_2} = 360\text{m/s}$

$$\frac{332}{360} = \sqrt{\frac{273}{T}}$$

$T = 321\text{K}$ , So  $T = 321 - 273$

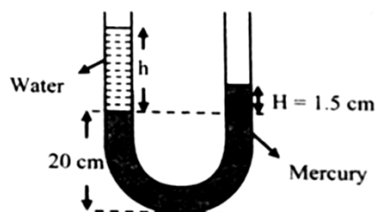
$T = 48^\circ\text{C}$

20. **C**

20. By lenz law, we know direction of induced current is such that it opposes its cause that creates it. Hence, when magnet comes closer to coil it generates field of higher magnitude in opposite direction that of magnet. Hence, magnet will slow down.

21. **B**

21.



$$\rho_w gh = \rho_{Hg} gH$$

$$h = \frac{13.6 \times 1.5}{1}$$

$$h = 20.4\text{cm}$$

22. **B**

$$x_1 x_2 = f^2$$

$$10 \times 40 = f^2$$

$$f = 20\text{cm}$$

23. **C**

23. By law of conservation of linear momentum

$$0.25 \times V = 1.25V'$$

( $V$  is velocity of bullet &  $v'$  is velocity of system after collision)

$$v' = \frac{V}{5}$$

By law of conservation of energy

$$mgh = \frac{1}{2}mv^2$$

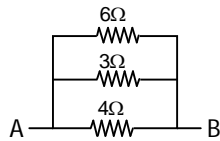
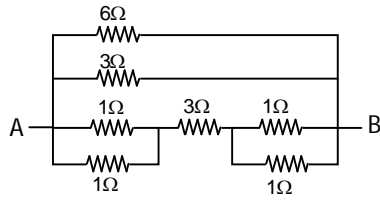
$$v^2 = 2 \times 9.8 \times \frac{19.6}{100}$$

$$v' = 1.96 \text{ m/s}$$

$$V = 5 \times 1.96 \text{ m/s}$$

$$V = 9.8 \text{ m/s}$$

24. **B**



$$\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{3} + \frac{1}{6}$$

$$R_{eq} = \frac{4}{3} \Omega$$

25. **B**

25. Let us assume weight is 800N

$$\text{Area} = 0.01 \text{ m}^2$$

Pressure is in order of  $10^4 \text{ Pa}$

26. **D**

$$26. i_1 = \frac{1}{2} \text{ A}$$

$$i_2 = \frac{3}{10} \text{ A} = 0.3 \text{ A}$$

$$i_3 = \frac{40}{200} = \frac{1}{5} \text{ A}$$

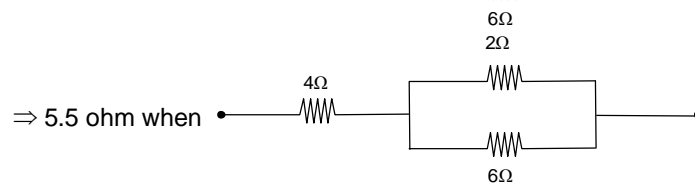
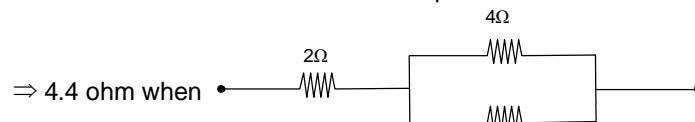
Total current = 1 A

27. **B**

27. Through out decreases (for convex mirror for a real object image will form between pole and focus. As object approach pole, image also approach pole.)

28. **D**

28.  $\Rightarrow$  Less than 2 when all resistance in parallel combination



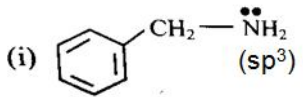
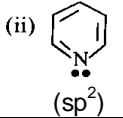
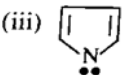
29. **D**

29. Work done by friction = change in mechanical energy

$$\begin{aligned}
 &= mg(0.3 - 0.5) \\
 F \times d \times \cos(180) &= -0.2 \text{ mg} \\
 F \times 0.8 &= 0.2 \text{ mg} \\
 F &= \frac{3 \times 10^{-3} \times 10}{4} = 7.36 \times 10^{-3} \text{ N}
 \end{aligned}$$

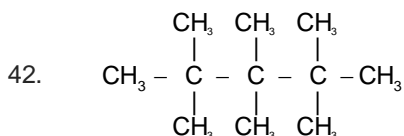
30. **D**
30.  $F_e = 0$ , because Net charge = zero  
By using right hand palm rule, magnetic force is attractive when both currents is in same direction in parallel straight wires  
 $F_e$  is zero and  $F_m$  is attractive
31. **B**
31.  $T = T$  (in degree celsius) + 273.15  
 $T = 37.3 + 273.15$   
 $T = 310.45\text{K}$
32. **D**
32. Orbital velocity  $v = \sqrt{\frac{GM_s}{R_1}}$
- $$\frac{v_{p_1}}{v_{p_2}} = \frac{\sqrt{\frac{GM_s}{R_1}}}{\sqrt{\frac{GM_s}{R_2}}}$$
- $$\frac{v_{p_1}}{v_{p_2}} = \sqrt{\frac{R_2}{R_1}} = \sqrt{\frac{10^{12}}{10^{13}}} = \frac{1}{\sqrt{10}}$$
33. **B**
33. The electron gain enthalpy of chlorine and oxygen are -349 and +702 KJ/mol respectively. Therefore, the process of formation of  $\text{Cl}^-$  and  $\text{O}^{2-}$  are exothermic and endothermic respectively.
34. **C**
34.  $\text{H}_2$  has low activation energy than  $\text{D}_2$ . Therefore,  $\text{D}_2$  has lesser rate of reaction with  $\text{Cl}_2$  as compared to  $\text{H}_2$ . This is also known as Deuterium isotope effect.
35. **A**
35. Dielectric constant and refractive index of  $\text{D}_2\text{O}$  is lower than that of  $\text{H}_2\text{O}$  and intermolecular forces are stronger in  $\text{D}_2\text{O}$ .
36. **B**
36. Potassium superoxide is used to purify the air space shuttles, submarines and breathing masks.
37. **D**
37. Each iodine has 3 lone pairs of electrons, so that, total number of lone pairs of electrons are  $3 \times 3 = 9$
- $$\left[ \begin{array}{c} \cdot\cdot & \cdot & \cdot\cdot & \cdot\cdot \\ : & \text{I} & - & \text{I} & - & \text{I} & : \\ \cdot\cdot & \cdot & \cdot\cdot & \cdot\cdot \end{array} \right]^-$$
38. **D**
38. One of the elements in all the options is known to exist naturally. So option (D) is correct
39. **B**
39. Plasma exists at very high temperature and BEC exists at very low temperature.
40. **B**
40. Bond b will break in first step.
41. **A**

41.

(i) 	Lone pair is available to donate, in addition, N is $sp^3$ hybridised, so lone pair will be more available to donate.
(ii) 	Lone pair is available to donate as it is not involved in conjugation but N is $sp^2$ hybridised, so ease of donation will be lesser than (i)
(iii) 	Lone pair is in conjugation, so not available to donate

(iii, ii, i)

42.

**C**The maximum no. of  $-\text{CH}_3$  groups (eight groups) are present in 2, 2, 3, 3, 4, 4 hexamethyl pentane.

43.

**B**

43.

Volume of bulb = 1L  
 Mass of methane gas = 4g  
 Pressure = 10 atm  
 Moles of methane =  $4/16 = 0.25$   
 Using ideal gas equation :  
 $PV = nRT$   
 $T = 10 \times 1 / 0.25 \times 0.0821 = 487.21\text{K}$

44.

**B**

44.

The pH of  $10^{-8}$  M HCl solution would be less than 7, that is approximately 6.96

45.

**D**

$$\begin{aligned}
 \text{Avg. atomic mass} &= \frac{\sum(\% \text{age abundance} \times \text{atomic mass of isotope})}{100} \\
 &= \frac{(19.8 \times 10.013) + (80.2 \times 11.009)}{100} \\
 &= 10.811
 \end{aligned}$$

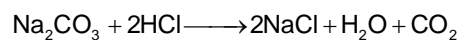
46.

**C**

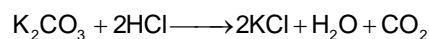
46.

$$\text{Let the mass of } \text{Na}_2\text{CO}_3 \text{ in mixture} = x \text{ g, } n_{\text{Na}_2\text{CO}_3} = \frac{x}{106}$$

$$\text{Then mass of } \text{K}_2\text{CO}_3 = (0.75 - x) \text{ g, } n_{\text{K}_2\text{CO}_3} = \frac{0.75 - x}{138}$$



$$\text{No. of moles } \frac{x}{106} \quad 2x \frac{x}{106}$$



$$\text{No. of moles } \frac{0.75 - x}{138} \quad 2x \frac{(0.75 - x)}{138}$$

$$\begin{aligned}
 \text{Total no. of moles of HCl} &= \left( 2 \times \frac{x}{106} \right) + \frac{2(0.75 - x)}{138} \\
 &= \frac{x}{53} + \frac{0.75 - x}{69}
 \end{aligned}$$

$$\text{No. of moles of HCl} = \frac{N \times V(\text{in L})}{\text{Valency factor}} = \frac{0.25 \times 50}{1 \times 1000}$$

$$\frac{x}{53} + \frac{0.75 - x}{69} = \frac{0.25 \times 50}{1000}$$

$$\Rightarrow \frac{69x + (53 \times 0.75) - 53x}{53 \times 69} = \frac{0.25 \times 50}{1000}$$

$$\Rightarrow 16x = 45.71 - 39.75 = 5.96$$

$$x = \frac{5.96}{16} = 0.372$$

$$\% \text{ of Na}_2\text{CO}_3 \text{ in mixture} = \frac{0.372\text{g}}{0.75\text{g}} \times 100 = 49.68\%$$

\* The exact answer is 49.68%

47. **C**

47. 1 Carat = 200mg

3 Carat = 200 × 3 = 600mg = 0.6g

No. Of mole = 0.6/12 = 0.05

1 moles have C atom = 6.022 × 10<sup>23</sup>

0.05 mole have C atom = 0.05 × 6.022 × 10<sup>23</sup>

= 3.011 × 10<sup>22</sup>

48. **C**

48. Ca<sup>2+</sup> and Mg<sup>2+</sup> are present in hard water and hard water form leather only with detergent. Potassium n-dodecyl benzene sulphonate is used as a detergent.

49. **A, B, C**

49. Lagomorpha - Incisors open-rooted and continue to grow throughout life.

Microchiroptera - First finger clawed, tail enclosed in an interfemoral membrane.

*Armadillo* - Toothless and polyembryony.

50. **B, D**

50. **Jukes of New York:** This was a pedigree of beggars and scoundrels. Dugdale and Estabrook Collected the history of 2094 descendents of this pedigree. Of these 299 were beggars. 378 prostitutes, 118 criminals and 86 immoral. The rest died in childhood. New York authorities had to spend about Nine million rupees on these people.

**Zero family of Switzerland:** This was also a famous pedigree of beggars and scoundrels. Starting from a characterless woman. Jorger recorded the history of this pedigree, including 800 descendents through six generations. Of these 181 were prostitutes, 120 beggars, 107 illegitimates, 80 prosecuted criminals and 54 deformed individuals. Rest had died in childhood.

51. **A, B**

51. Statoliths are specialized plastids that contain starch granules and settle downward in response to gravity.

Gravitropism is based on the redistribution of auxin in the elongation zone of the developing root. If the root is not growing vertically downward, then auxin accumulates in the lower parts of the root, inhibiting cell elongation and causing the root to bend in the direction of gravity.

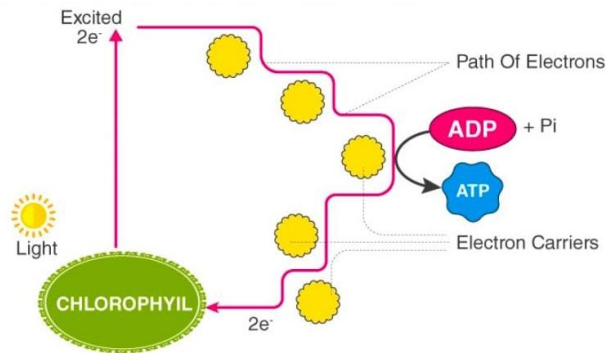
52. **A, B**

52. The photophosphorylation process which results in the movement of the electrons in a cyclic manner for synthesizing ATP molecules is called cyclic photophosphorylation.

In this process, plant cells just accomplish the ADP to ATP for immediate energy for the cells. This process usually takes place in the thylakoid membrane and uses Photosystem I and the chlorophyll P700.

During cyclic photophosphorylation, the electrons are transferred back to P700 instead of moving into the NADP from the electron acceptor. This downward movement of electrons from an acceptor to P700 results in the formation of ATP molecules.





## Cyclic Photophosphorylation

53. **B,C**

53. Work done by both the cranes =  $mgh$   
 $= 2000 \times 3 \times 10$   
 $= 6 \times 10^4 \text{ J}$

Since both the cranes do same amount of work. Thus they consume equal amount of fuel

$$\text{power of crane A} = \frac{\text{work}}{\text{time}} = \frac{6 \times 10^4}{60} = 10^3 \text{ W}$$

$$\text{Power of crane B} = \frac{6 \times 10^4}{120} = 5 \times 10^2 \text{ W}$$

$$P_A > P_B$$

54. **A,D**

54. Resistance of 100 watt bulb  $R_1 = \frac{V^2}{P} = \frac{200^2}{100} = 400 \Omega$

$$\text{Resistance of 60w bulb } R_2 = \frac{(200)^2}{60} = \frac{2000}{3} \Omega = 666.67$$

$$R_{eq} = 400 + \frac{2000}{3} = \frac{3200}{3} \Omega$$

$$I = \frac{200}{R_{eq}} = \frac{200}{3200/3} = \frac{3}{16} = 0.1875 \text{ A}$$

$$\text{current (I) rating of 100w bulb} = \frac{P}{V} = 0.5 \text{ A}$$

$$\text{current (I) rating of 60 w bulb} = \frac{P}{V} = 0.3 \text{ A}$$

$$\text{Power dissipated in both bulb} = I^2 R_{eq} = 37.5 \text{ W}$$

As 60 w bulb has greater resistance it will glow brighter

For 400 V

$$I = \frac{400}{3200/3} = 0.375 \text{ A}$$

As circuit current is greater than the current rating of 60W bulb, it will fuse and hence circuit will break.

Hence both bulb will not glow.

55. **A,B,C**

55.  $V = \frac{4}{3} \pi R^3 = \frac{4}{3} \times \pi \times \frac{1}{1000}$

$$V_{\text{water}} = \frac{60}{100} \times V$$

Let  $\rho$  be density of material of sphere

$$\rho v g = \rho_w \frac{6}{10} v g$$

$$\rho = 600 \text{ kg / m}^3$$

$$\text{Volume of displaced oil} = \frac{80}{100} \times v = \frac{8}{10} V$$

$$\rho v g = \rho_{\text{oil}} \frac{8}{10} v g$$

$$\rho_{\text{oil}} = 750 \text{ kg / m}^3$$

$$\text{Weight of sphere} = \rho v g$$

$$= 600 \times \frac{4}{3} \times \pi \times \left(\frac{10}{10}\right)^3 \times g$$

$$= 24.617 \text{ N}$$

56. **A,C,D**

56. According to Bohr's model of an atom, An electron near the nucleus is attracted more by the nucleus. This model could not explain the spectra of multi-electron atoms and this was the first atomic model based on quantization of energy

57. **A,B,C,D**

57. Ionization energy of depends on energy size of atom, shielding effect and d-effect

58. **A,B,C**

58.  $\text{CH}_3\text{COOH}$  acts as a strong acid in liquid ammonia, and sulphuric acid act as a strong acid in water as well as liquid ammonia, because  $\text{CH}_3\text{COOH}$  act as a liquid HCl

59. **A,B,C**

59. The given reaction is disproportion so in this iodine is getting oxidised as well as reduced.

60. **B,C,D**

60. Acceleration = slope of velocity time graph

$$\text{Initial acceleration } a = \frac{20}{6} = \frac{10}{3} \text{ m / s}^2$$

Displacement = Area of velocity – time graph  
= area of trapezium(OABE) + area of triangle(ECD)

$$= \frac{1}{2}(4 + 12) \times 20 - \frac{1}{2} \times 15 \times 4$$

$$= 160 - 30 = 130 \text{ m}$$

Average speed during 0 – 16 sec.

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$= \frac{160 + 30}{16} = \frac{190}{16}$$

$$= 11.88 \text{ m/sec}$$

Retardation of particle = negative slope of velocity time graph

$$= \frac{20}{2} = 10 \text{ m / s}^2$$