

Date: 26/11/2023

Max. Marks : 216

Time: 120 Minutes

Question Paper Code : 53



Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005 | Ph.: 011-47623456

Answers & Solutions

for

National Standard Examination in Junior Science (NSEJS-2023)

INSTRUCTIONS TO CANDIDATES

1. Use of mobile phone, smart watch, and iPad during examination is STRICTLY PROHIBITED.
2. In addition to this question paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the OMR Sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
Incomplete/incorrect/carelessly filled information may disqualify your candidature.
4. On the OMR Answer Sheet, use only **BLUE** or **BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **Ten-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in National Standard Examination in Junior Science-2023.
6. Question paper has two parts. In part A1 (Q. No. 1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q. No. 12 a b c d

In part A2 (Q. No. 49 to 60) each question has four alternatives out of which any number of alternative(s) (1, 2, 3 or 4) may be correct. You have to choose **all** correct alternative(s) and fill the appropriate bubble(s), as shown

Q. No. 52 a b c d

7. For **Part A1**, each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A2**, you get 6 marks if all the correct alternatives are marked and no incorrect. No negative marks in this part.
8. Rough work may be done in the space provided.
9. Use of calculator is **not** allowed.
10. No candidate should leave the examination hall before the completion of the examination.

11. After submitting answer paper, take away the question paper & Candidate's copy of the OMR for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the OMR Answer Sheet.

OMR Answer Sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE OMR ANSWER SHEET

Attempt All Sixty Questions

A-1

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.

1. In animals, heart is the main pumping station, supplying and collecting blood from various parts of the body. In mammals, which of the following structures regulates the unidirectional flow of blood and found between left auricle and ventricle?
- Tricuspid valve
 - Aortic semilunar valve
 - Pulmonary seminular valve
 - Mitral valve

Answer (d)

Sol. Mitral valve (bicuspid valve) lies between the left atrium and left ventricle of the human heart and enables the unidirectional flow of blood.

2. Which of the following refer to the units involved in most of the Reflex Arcs?
- Stimulus receptor, afferent nerve, efferent nerve and an effector neuron
 - Two receptor neurons, one or more internuncial neuron(s) and an effector neuron
 - One receptor neuron, one or more internuncial neuron(s) and an effector neuron
 - One receptor neuron, afferent nerve and an effector neuron

Answer (c)

Sol. The units involved in most of the reflex arcs are one receptor neuron, one or more internuncial neuron(s) and an effector neuron.

3. Through the process of cross-breeding/mutation breeding or cytoplasmic hybridization of animals and plants, new improved, high yielding varieties or exclusively distinct hybrids are obtained. Which of the following are cytoplasmic hybrids/cybrids?
- | | |
|--------------------------------|-----------------------|
| (a) Triticale & Fairchild Mule | (b) Tigon & Leocon |
| (c) Pomato & Bromato | (d) Jaya & Ratna Rice |

Answer (c)

Sol. A cybrid is a hybrid of cells of plants containing the genome of one species but cytoplasm of both species. Pomato is a cybrid of potato and tomato whereas bomato is a cybrid of tomato and brinjal.

4. In a kind of animal tissue all cells rest on a basement membrane, but the basal cells do not reach the free surface of the epithelium. Two layers of cells and two layers of nuclei are, therefore, observable. Thus, without being stratified, the epithelium appears to have 2 or 3 layers of cells. Such epithelia are mostly ciliated and contain mucus-secreting goblet cells. These epithelia are characteristic to which of the following?
- Thin bronchioles, Uriniferous tubules, Ciliary body
 - Bile ducts, lining of stomach, Trachea
 - Skin epidermis, Anal canal, Cornea of eye
 - Trachea, Vasa deferentia, Epididymes

Answer (d)

Sol. The given characteristics are of pseudostratified ciliated columnar epithelium which forms the lining of trachea, vasa deferentia and epididymis.

5. Phenylthiocarbamide (PTC) has a bitter taste. Non-tasting ability is reported to be due to recessive allele of the taster gene. In random populations about 30% people lack the ability to taste PTC. A non-taster woman is married to a PTC taster man and has three children. The first two children are born as non-tasters. What is the probability that their third child will be born a non-taster?
- 0.25
 - 0.50
 - 0.15
 - 0.75

Answer (b)

Sol. The inability to taste PTC is an autosomal recessive genetic disorder i.e. it occurs when the allele responsible for this trait is present in homozygous recessive condition on autosomes.

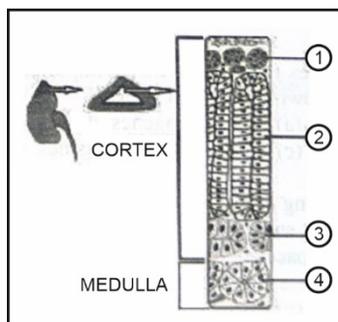
Parents: Non-taster woman \times Taster man
 tt Tt
 \downarrow \swarrow \searrow
 Gametes: t T t

	T	t
t	Tt (Taster)	tt (Non-taster)
t	Tt (Taster)	tt (Non-taster)

The children born will be non-taster only when the man is atleast carrier for the recessive allele in the given case.

The probability that child will be non-taster = 0.50 or $\frac{1}{2}$.

6. The diagram presented here is a sectional view of an endocrine gland. Its histologically characteristics layers are labeled as 1, 2, 3 and 4. Which of these is/are responsible for the secretion of C_{21} Cortisol and Corticosterone hormones?



- 1
- 1 and 3
- 2 and 4
- 2 and 3

Answer (d)

Sol. Layer 2 is zona fasciculata which secretes C_{21} cortisol and layer 3 is zona reticularis which secretes corticosterone hormone.

7. Which of the following eye defects, arises due to gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens?
- (a) Hyperopia (b) Presbyopia
(c) Astigmatism (d) Myopia

Answer (b)

Sol. Presbyopia arises due to gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens.

8. Which of the following is an Angoumois grain moth, causing severe damage to the stored grains, like paddy or wheat?
- (a) *Sitophilus* sp. (b) *Sitotroga* sp.
(c) *Gnorimoschema* sp. (d) *Plodia* sp.

Answer (b)

Sol. *Sitotroga cerealella* is the scientific name of Angoumois grain moth, which causes severe damage to the stored grains, like paddy or wheat.

9. To effect fertilization in angiosperms, pollen grains germinate on the stigma and give out pollen tubes which grow through the style and reach the ovule where the male gametes are discharged close to the egg. Suppose a brinjal plant has to produce 300 seeds in a particular fruit. How many cell divisions will be required to produce the desired fruit?
- (a) 250 Meiotic divisions (b) 375 Meiotic divisions
(c) 375 Mitotic divisions (d) 300 Mitotic and 125 Meiotic divisions

Answer (b)

Sol. In angiosperms, one megaspore mother cell undergoes meiosis to produce four megaspores, out of these, only one megaspore is functional and 300 megaspores are formed from 300 meiotic divisions. In microspore mother cell, one meiosis form four microspore so, 300 male gametes would be formed by $= \frac{300}{4} = 75$

Total meiotic divisions required to produce desired fruit = $300 + 75 = 375$.

10. In the Kingdom Plantae, which of the following examples is considered peculiar for the anatomical characters namely Carinal canals and Vallecular canals?
- (a) *Magnolia* (b) *Gnetum*
(c) *Equisetum* (d) *Lycopodium*

Answer (c)

Sol. Carinal canals and Vallecular canals are peculiar for the *Equisetum*.

11. The secondary constriction on the chromosomes always has a constant position. Therefore, it can be used as marker to identify specific chromosomes. In addition to the centromere, one or more secondary constrictions can be observed in Metaphase stage chromosomes. These chromosomes are called Satellite or SAT chromosomes. In man they are usually associated with the short arm of acrocentric chromosomes. Select the correct option for such types of chromosomes. Select the correct option for such types of chromosomes
- (a) 1, 10, 15, 16 and Y (b) 13, 14, 15, 21 and 22
(c) 13, 14, 16, 18 and 21 (d) 13, 14, 18 and 22

Answer (b)

Sol. In humans, 5 SAT chromosomes are present that are chromosome number 13, 14, 15, 21 and 22

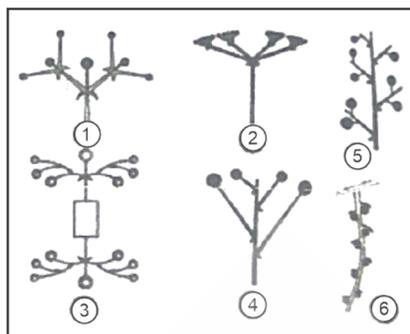
12. In some plants the secondary cell wall has depressions or pits. Adjacent pits are separated by the middle lamella and the primary cell wall, together forming the pit membrane. Which of the following is the thickening formed on the pit membrane by circular deposition of microfibrils?

- (a) Margo (b) Torus
(c) Zona occludens (d) Sclereid

Answer (b)

Sol. Torus is the thickening formed on the pit membrane by circular deposition of microfibrils.

13. The arrangement of flowers and their mode of distribution on the shoot system is characteristic to a particular plant. The diagrammatic presentation given herewith, illustrates various types of inflorescences. Select the option exemplifying a kind of Cymose type:



- (a) 2 and 4 (b) 1 and 6
(c) 1 and 3 (d) 3 and 5

Answer (c)

Sol. Arrangements 1 and 3 are showing cymose inflorescence because the main axis does not grow continuously and a flower is present terminally on the main axis.

14. Genes that are normally important in mammalian embryogenesis include members of all of the following classes, EXCEPT :

- (a) Proto-oncogenes (b) Growth factor genes
(c) Tumor suppressor genes (d) *Hox* genes

Answer (c)

Sol. Tumor suppressor gene slow down cell division or let the cells die at right time by apoptosis and these genes are not important in mammalian embryogenesis.

15. During a type of Carbon dioxide fixation occurring at night while the stomata are still open, the first step is the combination of CO_2 with phosphoenolpyruvate (PEP) to form 4-carbon oxaloacetate in the chloroplast of mesophyll cells. To which kind of ecological type of plant this process is related to?

- (a) *Cocos* (b) *Rhizophora*
(c) *Aloe* (d) *Vallisneria*

Answer (c)

Sol. Combination of carbon dioxide in night with phosphoenolpyruvate (PEP) to form 4-carbon oxaloacetate in the chloroplast of mesophyll cells is common in *Aloe*.

16. Some plants are specifically called hemiparasitic epiphytes. Included among them are the plants called as mistletoes. Which of the following is the most common hemiparasitic mistletoe occurring in India?

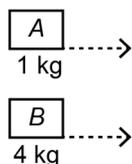
- (a) *Monotropa uniflora* (b) *Dendrophthoe falcata*
(c) *Orobanche cernua* (d) *Cuscuta reflexa*

Answer (b)

Sol. *Dendrophthoe falcata* is the most common hemiparasitic mistletoe occurring in India.

17. Two blocks A and B of masses 1 kg and 4 kg respectively are moving with equal kinetic energies.

Read the following statements S_1 and S_2



Statement S_1 : Ratio of speed of the block A to that of B is 1: 2

Statement S_2 : Ratio of magnitude of linear momentum of A to that of B is 1: 2

Now choose the correct option:

- (a) Both S_1 and S_2 are true
 (b) Both S_1 and S_2 are false
 (c) S_1 is true, S_2 is false
 (d) S_1 is false, S_2 is true

Answer (d)

Sol. $K_A = K_B$

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

$$\frac{v_A}{v_B} = \sqrt{\frac{m_B}{m_A}} = \sqrt{\frac{4}{1}}$$

$$\frac{v_A}{v_B} = \frac{2}{1}$$

$$\frac{p_A}{p_B} = \sqrt{\frac{m_A}{m_B}} = \sqrt{\frac{1}{4}} = 1:2$$

18. The mass of a straight copper wire is 20.95 g and its electrical resistance is 0.065 Ω . If the density and resistivity of copper are $d = 8900 \text{ kg/m}^3$ and $\rho = 1.7 \times 10^{-8} \text{ ohm-meter}$ respectively, the length of the copper wire is

- (a) 3 m
 (b) 6 m
 (c) 12 m
 (d) data is insufficient

Answer (a)

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

$$l = \sqrt{\frac{Rm}{\rho d}} = \sqrt{\frac{0.065 \times 0.02095}{1.7 \times 10^{-8} \times 8900}} = 3 \text{ m}$$

19. It is known that the speed of sound in a gas is directly proportional to square root of its absolute temperature T measured in Kelvin i.e. $v \propto \sqrt{T}$. Speed of sound in air at 0°C is 332 m/s. On a hot day, the speed of sound was measured 360 m/s in NCR Delhi, the temperature of air in Delhi on that very day must have been close to

- (a) 40°C
 (b) 42°C
 (c) 44°C
 (d) 48°C

Answer (d)

Sol. $\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}}$

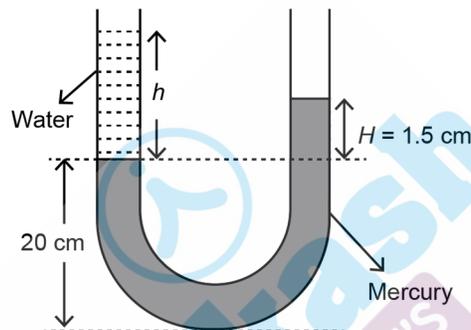
$$\Rightarrow \frac{360}{332} = \sqrt{\frac{T_2}{273}}$$

$$\Rightarrow T_2 = 48^\circ\text{C}$$

20. A small bar magnet is allowed to fall vertically through a metal ring lying in a horizontal plane. During its fall, the acceleration of the magnet in the region close to the ring must be (g is the acceleration due to gravity)
- (a) equal to g (b) less than g and uniform
(c) less than g and non-uniform (d) greater than g and uniform

Answer (c)

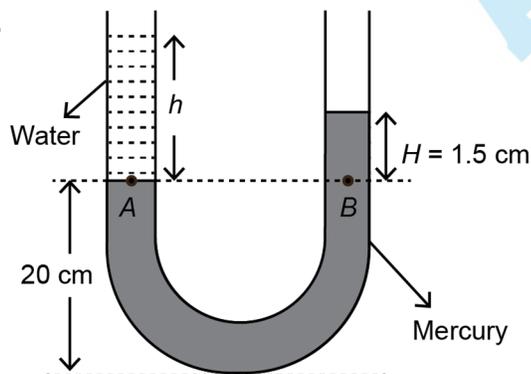
21. A U-tube of uniform cross section contains two different liquids in its limbs namely water (density $1.0 \times 10^3 \text{ kg/m}^3$) and Mercury (density $13.6 \times 10^3 \text{ kg/m}^3$) as shown in figure. The difference of height of mercury column in two limbs of the tube is $H = 1.5 \text{ cm}$. The height h of the water column in the left limb above the Mercury column must be nearly (neglect surface tension effects)



- (a) 13.6 cm (b) 20.4 cm
(c) 27.0 cm (d) 9.0 cm

Answer (b)

Sol.



$$P_A = P_B$$

$$P_0 + \rho_w gh = P_0 + \rho_m gH$$

$$h = \frac{\rho_m H}{\rho_w} = \frac{13.6 \times 10^3}{1 \times 10^3} \times 1.5$$

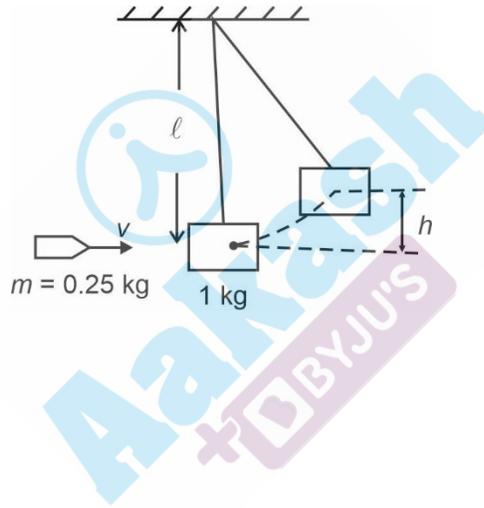
$$h = 20.4 \text{ cm}$$

22. An object pin is placed at a distance 10 cm from first focus of a thin convex lens on its principal axis, the lens forms a real and inverted image of this object pin at a distance 40 cm beyond the second focus. The focal length of the lens is
- (a) 16 cm
 (b) 20 cm
 (c) 25 cm
 (d) 40 cm

Answer (b)

Sol. $f = \sqrt{x_1 x_2} = \sqrt{10 \times 40} = 20 \text{ cm}$

23. A bullet of mass 0.25 kg moving horizontally with velocity v (m/s) strikes a stationary block of mass 1.00 kg suspended by a long inextensible string of negligible mass and length ℓ . The bullet gets embedded in the block and the system rises up to maximum height $h = 19.6 \text{ cm}$ (as shown in the figure. The string still remains taut). The value of initial speed v of the bullet is



- (a) 5.9 m/s
 (b) 7.8 m/s
 (c) 9.8 m/s
 (d) 11.8 m/s

Answer (c)

Sol. By momentum conservation

$$mv + 0 = (m + 1)v'$$

$$v' = \frac{0.25 \times v}{1.25}$$

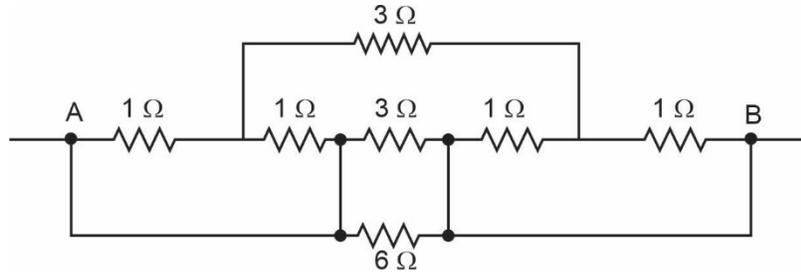
By energy conservation

$$h = \frac{v'^2}{2g} \Rightarrow \left(\frac{0.25 \times v}{1.25} \right)^2 = 2 \times 9.8 \times 19.6 \times 10^{-2}$$

$$\frac{v^2}{25} = 19.6 \times 19.6 \times 10^{-2}$$

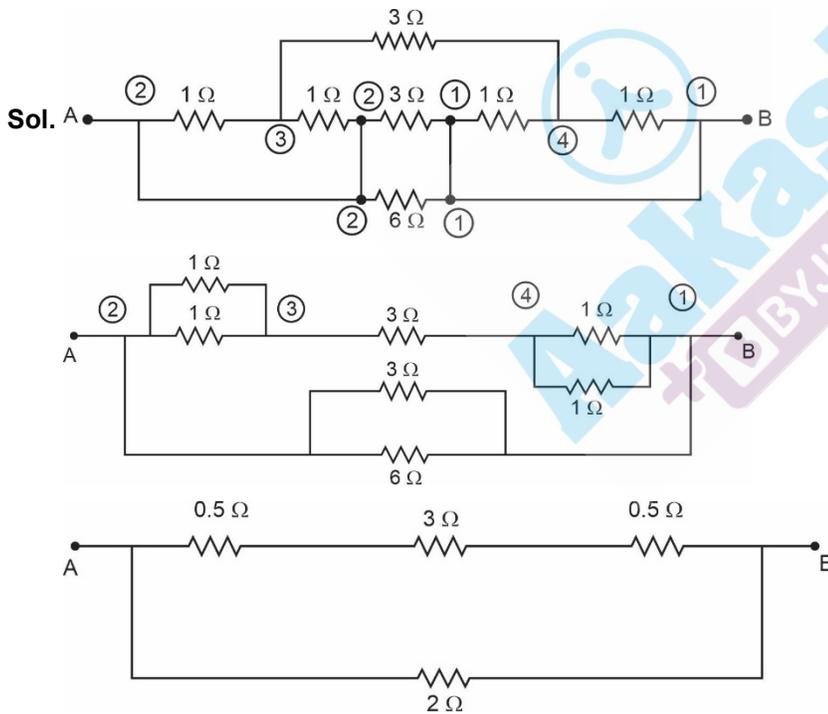
$$v = 9.8 \text{ m/s}$$

24. The equivalent resistance between points A and B in the following electrical network is



- (a) $\frac{3}{4} \Omega$
- (b) $\frac{4}{3} \Omega$
- (c) $\frac{2}{5} \Omega$
- (d) $\frac{9}{14} \Omega$

Answer (b)



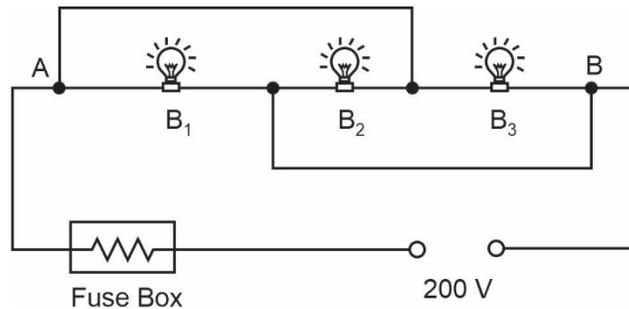
$$R_{eq} = \frac{4}{3} \Omega$$

25. The order of magnitude of the pressure (in pascal) exerted by an adult human on the Earth when he stands bare footed on the Earth on both of his legs, is

- (a) 10^2
- (b) 10^4
- (c) 10^7
- (d) 10^9

Answer (c)

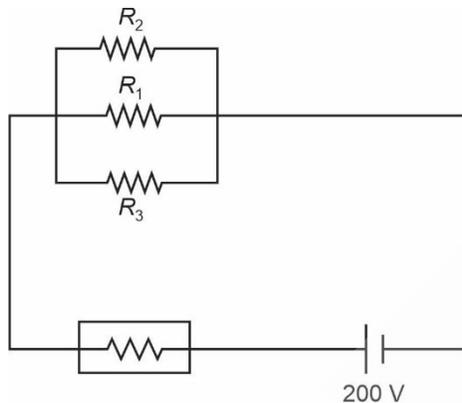
26. On the board of an experiment, three bulbs B_1 (100 W, 200 V), B_2 (60 W, 200 V) and B_3 (40 W, 200 V) are connected to a 200 V fluctuating supply with a fuse in series as shown in the figure. The electric current rating of the fuse required in the circuit to protect all the three bulbs must be



- (a) 0.2 Amp
(b) 0.3 Amp
(c) 0.5 Amp
(d) 1.0 Amp

Answer (d)

Sol.



$$P_{\text{eq}} = P_1 + P_2 + P_3$$

$$= 100 + 60 + 40$$

$$P_{\text{eq}} = 200 \text{ W}$$

$$i = \frac{P_{\text{eq}}}{V} = \frac{200}{200} = 1 \text{ Amp}$$

27. An ant is sitting on the principal axis of a convex mirror of focal length f , at a distance $2f$ from the pole in front of the mirror. It starts moving on principal axis towards the mirror. During the course of motion, the distance between the ant and its image
- (a) throughout increases
(b) throughout decreases
(c) first increases, then decreases
(d) first decreases, then increases

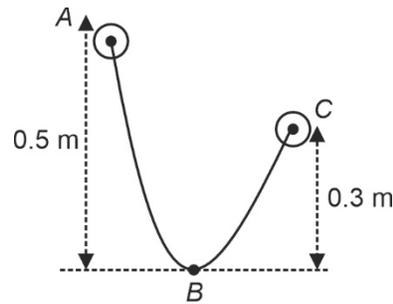
Answer (b)

Sol. Throughout decreases

28. You are given three resistance of values 2Ω , 4Ω and 6Ω . Which of the following values of equivalent resistance is not possible to get by using/arranging these three resistors in any circuit?
- (a) Less than 2Ω
(b) Equal to 4.4Ω
(c) Equal to 5.5Ω
(d) Equal to 7.6Ω

Answer (d)

29. ABC is a 0.8 meter long curved wire track in a vertical plane. A bead of mass 3 g is released from rest at A . It slides along the wire and comes to rest at C . The average frictional force opposing the motion in a single trip from A to C is



- (a) 18.40×10^{-3} N
 (b) 11.04×10^{-3} N
 (c) 29.04×10^{-3} N
 (d) 7.36×10^{-3} N

Answer (d)

Sol. $F_{\text{avg}} \times 0.8 = mg(0.5 - 0.3)$

$$F_{\text{avg}} = 3 \times 10^{-3} \times 9.8 \times \frac{0.2}{0.8}$$

$$= 7.36 \times 10^{-3} \text{ N}$$

30. Two long straight conductors 1 and 2, carrying parallel currents I_1 and I_2 in the same direction, are lying parallel and close to each other, as shown in the figure. F_e and F_m respectively represent the electric and magnetic forces, applied by conductor 1 on conductor 2.

Choose the correct alternative regarding nature of F_e and F_m



- (a) F_e is repulsive while F_m is attractive
 (b) F_e is repulsive and F_m is repulsive too
 (c) F_e is zero F_m is repulsive
 (d) F_e is zero F_m is attractive

Answer (d)

31. A doctor measures the temperature of a patient by a digital thermometer as 37.3°C . As a Physics student you will record his temperature in Kelvin as

- (a) 310.30 K
 (b) 310.45 K
 (c) 310.46 K
 (d) 310.31 K

Answer (b)

Sol. $T = 273.15 + 37.3$
 $= 310.45 \text{ K}$

32. Two planets P_1 and P_2 are moving around the Sun, in circular orbits of radii 10^{13} m and 10^{12} m respectively. The ratio of the orbital speeds of planets P_1 and P_2 in their respective orbits is

- (a) $\sqrt{10}$ (b) 10
 (c) $10\sqrt{10}$ (d) $\frac{1}{\sqrt{10}}$

Answer (d)

Sol. $v = \sqrt{\frac{GM}{R}}$

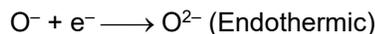
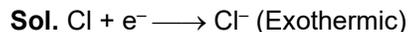
$$\frac{v_1}{v_2} = \sqrt{\frac{R_2}{R_1}} = \sqrt{\frac{10^{12}}{10^{13}}}$$

$$= \frac{1}{\sqrt{10}}$$

33. During the formation of which of the following ionic species, the process will be exothermic and endothermic respectively:

- (a) Na^+ and Cl^- (b) Cl^- and O^{2-}
 (c) He^+ and Mg^{2+} (d) F^- and Br^-

Answer (b)



34. H_2 reacts faster with Cl_2 at 13 times faster rate than D_2 because:

- (a) H_2 has high activation energy
 (b) In H_2 , H–H bond energy is higher than D–D bond energy in D_2
 (c) H_2 has low activation energy because H–H bond energy is lower than D–D bond energy
 (d) In H_2 there is no neutron therefore it reacts faster

Answer (c)

Sol. H_2 has low activation energy because H–H bond energy is lower than D–D bond energy.

35. Select the correct order of dielectric constant, refractive index and intermolecular forces for water (H_2O) and heavy water (D_2O) at 293 K respectively among those given below

- (i) Dielectric constant – $\text{H}_2\text{O} > \text{D}_2\text{O}$
 (ii) Dielectric constant – $\text{D}_2\text{O} > \text{H}_2\text{O}$
 (iii) Refractive index – $\text{H}_2\text{O} > \text{D}_2\text{O}$
 (iv) Refractive index – $\text{D}_2\text{O} > \text{H}_2\text{O}$
 (v) Intermolecular forces – $\text{H}_2\text{O} > \text{D}_2\text{O}$
 (vi) Intermolecular forces – $\text{D}_2\text{O} > \text{H}_2\text{O}$

The option containing all correct statements is

- (a) (i), (iii), (vi) (b) (i), (iv), (v)
 (c) (ii), (iii), (v) (d) (i), (iv), (vi)

Answer (a)

Properties	H ₂ O	D ₂ O
Dielectric constant (N·m ²)	78.39	78.06
Refractive index	1.333	1.328
Melting point (K)	273	276
Boiling point (K)	373	374

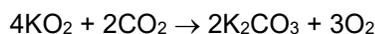
Since, melting and boiling points of D₂O are greater than H₂O, this proves that intermolecular forces of D₂O are stronger than H₂O.

36. The compound which is used to purify air in space shuttles, submarines and breathing masks is:

- (a) K₂O₂ (b) KO₂
(c) K₂O (d) Na₂O

Answer (b)

Sol. KO₂ is used because it produces oxygen by utilizing CO₂ exhaled by humans and thus we get a continuous supply of oxygen.



37. The total number of lone pairs of electrons in I₃⁻.

- (a) 3 (b) 6
(c) 2 (d) 9

Answer (d)



Total number of lone pairs present in I₃⁻ is 9.

38. Among the elements of atomic number (Z) from 1 to 92 (i.e., from H to U), the elements having atomic number....and.... are not found in nature.

- (a) 89, 92 (b) 83, 89
(c) 48, 61 (d) None of these

Answer (d)

Sol. Uranium (⁹²U), bismuth (⁸³Bi) and cadmium (⁴⁸Cd) are found in nature whereas actinium (⁸⁹Ac) and promethium (⁶¹Pm) are not found in nature.

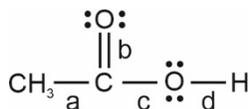
39. Which state of matter exists at very high temperature and at very low temperature (near absolute zero) respectively? BEC stands for Bose Einstein Condensate.

- (a) BEC, fermionic condensate
(b) Plasma, BEC
(c) Fermionic condensate, Plasma
(d) Gas, BEC

Answer (b)

Sol. State of matter which exist at very high temperature is plasma and the state of matter which exist at very low temperature is BEC.

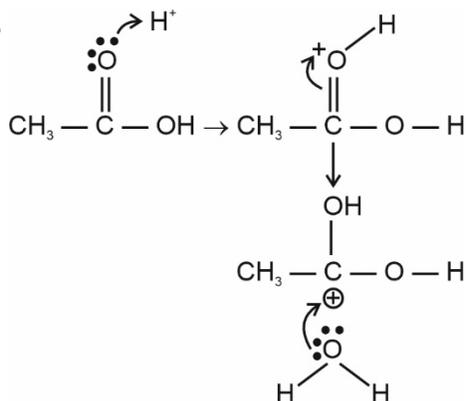
40. The bond which will break in first step when following compound reacts with H_3O^+ is



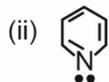
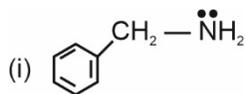
- (a) bond a (b) bond b
(c) bond c (d) bond d

Answer (b)

Sol.



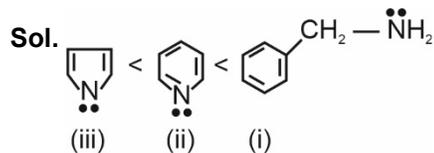
41. Arrange the following compounds in increasing order of Lewis base strength



The option containing correct increasing order is

- (a) iii, ii, i (b) i, ii, iii
(c) ii, i, iii (d) iii, i, ii

Answer (a)



In benzyl amine (i), nitrogen is sp^3 hybridised so it can donate its lone pair much easily than pyridine (ii), in which nitrogen is sp^2 hybridised.

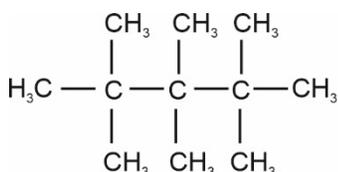
is least basic as lone pair is involved in resonance hence least available for donation.

42. The maximum number of $-\text{CH}_3$ groups which may be present in alkane $\text{C}_{11}\text{H}_{24}$ is close to

- (a) 6 (b) 7
(c) 8 (d) 2

Answer (c)

Sol. $\text{C}_{11}\text{H}_{24}$



The maximum number of methyl groups is 8.

43. A glass bulb of 1 litre capacity contains 4 g methane. The bulb is so as to burst out if the pressure exceeds just 10 atm. The temperature, at which the pressure of gas reaches the bursting point is close to (Given; $R = 0.0821$ lit atm K^{-1} mol^{-1})
- (a) 480 K (b) 487.6 K
(c) 500 K (d) 373 K

Answer (b)

Sol. $PV = nRT$

$$T = \frac{PV}{nR} = \frac{10 \times 1}{\frac{4}{16} \times 0.0821}$$

$$T = 487.21 \text{ K}$$

So, at $T = 487.21$ K, pressure will be 10 atm.

Above it, the pressure will increase and the glass bulb will burst.

44. The pH of 10^{-8} M HCl is
- (a) 7 (b) <7
(c) 8 (d) >8

Answer (b)

Sol. $[HCl] = 10^{-8}$ M, $[H^+]_{\text{water}} = 10^{-7}$ M

$$[H^+]_{\text{total}} = 10^{-8} \text{ M} + 10^{-7} \text{ M}$$

$$[H^+]_{\text{total}} = (1.1 \times 10^{-7}) \text{ M}$$

$$\text{pH} = -\log_{10}[H^+]$$

$$\text{pH} = -\log_{10}(1.1 \times 10^{-7})$$

$$\text{pH} = 7 - \log_{10}(1.1)$$

$$\text{pH} = 7 - 0.041$$

$$\text{pH} = 6.959$$

45. An element X has two natural isotopes: $^{10}_5\text{X}$ (atomic mass 10.013 u) and $^{11}_5\text{X}$ (atomic mass 11.009 u). Relative abundance of these isotopes in nature has been recorded 19.8% and 80.2 % respectively. On the basis of these data, average atomic mass of element X is close to
- (a) 10.210 u (b) 10.511 u
(c) 10.799 u (d) 10.812 u

Answer (d)

Sol. Average atomic mass = $\frac{\sum \% \text{Abundance} \times \text{Atomic mass}}{100}$

Average atomic mass of element 'X'

$$= \frac{10.013 \times 19.8 + 11.009 \times 80.2}{100}$$

$$= \frac{198.26 + 882.92}{100}$$

$$= 10.8118$$

$$= 10.812 \text{ u}$$

46. A mass 0.75 g of the mixture of Na_2CO_3 and K_2CO_3 is completely neutralized by 50 mL 0.25 N HCl. The percentage of Na_2CO_3 in the mixture is:

- (a) 50.6 (b) 49.4
(c) 50 (d) Data insufficient

Answer (b)

Sol. Let amount of Na_2CO_3 in mixture = xg

So, let amount of K_2CO_3 in mixture = (0.75 – x)g

Now, g eq. of Na_2CO_3 + g eq. of K_2CO_3 = g eq. of HCl

$$\left(\frac{x \times 2}{106}\right) + \left(\frac{(0.75 - x) \times 2}{138}\right) = \frac{50}{1000} \times 0.25$$

$$\frac{x}{53} + \frac{0.75 - x}{69} = 0.0125$$

$$69x + 39.75 - 53x = 45.71$$

$$16x = 5.96$$

$$x = 0.372 \text{ g}$$

$$\text{So, \% of } \text{Na}_2\text{CO}_3 \text{ in mixture} = \frac{0.372}{0.75} \times 100 = 49.6\%$$

47. A boy gifted a diamond ring to his mother on her wedding anniversary. If this diamond ring contains 3 carat diamond then number of carbon atoms he gifted to his mother is, Given – (1 carat = 200 mg)

- (a) 3.01×10^{23} (b) 2.1×10^{23}
(c) 3.01×10^{22} (d) 2.1×10^{22}

Answer (c)

Sol. 1 Carat = 200 mg

$$3 \text{ Carat} = 200 \times 3 = 600 \text{ mg} = 0.6 \text{ g}$$

$$\text{Moles of carbon in diamond ring} = \frac{0.6}{12} = 0.05 \text{ mole}$$

$$\begin{aligned} \text{Number of carbon atoms} &= 0.05 \times 6.022 \times 10^{23} \\ &= 3.011 \times 10^{22} \end{aligned}$$

48. Which of the following will form foam in water containing Ca^{2+} and Mg^{2+} ions?

- (a) Ba-stearate (b) Na-palmitate
(c) Potassium n-dodecyl benzene sulphonate (d) All of these

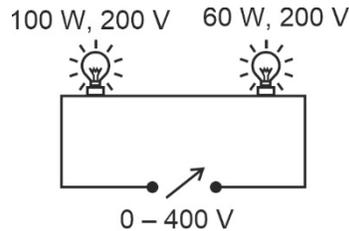
Answer (c)

Sol. Detergents will form foam with hard water (water containing Ca^{2+} and Mg^{2+} ions)

Ba-stearate and Na-palmitate are soaps

Potassium n-dodecyl benzene sulphonate is detergent

54. Two tungsten filament bulbs with rating 100 watt, 200 volt and 60 watt, 200 volt are connected in series with a variable supply of 0–400 V range, as shown. The supply voltage is gradually increased from 0 to 400 V. Choose the correct statement(s).



- (a) When supply voltage is 200 volt, 60 W bulb glows brighter
 (b) When supply voltage is 200 volt, total power dissipated in both the bulbs is greater than 37.5 W
 (c) When the supply voltage is 400 V, the 100 W bulb gets fused
 (d) When supply voltage becomes 400 V, none of the bulbs glow

Answer (a, d)

Sol. $R_1 = \frac{(200)^2}{100} = 400 \Omega$

$$R_2 = \frac{(200)^2}{60} = 666.67 \Omega$$

For, $V_s = 200 \text{ V}$: Same current is flowing

Bulb with higher resistance glows brighter.

\therefore (a) is correct

$$P_{\text{total}} = \left(\frac{200}{400 + 666.67} \right)^2 (400 + 666.67)$$

$$= \frac{(200)^2}{1066.67} = 37.5 \text{ W}$$

For, $V_s = 400 \text{ V}$

$$I = \frac{400}{1066.67} = 0.375 \text{ A}$$

$$V_1 = IR_1 = 150 \text{ V}$$

$$V_2 = IR_2 = 250 \text{ V}$$

\Rightarrow 60 W bulb gets fused. As, a result no bulb glows.

55. A solid sphere of radius $R = 10 \text{ cm}$ floats in water with 60% of its volume submerged. In an oil, this sphere floats with 80% of its volume submerged. If the density of water is 1000 kg/m^3 . The correct statement(s) is/are that
- (a) the density of the material of sphere is 600 kg/m^3
 (b) the density of the oil is 750 kg/m^3
 (c) the weight of the sphere in air is close to 24.64 N
 (d) the loss in weight of the sphere when floating in oil is close to 30.82 N

Answer (a, b, c)

Sol. $\sigma Vg = \rho_w (0.6 v)g$

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

$$\sigma Vg = \rho_{\text{oil}} (0.8 v)g$$

$$\rho_{\text{oil}} = \frac{600}{0.8} = 750 \text{ kg/m}^3$$

$$\text{Weight} = \sigma Vg$$

$$= 600 \times \frac{4}{3} \pi (10 \times 10^{-2})^3 \times 9.8$$

$$= 24.6 \text{ N}$$

56. Select the correct statement(s) pertaining to Bohr model of an atom.

- (a) An electron near the nucleus is attracted more by the nucleus; thereby has lower potential energy
- (b) An electron continuously radiates energy as long as it revolves in a discrete orbit
- (c) The model could not explain the spectra of multi-electron atoms
- (d) This is the first atomic model based on quantization of energy

Answer (a, c, d)

Sol. Electrons are believed to be revolving around the nucleus in discrete orbitals where they do not radiate energy. Absorption or emission of energy takes place when an electron jumps from one energy level to another, depending upon their respective energies.

57. The correct order(s) of first ionization energy for the following pairs is/are:

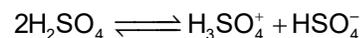
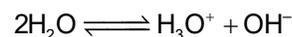
- (a) Ag < Au
- (b) Pd < Pt
- (c) Pb > Sn
- (d) Sb > Bi

Answer (a, b, c, d)

Sol. (a) First I.E of Ag < First I.E of Au due to more Z_{eff} in Au because 14 e^- of Au are filled in f-orbital

- (b) Pt has higher first I.E. due to lanthanide contraction, so first I.E of Pd < first I.E of Pt
- (c) First I.E of Pb > First I.E of Sn due to lanthanide contraction
- (d) First I.E of Sb > First I.E of Bi (Regular trend)

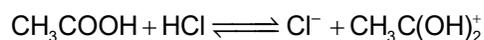
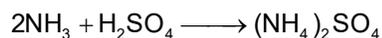
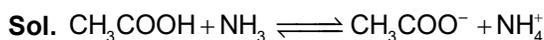
58. Every solvent undergoes self-ionization (autodissociation) and gives cations and anions. The substances which give solvent **cations** when dissolved in that particular solvent (or) increase the concentration of solvent cations are called acids. Similarly substances which give solvent **anions** when dissolved in that particular solvent (or) increase the concentration of solvent anion are called bases. Autoionisation of H_2O and H_2SO_4 are as below



- (a) CH_3COOH acts as a strong acid in liquid NH_3 solvent
- (b) H_2SO_4 acts as strong acid in H_2O and liquid NH_3 solvent
- (c) CH_3COOH acts as base in liquid HCl
- (d) H_2O acts as base in liquid NH_3 solvent

Answer (a, b, c)

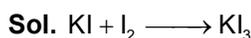
* Considering correct options are asked in question



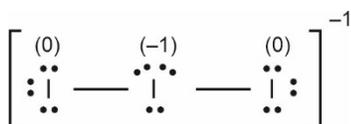
59. The reaction $\text{KI} + \text{I}_2 \rightarrow \text{KI}_3$ involves

- (a) oxidation
- (b) reduction
- (c) complex formation
- (d) neutralization

Answer (a, b, c)

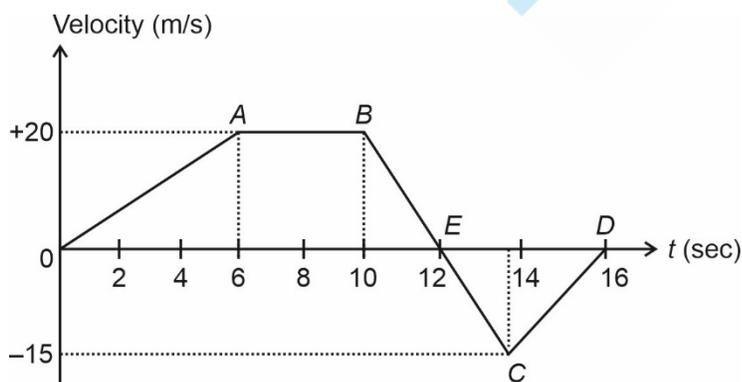


In this reaction, KI_3 is formed which contains I_3^- ion.



In KI, the oxidation state of I is (-1) which changes to (0) in KI_3 whereas in I_2 , the oxidation state of I is (0) which changes to (-1) in KI_3 . The first process describes oxidation and the second process describes reduction.

60. A particle starts moving from origin O along x axis. The velocity-time graph of motion of particle is given below. The positive values of v refer to direction of motion along $+x$ axis, the negative values of v refer to direction of motion along $-x$ direction. Choose the correct statement(s).



- (a) Initial acceleration of the particle is 4 m/s^2
- (b) The displacement of particle from origin is 130 m after 16 second
- (c) Average speed of the moving particle during 0 – 16 second is 11.88 m/s
- (d) Somewhere during the motion for 0 – 16 second, the retardation of the particle is 10 m/s^2

Answer (b, c, d)

Sol. (a) Initial acceleration

$$a = \frac{20 - 0}{6 - 0} = \frac{10}{3} \text{ m/s}^2$$

(b) Displacement = Area (*OABE*) – Area (*ECD*)

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

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

(c) Average speed = $\frac{\text{Total distance covered}}{\text{Total time taken}}$

$$= \frac{160 + 30}{16} = 11.875 \approx 11.88 \text{ m/s}$$

(d) From point *B* to *E* = $\frac{0 - 20}{12 - 10} = -10 \text{ m/s}^2$

