



INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS) 2023 – 24
Question Paper Code: 53
Held on: November 26, 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 **BLACK CAPITAL** 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 **10 – 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 A1 (Q. No 1 to 48) each question has four alternative, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No. 12 a 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 alternatives(s) and fill the appropriate bubble(s), as shown.

Q.No. 52 a c

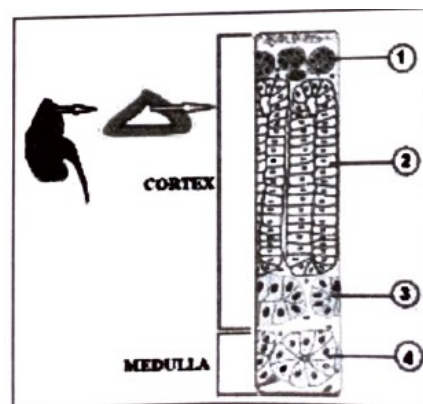
7. For **Part A1**, each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A2**, you get 6 marks if all the correct alternatives are marked. No negative marks in this part.
8. Rough work may be done in the space provided. There are **11** printed pages in this paper.
9. 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 OMR sheet for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles property 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.

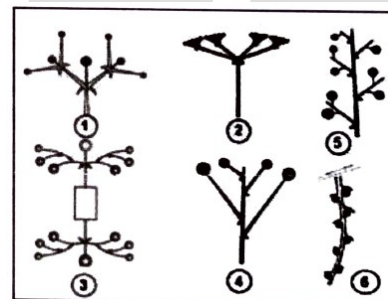
DO NOT WRITE ON THE BACK WISE OF THE OMR ANSWER SHEET.

- 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
- 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
- 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?
 - Triticale and Fairchild Mule
 - Tigon and Leocon
 - Pomato and Bromato
 - Jaya and Ratna Rice
- 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
- 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
- The diagram presented here is a sectional view of an endocrine gland. Its histologically characteristic 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



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
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
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
 (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
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 or microfibrils?
 (a) Margo (b) Torus
 (c) Zona occludens (d) Sclereid

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



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
15. During a type of Carbon dioxide fixation occurring at night while the stomata are still open, the first step is the combination of CO₂ 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
16. Some plants are specifically called hemiparasitic ephytes. 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

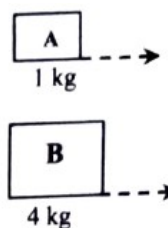
17. Two blocks A and B of masses 1 kg and 4 kg respectively are moving with equal kinetic energies.

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

18. The mass of a straight copper wire is 20.95 g and its electrical resistance is 0.065Ω . 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

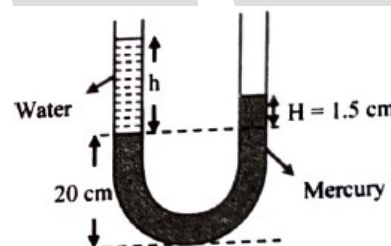
19. It is known that the speed of sound in a gas is directly proportional to square root of its absolute temperature T measured in Kelvin i.e. $v \propto \sqrt{T}$. Speed of sound in air at 0°C is 332 m/s. On a hot day, the speed of sound was measured 360 m/s in NCR Delhi, the temperature of air in Delhi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

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

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)

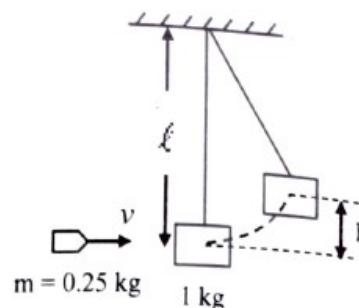


- (a) 13.6 cm
 (b) 20.4 cm
 (c) 27.0 cm
 (d) 9.0 cm

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

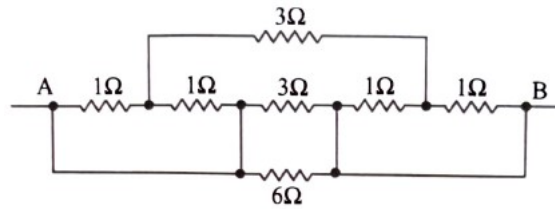
- (a) 16 cm
 (b) 20 cm
 (c) 25 cm
 (d) 40 cm

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

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

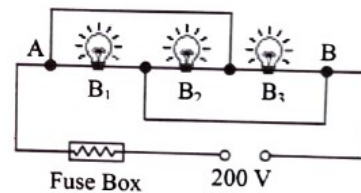


- (a) $\frac{3}{4}\Omega$ (b) $\frac{4}{3}\Omega$
 (c) $\frac{2}{5}\Omega$ (d) $\frac{9}{14}\Omega$

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) 10^2

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

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

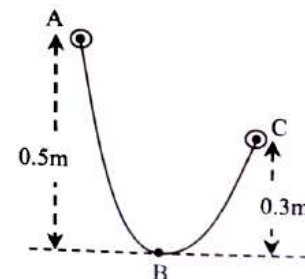
- (a) throughout increases (b) throughout decreases
 (c) first increases, then decreases (d) first decreases, then increases

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?

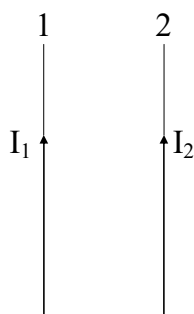
- (a) Less than 2Ω (b) Equal to 4.4Ω
 (c) Equal to 5.5Ω (d) Equal to 7.6Ω

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) $18.40 \times 10^{-3}\text{ N}$
 (b) $29.4 \times 10^{-3}\text{ N}$
 (c) $11.04 \times 10^{-3}\text{ N}$
 (d) $7.36 \times 10^{-3}\text{ N}$



30. Two long straight conductors 1 & 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 the magnetic forces, applied by conductor 1 on conductor 2.



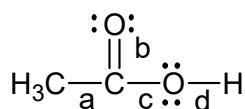
Choose the correct alternative regarding nature of F_e and F_m

- (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 and F_m is repulsive
- (d) F_e is zero and F_m is attractive

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
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) $\frac{1}{\sqrt{10}}$
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^-
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
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)
36. The compound which is used to purify air in space shuttles, submarines and breathing masks is:
- (a) K_2O_2
 - (b) KO_2

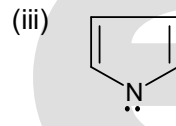
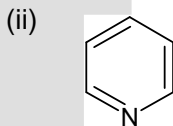
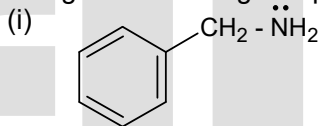
(c) K_2O (d) Na_2O

37. The total number of lone pairs of electrons in I_3^-
(a) 3 (b) 6
(c) 2 (d) 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
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
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

41. Arrange the following compounds in increasing order to 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

42. The maximum number of $-CH_3$ groups which may be present in alkane $C_{11}H_{24}$ is close to
(a) 6 (b) 7
(c) 8 (d) 2
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: $R = 0.0821 \text{ lit atm K}^{-1} \text{ mol}^{-1}$)
(a) 480 K (b) 487.6 K
(c) 500 K (d) 373 K
44. The pH of 10^{-8} M HCl is
(a) 7 (b) < 7
(c) 8 (d) > 8
45. An element X has two natural isotopes: $^{10}_5X$ (atomic mass 10.013 u) and $^{11}_5X$ (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

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
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}
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
49. In a classroom, students were taught typical mammalian characters along with the names of Orders and representative examples. In the Table given below, column I includes the names of examples or Orders whereas column 2 shows related characteristics.

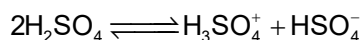
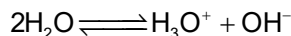
Order/representative example			Characteristics
(1)	Lagomorpha	(i)	First finger clawed, tail enclosed in an interfemoral membrane.
(2)	Microchiroptera	(ii)	Toothless and Polyembryony
(3)	Armadillo	(iii)	Baleen
(4)	Proboscidea	(iv)	Incisors open-rooted and continue to grow throughout life.

Choose the option(s) that has the correct match in the above table.

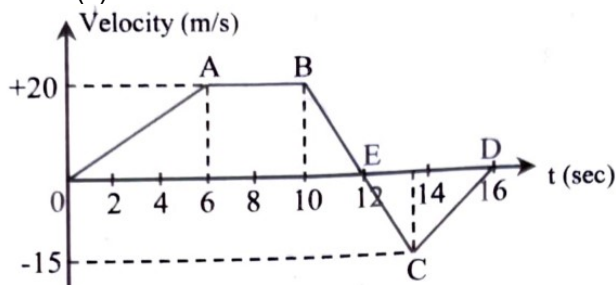
- (a) 1 → (iv) (b) 2 → (i)
 (c) 3 → (ii) (d) 4 → (iii)
50. Continuous inheritance of some characteristics in certain human families had attracted the attention of scientists. To improve human race by selective breeding led Sir Francis Galton to collect and statistically analyze genealogies or pedigrees of a number of families where some of the other traits were regularly transmitted through generations. Which of the following relate(s) to pedigree of beggars and scoundrels?
 (a) Bach family of Germany (b) Zero family of Switzerland
 (c) Kallikaks of America (d) Jukes of New York
51. An important feature of plants is the ability to adapt their growth towards or away from external stimuli such as light, water, temperature and gravity. The physiological process of root gravitropism comprises gravity perception, signal transmission, growth response and the reestablishment of normal growth. Following are some of the modern concept(s) explaining the mechanism of root gravitropism. Which of the following best explain(s) the root gravitropism?
 (a) Statoliths within columella cells of root cap sediment in the direction gravity, resulting in the generation of a signal that causes asymmetric growth.
 (b) Auxin influx and efflux carriers facilitate creation of a differential auxin gradient between the upper and lower side of gravi-stimulated roots. This causes differential growth responses in the gravi-responding tissue of the elongation zone, leading to root curvature.

- (c) Curvature in geo-stimulated roots is due the lateral redistribution of an inhibitor formed in the root cap.
- (d) Proplastids in root cap containing carotenoids and protochlorophyll respond to gravity.
52. Photosynthesis is the process in which the phosphorylation of ADP to generate ATP occurs with the help of sunlight energy. The process is known as photo-phosphorylation. Only two sources of energy are accessible to living organism: sunlight and reduction-oxidation (redox) reactions. Following are the requirements of cyclic and non-cyclic phosphorylations occurring in green plants. Choose the correct option(s) related to cycling photo-phosphorylation:
- (a) Photo system II is not involved
 (b) Only ATP molecules are generated but no NADH
 (c) Water is required
 (d) P 680 is the active reaction center
53. Crane A and crane B take 1 minute and 2 minute respectively to lift a car of mass 2 ton (2000 kg) upward through a vertical height $h = 3$ meter. If the efficiencies of the engines (defined as the ratio of work output to fuel energy input) of both the cranes are equal, your inference is that
- (a) the power supplied by crane B is 1000 kW
 (b) the crane A and the crane B consume equal amount of fuel
 (c) the power supplied by crane A is more than the power supplied by crane B
 (d) the crane A consumes more fuel in lifting the car than the crane B
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 the 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
-
55. A solid sphere of radius $R = 10$ 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
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.
57. The correct order(s) of first ionization energy for the following pairs is/are:
- (a) $\text{Ag} < \text{Au}$
 (b) $\text{Pd} < \text{Pt}$
 (c) $\text{Pb} > \text{Sn}$
 (d) $\text{Sb} > \text{Bi}$

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
59. The reaction $\text{KI} + \text{I}_2 \longrightarrow \text{KI}_3$ involves:
 (a) oxidation (b) reduction
 (c) complex formation (d) neutralization
60. A particle starts moving from origin O along x-axis. The velocity-time graph of motion of particle is given below. The positive value of v refers 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 of 0 - 16 second, the retardation of the particle is 10 m/s^2

ANSWER KEYS

- | | | | |
|----------|---------|---------|---------|
| 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. abc | 50. bd | 51. ab | 52. ab |
| 53. bc | 54. ad | 55. abc | 56. acd |
| 57. abcd | 58. abc | 59. abc | 60. bcd |

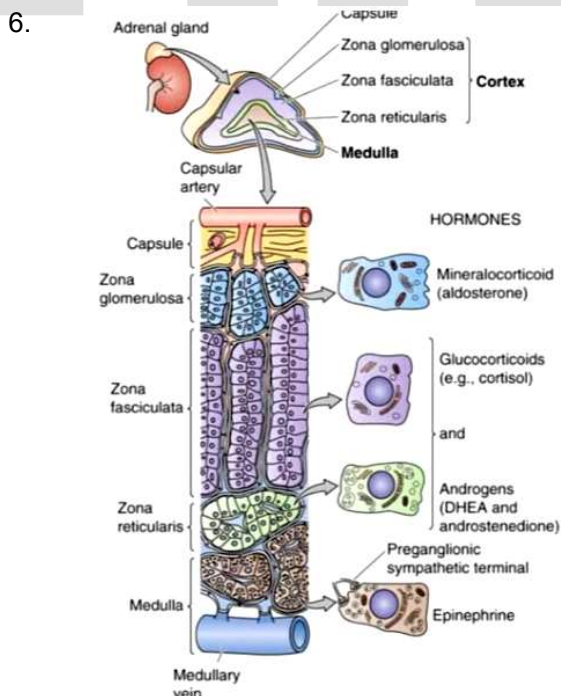
FIITJEE

Hints & Solutions

- In animals, heart is the main pumping station, supplying and collecting blood from various parts of the body. In mammals, Aortic semilunar valve regulates the unidirectional flow of blood and found between left auricle and ventricle.
1. Receptor & sensory organ
 2. Sensory neurine
 3. Relfex centre (brain or spinal cord)
 4. Motor neuron
 5. Effector
- A hybrid is a hybrid of cell or plants containing the genome of one species but cytoplasm of both species.
Pomato & Bromato are cytoplasmic hybrids/cybrids.
- These epithelia are characteristic to Trachea, Vasa deferentia, Epididymes.
- Taste blindness of PTC is a genetic trait. PTC (Phenyl Thiocarbamide) is a compound of nitrogen, carbon and sulphur with sour taste. This trait is transmitted by a dominant gene T. The genotypes TT and Tt are tasters of PTC, while tt are non tasters or taste blind persons.

In the given question, 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.

Hence the probability that their third child will be born a nontaster = Number of children as nontaster / Total number of children = $2/4 = 0.5$
So, the correct answer is 0.5



The zona reticularis produces androgens, including: Dehydroepiandrosterone (DHEA), DHEA sulfate (DHEA-S, Δ^4 -androstenedione, Cortisol, Corticosterone.

* (but the major percentage of corticosterone and cortisol are found in Zona Fasciculata (2)).

7. Presbyopia arise due to weakening of ciliary muscles & diminishing flexibility of the eye lens.
8. Sitotroga cerealella is an Angoumois grain moth, causing severe damage to stored grains, like paddy or wheat.
9. After 1 meiosis 4 pollen grains are produced to 300 pollen grains total number of divisions required = $\frac{300}{4} = 75$
To produce 300 megaspore we need 300 meiotic divisions.
Total meiotic divisions required = pollen grain + megaspore mother cell
= 70 + 300 = 375 meiotic divisions
10. The anatomy of equisetum stems is characterized by the occurrence of vallecular and carinal canals.
11. In humans SAT chromosomes are usually associated with the short arm of an acrocentric chromosome, such as in the chromosomes 13, 14, 15, 21, & 22.
12. 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.
13. 1 is biparous cyme and 3 is multiparous cyme.
So, option (c) is correct.
14. Genes that are normally important in mammalian embryogenesis include proto-oncogene, Tumor suppressor gene and HOX genes except growth factor genes.
15. Aloe plant open their stomata at night and do CAM cycle.
16. Dendrophthoe falcata is the most common hemiparasitic mistletoe occurring in India.
17. $\frac{1}{2}m_1v_1^2 = \frac{1}{2}m_2v_2^2$
 $\Rightarrow 1 \times v_1^2 = 4 \times v_2^2$
 $\Rightarrow \left(\frac{v_1}{v_2}\right)^2 = 4 \Rightarrow \frac{v_1}{v_2} = 2 : 1$
Also, $K_1 = K_2 \Rightarrow \frac{P_1^2}{2m_1} = \frac{P_2^2}{2m_2} \Rightarrow \frac{P_1^2}{2 \times 1} = \frac{P_2^2}{2 \times 4} \Rightarrow \frac{P_1^2}{P_2^2} = \frac{2}{8} = \frac{1}{4}$
 $\Rightarrow P_1 : P_2 = 1 : 2$
18. $R = \rho \frac{\ell}{A} = \rho \times \frac{\ell \times \ell}{A \times \ell}$
 $R = \frac{\rho \ell^2}{V}$
 $\Rightarrow \ell = \sqrt{\frac{RV}{\rho}} = \sqrt{\frac{0.065 \times M}{1.7 \times 10^{-8} \times d}} \left[V = \frac{M}{d} \right]$
 $\Rightarrow \ell = \sqrt{\frac{0.065 \times 20.95 \times 10^{-3}}{1.7 \times 10^{-8} \times 8900}} = \sqrt{9} = 3\text{m}$
19. $v \propto \sqrt{T}$

$$\Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}} \Rightarrow \frac{332}{360} = \sqrt{\frac{0+273}{T+273}} \Rightarrow (0.922)^2 = \frac{273}{T+273}$$

$$\Rightarrow 0.85(T+273) = 273$$

$$\Rightarrow 0.85T = 273 - 232 \Rightarrow T = \frac{41}{0.85} = 48.2 \approx 48^\circ\text{C}$$

20. When magnet falls through ring, flux increases and induced field directs in opposite direction of bar magnet. The magnet suffers repulsion, so acceleration is less than 'g'.

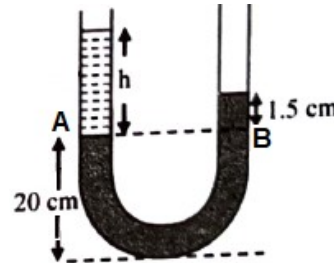
21. Pressure at A = pressure at B

$$\Rightarrow \rho_w \times h \times g = \rho_{Hg} \times 1.5 \times 10^{-2} \times g$$

$$\Rightarrow 1 \times 10^3 \times h = 13.6 \times 10^3 \times 1.5 \times 10^{-2}$$

$$\Rightarrow h = 20.4 \times 10^{-2} \text{ m}$$

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



22. $u = \text{object distance} = -(f + 10) \text{ cm}$
 $v = \text{image distance} = +(f + 40) \text{ cm}$
 focal length = f

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f+40} - \left(\frac{-1}{f+10} \right) = \frac{1}{f} \Rightarrow \frac{1}{f+40} + \frac{1}{f+10} = \frac{1}{f}$$

$$\Rightarrow \frac{f+10+f+40}{(f+40)(f+10)} = \frac{1}{f}$$

$$\Rightarrow (2f+50)f = f^2 + 40f + 10f + 400$$

$$\Rightarrow 2f^2 + 50f = f^2 + 50f + 400$$

$$\Rightarrow f^2 = 400 \Rightarrow f = 20 \text{ cm}$$

23. $m = 0.25 \text{ kg}$, velocity v
 $M = 1 \text{ kg}$, velocity = 0, $h = 19.6 \text{ cm} = 19.6 \times 10^{-2} \text{ m}$
 Let v_1 = combined speed of bullet + block after collision
 By conservation of momentum,

$$mv + M \times 0 = (m + M)v_1$$

$$\Rightarrow 0.25v = 1.25v_1 \Rightarrow v_1 = \frac{0.25v}{1.25} = \frac{v}{5}$$

Now, by conservation of energy,

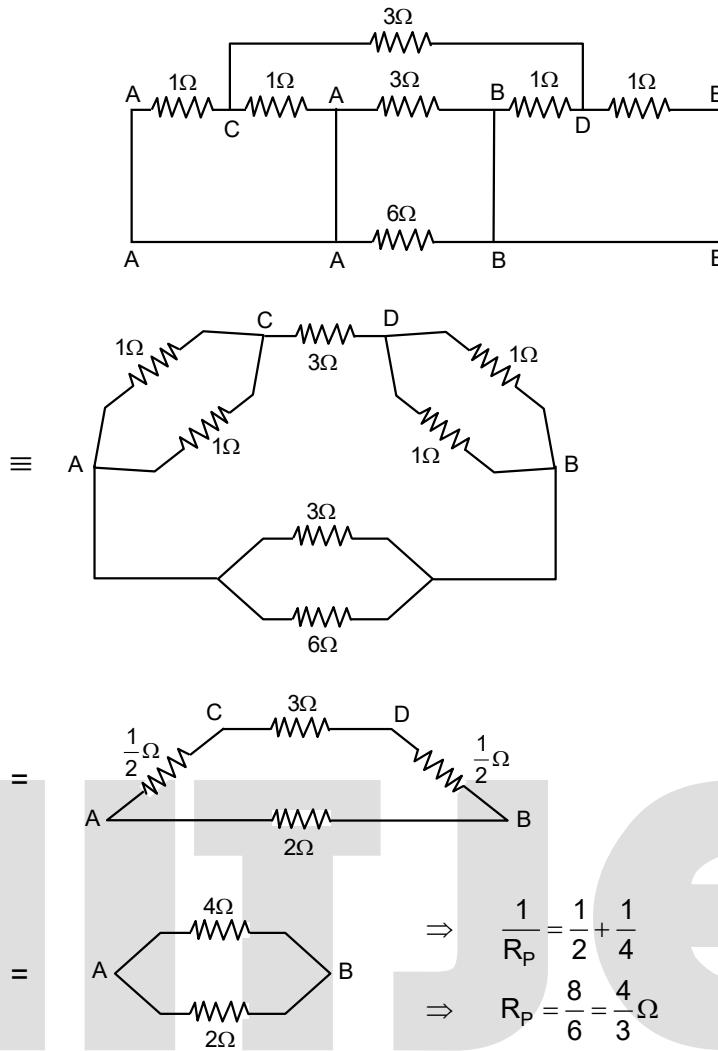
$$\frac{1}{2}(m + M)v_1^2 = (M + m)gh$$

$$\Rightarrow \frac{1}{2} \times \left(\frac{v}{5} \right)^2 = 9.8 \times 19.6 \times 10^{-2}$$

$$\Rightarrow v^2 = 50 \times 9.8 \times 19.6 \times 10^{-2} = 96.04$$

$$\Rightarrow v = \sqrt{96.04} = 9.8 \text{ m/sec}$$

24.



25. $P = \frac{\text{Force}}{\text{Area}} = \frac{mg}{A}$

26. B_1, B_2 and B_3 are in parallel
 We know, $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$

For $B_1, R_1 = \frac{V^2}{P_1} = \frac{(200)^2}{100} = \frac{K}{100}$ [Let $K = (200)^2$]

For $B_2, R_2 = \frac{V^2}{P_2} = \frac{(200)^2}{60} = \frac{K}{60}$

For $B_3, R_3 = \frac{V^2}{P_3} = \frac{(200)^2}{40} = \frac{K}{40}$

Equivalent resistance, $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{100}{K} + \frac{60}{K} + \frac{40}{K} = \frac{200}{K}$

$\Rightarrow R_p = \frac{K}{200} = \frac{(200)^2}{200} = 200\Omega$

$I = \frac{V}{R_p} = \frac{200}{200} = 1A$

27. The image forms between pole and focus. As ant moves close to mirror, image also moves closer to pole.
So, distance between ant and its image throughout decreases.

28. Maximum value by three resistors, when these are in series.

$$R_s = 2 + 4 + 6 = 12 \Omega$$

Minimum value by three resistors, when these are in parallel.

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6} = \frac{6+3+2}{12} = \frac{11}{12}$$

$$\Rightarrow R_p = \frac{12}{11} = 1.09 \Omega$$

When 6 and 4 in parallel, 2 in series, equivalent = 4.4 Ω

When 6 and 2 in parallel, 4 in series, equivalent = 5.5 Ω

So, answer is 7.6 Ω

29. Total initial energy + work done by friction = Total final energy

$$\Rightarrow mgh_1 - f \times s = mgh_2$$

$$\Rightarrow mg \times 0.5 - f \times 0.8 = mg \times 0.3$$

$$\Rightarrow 3 \times 10^{-3} \times 9.8 \times 0.5 - 3 \times 10^{-3} \times 9.8 \times 0.3 = 0.8 f$$

$$\Rightarrow \frac{3 \times 10^{-3} \times 9.8 \times 0.2}{0.8} = 7.36 \times 10^{-3} \text{ N}$$

$$\left[\begin{array}{l} h_1 = \text{initial height} = 0.5 \text{ m} \\ s = 0.8 \text{ m} \\ h_2 = \text{final height} = 0.3 \text{ m} \end{array} \right.$$

30. Magnetic field on wire 2 is into the plane due to wire 1.

$$F_2 = I(\vec{l} \times \vec{B}) \text{ is force on wire 2 and is towards left.}$$

Similarly, force on wire 1 is towards right.

So, magnetic force F_m is attractive.

There is no electric force between current carrying wires.

31. In $^{\circ}\text{C}$, $T = 37.3^{\circ}\text{C}$

$$\text{In Kelvin, } T = 273.15 + 37.3$$

$$= 310.45 \text{ K}$$

32. $r_1 = 10^{13} \text{ m}$ and $r_2 = 10^{12} \text{ m}$

$$\text{Orbital speed is given as, } v_o = \sqrt{\frac{GM}{r}}$$

$$\text{For planets } P_1 \text{ and } P_2, \frac{v_1}{v_2} = \frac{\sqrt{\frac{GM}{r_1}}}{\sqrt{\frac{GM}{r_2}}} = \sqrt{\frac{r_2}{r_1}} = \sqrt{\frac{10^{12}}{10^{13}}}$$

$$\Rightarrow \frac{v_1}{v_2} = \frac{1}{\sqrt{10}}$$

33. Formation of chloride ion is exothermic [$\Delta H_{eq} = -ve$] whereas second electron gain enthalpy of oxygen is positive and hence process will be endothermic in nature.

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

35. Dielectric constant of water (H_2O) = 78.39

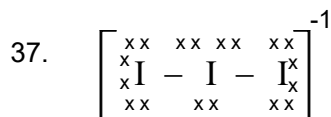
Dielectric constant of heavy water (D_2O) = 78.06

Refractive index of H_2O = 1.33 at 293 K

Refractive index of D_2O = 1.328 at 293 K

Intermolecular forces of D₂O is more than intermolecular forces of water

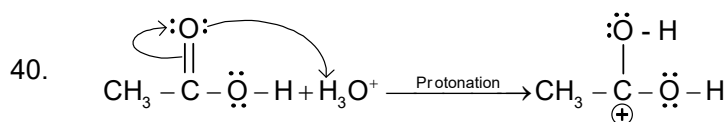
36. KO₂ is used to purify air in space shuttles, submarines and breathing masks.



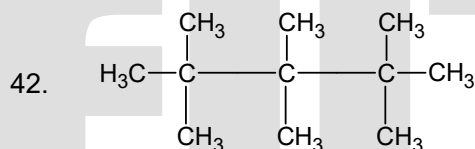
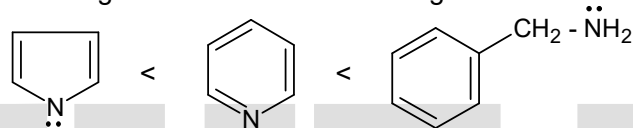
Total number of lone pairs of electrons in I₃⁻ is 9.

38. None of these

39. Plasma state of matter exists at very high temperature and BEC state of matter exists at very low temperature.



41. Increasing order of Lewis base strength



43. PV = nRT

$$10 \text{ atm} \times 1 \text{ litre} = \frac{4}{16} \times 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1} \times T$$

$$T = 487.2 \text{ K}$$

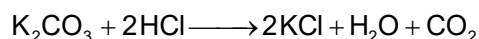
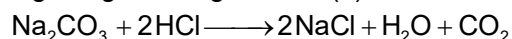
∴ Closest temperature at which pressure of gas reaches the bursting point is 487.6 K.

44. pH of 10⁻⁸ M HCl is less than 7.

$$10.013 \times \frac{19.8}{100} + 11.009 \times \frac{80.2}{100} = 10.812 \text{ u}$$

46. Na₂CO₃ + K₂CO₃

$$a \text{ g} + b \text{ g} = 0.75 \text{ g} \quad \text{--- (1)}$$



$$m_{\text{eq}} \text{ of HCl} = m_{\text{eq}} \text{ of Na}_2\text{CO}_3 + m_{\text{eq}} \text{ of K}_2\text{CO}_3$$

$$\frac{50 \times 0.25}{1000} = \frac{a}{106} \times 2 + \frac{b}{138} \times 2 \quad \text{--- (2)}$$

From (1) & (2)

$$a = 0.3726 \text{ g}$$

$$\therefore \text{Percentage of Na}_2\text{CO}_3 = \frac{0.3726}{0.75} \times 100 = 49.68 \approx 50$$

47. 1 carat = 200 mg
3 carat = 600 mg

$$= \frac{600 \times 10^{-3}}{12} \times 6.022 \times 10^{23} = 3.01 \times 10^{22} \text{ atoms}$$
48. Potassium n-dodecyl benzene sulphate will form foam in water containing Ca^{2+} and Mg^{2+} ion.
49. A characteristic of lagomorphs is the presence of four upper incisors. There is a second set of small incisors or 'peg teeth' situated just behind the large upper primary incisors. All lagomorph teeth are open rooted (elodont) and, in healthy animals, grow continually throughout life.
 Microchiroptera – have first finger clawed, tail enclosed in an interfemoral membrane.
 Armadillo are toothless and exhibit polyembryony
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.
 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.
 Armadillo are toothless and exhibit polyembryony.
51. The statements which explain the root gravitations are gravitropism:
 - Statoliths within columella cells of root cap sediment in the direction of gravity, resulting in the generation of a signal that causes asymmetric growth.
 - Auxin influx and efflux carriers facilitate creation of a differential auxin gradient between the upper and lower side of gravi-stimulated roots. This causes differential growth.
52. Choose the correct option(s) related to cyclic photo-phosphorylation:
 - Photo system II is not involved
 - Only ATP molecules are generated but no NADH
53. **For crane A**
 $t_1 = 1 \text{ min} = 60 \text{ sec}$
 $m = 2000 \text{ kg}$

$$P_1 = \frac{mgh}{t_1}$$
For crane B
 $t_2 = 2 \text{ min} = 120 \text{ sec}$

$$P_2 = \frac{mgh}{t_2}$$
 Since, $t_1 < t_2$
 So, $P_1 > P_2$
 Energy used by both are same. So, they will consume equal amount of fuel.
54. First bulb (100 W), $P_1 = 100 \text{ W}$, $V_1 = 200 \text{ V}$

$$R_1 = \frac{V_1^2}{P_1} = \frac{(200)^2}{100} = \frac{200 \times 200}{100} \left[\text{As } P = \frac{V^2}{R} \right]$$

$$= 400 \Omega$$
 Second bulb (60 W), $P_2 = 60 \text{ W}$, $V_2 = 200 \text{ V}$

$$R_2 = \frac{V_2^2}{P_2} = \frac{(200)^2}{60} = \frac{200 \times 200}{60} = \frac{2000}{3} \Omega$$

$$i = 400 \div \left(400 + \frac{2000}{3} \right) = 400 \times \frac{3}{3200} = \frac{3}{8} \text{ A}$$

$$V_{400\Omega} = 400 \times \frac{3}{8} = 150 \text{ V}$$

In series less power rating has higher resistance will glow brighter.

$$P_{\text{resultant}} = \frac{P_1 P_2}{P_1 + P_2}$$

55. $F_B = \rho v g$

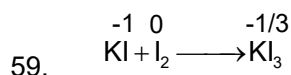
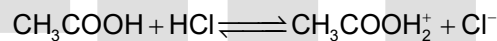
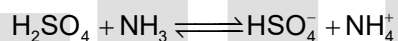
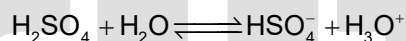
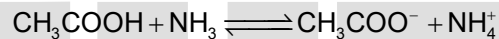
$$\frac{\rho_s}{\rho_w} = 0.6$$

$$\frac{\rho_s}{\rho_{\text{oil}}} = 0.8$$

56. Statements (A), (C) & (D) pertaining to Bohr model of an atom are correct.

57. Correct order of first ionisation energy is correct for the pairs given in option A, B, C and D.

58. A, B and C are correct statement.



60. $a_{\text{initial}} = \frac{20}{6} = \frac{10}{3} \text{ m/s}^2$

Displacement = Area under v-t graph

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