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INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS) 2023

(QUESTION PAPER CODE 54)

Date : 26/11/2023 **Time : 2 : 30 PM to 4 : 30 PM** **Maximum Marks: 216**

Write the question paper code (mentioned above) on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated, Note that the same Question paper code appears on each page of the question paper.

INSTRUCTIONS

1. Use of mobile phone, smart watches, 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 bubbles
5. Your **10-digit roll number and date of birth** entered in 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 (s) and fill the appropriate bubbles(s), as shown.

   Q.No.12 

   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 bubbles(s), as shown

   Q.No.52 

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 alternative are marked. No negative marks in this part.
8. Rough work should be done only in the space provided. There are __ 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 of 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 wrong score.
    DO NOT WRITE ON THE BACK SIDE OF THE OMR ANSWER SHEET.

Name of Student :.....

Batch : .....

Enrolment No. | | | | | | | | | | | | | | | | |

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INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS) 2023

PAPER CODE-54

Date of Examination – 26th November, 2023

SOLUTIONS

Attempt All Sixty Questions

(NSEJS) PART : A–1

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT, BUBLE 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?

(a) Tricuspid valve (b) Aortic semilunar valve

(c) Pulmonary semilunar valve (d) Mitral valve

Ans. (d)

2. Which of the following refer to the units involved in most of the Reflex Arcs ?

(a) Stimulus receptor, afferent nerve, efferent nerve and an effector neuron

(b) Two receptor neurons, one or more internuncial neuron(s) and an effector neuron

(c) One receptor neuron, one or more internuncial neuron(s) and an effector neuron

(d) One receptor neuron, afferent nerve and an effector neuron

Ans. (c)

3. Through the process of cross-breeding/mutation breeding or cytoplasmic hybridization of animals and plant, 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 & Leopon

(c) Pomato & Bromato (d) Jaya & Ratna Rice

Ans. (c)

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?

(a) Thin bronchioles, Urinifcrous tubules, Ciliary body

(b) Bile ducts. lining of stomach. Trachea

(c) Skin epidermis, Anal canal, Cornea of eye

(d) Trachea, Vasa deferentia, Epididymes

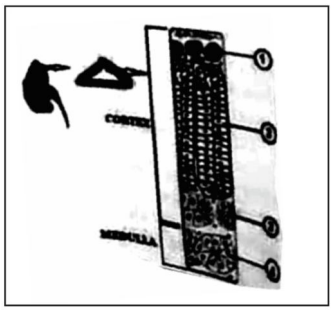
Ans. (d)

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 as non-tasters. What is the probability that their third child will be born a non-tester?

(a) 0.25 (b) 0.50 (c) 0.15 (d) 0.75

Ans. (b)

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



(a) 1 (b) 1 and 3 (c) 2 and 4 (d) 2 and 3

Ans. (d)

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

Ans. (b)

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.

Ans. (b)

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

Ans. (b)

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*

Ans. (c)

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) 3, 14, 18 and 22

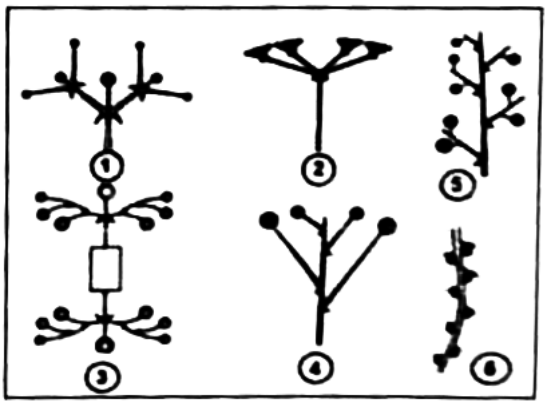
Ans. (b)

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

Ans. (b)

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

Ans. (c)

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

Ans. (c)

15. During a type of Carbon dioxide fixation occurring at night while the stomata are still 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

Ans. **(c)**

16. Some plants are specifically called hemiparasitic epiphytes. Included among them are the plants called 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*

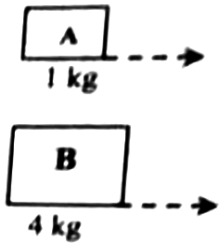
Ans. **(b)**

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

Ans. **(d)**

Sol.

$\xrightarrow[1]{2V} \boxed{A} \longrightarrow V_A \quad KE_A = \frac{1}{2}1.V_A^2 = \frac{V_A^2}{2}$

$\xrightarrow[4\text{ kg}]{V} \square \longrightarrow B \quad KE_B = \frac{1}{2} \times 4 \times V_B^2 = 2V_B^2$

$KE_A = KE_B$

$V_A^2 = 4V_B^2$

$\frac{V_A^2}{V_B^2} 4 \Rightarrow \frac{V_A}{V_B} = \frac{2}{1}$

$V_A : V_B = 2 : 1$

$P_A = 2V \quad \frac{P_A}{P_B} = \frac{2V}{4V} = \frac{1}{2}$

$P_B = 4V$

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

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

Ans. **(a)**

Sol. m = 20.95 g. R = 0.065

$$R = \frac{\rho \ell}{A} \Rightarrow A \Rightarrow \frac{V}{\ell} \therefore R = \frac{\rho \ell^2}{V}$$

$$V = \frac{20.95 \times 10^{-3}}{8900} \Rightarrow \sqrt{\frac{0.065 \times 2.354 \times 10^{-6}}{1.7 \times 10^{-8}}} = \ell = 3m$$

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

Ans. **(d)**

Sol. $$\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$$

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

$$\Rightarrow \frac{273}{273 + T} = 0.85$$

$$\Rightarrow 273 = 273 \times 0.85 + 0.85\ T$$

$$\Rightarrow T = 48°C$$

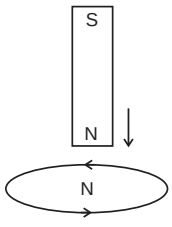
20. A small bar magnet is allowed to fall vertically through a metal ring lying in a horizontal plane. During its fall, the acceleration of the magnet in the region close to the ring must be (g is acceleration due to gravity)

(a) equal to g (b) less than g and uniform

(c) less than g and non-uniform (d) greater than g and uniform

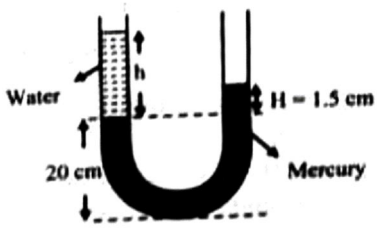
Ans. **(c)**

Sol.



Less than g and non-uniform. As speed of Magnet changes, so opposing force changes.

21. A U-tube of uniform cross section contains two different liquids in its limbs namely water (density 1.0 x 10^3 kg/m^3) and Mercury (density 13.6 x 10^3 kg/m^3) as shown in figure. The difference of height of mercury column in two limbs of the tube is H = 1.5 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

Ans. **(b)**

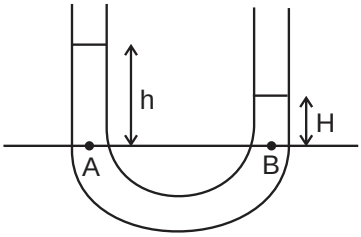
Sol. $\Rightarrow$ $13.6 \times \rho H_2O = \rho Hg$

PA = PB

$\rho H_2O \times g \times h = \rho Hg \times g \times H$

$\rho H_2O \times h = 13.6 \times \rho H_2O \times H$

$h = 13.6 \times H = 13.6 \times 1.5$ cm = 20.4 cm



22. An object pin is placed at a distance 10 cm rom 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

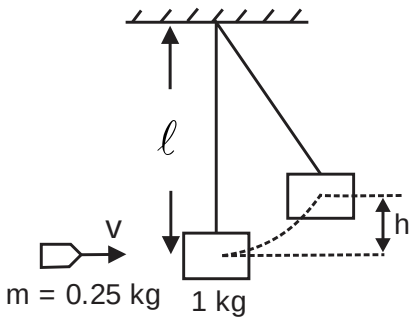
(a) 16 cm (b) 20 cm (c) 25 cm (d) 40 cm

Ans. **(b)**

Sol. From Newton's formula,

$f = \sqrt{X_1.X_2} = \sqrt{10 \times 40} = 20$ 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 get, embedded in the block and the system rises up to maximum height h = 19.6 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 mis (d) 11.8 m/s

Ans. **(c)**

Sol. Momentum conservation,

$0.25\ V = 1.25\ V'$

$V = 5V'$ … (i)

Energy conservation,

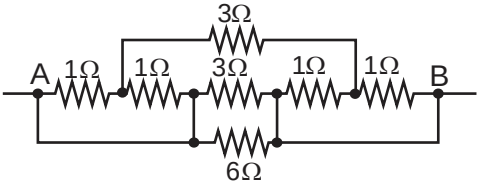
$\frac{1}{2}m'(v')^2 = m'gh$ … (ii)

$\frac{1}{2}\left(\frac{V}{5}\right)^2 = 10 \times \frac{19.6}{100}$

$\frac{1}{2}\frac{V^2}{25} = \frac{19.6 \times 50}{10}$

$V' = \sqrt{19.6 \times 5}$ 9.8 m/s

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



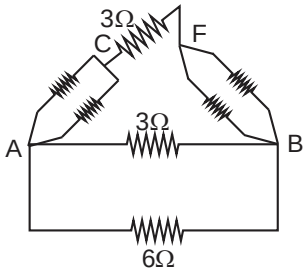
(a) $\frac{3}{4}\Omega$ (b) $\frac{4}{3}\Omega$ (c) $\frac{2}{5}\Omega$ (d) $\frac{9}{14}\Omega$

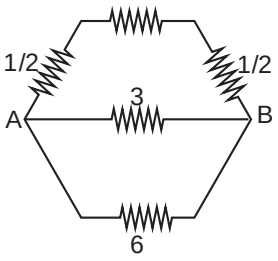
Ans. (b)

Sol. $\frac{1}{4}+\frac{1}{3}+\frac{1}{6}=\frac{3+4+2}{12}$

$\frac{1}{Req.} = \frac{9}{12} = \frac{3}{4}$

$\rho = \frac{V^2}{R}$ $\boxed{Req = \frac{4}{3}}$





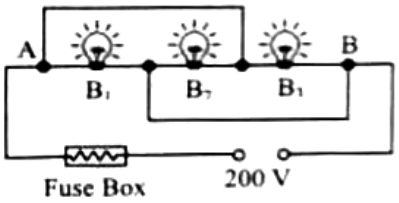
25. The order of magnitude of the pressure (in pascal) exerted by an adult human on the Earth when he stands bare footed on the Earth on both of his legs, is

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

Ans. (b)

Sol. Conceptual.

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

Ans. **(d)**

Sol. $R_1 = \frac{V_1^2}{P_1} = \frac{200 \times 200}{100} = 400\ \Omega$

$R_2 = \frac{200 \times 200}{60} = \frac{2000}{3}\ \Omega$

$R_3 = \frac{200 \times 200}{40} = 1000\ \Omega$

$\frac{1}{Req} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{400} + \frac{3}{2000} + \frac{1}{1000}$

$= \frac{5+3+2}{2000} = \frac{10}{2000} = \frac{1}{200}$

Req. = 200 Ω

$I = \frac{V}{Req} = \frac{200}{200} = 1\ Amp$

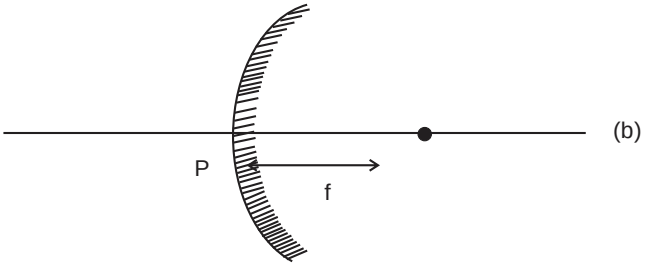
27. An ant is sitting on the principal axis of a convex mirror of focal length f, at a distance 2f from the pole in front of the mirror. It starts moving on principal axis towards the mirror. During the course of motion, the distance between the ant and its image

(a) throughout increases (b) throughout decreases

(c) first increases, then decreases (d) first decreases, then increases

Ans. **(b)**

Sol.



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

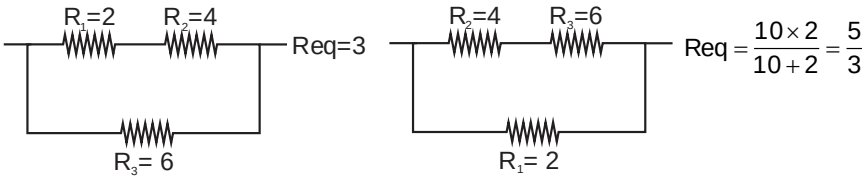
Ans. **(d)**

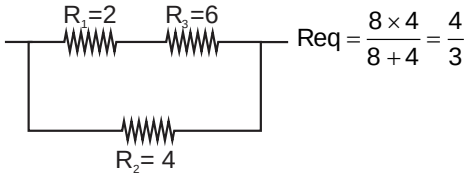
Sol. $R_1 = 2\Omega, R_2 = 4\Omega, R_3 = 6\Omega$

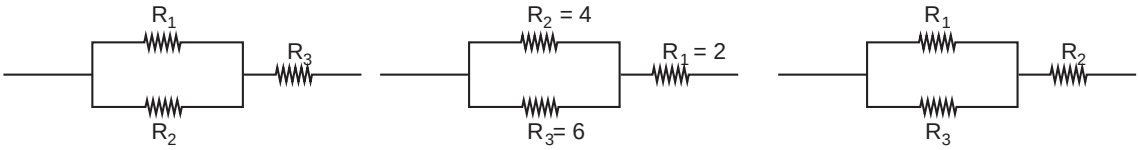
$$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6} = \frac{6+3+2}{12} = \frac{11}{12}$$

$$R_p \rightarrow R_{eq} = \frac{12}{11} = 1.09\ \Omega$$

$$R_s \rightarrow R_{eq} = 2\Omega + 4\Omega + 6\Omega = 12\Omega$$







$$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{4} = \frac{2+1}{4} = \frac{3}{4}$$

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

$$R'_{eq} = \frac{4}{3} + 6$$

$$= \frac{4+18}{3} = \frac{22}{3}$$

$$= 7.33\ \Omega$$

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

$$= \frac{3+2}{12} = \frac{5}{12}$$

$$R_{eq} = \frac{12}{5}$$

$$R'_{eq} = R_{eq} + R_1$$

$$R'_{eq} = R_{eq} + R_1$$

$$= \frac{12}{5} + 2$$

$$= \frac{12+10}{5}$$

$$= \frac{22}{5}$$

$$R'_{eq} = 4.4$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_3}$$

$$= \frac{1}{2} + \frac{1}{6}$$

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

$$R_{eq} = \frac{6}{4} = \frac{3}{2}$$

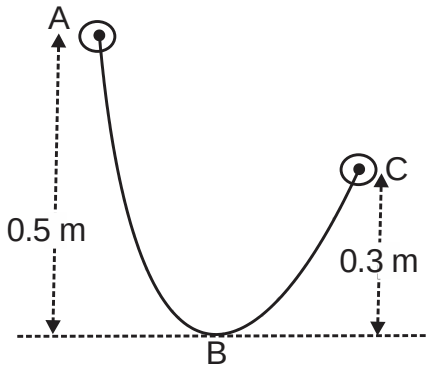
$$R'_{eq} = R_{eq} + R_2$$

$$= \frac{3}{2} + 4$$

$$= \frac{3+8}{2}$$

$$R_{eq} = \frac{11}{2} = 5.5$$

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) 29.4×10^{-3} N

(c) 1104×10^{-3} N (d) 7.36×10^{-3} N

Ans. **(d)**

Sol. Work done by conservative forces = $\Delta KE + \Delta U$

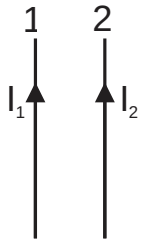
$$W_f + \overset{O}{\cancel{W_N}} + \cancel{W_{mg}} = O + mgh_N - mgh_c$$

$$W_f = \frac{1.5}{100} - \frac{0.1}{100} = \frac{0.6}{100} = 6 \times 10^{-3}$$

$$W_f = mg(0.5 - 0.3) = \frac{3}{1000} \times 9.8 \times 0.2$$

$$f.s = \frac{3}{1000} \times 9.8 \times 0.2 \qquad f = \frac{3 \times 9.8 \times 0.2}{1000 \times 0.8} = 7.35 \times 10^{-3} \text{ N}$$

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 the magnetic forces, applied by conductor I on conductor 2.



(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 Fm is repulsive (d) F_e is zero and F_m is attracive

Ans. **(d)**

Sol. Fe is repulsive whereas F_m will be 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 is Kelvin as

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

Ans. **(b)**

Sol. 0°C = 273.15 K

$\therefore 37.3°C = 310.45K$

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

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

Ans. **(d)**

Sol. $V = \frac{2\pi R}{T} = \frac{2\pi R}{R^{3/2}}$

$V \propto R^{1-3/2}$

$V \propto R^{-1/2}$

$\frac{V_1}{V_2} = \left(\frac{10^{12}}{10^{13}}\right)^{\frac{1}{2}}$

$\frac{V_1}{V_2} = \frac{1}{\sqrt{10}}$

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^-

Ans. **(b)**

Sol. $Cl + e^- \rightarrow Cl^-$

$\downarrow$

Highly Electronegative so, Exothermic

$O^- + e^- \rightarrow O^{2-}$

$\uparrow$

Here due to repulsion by e, it is endothermic.

34. H_2 reacts faster with Cl_2 and 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

Ans. **(c)**

Sol. H – H Bond energy is lower as compared to D-D.

As Deuterium D as slightly smaller size than H, so, Higher 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 – $H_2O > D_2O$ (ii) Dielectric constant – $D_2O > H_2O$

(iii) Refractive Index – $H_2O > D_2O$ (iv) Refractive Index – $D_2O > H_2O$

(v) Intermolecular forces – $H_2O > D_2O$ (vi) Intermolecular forces – $D_2O > H_2O$

The option containing all correct statements is

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

Ans. **(b)**

Sol. Dielectric constant $\rightarrow H_2O > D_2O$

Intermolecular force $\rightarrow H_2O > H_2O$ due to H–Bonding

Refractive index $D_2O > H_2O$

$\uparrow$

Heavy water

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

(a) K_2O_2 (b) KO_2 (c) K_2O (d) Na_2O

Ans. **(b)**

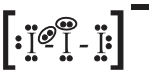
Sol. $KO_2 \rightarrow$ is used as it absorbs CO_2 to release O_2(g)

$4KO_2 + 2CO_2 \rightarrow 2K_2CO_3 + 3O_2$

37. The total number of lone pairs of electrons in I_3^- :

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

Ans. **(d)**

Sol. $I_3^- \Rightarrow$ 

9 lone pairs.

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

Ans. **(d)**

Sol. None of these $\rightarrow$ as elements 43 and 61 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 stand for Bose Einstein Condensate.

(a) BEC, fermionic condensate (b) Plasma, BEC

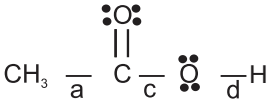
(c) Fermionic condensate, Plasma (d) Gas, BEC

Ans. **(b)**

Sol. Plasma $\rightarrow$ is a heated state

BEC $\rightarrow$ super-cooled state

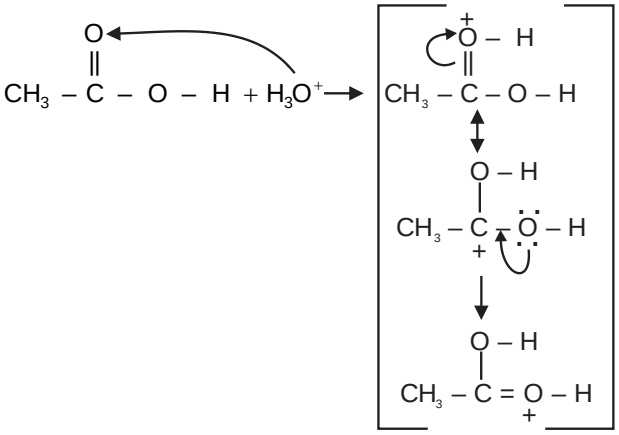
40. The bond which will break in first step when following compound reacts with H_2O^+ is



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

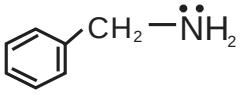
Ans. **(b)**

Sol.



$\therefore$ Bond b will Break first.

41. Arrange the following compound is increasing order of Lewis base strength

(i)  (ii)  (iii) 

The option containing correct increasing order is

(a) iii, ii, i (b) i, ii, iii (c) ii, i, iiii (d) iii, I, ii

Ans. **(b)**

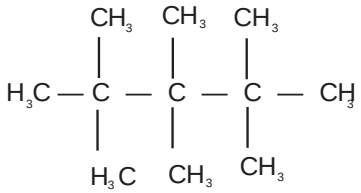
Sol. (i) > (ii) > (iii)

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

Ans. **(c)**

Sol.



Maximum no. of $-CH_3 = 8$

43. A glass bulb of 1 liter capacity contains 4g 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) 500m K (d) 373 K

Ans. **(b)**

Sol. PV= nRT

$CH_4 \rightarrow 16\ g/mol$

$$\therefore\ n = \frac{4g}{16\ g/mol} = \frac{1}{4}\ mol$$

$$T = \frac{PV}{n.R} = \frac{10\times 1}{\frac{1}{4}\times 0.0821} = \frac{4.0}{0.0821}K = 487.6K$$

44. The pH of 10^{-8} M HCl is

(a) 7 (b) <7 (c) 8 (d) >8

Ans. **(b)**

Sol. 10^{-8} M HCl

As solution is acidic, so pH will obviously be < 7.

45. An element X has two natural isotopes: $^{10}_{3}X$ (atomic mass 10.013 u) and $^{11}_{5}X$ (atomic mass 11,009 u). Relative abundance of these isotopes in nature has been recorded 19.8% and 80.2% respective. 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

Ans. **(d)**

Sol. $_5X^{10}$ $_5X^{11}$

$\downarrow$ $\downarrow$

19.8% 80.2%

$$\therefore Avg = \frac{10\times 19.8 + 11\times 80.2}{100}$$

$$= \frac{198 + 882.2}{100} = \frac{1080.2}{100} = 10.802$$

46. A mass 0.75 g of 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 is the mixture is :

(a) 50.6 (b) 49.4 (c) 50 (d) data insufficient

Ans. **(c)**

Sol.

$$Na_2CO_3 + K_2CO_3 = 0.75\ g$$
$$\downarrow \qquad \downarrow$$
$$xg \qquad (0.75 - x)\ g$$

$\therefore$ (no. of gm. eq. of Na_2CO_3 + no. of gm. eq. of K_2CO_3) = no. of gm. eq. of HCl

$\downarrow$

no. of gm. eq. = no. of mol $\times$ n.f.

n-f of K_2CO_3 and Na_2CO_3 = 2.

$\therefore$ M of Na_2CO_3 = 106 g/mol K_2CO_3 = 138 g/mol.

$$\text{n of } Na_2CO_3 = \frac{x}{106} \qquad \text{n of } K_2CO_3 = \frac{0.75 - x}{138}$$

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

x = 0.373 g

$\therefore$ % of $Na_2CO_3 \approx$ 50.

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^{23}

Ans. **(c)**

Sol. $3\ \text{carat} \Rightarrow 3 \times 200 \times 10^{-3}\ g = 0.6\ g$

$$\therefore \text{ no. of moles of C} = \frac{0.6\ g}{12\ g/mol} = \frac{6 \times 10^{-1}}{12} = 0.05\ mol.$$

$$\therefore 0.05 \times 6.022 \times 10^{23}$$

$$\Rightarrow 3.01 \times 10^{22}$$

48. Which of the following will from 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

Ans. **(c)**

Sol. Potassium n-dodecyl Benzene sulphonate is present in detergents, so it forms foam even in Hard water.

NSEJS) PART : A–2

ANY NUMBER OF OPTIONS 4, 3, 2 OR 1 MAY BE CORRECT

MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED.

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 1 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	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)

Ans. (a, b & c)

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 or 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

Ans. (b & d)

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) explaning the mechanism of root gravitropism. Which of the following best explain(s) the root gravitropism ?

(a) Statoliths within columella cells or root cap sediment in the direction of gravity, resulting in the generation of a signal that causes asymmetric growth.

(b) Auxin influx and efflux carries 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 containg carotenoids and protochlorophyll respond to gravity.

Ans. (a & b)

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 organisms: sunlight and reduction-oxidation (redox) reactions. Following are the requirements of cyclic and noncyclic phosphorylations occurring in green plants. Choose the correct option(s) related to cyclic 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

Ans. **(a & b)**

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

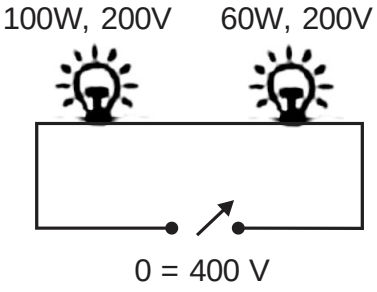
Ans. **(b & c)**

Sol.

$$P_A = \frac{W}{t_A} = \frac{mgh}{t_A} = \frac{2000 \times 10 \times 3}{60} = 1000W$$

$$P_B = \frac{W}{t_B} = \frac{mgh}{t_B} = \frac{2000 \times 10 \times 3}{2 \times 60} = 500W$$

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 volt, the 100 W bulb gets fused.

(d) When supply voltage becomes 400 V, none of the bulbs glow

Ans. **(a & d)**

Sol. * In series combination lower wattage bulb slows brighter.

$$\frac{1}{P_T}=\frac{1}{P_1}+\frac{1}{P_2}\Rightarrow P_T=\frac{P_1\times P_2}{P_1+P_2}=\frac{60\times 100}{160}=\frac{150}{4}=37.5W$$

$$R_{100}=\frac{200^2}{100}=400\Omega$$

$$R_{60}=\frac{200^2}{60}=\frac{2000}{3}\Omega$$

$$\therefore R_{es}=R_{100}+R_{60}=\frac{3200}{3}\Omega$$

$$I=\frac{V}{R_{es}}=\frac{400}{\frac{3200}{3}}=\frac{3}{8}A.$$

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

Ans. **(c)**

Sol. $R=10cm=0.1m$

$$\text{Volume of sphere}=\frac{4}{3}\pi\times(0.1)^3=\frac{4}{3}\pi\times10^{-3}m^3$$

In water 60% submerged.

$$\therefore \text{Volume in water}=(0.6\times\frac{4}{3}\pi 10^{-3})$$

$\therefore$ Mass of water displaced = Mass of Sphere

$$0.6\times\frac{4}{3}\pi 10^{-3}\times1000\,kg/m^3=\frac{4}{3}\pi 10^{-3}\times\rho\,\text{material}$$

ρ material $= 600\,kg/m^3$.

In oil :

$$0.8\times\frac{4}{3}\pi r^3\times\rho=\frac{4}{3}\pi 10^{-3}\times600\quad \rho=\frac{600}{0.8}=750\,kg/m^3$$

$$\therefore \text{Weight of sphere}=\frac{4}{3}\pi 10^{-3}\times600\times9.8\,ms^{-2}=24.64\,N$$

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.

Ans. **(a, c & d)**

Sol. (a) Correct $\rightarrow$ Electron close to nuclear has lower P.E.

(b) Incorrect (because, in orbit, it has stable energy and does not radiate it. Therefore, called stationary state.)

(c) Correct $\rightarrow$ Bohr's Model fail in the case of multi-electron species.

(d) Correct $\rightarrow$ Quantization of energy.

$$mvr = \frac{nh}{2\pi}$$

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

Ans. **(a, b, c & d)**

Sol. (a) Ag < Au $\rightarrow$ due to poor shielding effect.

(a) Ni < Pd < Pt

Pd – Higher ionization energy than Ni due to exceptional electronic configuration.)

(Pt – Higher ionization energy due to Lanthanide contraction.)

(b) Pb > Sn $\rightarrow$ due to Lanthanide contraction.

(d) Sb > Bi $\rightarrow$ correct

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 :

$$2H_2O \rightleftharpoons H_2O^+ + OH^-$$

$$2H_2SO_4 \rightleftharpoons H_2SO_4^+ + HSO_4^-$$

(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

Ans. **(a, b & c)**

Sol. → A substances behaves as an acid if it is more acidic than its solvent.

a) CH_3COOH ↓ so act as strong acid in NH_3 ↓ Base

b) H_2SO_4 is strong acid both in H_2O and NH_3

c) CH_3COOH ↓ so behaves as Base in liq. HCl ↓ Strong Acid

d) H_2O ↓ act as acid in NH_3 ↓ More Basic than H_2O

59. The reaction $KI + I_2 \longrightarrow KI_3$ involves :

(a) oxidation (b) reduction

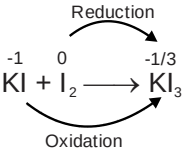
(c) complex formation (d) neutralization

Ans. **(a, b & c)**

Sol. (a) oxidation

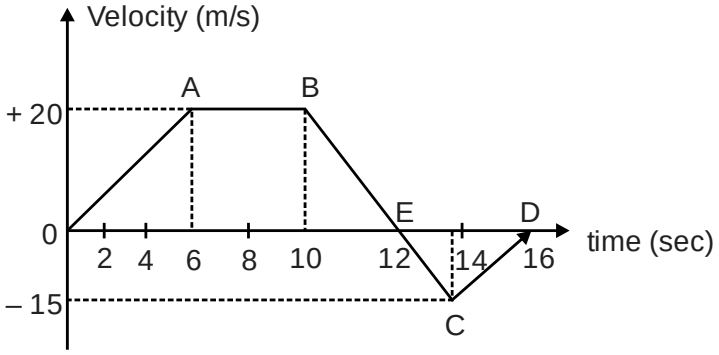
(b) reduction

(c) complex formation



$[I_3]^-$ is a complex ion

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 statements(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

Ans. **(b, c & d)**

Sol. (a) Initial acceleration $= \frac{20}{6} = \frac{10}{3} = 3.33\ ms^{-2}$

(b) Total displacement $= \left(\frac{1}{2}\times 6\times 20 + 4\times 20 + \frac{1}{2}\times 2\times 20\right) - \left(\frac{1}{2}\times 4\times 15\right)$

$= (60 + 80 + 20) - 30 = 130\ m$

(c) Avg. Speed $= \frac{\text{Distance}}{\text{Time}} = \frac{190}{16} = 11.875\ ms^{-2}$

(d) From B to E; Retardation $= \frac{20-0}{12-10} = \frac{20}{2} = 10\ ms^{-2}$