

Student's

Roll No:

**INDIAN ASSOCIATION OF PHYSICS TEACHERS**  
**NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS) 2019 – 20**

Instructions to Candidates – read carefully and strictly follow each of them

1. Question paper code is given on top right corner of each page of question paper. It must be mentioned in YOUR OMR sheet (in the space provided). Otherwise your answer sheet (OMR sheet) will NOT be assessed.
2. Refer page 20: for periodic table and some useful information of mathematics.
3. Use and carrying calculators of any type is strictly prohibited.
4. Use and even carrying smart watches, phones, i-pads or any other communication devices or any other objectionable material in examination centre is strictly prohibited.
5. On the answer sheet, make all the entries correctly, carefully in the space (s) provided, in capital letters as well as by properly darkening the appropriate bubbles using blue or black ball point pen only. Incomplete/ incorrect/ carelessly filled information may disqualify your candidature. Please take care while entering.
6. Please do not make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet. Further, do not write on the back side of the answer sheet.
7. As answer sheets are evaluated using machine, change of entry is not allowed. Even scratching or overwriting may result in a wrong score.
8. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which only one is correct. Choose the correct alternative and fill the appropriate bubble, as shown:

Q. ☐ ☒ ☐ ☐

9. Correct answer carries 3 marks, wrong answer - 1 mark (negative 1), no attempt – zero marks.
  10. Rough work should be done in the space provided in the question paper only.
  11. Candidates are not permitted to leave the examination hall before the completion of the examination schedule (i.e. before 1200 Hrs).
  12. Your answer sheet consists of two pages original copy and candidate's copy. Do not detach them till the end of the examination. At the end of examination, submit your answer paper (original copy) to the invigilator and take away the student's copy for your further reference.
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13. Comments regarding this question paper, if any, may be filled in Google forms only at <https://goo.gl/forms/9GP03NRgUVuhWJn52> till 22<sup>nd</sup> November, 2019. The answers/solutions to this question paper will be available on our website: [www.iapt.org.in](http://www.iapt.org.in) by 2<sup>nd</sup> December, 2019.
  14. For Certificates and awards – Please see the website of IAPT: [www.iapt.org.in](http://www.iapt.org.in)

Rough work below this line:

**QUESTION PAPER STARTS HERE**

Q1: Let  $\alpha$  and  $\beta$  be the roots of  $x^2 - 5x + 3 = 0$  with  $\alpha > \beta$ . If  $a_n = \alpha^n - \beta^n$  for  $n \geq 1$  then the value of  $\frac{3a_6 + a_8}{a_7}$  is

- (a) 2 (b) 3 (c) 4 (d) 5

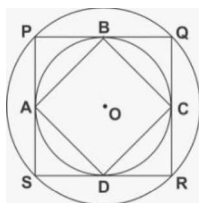
Q2: The number of triples  $(x, y, z)$  such that any one of these numbers is added to the product of the other two, the result is 2, is

- (a) 1 (b) 2 (c) 4 (d) infinitely many

Q3: In rectangle ABCD, AB=5 and BC=3. Points F and G are on the line segment CD so that DF = 1 and GC=2. Lines AF and BG intersect at E. What is the area of AEB?

- (a) 10 sq. units (b) 15/2 sq. units (c) 25/2 sq. units (d) 20 sq. units

Q4:



In the given figure, two concentric circles are shown with centre O. PQRS is a square inscribed in the outer circle. It also circumscribes the inner circle, touching it at points B, C, D and A. What is the ratio of the perimeter of the outer circle to that of quadrilateral ABCD?

- (a)  $\frac{\pi}{4}$  (b)  $\frac{3\pi}{2}$  (c)  $\frac{\pi}{2}$  (d)  $\pi$

Q5: How many positive integers N give a remainder 8 when 2008 is divided by N.

- (a) 12 (b) 13 (c) 14 (d) 15

Q6: What is the product of all the roots of the equation  $\sqrt{5|x| + 8} = \sqrt{x^2 - 16}$ ?

- (a) - 64 (b) - 24 (c) 576 (d) 24.

Q7: LCM of two numbers is 5775. Which of the following cannot be their HCF?

- (a) 175 (b) 231 (c) 385 (d) 455

Rough work below this line:

Q8: If  $a, b, c$  are distinct real numbers such that  $a + \frac{1}{b} = b + \frac{1}{c} = c + \frac{1}{a}$  evaluate  $abc$ .

- (a)  $\pm\sqrt{2}$       (b)  $\sqrt{2} - 1$       (c)  $\sqrt{3}$       (d)  $\pm 1$

Q9: If the equation  $(\alpha^2 - 5\alpha + 6)x^2 + (\alpha^2 - 3\alpha + 2)x + (\alpha^2 - 4) = 0$  has more than two roots, then the value of  $\alpha$  is

- (a) 2      (b) 3      (c) 1      (d) none of these

Q10: Mr. X with his eight children of different ages is on a family trip. His oldest child, who is 9 years old saw a license plate with a 4-digit number in which each of two digits appear two times. "Look daddy!" she exclaims. "That number is evenly divisible by the age of each of us kids!" "That's right," replies Mr. X, "and the last two digits just happen to be my age". Which of the following is not the age of one of Mr. X's children?

- (a) 4      (b) 5      (c) 6      (d) 7

Q11: How many numbers lie between 11 and 1111 which divided by 9 leave a remainder 6 and when divided by 21 leave a remainder 12?

- (a) 18      (b) 28      (c) 8      (d) None of these

Q12: Two unbiased dice are rolled. What is the probability of getting a sum which is neither 7 nor 11?

- (a)  $7/9$       (b)  $7/18$       (c)  $2/9$       (d)  $11/18$

Q13: The solution of the equation  $1 + 4 + 7 + \dots + x = 925$  is

- (a) 73      (b) 76      (c) 70      (d) 74

Q14: If  $\tan \theta + \sec \theta = 1.5$ , then value of  $\sin \theta$  is

- (a)  $\frac{5}{13}$       (b)  $\frac{12}{13}$       (c)  $\frac{3}{5}$       (d)  $\frac{2}{3}$

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Rough work below this line:

Q15: An observer standing at the top of a tower, finds that the angle of elevation of a red bulb on the top of a light house of height  $H$  is  $\alpha$ . Further, he finds that the angle of depression of reflection of the bulb in the ocean is  $\beta$ . Therefore, the height of the tower is

- (a)  $\frac{H(\tan\beta - \tan\alpha)}{(\tan\beta + \tan\alpha)}$       (b)  $\frac{H\sin(\beta - \alpha)}{\cos(\alpha + \beta)}$       (c)  $\frac{H(\cos\alpha - \cos\beta)}{(\cot\alpha + \cot\beta)}$       (d)  $H$

Q16: The sum of the roots of  $\frac{1}{x+a} + \frac{1}{x+b} = \frac{1}{c}$  is zero. The product of roots is

- (a) 0      (b)  $\frac{a+b}{2}$       (c)  $-\frac{1}{2}(a^2 + b^2)$       (d)  $2(a^2 + b^2)$

Q17: In the convex quadrilateral ABCD, the diagonals AC and BD meet at O and the measure of angle AOB is  $30^\circ$ . If the areas of triangle AOB, BOC, COD and AOD are 1, 2, 8 and 4 square units respectively, what is the product of the lengths of the diagonals AC and DB in sq. units?

- (a) 60      (b) 56      (c) 54      (d) 64

Q18: If  $\sin^2 x + \sin^2 y + \sin^2 z = 0$ , then which of the following is NOT a possible value of  $\cos x + \cos y + \cos z$ ?

- (a) 3      (b) -3      (c) -1      (d) -2

Q19: Find the remainder when  $x^{51}$  is divided by  $x^2 - 3x + 2$ .

- (a)  $x$       (b)  $(2^{51} - 2)x + 2 - 2^{51}$       (c)  $(2^{51} - 1)x + 2 - 2^{51}$       (d) 0

Q20: In an equilateral triangle, three coins of radii 1 unit each are kept so that they touch each other and also sides of the triangle. The area of triangle ABC (in sq. units) is

- (a)  $4 + 2\sqrt{3}$       (b)  $4\sqrt{3} + 6$       (c)  $12 + \frac{7\sqrt{3}}{4}$       (d)  $3 + \frac{7\sqrt{3}}{4}$

Q21: Gymnosperms are called 'naked seed bearing plants' because they lack:

- (a) Male gamete      (b) Ovule      (c) Ovary      (d) Seeds

Rough work below this line:

Q22: In case of mice coat colour, two genes are responsible for colour of the hair. Gene 'A' is responsible for distribution of pigments on shaft of hair. Wild type allele of 'A' produces a yellow band on dark hair shaft (agouti), whereas recessive allele produces no yellow band. There is another allele of A, known as  $A^Y$ , which is embryonic lethal in homozygous condition only. In an experiment, two yellow mice were crossed to obtain a progeny of 6 pups. What would be the most probable number of agouti mice among them?

- (a) 0                      (b) 2                      (c) 4                      (d) None of the above

Q23. A stain was developed by a group of scientists to stain a particular cell organelle. The stain was tested on various tissues derived from an autopsy sample from a mammal. The organelles were counted. The results showed maximum number of the organelles in cells of brain, lesser in cells of heart, least in mature sperms and absent in erythrocytes. Identify the organelles from following options.

- (a) Nissl bodies                      (b) Mitochondria  
(c) Golgi bodies                      (d) Endoplasmic reticulum

Q24: *Pinus sylvestris* grows at low temperatures in Russia. The plant survives under such freezing conditions due to the presence of:

- (a) Saturated lipids in plasma membrane                      (b) Glycoproteins in plasma membrane  
(c) Glycolipids in plasma membrane                      (d) Polyunsaturated lipids in plasma membrane

Q25: In an experimental setup, certain pathogen caused a disease in primates with nasal congestion, sore throat and fever being the common symptoms. The scientists injected an extract from blue-green mold as the first line of action. However, the symptoms did not subside. The possible causative agents of the disease were listed out as follows.

- i. a virus                      ii. a fungus                      iii. a conjugation deficient bacterium                      iv. a tapeworm

Choose the correct option from the following that indicate the pathogen.

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

Q26: An organism has 27 pairs of homologous chromosomes. In each daughter cell after completion of mitosis and in each gamete after completion of meiosis II, \_\_\_\_\_ and \_\_\_\_\_ chromosomes would be present respectively.

- (a) 27 and 27                      (b) 54 and 27                      (c) 108 and 54                      (d) 54 and 108

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Rough work below this line:

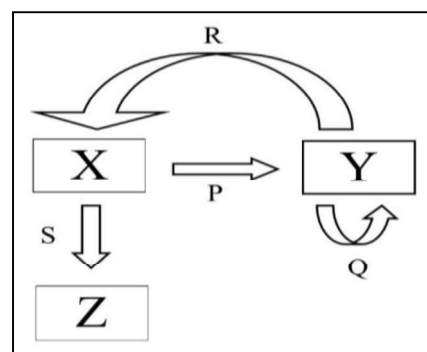
Q27: A group of students was studying development of an organism under controlled laboratory conditions. Following observations were made by them.

- i. The larvae had a rod-like supporting structure that separated the nervous system and the gut.
- ii. A prominent central cavity was present in the transverse section of the part of the nervous system of the larvae; while the adults had cerebral ganglia as the main component of the nervous system.
- iii. The eyes were prominently seen in larvae.
- iv. The tails were absent in the adults, which the larvae had.
- v. A lot of phagocytic activity was observed before conversion of larvae into adults.
- vi. The adults had a cuticular exoskeleton.

The organism under study must be belonging to:

- (a) Amphibia                      (b) Pisces                      (c) Protochordata                      (d) Arthropoda

Q28: A process is represented in the adjacent figure. The arrows indicate the flow of a biochemical reaction. The arrowhead points to the product, while the base of the arrow indicates the template biomolecule. What do P, Q, R, and S represent?



- (a) P : Replication, Q : Translation, R : Transcription, S : Reverse Transcription  
 (b) P : Transcription, Q : Replication, R : Reverse Transcription, S : Translation  
 (c) P : Reverse Transcription, Q : Replication, R : Translation, S : Transcription  
 (d) P : Reverse Transcription, Q : Replication, R : Transcription, S : Translation

Q29: The whooping cranes were on the verge of extinction with only 21 individuals in wild in 1941. After conservation measures, the cranes are now included in the endangered category by IUCN. The highlight of the conservation efforts is the reintroduction of the whooping cranes in wild. This was possible due to raising of the young cranes in absence of their parents by biologists dressed in crane costumes. Aircraft Guided bird migration technique was used for teaching the captive-bred cranes to follow the scientists to learn the migratory route. What type of animal behaviour might be responsible for these captive-bred cranes to follow the crane costume dressed scientists?

- (a) Cognitive learning      (b) Habituation      (c) Operant conditioning      (d) Genetic Imprinting

Rough work below this line:

Q30: In the baking industry, when the dough is prepared, various ingredients are mixed together with the flour. At one instance, the dough was fermented, but failed to rise sufficiently during the baking process. Choose the correct cause(s) from following possibilities.

- i. The salt was mixed before the fermentation process was completed
- ii. The sugar was added in excess
- iii. Yeast granules were not activated prior to mixing with the flour.

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

Q31: Given below are four statements.

- I. Prokaryotic cells are unicellular while eukaryotes are multicellular.
  - II. Histones are present in eukaryotes and absent in prokaryotes.
  - III. The nucleoid contains the genetic material in prokaryotes and eukaryotes.
  - IV. Prokaryotic flagellum is composed of flagellin while eukaryotic flagellum is composed of tubulin.
- Identify which amongst these are false.

(a) I and II                      (b) III and IV                      (c) II and III                      (d) I and III

Q32: The students of a college were working on regeneration using *Planaria* (Platyhelminthes) and *Asterias* (Echinodermata). *Planaria* was cut in three pieces, namely, a piece with head, with tail and the middle piece. *Asterias* (bearing five arms) was cut in such a way that after separation, six pieces were obtained, namely, an arm with a portion of the central disc, four pieces cut from tips of each of the remaining arms and the remaining body. The animals were allowed to regenerate completely. How many *Planaria* and *Asterias* respectively will be obtained after the completion of regeneration in both?

(a) 1, 1                      (b) 3, 2                      (c) 3, 6                      (d) 1, 2

Q33: Fecundity in animal world is the maximum possible ability of an individual to produce offsprings during its entire lifetime. Following factors were checked for their effect on fecundity of different animal models.

- i. Availability of food during breeding season
- ii. Mode of fertilization
- iii. Population density

Which of these factor(s) can regulate fecundity?

(a) i, ii                      (b) ii, iii                      (c) i, ii, iii                      (d) None of the above

Q34: Rahul sprayed a chemical 'X' on a plant with rosette habit. After few days, he found the internodal distances to have increased suddenly. The chemical 'X' might be:

- (a) Ethylene                      (b) Absciscic acid                      (c) Auxin                      (d) Gibberellic acid

Q35: In case of peppered moths, pale and dark moths are observed. Pale variety is known to be the wild type variety. During industrial revolution, industrial melanism led to prevalence of dark variety around the cities and pale variety continued to be in majority in areas away from the industries. After enforcement of regulations for controlling pollution, reappearance of pale moths in majority was observed around cities again. Driving force(s) for these adaptive changes is/are:

- i. Increased pollution around industries
- ii. A stable transposition of a gene in moths
- iii. Limitations of the vision of birds to differentiate dark moths on darkened barks and pale moths in presence of lichens
- iv. Ability of lichens to grow on barks in less polluted areas only.

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

Q36: Any damage or injury to a particular area causes nociceptors to release some chemicals, which carry the signal to the higher centres in the nervous system for the processing and a subsequent action. However, there is a difference in the way in which the stimulus is received which is related to the acuity of the detection. Fingertips are more sensitive as compared to the forearm. Following reasons for the observed phenomenon were suggested.

- i. The receptive fields in the fingertip are smaller
  - ii. The number of nociceptors per receptive field in the forearm is lesser
  - iii. The amount of prostaglandins released by the nociceptors per receptive field is more in fingertips
- The most probable reason(s) for this may be:

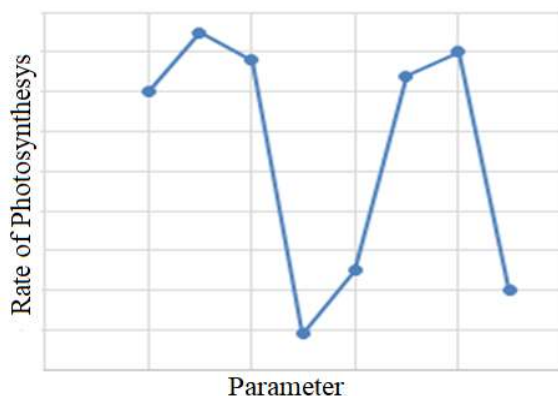
- (a) i                      (b) i, iii                      (c) ii, iii                      (d) i, ii, iii

Q37: On a study tour, plants with leathery leaves with thick cuticle, vivipary, salt glands, apogeotropic roots, and stomata limited to abaxial surface were observed. The plants might be:

- (a) Bromeliads                      (b) Cycads  
(c) Mangroves                      (d) None of the above



Q38:



Rate of photosynthesis in hydrophytes depends on various parameters. The adjacent graph shows the effect of one parameter (while keeping all the others constant) on the rate of photosynthesis. Rate of photosynthesis is plotted on Y axis. Identify the parameter which is plotted along X axis:

- (a) light intensity      (b) wavelength      (c) temperature      (d)  $\text{CO}_2$  concentration

Q39: A  $4\text{ }\mu\text{m}$  long bacterial cell was magnified and drawn to a dimension of 6 cm. How many times has it been magnified?

- (a)  $1.5 \times 10^3$       (b)  $15 \times 10^4$       (c)  $1.5 \times 10^4$       (d) 1.5

Q40: Four different human body fluid samples were subjected to quantification of hydrogen ion concentration. mEq/L is the unit of measurement for hydrogen ion concentration. The results of the experiment were as follows:

Sample A:  $1.6 \times 10^2$  units

Sample B:  $4.5 \times 10^{-5}$  units

Sample C:  $1 \times 10^{-3}$  units

Sample D:  $3 \times 10^{-2}$  units

Identify the samples in sequence from A to D.

- (a) Gastric HCl, Venous blood, Intracellular Fluid, Urine  
 (b) Venous blood, Intracellular Fluid, Gastric HCl, Urine  
 (c) Urine, Gastric HCl, Venous blood, Intracellular Fluid  
 (d) Intracellular Fluid, Urine, Gastric HCl, Venous blood

Q41: Four gram of mixture of calcium carbonate and sand is treated with excess of HCl and 0.880 g of carbon-di-oxide is produced. What is the percentage of calcium carbonate in original mixture?

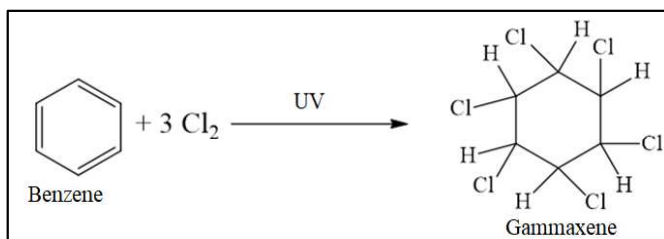
- (a) 40 %      (b) 50%      (c) 55%      (d) 45%

Q42: How many sigma bonds are present between any two carbon atoms in fullerenes?

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

Rough work below this line:

Q43:



Gammmaxene insecticide powder is prepared by the reaction given in the adjacent box. If 78 g of benzene when reacted with 106.5 g of chlorine, how much Gammmaxene would be formed?

- (a) 140 g                      (b) 154.5 g                      (c) 145.5 g                      (d) 160 g

Q44: An element Y is a white translucent solid at room temperature and exhibits various allotropic forms. Some compounds of element Y find application in agricultural industry. Y forms two solid oxides which dissolve in water to form comparatively weak acids. The element Y is:

- (a) Sulphur                      (b) Nitrogen                      (c) Phosphorous                      (d) Carbon

Q45: A student was studying reactions of metals with dilute NaOH at room temperature. The student took dilute NaOH in four different test tubes and added copper powder to test tube A, zinc dust to test tube B, aluminium powder to test tube C and iron powder to test tube D and observed effervescence in\_\_.

- (a) Test tubes A & B    (b) Test tubes B & C    (c) Test tubes C & D    (d) Test tubes A & D

Q46. Which of the following polymeric material will be ideal for remoulding?

- (a) Polythene and Melamine    (b) Polyvinyl chloride and Polythene  
(c) Melamine and Bakelite    (d) Bakelite and Polyvinyl chloride

Q47: A magician performed following act: He dipped Rs. 50 note in a 50% solution of alcohol in water and held it on the burning flame, but the note did not burn. The reason behind this is -

- (a) The alcohol kept on dousing the fire                      (b) Air required for burning was not available  
(c) The Rs 50 note failed to reach ignition temperature                      (d) The Rs. 50 note is fire proof

Q48. Which of the following is iso-structural with CO<sub>2</sub>?

- (a) NO<sub>2</sub>                      (b) N<sub>2</sub>O<sub>4</sub>                      (c) NO                      (d) N<sub>2</sub>O

Rough work below this line:

Q49: Substance X is white crystalline solid which melts after 10 seconds on burner flame. It is soluble in water and insoluble in  $\text{CCl}_4$ . It is a poor conductor of electricity in molten state as well as in the form of aqueous solution, hence we conclude that substance X is

- (a) an ionic compound (b) a non polar covalent compound  
(c) a polar covalent compound (d) a pure element

Q50: In a beaker 50 ml of a normal HCl solution was taken and  $\text{NH}_3$  gas was passed through it for some time. The contents of the beaker were then titrated, which required 60 ml of semi normal NaOH solution. How much ammonia was passed through the beaker?

- (a) 0.85 g (b) 0.34 g (c) 0.51 g (d) 0.4 g

Q51: Which is the correct order of metals with reference to their melting point in increasing order?

- (a) Hg, Ga, Li, Ca (b) Ca, Li, Ga, Hg (c) Hg, Li, Ga, Ca (d) Hg, Ga, Ca, Li

Q52: Sodium tungstate has formula  $\text{Na}_2\text{WO}_4$ , lead phosphate has formula  $\text{Pb}_3(\text{PO}_4)_2$ , formula for lead tungstate should be:

- (a)  $\text{PbWO}_4$  (b)  $\text{Pb}_2(\text{WO}_4)_3$  (c)  $\text{Pb}_3(\text{WO}_4)_2$  (d)  $\text{Pb}_3(\text{WO}_4)_4$

Q53: What is the ratio of reducing agent to oxidizing agent, if the following reaction is correctly balanced?  $\text{NH}_3 + \text{O}_2 \rightarrow \text{NO} + \text{H}_2\text{O}$

- (a) 4:5 (b) 5:4 (c) 5:3 (d) 3:5

Q54: Arrange following solutions in increasing hydronium ion concentration. The solutions are:

(P) 0.1 M HCl (Q) 0.1 M  $\text{H}_2\text{SO}_4$  (R) 0.001 M  $\text{NH}_4\text{OH}$  (S) 0.001 M  $\text{Ca}(\text{OH})_2$ .

The correct order will be

- (a)  $\text{P} > \text{Q} > \text{R} > \text{S}$  (b)  $\text{Q} > \text{P} > \text{S} > \text{R}$  (c)  $\text{S} > \text{R} > \text{Q} > \text{P}$  (d)  $\text{S} > \text{R} > \text{P} > \text{Q}$

Q55: In one litre of pure water, 44.4 g of calcium chloride is dissolved. The number of ions in one mL of the resultant solution is:

- (a)  $7.23 \times 10^{23}$  (b)  $7.23 \times 10^{20}$  (c)  $4.82 \times 10^{23}$  (d)  $4.82 \times 10^{20}$

Rough work below this line:

Q56: A zinc rod was dipped in 100 cm<sup>3</sup> of 1M copper chloride solution. After certain time the molarity of Cu<sup>2+</sup> ions in the solution was found to be 0.8 M. If the weight of zinc rod is 20 g, then the molarity of chloride ions is\_\_\_\_\_.

- (a) 2 M                      (b) 1.5 M                      (c) 1 M                      (d) 0.5 M

Q57: When four dilute solutions of (I) vinegar, (II) common salt, (III) caustic soda and (IV) baking soda are tested with universal indicator which will be the correct observation

- (a) I- Green, II - Violet, III - Blue, IV - Red    (b) I - Green, II - Blue, III -Violet, IV- Red  
(c) I - Red, II - Green, III - Violet, IV - Blue    (d) I-Red, II- Violet, III - Green, IV – Blue

Q58: Which of the following species is / are isoelectronic with Neon?

- (i) N<sup>3-</sup>    (ii) Mg<sup>2+</sup>    (iii) K<sup>+</sup>    (iv) Ca<sup>2+</sup>

- (a) only (iv)                      (b) only (ii)                      (c) both (i) & (ii)                      (d) both (i) & (iii)

Q59: Which of the following gases will have equal volume at STP, if the weight of gases is 14.0 g?

- (i) N<sub>2</sub>O                      (ii) NO<sub>2</sub>                      (iii) N<sub>2</sub>                      (iv) CO

- (a) (i) & (ii)                      (b) (ii) & (iii)                      (c) (i) & (iii)                      (d) (iii) & (iv)

Q60: Which of the following are not ionic?

- (i) AlCl<sub>3</sub>    (ii) CaCl<sub>2</sub>    (iii) MgCl<sub>2</sub>    (iv) LiCl

- (a) (i) and (iv)                      (b) (i) and (ii)                      (c) (ii) and (iii)                      (d) (iii) and (iv)

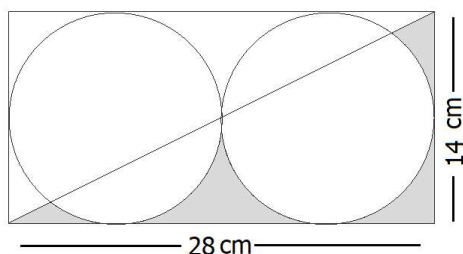
Q61: Apples dropping from apple trees were observed by many people before Newton. But why they fall, was explained by Isaac Newton postulating the law of universal gravitation. Which of the following statements best describes the situation?

- (a) The force of gravity acts only on the apple  
(b) The apple is attracted towards the surface of the earth  
(c) Both earth and apple experience the same force of attraction towards each other  
(d) Apple falls due to earth's gravity and hence only (a) is true and (c) is absurd

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Rough work below this line:

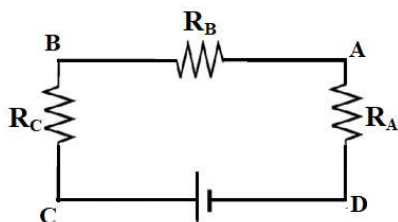
Q62:



A rectangular metal plate, shown in the adjacent figure has a charge of  $420 \mu\text{C}$  assumed to be uniformly distributed over it. Then how much is the charge over the shaded area? No part of metal plate is cut. (Circles and the diagonal are shown for clarity only.  $\pi = 22/7$ )

- (a)  $45 \mu\text{C}$  (b)  $450 \mu\text{C}$  (c)  $15 \mu\text{C}$  (d)  $150 \mu\text{C}$

Q63:



In the adjacent circuit, the voltages across AD, BD and CD are 2 V, 6 V and 8 V respectively. If resistance  $R_A = 1 \text{ k}\Omega$ , then the values of resistances  $R_B$  and  $R_C$  are \_\_\_\_\_ and \_\_\_\_\_ respectively.

- (a)  $4 \text{ k}\Omega$  and  $6 \text{ k}\Omega$  (b)  $2 \text{ k}\Omega$  and  $1 \text{ k}\Omega$   
 (c)  $1 \text{ k}\Omega$  and  $2 \text{ k}\Omega$  (d) data insufficient as battery voltage is not given

Q64: A new linear scale of temperature measurement is to be designed. It is called a 'Z scale' on which the freezing and boiling points of water are 20 Z and 220 Z respectively. What will be the temperature shown on the 'Z scale' corresponding to a temperature of  $20^\circ \text{C}$  on the Celsius scale?

- (a) 10 Z (b) 20 Z (c) 40 Z (D) 60 Z

Q65: Consider the motion of a small spherical steel body of mass  $m$ , falling freely through a long column of a fluid that opposes its motion with a force proportional to its speed. Initially the body moves down fast, but after some time attains a constant velocity known as terminal velocity. If weight  $mg$ , opposing force ( $F_v$ ) and buoyant force ( $F_b$ ) act on the body, then the correct equation relating these forces, after the terminal velocity is reached, is:

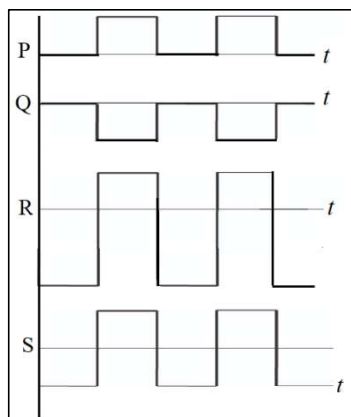
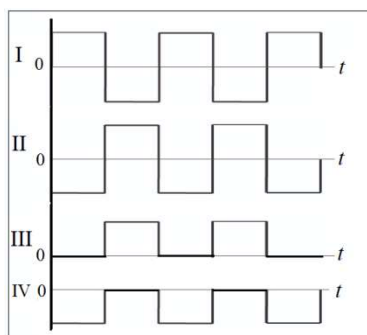
- (a)  $mg + F_v = F_b$  (b)  $mg = F_v - F_b$  (c)  $mg = F_v + F_b$  (d) none

Rough work below this line:

Q66: A piece of wire P and three identical cells are connected in series. An amount of heat is generated in a certain time interval in the wire due to passage of current. Now the circuit is modified by replacing P with another wire Q and  $N$  identical cells, all connected in series. Q is four times longer in length than P. The wire P and Q are of same material and have the same diameter. If the heat generated in second situation is also same as before in the same time interval, then find  $N$ .

- (a) 4                      (b) 6                      (c) 16                      (d) 36

Q67:



Some waveforms among I, II, III and IV superpose (add graphically) to produce the waveforms P, Q, R and S. Among the following, match the pairs that give the correct combinations:

**Resultant**

P  
Q  
R  
S

**Superposition of**

(K) III and IV  
(L) II and IV  
(M) I, II and III  
(N) I and IV  
(O) II and III

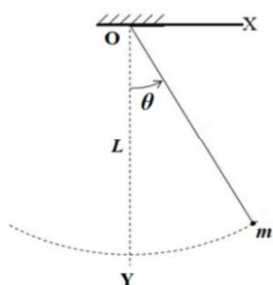
- (a)  $P \leftrightarrow O, Q \leftrightarrow N, R \leftrightarrow L, S \leftrightarrow M$       (b)  $P \leftrightarrow M, Q \leftrightarrow N, R \leftrightarrow L, S \leftrightarrow K$   
(c)  $P \leftrightarrow M, Q \leftrightarrow N, R \leftrightarrow K, S \leftrightarrow L$       (d)  $P \leftrightarrow O, Q \leftrightarrow M, R \leftrightarrow L, S \leftrightarrow K$

Q68: At any instant of time, the total energy ( $E$ ) of a simple pendulum is equal to the sum of its kinetic energy  $\left(\frac{1}{2}mv^2\right)$  and potential energy  $\left(\frac{1}{2}kx^2\right)$ , where,  $m$  is the mass,  $v$  is the velocity,  $x$  is the displacement of the bob and  $k$  is a constant for the pendulum. The amplitude of oscillation of the pendulum is 10 cm and its total energy is 4 mJ. Find  $k$ .

- (a)  $1.8 \text{ Nm}^{-1}$       (b)  $0.8 \text{ Nm}^{-1}$       (c)  $0.5 \text{ Nm}^{-1}$       (d) data insufficient

Rough work below this line:

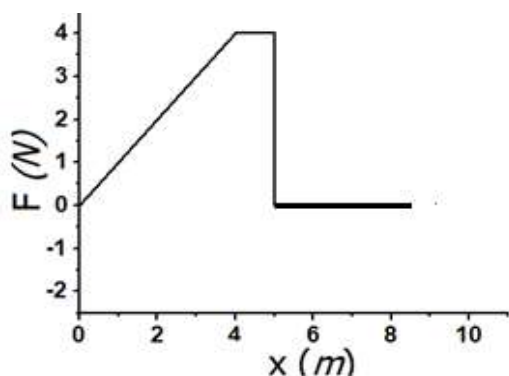
Q69:



A rigid body of mass  $m$  is suspended from point  $O$  using an inextensible string of length  $L$ . When it is displaced through an angle  $\theta$ , what is the change in the potential energy of the mass? (Refer adjacent figure.)

- (a)  $mgL(1 - \cos \theta)$       (b)  $mgL(\cos \theta - 1)$       (c)  $mgL \cos \theta$       (d)  $mgL(1 - \sin \theta)$

Q 70:



Refer to the adjacent figure. A variable force  $F$  is applied to a body of mass 6 kg at rest. The body moves along  $x$  - axis as shown. The speed of the body at  $x = 5$  m and  $x = 6$  m is \_\_\_ and \_\_\_ respectively.

- (a) 0 m/s, 0 m/s      (b) 0 m/s, 2 m/s      (c) 2 m/s, 2 m/s      (d) 2 m/s, 4 m/s

Q71: When a charged particle with charge  $q$  and mass  $m$  enters uniform magnetic field  $B$  with velocity  $v$  at right angles to  $B$ , the force on the moving particle is given by  $qvB$ . This force acts as the centripetal force making the charged particle go in a uniform circular motion with radius  $r = \frac{mv}{Bq}$ . Now if a hydrogen ion and a deuterium ion enter the magnetic field with velocities in the ratio 2:1 respectively, then the ratio of their radii will be\_\_\_\_\_.

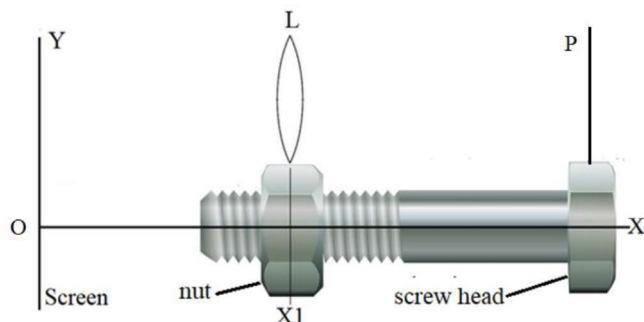
- (a) 1:2      (b) 2:1      (c) 1:4      (d) 1:1

Q72: A piece of ice is floating in water at  $4^\circ \text{C}$  in a beaker. When the ice melts completely, the water level in the beaker will

- (a) rise      (b) fall      (c) remains unchanged      (d) unpredictable

Rough work below this line:

Q73: In a screw-nut assembly (shown below) the nut is held fixed in its position and the screw is allowed to rotate inside it. A convex lens (L) of focal length 6.0 cm is fixed on the nut. An object pin (P) is attached to the screw head. The image of the object is observed on a screen Y. When the screw head is rotated through one rotation, the linear distance moved by the screw tip is 1.0 mm. The observations are made only when the image is obtained in the same orientation on the screen. At a certain position of P, the image formed is three times magnified as that of the pin height. Through how many turns should the screw head be rotated so that the image is two times magnified?



- (a) 8                      (b) 10                      (c) 12                      (d) 14

Q74: A school is located between two cliffs. When the metal bell is struck by school attendant, first echo is heard by him after 2.4 s and second echo follows after 2.0 s for him at the same position near the bell. If the velocity of sound in air is  $340 \text{ ms}^{-1}$  at the temperature of the surroundings, then the distance between the cliffs is approximately \_\_\_\_.

- (a) 0.488 km                      (b) 0.751 km                      (c) 1.16 km                      (d) 1.41 km

Q75: The triangular face of a crown glass prism ABC is isosceles. Length AB = length AC and the rectangular face with edge AC is silvered. A ray of light is incident normally on rectangular face with edge AB. It undergoes reflections at AC and AB internally and it emerges normally through the rectangular base with edge BC. Then angle BAC of the prism is \_\_\_\_.

- (a)  $24^\circ$                       (b)  $30^\circ$                       (c)  $36^\circ$                       (d)  $42^\circ$

Q76: The radius of curvature of a convex mirror is 'x'. The distance of an object from focus of this mirror is 'y'. Then what is the distance of image from the focus?

- (a)  $y^2 / 4x$                       (b)  $x^2 / y$                       (c)  $x^2 / 4y$                       (d)  $4y^2 / x$

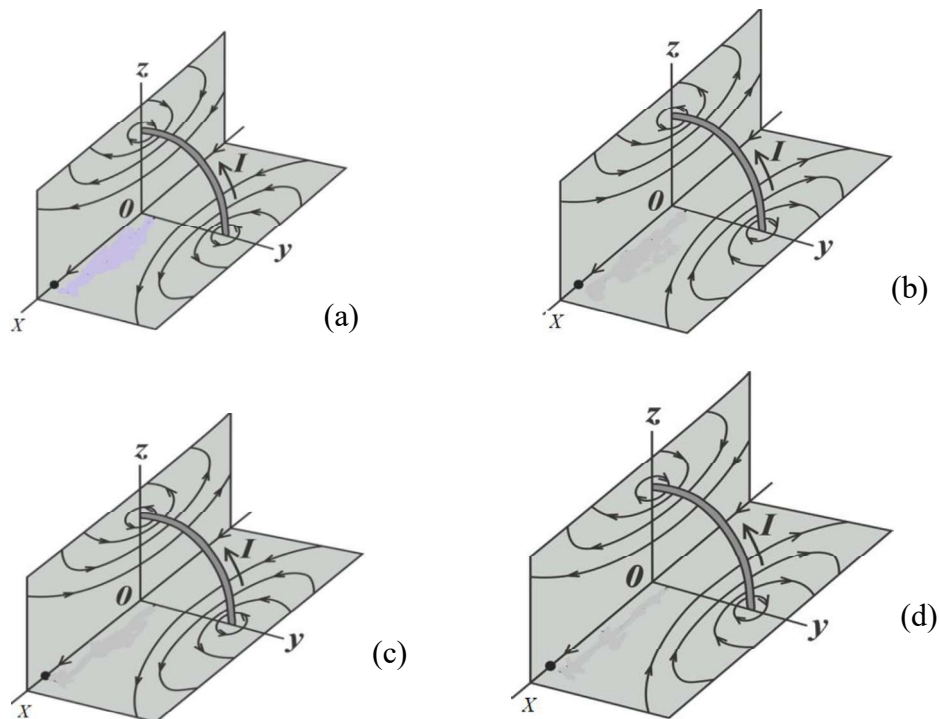
Rough work below this line:



Q77: A physics teacher and his family are travelling in a car on a highway during a severe lightning storm. Choose the correct option:

- (a) Safest place will be inside the car as the charges due to lightning tend to remain on the metal sheet / skin of the vehicle if struck by lightning.
- (b) It's too dangerous to be inside the car. As the car has a metal body the charges tend to accumulate on the surface and will generate a strong electric field inside the car.
- (c) Safest place is under a tree. It's better to get drenched under a tree as the wet tree will provide a path to the charges for earthing.
- (d) It is safer to exit the car and stand on open ground

Q78: A conductor in the form of a circular loop is carrying current  $I$ . The direction of the current is as shown. Then which figure represents the correct direction of magnetic field lines on the surfaces of the planes XY and XZ. (Consider those surfaces of the XY and XZ planes which are seen in the figure.)



Rough work below this line:

Q79: A particle experiences constant acceleration for 20 s after starting from rest. If it travels a distance  $S_1$  in the first 10 s and distance  $S_2$  in the next 10 s, the relation between  $S_1$  and  $S_2$  is:

- (a)  $S_2=3S_1$                       (b)  $S_1=3S_2$                       (c)  $S_2= 2S_1$                       (d)  $S_1=10S_2$

Q80: A sound wave is produced by a vibrating metallic string stretched between its ends.

Four statements are given below. Some of them are correct.

- (P) Sound wave is produced inside the string.  
(Q) Sound wave in the string is transverse.  
(R) Wavelength of the sound wave in surrounding air is equal to the wavelength of the transverse wave on the string.  
(S) Loudness of sound is proportional to the square of the amplitude of the vibrating string.

Choose the correct option.

- (a) P                      (b) R and S                      (c) P and Q                      (d) S

**QUESTION PAPER ENDS HERE**

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Rough work below this line:

1. Trigonometric ratios are defined for angles greater than  $90^\circ$  also.
2. The following identities may be useful:  
$$\sin(180^\circ - \theta) = \sin\theta; \quad \cos(180^\circ - \theta) = -\cos\theta$$
3. Periodic Table of elements

PERIODIC TABLE OF THE ELEMENTS

1	2																				
H	He																				
1.008	4.00																				
3	4																				
Li	Be																				
6.94	9.01																				
11	12																				
Na	Mg																				
22.99	24.30																				
19	20	21	22	23	24	25	26	27	28	29	30					31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr				
39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.59	74.92	78.96	79.90	83.80				
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54				
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe				
85.47	87.62	88.91	91.22	92.91	95.94	(98)	101.1	102.91	106.42	107.87	112.41	114.82	118.71	121.75	127.60	126.91	131.29				
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86				
Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn				
132.91	137.33	138.91	178.49	180.95	183.85	186.21	190.2	192.2	195.08	196.97	200.59	204.38	207.2	208.98	(209)	(210)	(222)				
87	88	89	104	105	106	107	108	109	110	111											
Fr	Ra	†Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg											
(223)	226.02	227.03	(261)	(262)	(266)	(264)	(277)	(268)	(271)	(272)											
<div>*Lanthanide Series</div>																					
<div>†Actinide Series</div>																					