BITSAT 2023 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**390	**Total Questions :**130

General Instructions

Read the following instructions very carefully and strictly follow them:

1. **Mode**: Computer-based online test
2. **Duration**: 3 hours (180 minutes)
3. **Sections**: The exam consists of four parts:
   (a) Part I: Physics (30 questions)
   (b) Part II: Chemistry (30 questions)
   (c) Part III: English Proficiency (10 questions) and Logical Reasoning (20 questions)
   (d) Part IV: Mathematics (40 questions) or Biology (for B.Pharm candidates)
4. **Total Marks**: 390
5. **Marking Scheme**: Each correct answer awards 3 marks, and 1 mark is deducted for each incorrect answer
6. **Subjects**:
   (a) Physics: Mechanics, Electromagnetism, Thermodynamics, Modern Physics
   (b) Chemistry: Organic, Inorganic, and Physical Chemistry
   (c) Mathematics: Calculus, Algebra, Geometry (or Biology for B.Pharm candidates)
   (d) English Proficiency: Reading Comprehension, Vocabulary
   (e) Logical Reasoning: Analytical and Problem-solving skills

1. An object moves with speed v_1, v_2, and v_3 along a line segment AB, BC, and CD respectively as shown in the figure. Where $AB = BC$ and $AD = 3AB$, then the average speed of the object will be:

(A) $\frac{v_1 v_2 v_3}{3(v_1 v_2 + v_2 v_3 + v_3 v_1)}$

(B) $\frac{3 v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$

(C) $\frac{(r_1^2 + r_2^2 + r_3^2)}{3}$

(D) $\frac{(v_1 + v_2 + v_3)}{3 v_1 v_2 v_3}$

---

2. The effect of an increase in temperature on the number of electrons in the conduction band (n_e) and the resistance of a semiconductor will be as follows:

(A) Both n_e and resistance decrease

(B) Both n_e and resistance increase

(C) n_e increases, resistance decreases

(D) n_e decreases, resistance increases

---

3. A radioactive material is reduced to $\frac{1}{8}$ of its original amount in 3 days. If 8×10^{-3} kg of the material is left after 5 days, what was the initial amount of the material?

(A) 700 gm

(B) 900 gm

(C) 475 gm

(D) 256 gm

---

4. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. The number of spectral lines emitted will be:

(A) 2

(B) 1

(C) 3

(D) 4

---

5. If 1000 droplets of water of surface tension 0.07. having same radius 1mm each, combine to from a single drop. In the process the released surface energy is-
(Take $\pi = \frac{22}{7}$):

(A) 7.92×10^{-6} J

(B) 7.92×10^{-4} J

(C) 9.68×10^{-4} J

(D) 8.8×10^{-5} J

---

6. The force between two small charged spheres having charges of 1×10^{-7} C and 2×10^{-7} C placed 20 cm apart in air is:

(A) 4.5×10^{-2} N

(B) 4.5×10^{-3} N

(C) 5.4×10^{-2} N

(D) 5.4×10^{-3} N

---

7. The work done in placing a charge of 8×10^{-18} coulomb on a capacitor of capacitance 100 microfarad is:

(A) 3.1×10^{-26} joule

(B) 4×10^{-10} joule

(C) 32×10^{-32} joule

(D) 16×10^{-32} joule

---

8. The resistance of a wire is 5Ω. What will be its new resistance in ohms if stretched to 5 times its original length?

(A) 625

(B) 5

(C) 125

(D) 25

---

9. A charged particle is moving in a uniform magnetic field $\mathrm{B} = 2\hat{i} + 3\hat{j}$ T. If it has an acceleration of $\mathrm{a} = \alpha\hat{i} - 4\hat{j}$ m/s², then the value of α will be:

(A) 3

(B) 6

(C) 12

(D) 2

---

10. A proton (p) and an electron (e) will have the same de-Broglie wavelength when the ratio of their momenta is (Assume $m_p = 1849 m_e$):

(A) $1 : 43$

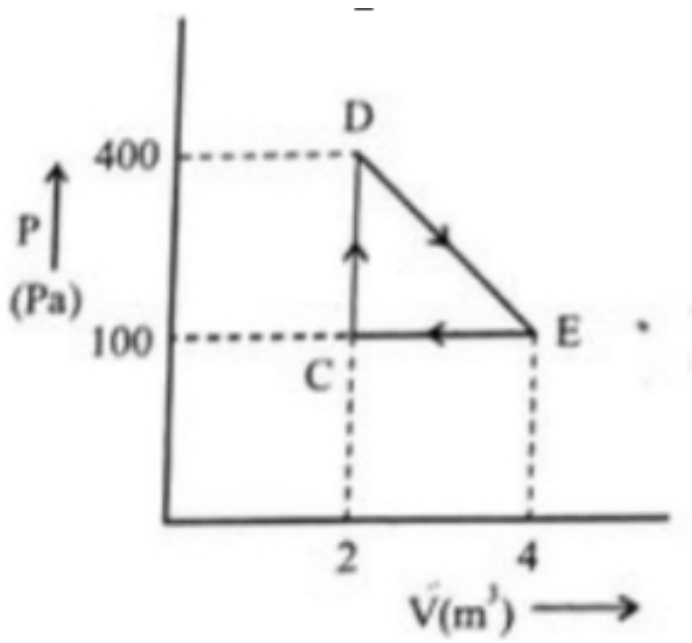
(B) $43 : 1$

(C) $1 : 1849$

(D) $1 : 1$

---

11. A thermodynamic system is taken through a cyclic process as shown in the PV diagram. The total work done in the process is:



(A) 100 J

(B) 300 J

(C) 0

(D) 200 J

---

12. In a reflecting telescope, a secondary mirror is used to:

(A) Reduce the problem of mechanical support

(B) Remove spherical aberration

(C) Make chromatic aberration zero

(D) Move the eyepiece outside the telescopic tube

---

13. The magnetic moment of an electron (e) revolving in an orbit around the nucleus with an orbital angular momentum is given by:

(A) $\vec{\mu}_L = \frac{e\vec{L}}{2m}$

(B) $\vec{\mu}_L = -\frac{e\vec{L}}{2m}$

(C) $\vec{\mu}_L = -\frac{e\vec{L}}{m}$

(D) $\vec{\mu}_L = \frac{2e\vec{L}}{m}$

---

14. The ratio of intensities at two points P and Q on the screen in a Young's double-slit experiment, where the phase difference between two waves of the same amplitude are $\frac{\pi}{3}$ and $\frac{\pi}{2}$, respectively, is:

(A) $1:3$

(B) $3:1$

(C) $3:2$

(D) $2:3$

---

15. A bicycle tire is filled with air at a pressure of 270 kPa at $27°C$. What is the approximate pressure of the air in the tire when the temperature increases to $36°C$?

(A) 270 kPa

(B) 262 kPa

(C) 278 kPa

(D) 360 kPa

---

16. A particle executes Simple Harmonic Motion (SHM) with amplitude A. The distance from the mean position when its kinetic energy becomes equal to its potential energy is:

(A) $\sqrt{2}A$

(B) $2A$

(C) $\frac{A}{\sqrt{2}}$

(D) $\frac{A}{2}$

---

17. Electric field in a certain region is given by $\vec{E} = \left(\frac{A}{x^2}\hat{i} + \frac{B}{y^3}\hat{j}\right)$. The SI unit of A and B are:

(A) Nm^3C^{-1}; Nm^2C^{-1}

(B) Nm^2C^{-1}; Nm^3C^{-1}

(C) Nm^3C; Nm^2C

(D) Nm^2C; Nm^3C

---

18. At any instant the velocity of a particle of mass 500g is $\left(2t\hat{i} + 3t^2\hat{j}\right)$ ms^{-1}. If the force acting on the particle at $t = 1$ s is $\left(\hat{i} + x\hat{j}\right)$ N, then the value of x will be:

(A) 3

(B) 4

(C) 6

(D) 2

---

19. A particle of mass m moving with velocity v collides with a stationary particle of mass $2m$. After the collision, they stick together and continue to move with velocity:

(A) v

(B) $\frac{v}{2}$

(C) $\frac{v}{3}$

(D) $\frac{v}{4}$

---

20. Which of the following Maxwell's equations is valid for time varying conditions but not valid for static conditions:

(A) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

(B) $\oint \vec{E} \cdot d\vec{l} = 0$

(C) $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \vec{B}}{\partial t}$

(D) $\oint \vec{D} \cdot d\vec{A} = Q$

21. In an LC oscillator, if the values of inductance and capacitance become twice and eight times, respectively, then the resonant frequency of the oscillator becomes x times its initial resonant frequency ω_0. The value of x is:

(A) $\frac{1}{4}$

(B) 16

(C) $\frac{1}{16}$

(D) 4

---

22. A conducting loop of radius $\frac{10}{\sqrt{\pi}}$ cm is placed perpendicular to a uniform magnetic field of 0.5T. The magnetic field is decreased to zero in 0.5 s at a steady rate. The induced emf in the circular loop at 0.25s is:

(A) emf = 1 mV

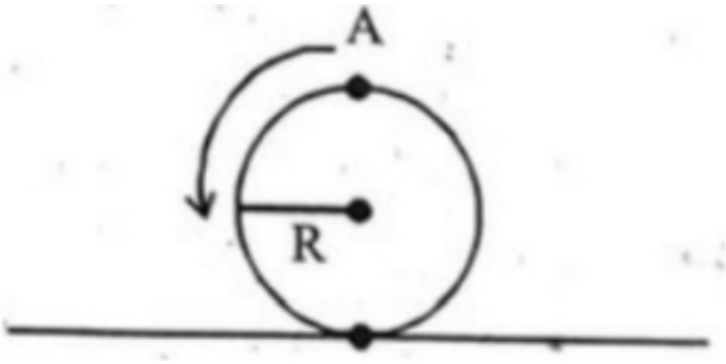
(B) emf = 10 mV

(C) emf = 100 mV

(D) emf = 5 mV

---

23. A disc is rolling without slipping on a surface. The radius of the disc is R. At $t = 0$, the topmost point on the disc is A as shown in the figure. When the disc completes half of its rotation, the displacement of point A from its initial position is:



(A) $R\sqrt{\pi^2 + 4}$

(B) $R\sqrt{\pi^2 + 1}$

(C) $2R$

(D) $2R\sqrt{1 + 4\pi^2}$

---

24. Two planets A and B have radii R and $1.5R$, and densities ρ and $\frac{\rho}{2}$ respectively. The ratio of acceleration due to gravity at the surface of B to A is:

(A) $2:3$

(B) $2:1$

(C) $3:4$

(D) $4:3$

---

25. A 100m long wire having cross-sectional area 6.25×10^{-4} m^2 and Young's modulus is 10^{10} Nm^{-2} is subjected to a load of 250N, then the elongation in the wire will be:

(A) 6.25×10^{-3} m

(B) 4×10^{-4} m

(C) 6.25×10^{-6} m

(D) 4×10^{-3} m

---

26. The ratio of the speed of sound in hydrogen gas to the speed of sound in oxygen gas at the same temperature is:

(A) $4:1$

(B) $1:2$

(C) $1:4$

(D) $1:1$

---

27. The free space inside a current carrying toroid is filled with a material of susceptibility $\chi = 2 \times 10^{-2}$. The percentage increase in the value of magnetic field inside the toroid will be:

(A) 2%

(B) 0.2%

(C) 0.1%

(D) 1%

---

28. The ratio of average electric energy density and total average energy density of an electromagnetic wave is:

(A) 2

(B) $\frac{1}{2}$

(C) 1

(D) 3

---

29. In a Young's double slit experiment, the intensities at two points, for the path difference $\frac{\lambda}{4}$ and $\frac{\lambda}{3}$ (λ being the wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits, then $\frac{I_1+I_2}{I_0}$ is equal to:

(A) 3

(B) 5

(C) 7

(D) 10

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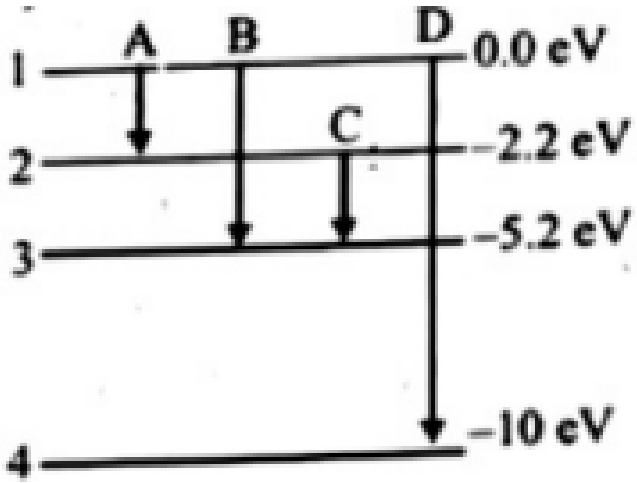
30. The energy levels of an atom are shown in the figure. Which one of these transitions will result in the emission of a photon of wavelength 124.1 nm? Given $h = 6.62 \times 10^{-34}$ Js.



(A) B

(B) A

(C) C

(D) D

---

31. Frenkel and Schottky defects are:

(A) Nucleus defects

(B) Non-crystal defects

(C) Crystal defects

(D) Nuclear defects

---

32. The Bohr orbit radius for the hydrogen atom ($n = 1$) is approximately 0.530 Å. The radius for the first excited state ($n = 2$) orbit is (in Å):

(A) 0.13

(B) 1.06

(C) 4.77

(D) 2.12

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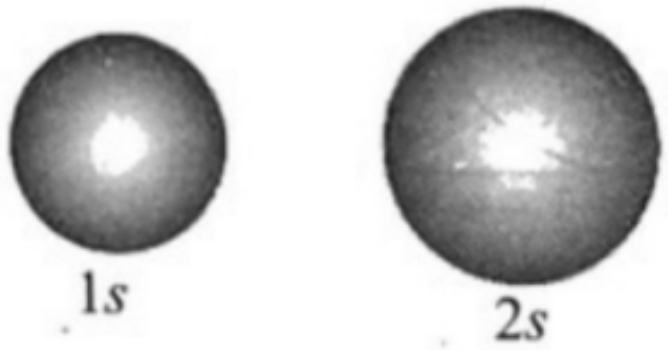
33. The probability density plots of 1s and 2s orbitals are given in figure.



The density of dots in a region represents the probability density of finding electrons in the region.

On the basis of the above diagram, which of the following statements is incorrect?

(A) 1s and 2s orbitals are spherical in shape.

(B) The probability of finding the electron is maximum near the nucleus.

(C) The probability of finding the electron at a given distance is equal in all directions.

(D) The probability density of electrons for 2s orbital decreases uniformly as distance from the nucleus increases.

---

34. Element with electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3$ belongs to the following group of the periodic table:

(A) 5th

(B) 15th

(C) 3rd

(D) 17th

---

35. Which of the following pairs will form the most stable ionic bond?

(A) Na and Cl

(B) Mg and F

(C) Li and F

(D) Na and F

---

36. How much ethyl alcohol must be added to 1 litre of water so that the solution will freeze at -14°C?

(K_f for water $= 1.86\,^{\circ}$C/mol)

(A) 7.5 mol

(B) 8.5 mol

(C) 9.5 mol

(D) 10.5 mol

---

37. The conductivity of a weak acid HA of concentration 0.001 mol L^{-1} is 2.0×10^{-5} S cm^{-1}. If Λ_m°(HA) $= 190$ S cm^{2}mol^{-1}, the ionization constant (K_a) of HA is equal to $\_\_\_\_\_ \times 10^{-6}$.

(A) 24

(B) 48

(C) 12

(D) 45

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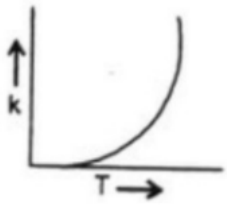
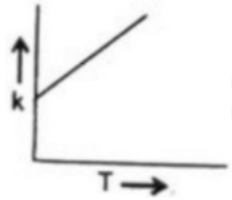
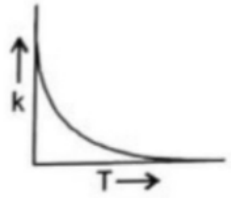
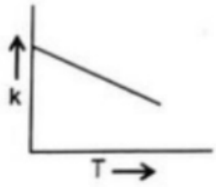
38. Plots showing the variation of the rate constant (k) with temperature (T) are given below. The plot that follows the Arrhenius equation is:

(A) 

(B) 

(C) 

(D) 

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39. Which of the following method is used for coagulation of the sol?

(A) By mixing two oppositely charged sols.

(B) By electrophoresis.

(C) By addition of electrolytes.

(D) All of the above.

---

40. The reaction that does NOT take place in a blast furnace between 900K to 1500K temperature range during extraction of iron is:

(A) $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$

(B) $FeO + CO \rightarrow Fe + CO_2$

(C) $C + CO_2 \rightarrow 2CO$

(D) $CaO + SiO_2 \rightarrow CaSiO_3$

---

41. Kinetic theory of gases proves:

(A) only Boyle's law

(B) only Charles' law

(C) only Avogadro's law

(D) all of these

---

42. If enthalpies of formation of $C_2H_4(g)$, $CO_2(g)$ and $H_2O(l)$ at 25°C and 1 atm pressure are 52, 394 and -286 kJ/mol respectively, the change in enthalpy for combustion of C_2H_4 is equal to:

(A) -141.2 kJ/mol

(B) -1412 kJ/mol

(C) +14.2 kJ/mol

(D) +1412 kJ/mol

---

43. The photochemical smog does not generally contain:

(A) NO

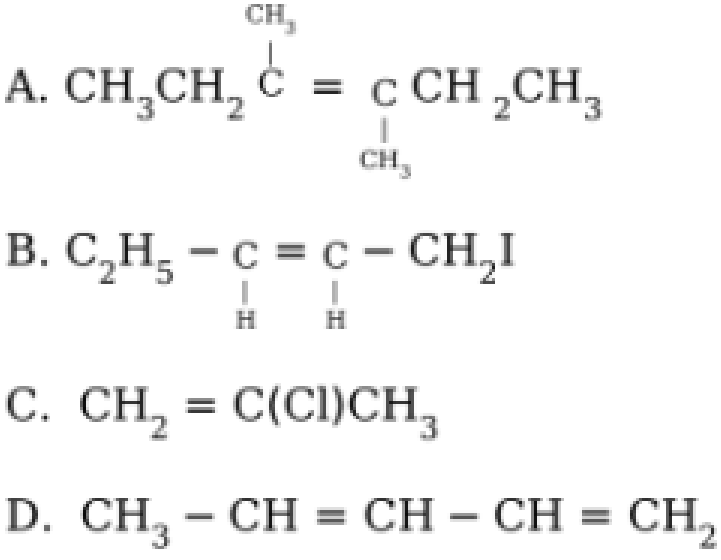
(B) SO_2

(C) NO_2

(D) HCHO

---

44. Geometrical isomerism is not shown by:



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45. For the separation of two immiscible liquids, which method is used?

(A) Chromatography

(B) Fractionating column

(C) Fractional distillation

(D) Separating funnel

---

46. What is x in the following reaction?

$$\text{Al}(s) + \text{NaOH}(aq) + \text{H}_2O(l) \rightarrow x + \text{H}_2(g)$$

(A) $Na_2[Al(OH)_4]^-$

(B) $Na^+[Al(OH)_4]^-$

(C) $Na_2[Al(OH)_6]^-$

(D) $Na^+[Al(OH)_6]^-$

---

47. Which of the following will precipitate first when an aqueous solution containing sulphate ions is added?

(A) Mg^{2+}

(B) Ca^{2+}

(C) Sr^{2+}

(D) Ba^{2+}

---

48. Ionic hydrides react with water to give:

(A) Acidic solutions

(B) Hydride ions

(C) Basic solutions

(D) Electrons

---

49. The drug used as an antidepressant is:

(A) Luminol

(B) Tofranil

(C) Mescaline

(D) Sulphadiazine

---

50. Melamine plastic crockery is a copolymer of:

(A) HCHO and melamine

(B) HCHO and ethylene

(C) Melamine and ethylene

(D) None of these

---

51. The helical structure of a protein is stabilized by:

(A) Dipeptide bonds

(B) Hydrogen bonds

(C) Ether bonds

(D) Peptide bonds

---

52. Which of the following factors affect the basic strength of amines?

(i) Inductive effect

(ii) Steric hindrance

(iii) Solvation effect

(iv) Solubility in organic solvents

(A) (i) and (iv)

(B) (i), (ii), and (iii)

(C) (ii) and (iii)

(D) (ii) and (iv)

---

53. Find out compound B in the given reaction sequence:

$$C_6H_6 + CH_3X \xrightarrow{AlCl_3} A \xrightarrow{CrO_3 \text{ in } (CH_3CO)_2O/H_3O^+} B$$

(A) Acetophenone ($C_6H_5COCH_3$)(B)Benzaldehyde(C_6H_5CHO)

(C) Cyclohexyl carbaldehyde ($C_6H_{11}CHO$)

(D) Benzoic acid (C_6H_5COOH)

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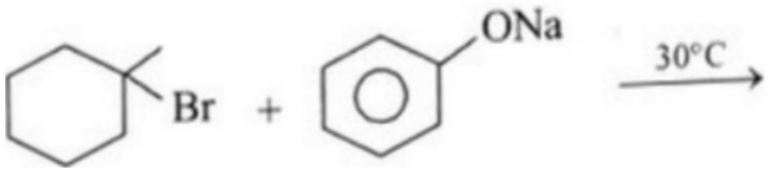
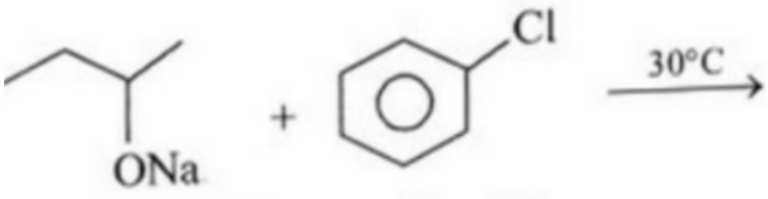
54. Which method is useful for the synthesis of ether?

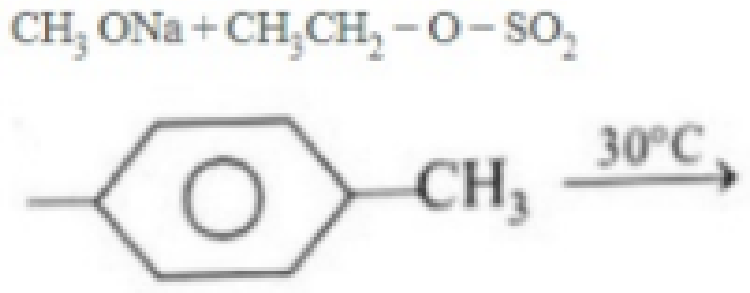
(A) Williamson Ether Synthesis with a benzyl bromide derivative



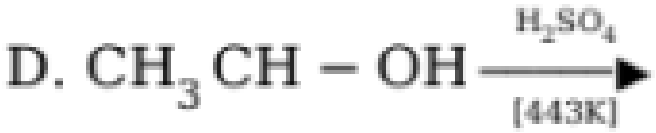
(B) Nucleophilic substitution involving sodium phenoxide



(C) Williamson Ether Synthesis with alkoxide and alkyl sulfonate



(D) Dehydration of alcohol using sulfuric acid at high temperature



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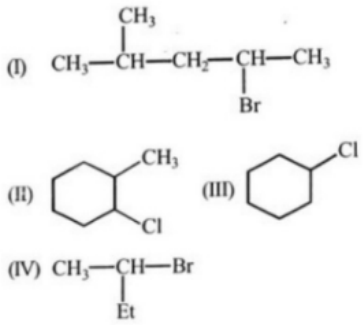
55. Among the given halides, which one will give the same product in both S_N1 and S_N2 reactions?



(A) (III) only

(B) (I) and (II)

(C) (III) and (IV)

(D) (I), (III), and (IV)

---

56. Among the ligands NH_3, en, CN^-, CO, the correct order of their increasing field strength is:

(A) $NH_3 < en < CN^- < CO$

(B) $CN^- < NH_3 < en$

(C) $en < CN^- < NH_3 < CO$

(D) $CO < NH_3 < en < CN^-$

---

57. The S – S bond is not present in:

(A) $S_2O_4^{2-}$

(B) $S_2O_5^{2-}$

(C) $S_2O_3^{2-}$

(D) $S_2O_7^{2-}$

---

58. In the laboratory, manganese (II) salt is oxidized to permanganate ion in aqueous solution by:

(A) hydrogen peroxide

(B) conc. nitric acid

(C) peroxy disulphate

(D) dichromate

---

59. Which one of the following molecular hydrides acts as a Lewis acid?

(A) NH_3

(B) H_2O

(C) B_2H_6

(D) CH_4

---

60. Electrode potential data are given below:

$$\mathrm{Fe}^{3+}(\mathrm{aq}) + e^- \rightarrow \mathrm{Fe}^{2+}(\mathrm{aq}); E^\circ = +0.77\,\mathrm{V}$$

$$\mathrm{Al}^{3+}(\mathrm{aq}) + 3e^- \rightarrow \mathrm{Al(s)}; E^\circ = -1.66\,\mathrm{V}$$

$$\mathrm{Br_2(aq)} + 2e^- \rightarrow 2\mathrm{Br}^-(\mathrm{aq}); E^\circ = +1.08\,\mathrm{V}$$

Based on the data, the reducing power of Fe^{2+}, Al, and Br^- will increase in the order:

(A) $\mathrm{Br}^- < \mathrm{Fe}^{2+} < \mathrm{Al}$

(B) $\mathrm{Fe}^{2+} < \mathrm{Al} < \mathrm{Br}^-$

(C) $\mathrm{Al} < \mathrm{Br}^- < \mathrm{Fe}^{2+}$

(D) $\mathrm{Al} < \mathrm{Fe}^{2+} < \mathrm{Br}^-$

---

61. Write the antonym: **Fricassee**

(A) grill

(B) decorate

(C) stew

(D) to baste

---

62. Write the antonym: **Retribution**

(A) compensation

(B) forgiveness

(C) contempt

(D) grudge

---

63. Write the antonym: **Sumptuous**

(A) irritable

(B) meagre

(C) fancy

(D) sad

---

64. Rajeev failed in the examination because his answers were not . . . . . to the questions asked

(A) allusive

(B) pertinent

(C) revealing

(D) referential

---

65. Choose the correct words to complete the sentence: *It was . . . . . cold . . . . . we couldn't go out.*

(A) so, that

(B) too, to

(C) neither, nor

(D) either, or

---

66. Faced with the

P: traditional culture in the pre-independence India

Q: challenge of the intrusion of colonial culture and ideology

R: developed during the nineteenth century

S: at attempt to reinvigorate traditional institutions and realize the potential of

Which one of the following is the correct sequence?

(A) P - R - Q - S

(B) Q - S - P - R

(C) P - S - Q - R

(D) Q - R - P - S

---

67. A diversified use

P: as a heating or power generation fuel by converting gas into

Q: adding a new dimension to the traditional use of gas

R: of natural gas is emerging

S: amongst other products, high quality diesel transportation fuel virtually free of sulphur

Which one of the following is the correct sequence?

(A) R - P - Q - S

(B) S - Q - P - R

(C) R - Q - P - S

(D) S - P - Q - R

---

68. Music is often linked to .....

(A) anger

(B) mood

(C) anxiety

(D) happiness

---

69. How is music an important part of life?

(A) It makes us feel different emotions

(B) It makes us sad

(C) It helps in our daily activities

(D) It helps us in remembering things

---

70. Which of the statements is true?

(A) All forms of music may heal wounds

(B) All forms of music may have good effect

(C) All forms of music may be soothing

(D) All forms of music may have therapeutic effects

---

71. On the following questions, select the related word/letters from the attractive

MASTER: OCUVGT :: LABOUR:?

(A) NCDQWT

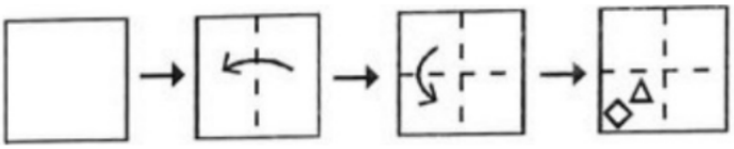
(B) HDERWT

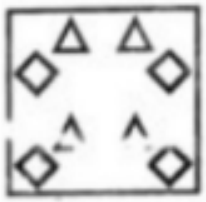
(C) NBECRWT

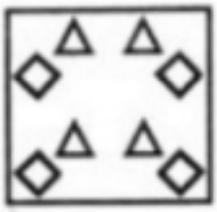
(D) NEDRWT

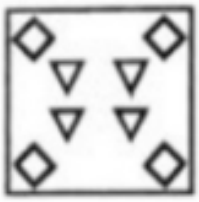
---

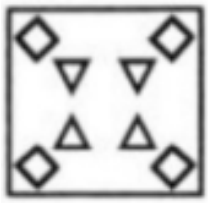
72. The sequence of folding a paper and the manner in which the folded paper has been cut is shown in the following figures. How would this paper look when unfolded?



(A) 

(B) 

(C) 

(D) 

---

73. In a given code, SISTER is coded as 535301, UNCLE as 84670, and BOY as 129. How is RUSTIC written in that code?

(A) 633185

(B) 185336

(C) 363815

(D) 581363

---

74. Daya has a brother, Anil. Daya is the son of Chandra. Bimal is Chandra's father. In terms of relationship, what is Anil of Bimal?

(A) Son

(B) Grandson

(C) Brother

(D) Grandfather

---

75. Find the odd word pair among the given four word pairs.

(A) Error : Accurate

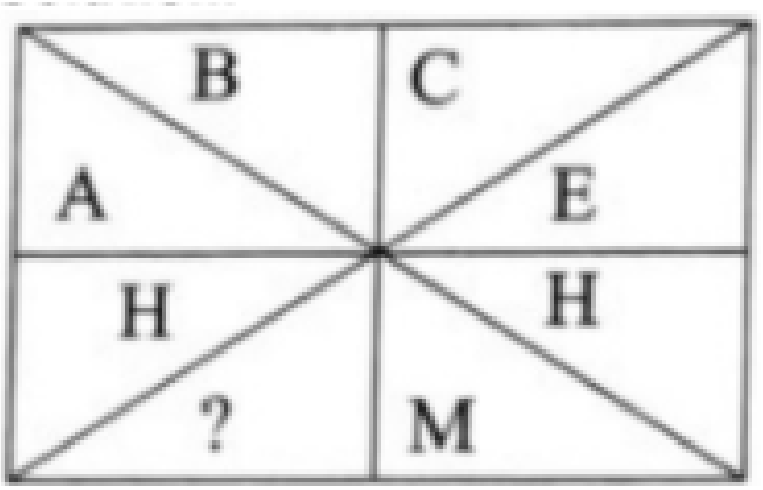
(B) Careless : Casual

(C) Strength : Lethargy

(D) Gloomy : Cheerful

---

76. Which letter will come at the place of question mark (?)



(A) U

(B) V

(C) W

(D) X

---

77. Arrange the following words as per order in the dictionary.

1. Flunching

2. Fluntlock

3. Flunpites

4. Fluntlocks

5. Flunchers

(A) 1, 5, 2, 4, 3

(B) 5, 1, 2, 4, 3

(C) 5, 1, 3, 2, 4

(D) 5, 1, 3, 4, 2

---

78. Two statements are given followed by three conclusions numbered I, II, and III. Assuming the statements to be true, even if they seem to be at variance with commonly known facts, decide which of the conclusions logically follow(s) from the statements.

Statements:

- All utensils are spoons.
- All bowls are spoons.

Conclusions:

- I. No utensil is a bowl.
- II. Some utensils are bowls.
- III. No spoon is a utensil.

(A) Only conclusion I follows

(B) Conclusions I and III follow

(C) Either conclusion I or II follows

(D) Only conclusion III follows

---

79. In this question, a word has been given followed by four other words, one of which cannot be formed by using the letters of the given word. Find this word.

Word: CHEMOTHERAPY

(A) HECTARE

(B) MOTHER

(C) THEATER

(D) FATHER

---

80. Which one set of letters when sequentially placed at the gaps in the given letter series would complete it?

fgg _____ gff _____ f _____ gfg _____ fgfo

(A) fggf

(B) ccfc

(C) fgfg

(D) ffgg

---

81. Select the option in which the numbers are related in the same way as are the numbers in the given set.

(9, 217, 8)

(A) (4, 37, 3)

(B) (2, 76, 5)

(C) (5, 625, 6)

(D) (3, 49, 2)

---

82. Find the next term in the following series:

X24C, V22E, T20G, _____

(A) RI 19

(B) R19I

(C) R18I

(D) RI 18

---

83. In the following question, select the related number that will correct the place of the question mark.

108 : 11664 :: 112 : ?

(A) 12504

(B) 12544

(C) 13644

(D) 17644

---

84. Which number pair is odd among the given four number pairs?

(A) 123 - 321

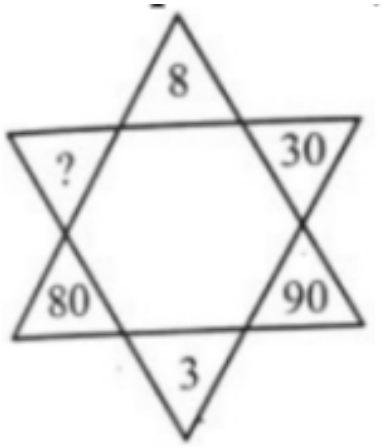
(B) 456 - 654

(C) 789 - 978

(D) 678 - 876

---

85. In the questions, select the missing number from the given responses.



(A) 20

(B) 15

(C) 40

(D) 10

---

86. Find the Missing Number: 2, 12, 36, 80, 150, ?

(A) 195

(B) 210

(C) 252

(D) 258

---

87. If 'when' means ' x ', 'you' means ' ÷ ', 'come' means '-' and 'will' means '+', then what will be the value of " 8 when 12 will 16 you 2 come 10" = ?

(A) 45

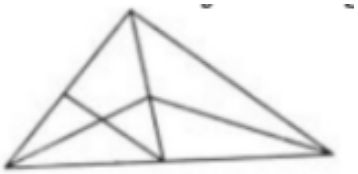
(B) 94

(C) 96

(D) 112

---

88. How many triangles are there in the following figure?



(A) 11

(B) 13

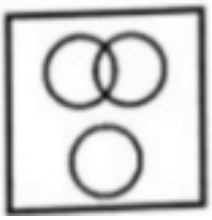
(C) 9

(D) 15

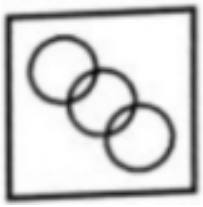
---

89. Identify the Venn diagram that best represents the relationship among classes given below: Profit, Dividend, and Bonus.

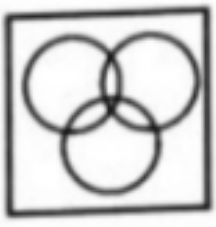
(A) Venn Diagram 1



(B) Venn Diagram 2



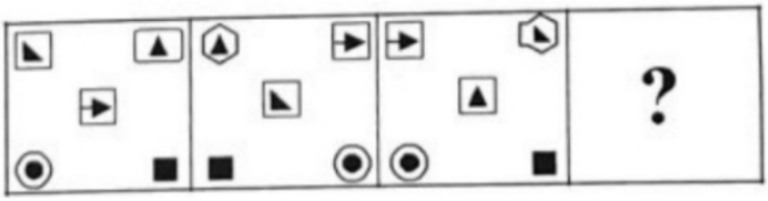
(C) Venn Diagram 3



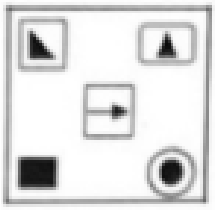
(D) Venn Diagram 4

---

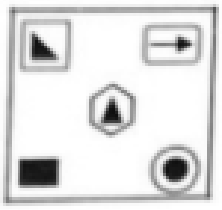
90. Select the figure from among the given Option that can replace the question mark (?) in the following series.



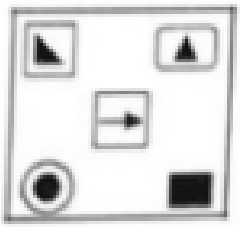
(A) Figure 1



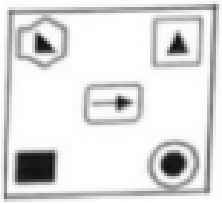
(B) Figure 2



(C) Figure 3



(D) Figure 4



91. If $\sec^2\theta = \frac{4}{3}$, then the general value of θ is:

(A) $2n\pi \pm \frac{\pi}{6}$

(B) $n\pi \pm \frac{\pi}{6}$

(C) $2n\pi \pm \frac{\pi}{3}$

(D) $n\pi \pm \frac{\pi}{3}$

---

92. Number of words from the letters of the word BHARAT in which B and H will never come together is:

(A) 210

(B) 240

(C) 422

(D) 400

---

93. The ratio in which the YZ-plane divides the line segment formed by joining the points (-2, 4, 7) and (3, -5, 8) is 2 : m. The value of m is:

(A) 2

(B) 3

(C) 4

(D) 1

---

94. A set A has 3 elements and another set B has 6 elements. Then:

(A) $3 \leq n(A \cup B) \leq 6$

(B) $3 \leq n(A \cup B) \leq 9$

(C) $6 \leq n(A \cup B) \leq 9$

(D) $0 \leq n(A \cup B) \leq 9$

---

95. For all $n \in \mathbb{N}$, the sum of $\frac{n^5}{5} + \frac{n^3}{3} + \frac{7n}{15}$ is:

(A) a negative integer

(B) a whole number

(C) a real number

(D) a natural number

---

96. The roots of the given equation $(p-q)x^2+(q-r)x+(r-p)=0$ **are:**

(A) $\frac{p-q}{r-p}, 1$

(B) $\frac{q-r}{p-q}, 1$

(C) $\frac{r-p}{p-q}, 1$

(D) None of these

---

97. What is the angle between the two straight lines $y=(2-\sqrt{3})x+5$ **and** $y=(2+\sqrt{3})x-7$**?**

(A) 60°

(B) 45°

(C) 30°

(D) 15°

---

98. The range of the function $f(x)=\sqrt{3x^2-4x+5}$ **is:**

(A) $(-\infty, \sqrt{\frac{11}{3}})$

(B) $(-\infty, \sqrt{\frac{11}{5}})$

(C) $\left[\sqrt{\frac{11}{3}}, \infty\right)$

(D) $\left[\sqrt{\frac{11}{5}}, \infty\right)$

---

99. If $f(x)=\frac{x}{\sqrt{1+x^2}}$**, then** $(f\circ f)(x)$ **is:**

(A) $\frac{3x}{1+x^2}$

(B) $\frac{x}{\sqrt{1+3x^2}}$

(C) $\frac{3x}{\sqrt{1-x^2}}$

(D) None of these

---

100. The derivative of e^{x^3} **with respect to** $\log x$ **is:**

(A) e^{x^3}

(B) $3x^2e^{x^3}$

(C) $3x^3e^{x^3}$

(D) $3x^3e^{x^3} + 3x^2$

---

101. If the coordinates of the points A and B are $(3, 3)$ and $(7, 6)$,

then the length of the portion of the line AB intercepted between the axes is:

(A) $\frac{5}{4}$

(B) $\frac{\sqrt{10}}{4}$

(C) $\frac{\sqrt{13}}{3}$

(D) None of these

---

102. Solution of $2^x + 2^{|x|} \geq 2\sqrt{2}$ is:

(A) $(-\infty, \log_2(\sqrt{2}+1))$

(B) $(0, \infty)$

(C) $\left(\frac{1}{2}, \log_2(\sqrt{2}-1)\right)$

(D) $\left(-\infty, \log_2(\sqrt{2}-1)\right) \cup \left[\frac{1}{2}, \infty\right)$

---

103. If $y = \sqrt{\frac{1+\cos 2\theta}{1-\cos 2\theta}}$**, then** $\frac{dy}{d\theta}$ **at** $\theta = \frac{3\pi}{4}$ **is:**

(A) -2

(B) 2

(C) ± 2

(D) None of these

---

104. The number of solutions of the differential equation

$$\frac{dy}{dx} = \frac{y+1}{x-1}$$

when $y(1) = 2$ **is:**

(A) none

(B) one

(C) two

(D) infinite

---

105. The probability of getting a sum greater than 7 when a pair of dice are thrown is:

(A) $\frac{7}{36}$

(B) $\frac{5}{12}$

(C) $\frac{7}{12}$

(D) None of these

---

106. The probability that a card drawn from a pack of 52 cards will be a diamond or a king is:

(A) $\frac{1}{52}$

(B) $\frac{2}{13}$

(C) $\frac{4}{13}$

(D) $\frac{1}{13}$

---

107. If

$$A = \begin{bmatrix} 0 & 2 \\ 3 & -4 \end{bmatrix}$$

and

$$kA = \begin{bmatrix} 0 & 3a \\ 2b & 24 \end{bmatrix},$$

then the values of k, a, and b respectively are:

(A) $-6, -12, -18$

(B) $-6, -4, -9$

(C) $-6, 4, 9$

(D) $-6, 12, 18$

---

108. If the eccentricity and length of the latus rectum of a hyperbola are $\frac{\sqrt{13}}{3}$ and $\frac{10}{3}$ units respectively, then what is the length of the transverse axis?

(A) $\frac{7}{2}$ unit

(B) 12 unit

(C) $\frac{15}{2}$ unit

(D) $\frac{15}{4}$ unit

---

109. If the sum of an infinite GP $a, ar, ar^2, ar^3, \ldots$ is 15 and the sum of the squares of

each term is 150, then the sum of the series $ar^2, ar^4, ar^6, \ldots$ is:

(A) $\frac{5}{2}$

(B) $\frac{1}{2}$

(C) $\frac{25}{2}$

(D) $\frac{9}{2}$

---

110. The interval in which the function $f(x) = \frac{4x^2+1}{x}$ is decreasing is:

(A) $\left(-\frac{1}{2}, \frac{1}{2}\right)$

(B) $\left[-\frac{1}{2}, \frac{1}{2}\right]$

(C) $(-1, 1)$

(D) $[-1, 1]$

---

111. If $\int \frac{e^x(1+\sin x)}{1+\cos x}\, dx = e^x f(x) + C$, then $f(x)$ is equal to:

(A) $\sin \frac{x}{2}$

(B) $\cos \frac{x}{2}$

(C) $\tan \frac{x}{2}$

(D) $\log \frac{x}{2}$

---

112. The curve given by $x + y = e^{xy}$ has a tangent parallel to the Y-axis at the point:

(A) $(0, 1)$

(B) $(1, 0)$

(C) $(1, 1)$

(D) None of these

---

113. The area enclosed between the curve $y = \log_e(x + e)$ and the coordinate axes is:

(A) 1

(B) 2

(C) 3

(D) 4

---

114. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{a} \cdot \vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{j} - \hat{k}$, then $\vec{b}$ is:

(A) $\hat{i} - \hat{j} + \hat{k}$

(B) $2\hat{j} - \hat{k}$

(C) $2\hat{i}$

(D) $\hat{i}$

---

115. Find: $\lim_{x \to 0} \frac{|\sin x|}{x}$

(A) 1

(B) -1

(C) Does not exist

(D) None of these

---

116. The lines

$$\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$$

and

$$\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$$

are coplanar if:

(A) $k = 3$ or -2

(B) $k = 0$ or -1

(C) $k = 1$ or -1

(D) $k = 0$ or -3

---

117. Negation of the Boolean expression $p \Leftrightarrow (q \Rightarrow p)$ **is:**

(A) $(\sim p) \wedge q$

(B) $p \wedge (\sim q)$

(C) $(\sim p) \vee (\sim q)$

(D) $(\sim p) \wedge (\sim q)$

---

118. The maximum value of $z = 5x + 2y$ **subject to the constraints:**

$$x + y \leq 7, \quad x + 2y \leq 10, \quad x, y \geq 0$$

(A) 10

(B) 26

(C) 35

(D) 70

---

119. Find the mean deviation about the mean for the data: $4, 7, 8, 9, 10, 12, 13, 17$

(A) 3

(B) 24

(C) 10

(D) 8

---

120. Bag P contains 6 red and 4 blue balls, and bag Q contains 5 red and 6 blue balls. A ball is transferred from bag P to bag Q and then a ball is drawn from bag Q. What is the probability that the ball drawn is blue?

(A) $\frac{7}{15}$

(B) $\frac{8}{15}$

(C) $\frac{4}{19}$

(D) $\frac{8}{19}$

---

121. Find the value of

$$\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{2}{9}\right)$$

(A) $\frac{1}{2}\cos^{-1}\left(\frac{3}{5}\right)$

(B) $\frac{1}{2}\sin^{-1}\left(\frac{3}{5}\right)$

(C) $\frac{1}{2}\tan^{-1}\left(\frac{3}{5}\right)$

(D) $\tan^{-1}\left(\frac{1}{2}\right)$

---

122. The middle term in the expansion of $\left(\frac{10}{x} + \frac{x}{10}\right)^{10}$ is:

(A) ${}^{10}C_5$

(B) ${}^{10}C_6$

(C) ${}^{10}C_5 \frac{1}{x^{10}}$

(D) ${}^{10}C_5 x^{10}$

---

123. The equation of a common tangent to the parabolas $y = x^2$ and $y = -(x-2)^2$ is:

(A) $y = 4(x-2)$

(B) $y = 4(x-1)$

(C) $y = 4(x+1)$

(D) $y = 4(x+2)$

---

124. A circle touches both the y-axis and the line $x + y = 0$. Then the locus of its center is:

(A) $y = \sqrt{2}x$

(B) $x = \sqrt{2}y$

(C) $y^2 - x^2 = 2xy$

(D) $x^2 - y^2 = 2xy$

---

125. The function $f(x) = \tan^{-1}(\sin x + \cos x)$ is an increasing function in:

(A) $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

(B) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right)$

(C) $\left(0, \frac{\pi}{2}\right)$

(D) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

---

126. Simplify $i^{57} + \frac{1}{i^{25}}$ and find its value:

(A) 0

(B) $2i$

(C) $-2i$

(D) 2

---

127. If one root of the equation $x^2 + px + 12 = 0$ is 4, while the equation $x^2 + px + q = 0$ has equal roots, then the value of q is:

(A) 4

(B) 12

(C) 3

(D) $\frac{49}{4}$

128. Evaluate the integral:

$$I = \int \frac{x+3}{(x+4)^2} e^x \, dx$$

(A) $e^x \frac{1}{x+4} + C$

(B) $e^{-x} \frac{1}{x+4} + C$

(C) $e^{-x} \frac{1}{x-4} + C$

(D) $e^{2x} \frac{1}{x-4} + C$

---

129. The shortest distance between the lines

$$\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-1}{-1}$$

and

$$\frac{x+3}{2} = \frac{y-6}{1} = \frac{z-5}{3}$$

is:

(A) $\frac{18}{\sqrt{5}}$

(B) $\frac{22}{3\sqrt{5}}$

(C) $\frac{46}{3\sqrt{5}}$

(D) $6\sqrt{3}$

---

130. If $P(B) = \frac{3}{5}$**,** $P(A \mid B) = \frac{1}{2}$**, and** $P(A \cup B) = \frac{4}{5}$**, then the value of** $P(A \cup B)' + P(A' \cup B)$ **is:**

(A) $\frac{1}{5}$

(B) $\frac{4}{5}$

(C) $\frac{1}{2}$

(D) 1
