70

QUESTION PAPER SERIES CODE

B

Registration No. :

Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

ENTRANCE EXAMINATION, 2017
P.G. DIPLOMA IN BIG DATA ANALYTICS
[Field of Study Code : PGDE (184)]

Time Allowed : 3 hours   *Maximum Marks* : 70

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper consists of two Parts : **Part—A** and **Part—B**.

(iv) **Part—A** contains thirty (**30**) questions. Answer **all** questions. Each correct answer carries 1 mark and **0·25** mark **will be deducted for every wrong answer**.

(v) **Part—B** has **six** sections of twenty (**20**) questions each. Candidates may choose any **one** section and answer twenty (**20**) questions. Each question carries **2** marks and **0·5** mark **will be deducted for every wrong answer**.

(vi) Answer all the questions in the Answer Sheet provided for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BLUE/BLACK BALLPOINT PEN only against each question in the corresponding circle.

(vii) In case you think none of the possible answers are correct, mark the correct answer which you think is closest to the correct one.

(viii) Answer written by the candidates inside the Question Paper will not be evaluated.

(ix) Simple Calculators and Log Tables may be used.

(x) Pages at the end have been provided for Rough Work.

(xi) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.

2. Please darken the whole Circle.

3. Darken ONLY ONE CIRCLE for each question as shown in example below :

Wrong	Wrong	Wrong	Wrong	Correct
○ ⓑ ⓒ ○	ⓐ̸ ⓑ ⓒ ⓓ	ⓐ̸ ⓑ ⓒ ⓓ̸	⊙ ⓑ ⓒ ○	ⓐ ⓑ ⓒ ○

4. Once marked, no change in the answer is allowed.

5. Please do not make any stray marks on the Answer Sheet.

6. Please do not do any rough work on the Answer Sheet.

7. Mark your answer only in the appropriate space against the number corresponding to the question.

8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**
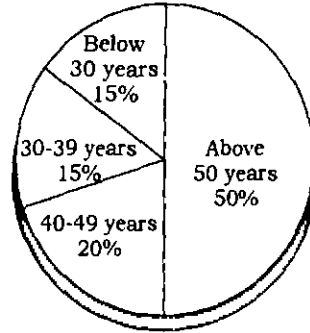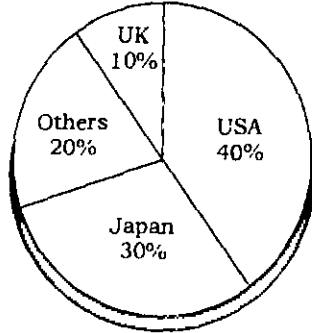
/70-B

PART—A

(Data Science Aptitude)

Answer all questions

1 Following pie charts were obtained for tourism destination of Indians :

Distribution of Overseas Tourist Traffic from India

UK 10%
Others 20%
USA 40%
Japan 30%

Below 30 years 15%
30-39 years 15%
40-49 years 20%
Above 50 years 50%

What is the expected number of visitors in the age group 30–50, going to Japan (select the closest answer)?

(a) 30%

(b) 35%

(c) 10%

(d) 20%

2. Here are some words translated from an artificial language :

haptlesh means cloudburst
srenchoch means pinball
resbosrench means ninepin

Which word could mean "cloud nine"?

(a) leshsrench

(b) ochhapl

(c) haploch

(d) haplresbo

3. Complete the series :

FAG, GAF, HAI, IAH, _ _ _

(a) JAK

(b) HAL

(c) HAK

(d) JAI

4. Posthumous Publication occurs when a book is published after the author's death. Which situation below is the best example of Posthumous Publication?

   (a) Richard's illness took his life before he was able to enjoy the amazing early reviews of his novel

   (b) Melissa's book on the experiences of doctor about her dying patient

   (c) Clarence never thought he'd live to see the third book in his trilogy published

   (d) Elizabeth is honored with a prestigious literary award for her writing career and her daughter accepts the award on behalf of her deceased mother

5. Which word *does not* belong with the others?

   (a) Wheel

   (b) Steering

   (c) Brakes

   (d) Petrol

6. A table has four objects X, Y, Z and T each having a different weight.

   I. X weighs twice as much as Y

   II. Y weighs four and a half times as much as Z

   III. Z weighs half as much as T

   Which of the following is the lightest?

   (a) Object Y

   (b) Object Z

   (c) Object T

   (d) Cannot be determined from this data

7. Forest is to tree as tree is to what?

   (a) Plant

   (b) Leaf

   (c) Branch

   (d) Garden

8. If A and B are two non-empty sets, which of the following will always be true?

   (a) $A \cap B$ is smaller than $A \cup B$

   (b) $A \cap B$ is non-empty

   (c) $(A \cap B) = (B \cap A)$

   (d) All of the above

9. Insert the missing figure from the options given below :

(a)

(b)

(c)

(d)
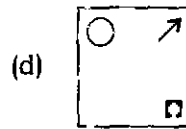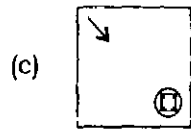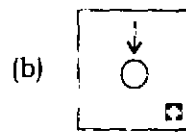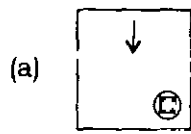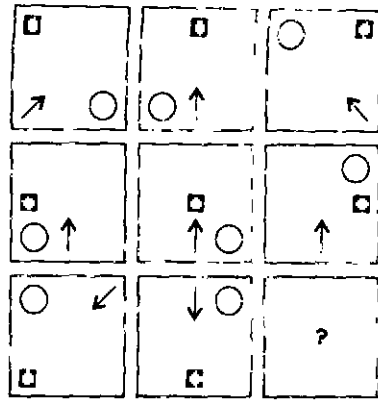
10. If 10 farmers can till 10 equally sized fields in 10 days, then 1 farmer could till 1 field in how many days?

(a)   1

(b)   10

(c)   100

(d)   1000

11. In how many different unique ways, can the letters of the word 'GENES' be arranged?

(a)   60

(b)   25

(c)   10

(d)   20

12. Which one of the following is **not** a probability distribution?

    (a) Exponential

    (b) Tangential

    (c) Normal

    (d) Geometric

13. The probability density function for a Gaussian distribution is given by

    (a) $f(x) = \dfrac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$

    (b) $f(x) = \lambda e^{-\lambda x}$

    (c) $f(x) = \dfrac{1}{4\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$

    (d) $f(x) = \lambda^2 e^{-\lambda x}$

14. Which one of the following is **not** a number system?

    (a) Octal

    (b) Trinary

    (c) Hexadecimal

    (d) Binary

15. Which one of the following terms **does not** represent a standard statistical measure?

    (a) Kurtosis

    (b) Skewness

    (c) Degree

    (d) Correlation

16. Let **A** be a square matrix of order 3×3, then $|k\mathbf{A}|$ is equal to

(a) $k|\mathbf{A}|$

(b) $k^3|\mathbf{A}|$

(c) $3k|\mathbf{A}|$

(d) $k|\mathbf{A}|\cdot 3$

17. The total cost $C(x)$ in rupees associated with the production of x units of an item is given by $C(x) = 0 \cdot 007x^3 - 0 \cdot 003x^2 + 15x + 4000$. Find the marginal cost when 17 units are produced.

(a) ₹ 15·967

(b) ₹ 10·967

(c) ₹ 20·967

(d) ₹ 12·967

18. The value of $\vec{i}\cdot(\vec{j}\times\vec{k})+\vec{j}\cdot(\vec{i}\times\vec{k})+\vec{k}\cdot(\vec{i}\times\vec{j})$ is

(a) 0

(b) 3

(c) 1

(d) ·1

19. If $P(A) = \dfrac{1}{2}$, $P(B) = 0$, then $P(A \mid B)$ is

(a) 0

(b) 1

(c) not defined

(d) $\dfrac{1}{2}$

20. Find the point at which the tangent to the curve $y = \sqrt{4x-3} - 1$ has its slope $\frac{2}{3}$.

(a) $(-3, 2)$

(b) $(3, -2)$

(c) $(-3, -2)$

(d) $(3, 2)$

21. Find the mean of the number obtained on a throw of an unbiased die.

(a) $\frac{21}{3}$

(b) $\frac{21}{6}$

(c) $\frac{21}{2}$

(d) $\frac{21}{12}$

22. A person drives a car for half of his distance at 20 km/hr and the remaining half at 30 km/hr. What is his average speed?

(a) 25 km/hr

(b) Less than 25 km/hr

(c) More than 25 km/hr

(d) It depends on the actual distance

23. If $a:b$ and $c:d$ are two ratios such that $a:b \leq c:d$, which of the following values of (a, b, c, d) **does not** satisfy the above relationship?

(a) 1, 2, 3, 4

(b) 0, 1, 2, 3

(c) 0, 1, 0, 4

(d) 0, 0, 0, 0

24. Pulse rate measurements in one group of 3 people were 75, 60 and 105, while in another group the observations are 63, 77 and 91.Which of the following conclusions is most appropriate?

(a) The two groups have similar pulse rates

(b) First group has a higher pulse rate

(c) Second group has a higher pulse rate

(d) First group has larger variation

25. If we solve equations graphically, then the number of solutions of $e^x = x^4$ is

(a) one solution

(b) no solution

(c) two solutions

(d) it depends on the value of x

26. If at a point P, a curve changes its concavity from upwards to downwards or vice versa, the P is called

(a) tangent line

(b) point of inflection

(c) convex curve

(d) convoluted curve

27. The curve shown below represents

(a) $y = \log x$ (b) $y = \log |x|$
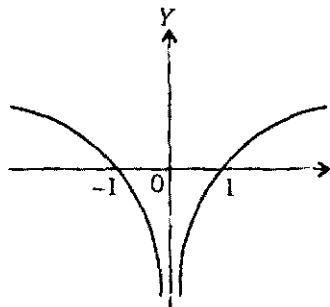
(c) $y = e^x$ (d) $y = e^{|x|}$

28. The following graph depicts
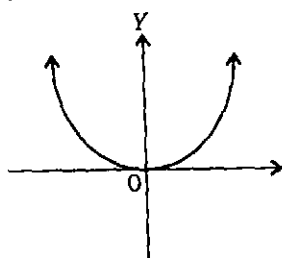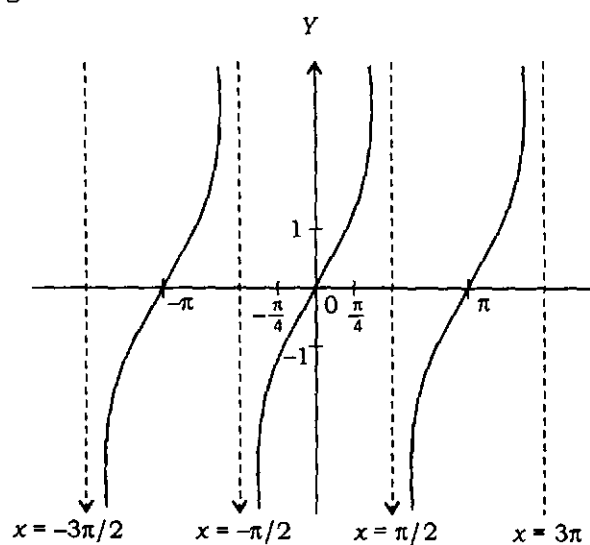

(a) $y = x^3$

(b) $y = x^2$

(c) $y = -x^3$

(d) $y = 4ax$

29. The range of the transcendental function shown below is

$$x = -3\pi/2 \qquad x = -\pi/2 \qquad x = \pi/2 \qquad x = 3\pi$$

(a) $[-1, 1]$

(b) $[-\infty, \infty]$

(c) $[1, -1]$

(d) $[0, \infty]$

30. The following figure represents
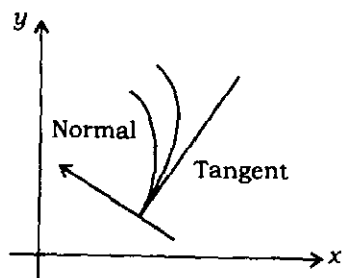
(a) inflection

(b) cusp

(c) convexity

(d) non-differentiability

PART—B

Answer all questions from any ONE of the Sections

Section—A

(Biology)

31. Which of the following will be most appropriate for functional characterization of an essential gene?

    (a) Insertion of a frameshift mutation

    (b) Gene knock-out

    (c) RNA interferance-mediated gene silencing

    (d) Chimeric repressor gene silencing technology (Cres-T)

32. Edman degradation is a method used for sequencing

    (a) GC-rich DNA sequences

    (b) non-coding RNA

    (c) repetitive regions

    (d) proteins

33. The components arrayed on the surface in analytical microarrays are

    (a) oligonucleotide probes

    (b) cDNA probes

    (c) antibodies

    (d) cell lysates

34. Activation of a marker gene in absence of interaction in a yeast-two hybrid assay would led to

    (a) false positives

    (b) false negatives

    (c) enhanced signal

    (d) decreased signal

35. Sequencing-based methods are more sensitive than hybridization based microarrays in detecting

   (a) very low expressed genes

   (b) very high expressed genes

   (c) both very low and very high expressed genes

   (d) genes with medium-level expression

36. After doing a PCR with a vector to amplify a 0·8 kb gene cloned in it, you see two bands on agarose gel, one at 0·8 kb and another at 0·5 kb. When sequenced with forward primer, both the bands correspond to exactly same sequence. What could be the possible explanation?

   (a) There are two copies of the gene in genome with one slightly smaller than the other

   (b) Reverse prime is binding to two different sites in the gene

   (c) Forward prime is binding to two different sites in the gene

   (d) Both the bands are coming from non-specific amplification of vector

37. A researcher wants to sequence 3·1 Gb genome using 2×125 bp illumina reads. How many reads are required to get 30X coverage?

   (a) 276 million

   (b) 372 million

   (c) 744 million

   (d) 926 million

38. Sania was diagnosed with a disease condition that her doctor said has come from mosquito bite. Which of the following might be possible diagnosis?

   (a) Yellow fever, Ebola virus, Zika virus and Malaria

   (b) Ebola virus, Dengu, Zika virus and Malaria

   (c) Ebola virus, Dengue, Yellow fever and Chikungunya

   (d) Chikungunya, Yellow Fever, Zika virus and Dengue

39. LOD scores are used to predict

(a) crossover frequency

(b) gene sequence

(c) gene linkage

(d) number of genes involved in determination of a given phenotype

40. A halophyte plant can grow better under

(a) high light intensity

(b) high salinity

(c) drought

(d) low wavelength light

41. The codominant marker which uses PCR and two restriction enzymes is

(a) RFLP (b) STS

(c) AFLP (d) RAPD

42. Which of the following DNA sequences is likely to be a restriction endonuclease site?

(a) GTTCCA

(b) GTCGAC

(c) ATTTAA

(d) GCGGGC

43. Micro-RNAs are encoded by

(a) integenic DNA

(b) exonic DNA

(c) intronic DNA

(d) Any of them

44. A 50 kDa secretory protein in ribosomes after passing through ER is found to be only of 46 kDa. What led to reduction in molecular weight of the protein in ER?

(a) Post-translational modification

(b) Cleavage of signal peptide at N-terminus

(c) Proteolytic cleavage of protein at both ends

(d) Cleavage of protein at C-terminal

45. FASTQ refers to

(a) a format to write protein sequences

(b) a fast method for performing RT-PCR

(c) raw data files from an NGS experiment

(d) a software used for mapping RNA-Seq data to reference genomes

46. Rice plants were transformed with *Agrobacterium* harboring Ti plasmid that lacks vir A gene. What would be the consequences?

(a) Only partial T-DNA will be transformed

(b) T-DNA will not be transformed

(c) T-DNA will be transformed but not transcribed in the host cell

(d) T-DNA integration will not be stable and may be lost in subsequent generations

47. DNA extracted from a virus is sensitive to digestion with S1 nuclease. This indicates that the genome in this virus consists of

(a) double-stranded DNA

(b) linear DNA

(c) double-stranded RNA

(d) single-stranded DNA

48. In *E. coli* bacteria, DNA replication takes about 40 min and the cell divides about 20 min after the replication. The *E. coli* cells, however, is known to divide every 18 min. Which of the following statements provides possible explanation for the same?

(a) DNA replication does not happen in all cells of *E. coli*

(b) DNA replication in *E. coli* happens in bulk leading to multiple copies which are eventually sorted during subsequent cell divisions

(c) Second round of replication is initiated much before the completion of the first round of replication

(d) There is only one origin of replication in *E. coli*

49. Which of the following is *not* true about tRNA?

(a) Three bases in anticodon arm of tRNA pair with codon in mRNA

(b) Methylated purines and pyrimidines are common in tRNA

(c) tRNA typically comprises of 300 to 500 nucleotides in length

(d) tRNA may contain unusual bases other than usual A, G, C and U

50. To increase the shelf life of tomatoes, which of the following genes should be silenced?

(a) ACC (Aminocyclopropane-1-carboxylate) synthase

(b) CrylAc

(c) Phytoene synthase

(d) Carotene desaturase

Section—B

(Chemistry)

51. For the process H_2O (l) (1 bar, 373 K) $\rightarrow$ H_2O (g) (1 bar, 373 K), the correct set of thermo-dynamics parameters is

    (a) $\Delta G = 0$, $\Delta S = +ve$

    (b) $\Delta G = 0$, $\Delta S = -ve$

    (c) $\Delta G = +ve$, $\Delta S = 0$

    (d) $\Delta G = -ve$, $\Delta S = +ve$

52. Conjugate acid for PO_4^{-3} is

    (a) H_3PO_4

    (b) $H_3PO_4^{-}$

    (c) HPO_4^{-2}

    (d) HPO_3^{-}

53. Oxidation number of Cr in K_3CrO_8 is

    (a) + 6

    (b) + 5

    (c) + 3

    (d) + 2

54. The stoichiometry of S if the following reaction
$$H_2S + HNO_3 \rightarrow NO + S + H_2O$$
is balanced (in acidic medium) is

    (a) 1

    (b) 2

    (c) 3

    (d) 4

55. Which of the following reactions yields the indicated compound as a major product?

(a)

(b)

(c)

(d)
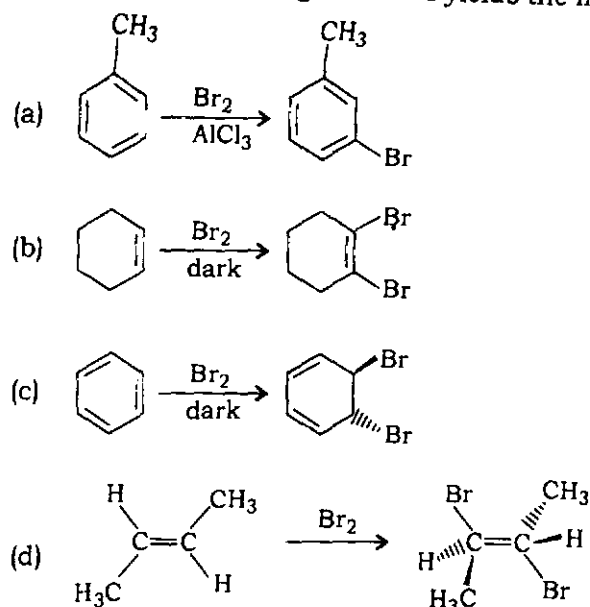
56. Of the following, which one corresponds to a compound with exactly one ring or double bond?

(a) $C_5H_{10}O$

(b) $C_5H_{10}Cl_2O$

(c) $C_5H_{11}Cl$

(d) $C_5H_{11}ClO$

57. Which of the following gas properties is not directly related to sigma, the molecular diameter?

(a) Viscosity coefficient

(b) Mean free path

(c) Average speed

(d) The parameter b in the van der Waals equation of state

58. The freezing point of water is lowered by the addition of a soluble substance such as NaCl. This lowering is considered to be a consequence of the fact that

(a) the partial molar volume of ice is greater than that of liquid water at the freezing point of the solution

(b) the chemical potential of water in the solution at the normal freezing point of water is less than that of pure ice

(c) sodium chloride dissociated into ions when it dissolves in water

(d) the dissolving of NaCl in water is an exothermic process

59. Points R and T are each a distance d from each of two equal and opposite charges as shown below. If $k = 1/4\pi\varepsilon_0$, the work required to move a negative charge q from R to T is
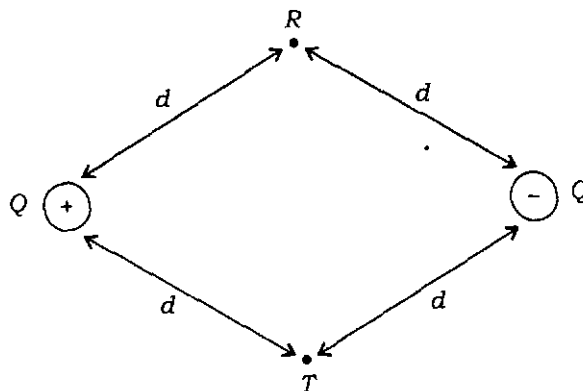
(a) zero

(b) $kqQ/(4d^2)$

(c) kqQ/d^2

(d) $kqQ/(2d)$

60. Calculate the change in entropy when one mole of water is heated from $0\ °C$ to steam $100\ °C$ at a constant pressure of 1 atom (specific heat of $H_2O = 1\ cal\ deg^{-1}\ g^{-1}$, heat of vaporization of $H_2O = 540\ cal\ g^{-1}$).

(a) 29·5

(b) 15·7

(c) 26·059

(d) 31·6

61. If ψ is a normalized solution of the Schrödinger equation and Q is an operator corresponding to a physical observable x, the quantity $\psi \cdot Q\psi$ may be integrated to obtain

(a) normalization constant of ψ

(b) mean value of x

(c) uncertainty in x

(d) spatial overlap of Q with ψ

62. Which of the following equations was suggested by de Broglie?

(a) $2\pi r = n\lambda$

(b) $\lambda = \dfrac{p}{h}$

(c) $\pi r^2 = n\lambda$

(d) $2\pi r = \dfrac{nh}{\lambda}$

63. In given electronic configurations, which violates Hund's rule?

(a) $\boxed{\uparrow}\,\boxed{\uparrow}\,\boxed{\uparrow}\,\boxed{\uparrow}\,\boxed{\downarrow}$

(b) $\boxed{\uparrow\downarrow}\,\boxed{\uparrow}\,\boxed{\uparrow}$

(c) $\boxed{\uparrow}\,\boxed{\uparrow}\,\boxed{\uparrow}\,\boxed{\uparrow}\,\boxed{\uparrow}$

(d) $\boxed{\downarrow}\,\boxed{\downarrow}\,\boxed{\downarrow}$
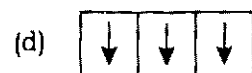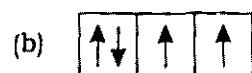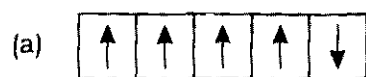
64. Which of the following ions has the maximum magnetic moment?

(a) Mn^{3+}

(b) Cu^{2+}

(c) Fe^{3+}

(d) V^{3+}
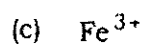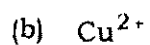
65. The mathematical expression which is true for the uncertainty principle is

(a) $(\Delta x)(\Delta v) \geq \dfrac{h}{4\pi}$

(b) $(\Delta E)(\Delta x) \geq \dfrac{h}{4\pi}$

(c) $(\Delta\theta)(\Delta\phi) \geq \dfrac{h}{4\pi}$

(d) $(\Delta x)(\Delta m) \geq \dfrac{h}{4\pi}$

66. Which of the following compounds is non-polar?

    (a) CCl_4

    (b) CH_2Cl_2

    (c) $CHCl_3$

    (d) CH_3Cl

67. Paracetamol is

    (a) methyl salicylate

    (b) phenyl salicylate

    (c) N-acetyl-p-amino phenol

    (d) acetyl salicylic acid

68. Two samples of gases A and B are at the same temperature. The molecules of A are travelling four times faster than the molecules of B. The ratio of $\dfrac{m_A}{m_B}$ of their masses will be

    (a) 16

    (b) 4

    (c) 1/4

    (d) 1/16

69. Bond energies of H—H bond is 80 kJ/mol, I—I bond is 100 kJ/mol and for H—I bond is 200 kJ/mol. The enthalpy of the reaction H_2 (g) $+ I_2$ (g) $\rightarrow 2HI$ (g) is

    (a) – 120 kJ

    (b) – 220 kJ

    (c) + 100 kJ

    (d) + 120 kJ

70. For the reaction $2HgO$ (s) $\rightarrow 2Hg$ (l) $+ O_2$ (g)

    (a) $\Delta H > 0$ and $\Delta S < 0$

    (b) $\Delta H > 0$ and $\Delta S > 0$

    (c) $\Delta H < 0$ and $\Delta S < 0$

    (d) $\Delta H < 0$ and $\Delta S > 0$

71. A field $\vec{A}$ is an irrotational, if

    (a) grad $\vec{A} = 0$

    (b) div $\vec{A} = 0$

    (c) curl $\vec{A} = 0$

    (d) $\nabla^2 = 0$

72. Which one of the following matrices is Hermitian?

    (a) $\begin{bmatrix} 0 & i \\ i & 0 \end{bmatrix}$
    (b) $\begin{bmatrix} 0 & i \\ -i & 0 \end{bmatrix}$

    (c) $\begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$
    (d) $\begin{bmatrix} i & 0 \\ 0 & -i \end{bmatrix}$

73. Inverse of the matrix $\begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 4 \\ 1 & 3 & 4 \end{bmatrix}$ is

    (a) $\begin{bmatrix} 7 & -3 & 3 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$
    (b) $\begin{bmatrix} 7 & -3 & -3 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$

    (c) $\begin{bmatrix} -1 & 1 & -3 \\ -1 & 0 & 0 \\ 7 & -3 & 1 \end{bmatrix}$
    (d) $\begin{bmatrix} -1 & -3 & 3 \\ -1 & 0 & 0 \\ 7 & 1 & 1 \end{bmatrix}$

74. Which of the following represents a steady motion of a fluid?

    (a) $\dfrac{dy}{dt} + \vec{v}\nabla\rho = 0$

    (b) $\dfrac{d\vec{v}}{dt} + \rho\nabla\rho = 0$

    (c) $\dfrac{d\rho}{dt} + \rho\,\mathrm{div}\,\vec{v} = 0$

    (d) $\dfrac{d\rho}{dt} + \rho\,\mathrm{curl}\,\vec{v} = 0$

75. An astronaut moves in a superspace ship travelling at a speed of $0.8c$. The astronaut observes a photon approaching him from space. The speed of photon w.r.t. the astronaut is

   (a) $1.8c$

   (b) c

   (c) $0.2c$

   (d) $0.9c$

76. A Zener diode can be used to develop

   (a) constant current supply

   (b) constant voltage supply

   (c) fixed resistance device

   (d) All of the above

77. Out of the following quantities, pick out that is invariant under the Galilean transformation.

   (a) Displacement

   (b) Velocity

   (c) Force

   (d) Momentum

78. Time base of a CRO is developed by

   (a) sawtooth waveform

   (b) square waveform

   (c) triangular waveform

   (d) sinusoidal waveform

79. A particle of mass m moves in a potential given by $V(r) = \beta r^k$. Let the angular momentum be L. The radius, r_0, of the circular orbit is given by

   (a) $r_0 = \left(\dfrac{L}{m\beta k}\right)^{1/(k)}$

   (b) $r_0 = \left(\dfrac{m\beta k}{L^2}\right)^{k+2}$

   (c) $r_0 = \left(\dfrac{L^2}{m\beta k}\right)^{1/(k+2)}$

   (d) $r_0 = \left(\dfrac{L^2}{m\beta k}\right)$

80. Angular momentum of an electron in the hydrogen atom can possibly be

(a) $h/4\pi$

(b) $h/2\pi$

(c) $2\pi/h$

(d) h/π

81. A reversible heat engine can have 100% efficiency if the temperature of the sink is

(a) less than that of source

(b) equal to that of source

(c) 0 °C

(d) 0 K

82. If $P_n(x)$ is the Legendre polynomial of x and order n, then for any n, $P_n(-x)$ is represented by

(a) $P_{-n}(x)$

(b) $(-1)^n P_n(x)$

(c) $-P_n(x)$

(d) $P_n(x)$

83. A current I flows through a straight cylindrical wire of radius r and length L, and shows up as Joule heating of the wire. The magnitude of Poynting vector (S) and the energy per unit time (E) delivered to the wire are given by

(a) $S = \dfrac{VI}{2\pi rL}$, $E = VI$

(b) $S = \dfrac{VI}{2\pi r}$, $E = V/I$

(c) $S = \dfrac{VI}{2\pi}$, $E = I/V$

(d) $S = \dfrac{V}{2\pi IL}$, $E = VIL$

84. A particle of mass m moves frictionless under the influence of gravity g along the helix $z = k\theta$, r = constant, where k is a constant, and z is vertical. Using Hamilton's equations of motion, the equation of motion of the particle is

(a) $\ddot{z}^2 = \dfrac{\left[\dfrac{r^2}{k^2} + 1\right]}{g}$

(b) $\ddot{z}^2 = \left[\dfrac{r^2}{k^2} + 1\right]$

(c) $\ddot{z}^2 = \dfrac{g}{\left[\dfrac{r^2}{k^2} + 1\right]}$

(d) $\ddot{z}^2$ = constant

85. Three particles of equal mass $m = m_1 = m_2 = m_3$ are constrained to slide around a frictionless circular track and are connected by three equal length springs that have spring constants k, k and $2k$ respectively. Initially the system is in equilibrium and the springs are initially without any tension. The Lagrangian of the system is given by

(a) $L = \dfrac{1}{2}m\dot{x}_1^2 + \dfrac{1}{2}m\dot{x}_2^2 + \dfrac{1}{2}m\dot{x}_3^2 - \dfrac{1}{2}k(x_1 - x_2)^2 - \dfrac{1}{2}(2k)(x_2 - x_3)^2 - \dfrac{1}{2}k(x_3 - x_1)^2$

(b) $L = \dfrac{1}{2}m\dot{x}_1^2 + \dfrac{1}{2}m\dot{x}_2^2 + \dfrac{1}{2}m\dot{x}_3^2 + \dfrac{1}{2}k(x_1 - x_2)^2 + \dfrac{1}{2}(2k)(x_2 - x_3)^2 + \dfrac{1}{2}k(x_3 - x_1)^2$

(c) $L = \dfrac{1}{2}m\dot{x}_1^2 + \dfrac{1}{2}m\dot{x}_2^2 + \dfrac{1}{2}m\dot{x}_3^2$

(d) $L = \dfrac{1}{2}k(x_1 - x_2)^2 + \dfrac{1}{2}(2k)(x_2 - x_3)^2 + \dfrac{1}{2}k(x_3 - x_1)^2$

86. An ideal monatomic gas of N particles, each of mass m, is in thermal equilibrium at absolute temperature T. The gas is confined in a cubical box of side L. The velocities of the particles are distributed according to the Maxwellian distribution. Now consider the effect of the earth's gravitational field, assumed uniform over the height L of the container, with acceleration due to gravity being g. What is the average potential energy of a particle?

(a) $<V> = -\dfrac{L}{\exp\left(\dfrac{mgL}{k_B T}\right) - 1}$

(b) $<V> = mg\left[\dfrac{k_B T}{mg} - \dfrac{L}{\exp\left(\dfrac{mgL}{k_B T}\right) - 1}\right]$

(c) $<V> = \dfrac{k_B T}{mg}$

(d) $<V>$ = constant

(T is temperature, k_B is Boltzmann constant.)

87. Consider a polymeric chain of N links, each of length a. In the absence of an applied force, each link is equally likely to be directed to the left or to the right. The polymer is extended to a length l under the influence of an external force f. The external force per unit temperature (T), $\dfrac{f}{T}$ is given by

(a) $\dfrac{f}{T} = \left(\dfrac{\partial S}{\partial V}\right)_T$

(b) $\dfrac{f}{T} = -\left(\dfrac{\partial U}{\partial S}\right)_t$

(c) $\dfrac{f}{T} = \left(\dfrac{\partial S}{\partial U}\right)_t$

(d) $\dfrac{f}{T} = -\left(\dfrac{\partial S}{\partial t}\right)_U$

88. The wave function of a particle trapped in a box of size U is given by $\psi = \sqrt{\dfrac{2}{L}}\sin\dfrac{n\pi}{U}$ with n as natural number. What is the expectation value $< x >$ of the position of a particle in the box?

(a) $< x > = 0$

(b) $< x > = \sqrt{\dfrac{L}{2}}$

(c) $< x > = \dfrac{U}{2}$

(d) $< x > = 2U$

89. The energy needed to remove a neutron from the nucleus of calcium isotope $^{42}_{20}\text{Ca}$ is

(a) $1\cdot48$ MeV

(b) $11\cdot48$ MeV

(c) $111\cdot48$ MeV

(d) $1111\cdot48$ MeV

(1 amu $= 931\cdot49$ MeV)

90. The specific heat per mole of a diatomic gas at constant volume C_V is given by

(a) $C_V = \dfrac{1}{2}R$

(b) $C_V = 2R$

(c) $C_V = \dfrac{3}{2}R$

(d) $C_V = \dfrac{5}{2}R$

(R is gas constant)

Section—D

(Mathematics and Statistics)

91. Approximate y and z by using Picard's methods for the particular solution of $\dfrac{dy}{dx} = x + z$, $\dfrac{dz}{dx} = x = y^2$, given that $y = 2$, $z = 1$, when $x = 0$.

   (a) $y^{(2)} = 2 + x - \dfrac{3}{2}x^2 + \dfrac{1}{6}x^3$, $z^{(2)} = 1 - 4x - \dfrac{3x^2}{2} - x^3 - \dfrac{x^4}{4} - \dfrac{x^5}{20}$

   (b) $y^{(2)} = 2 + x - \dfrac{3}{2}x^2 + \dfrac{1}{6}x^3$, $z^{(2)} = 1 + 4x - \dfrac{x^2}{2} - x^3 - \dfrac{x^3}{4} - \dfrac{x^4}{10}$

   (c) $y^{(2)} = 2 + x + \dfrac{3}{2}x^2 - \dfrac{1}{6}x^3$, $z^{(2)} = 1 - 4x + \dfrac{3x^2}{2} + x^3 + \dfrac{x^4}{4} + \dfrac{x^5}{20}$

   (d) $y^{(2)} = 1 - x - \dfrac{3}{2}x^2 - \dfrac{1}{6}x^4$, $z^{(2)} = 1 - 4x - \dfrac{9x^2}{2} - x^4 - \dfrac{x^4}{6} - \dfrac{x^5}{200}$

92. Rate of convergence of secant method is

   (a) ≈ 3

   (b) ≈ 1

   (c) $\approx 2 \cdot 73$

   (d) $\approx 1 \cdot 62$

93. If $a + b + c = 0$, then for what value of x, the determinant value of $\begin{bmatrix} a - x & c & b \\ c & b - x & a \\ b & c & c - x \end{bmatrix} = 0$?

   (a) -1

   (b) 1

   (c) $x = 0, \pm\sqrt{a^2 + b^2 + c^2 - ab - bc - ca}$

   (d) $x = 0, \pm\sqrt{a^2 - b^2 - c^2 - ab - bc - ca}$

94. Find the equation of plane which passes through the point $(3, -3, 1)$ and is perpendicular to the planes $7x + y + 2z = 6$ and $3x + 5y - 6z = 8$.

   (a) $x - 3y - 2z - 10 = 0$

   (b) $x - y - z - 10 = 0$

   (c) $x + 3y - 2z + 10 = 0$

   (d) $x - 2y - 2z - 10 = 0$

95. If θ is the angle between the two regression lines, then

(a) $\tan\theta = \dfrac{1+r^2}{r} \times \dfrac{\sigma_x \sigma_y}{\sigma_x^2 - \sigma_y^2}$

(b) $\tan\theta = \dfrac{1-r^2}{r} \times \dfrac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}$

(c) $\tan\theta = \dfrac{1-r^3}{r} \times \dfrac{\sigma_x \sigma_y}{\sigma_x^3 + \sigma_y^3}$

(d) $\tan\theta = \dfrac{1+r^3}{r} \times \dfrac{\sigma_x \sigma_y}{\sigma_x^2 - \sigma_y^2}$

96. If the probability of a bad reaction from a certain injection is 0.001, determine the chance that out of 2000 individuals more than two will get a bad reaction.

(a) $1 + \dfrac{5}{e^2}$

(b) $1 - \dfrac{1}{e^2}$

(c) $1 - \dfrac{5}{e^2}$

(d) $1 + \dfrac{1}{e^2}$

97. A random variable X has a uniform distribution over $(-3, 3)$, find k for which $P(X > k) = \dfrac{1}{3}$. Also evaluate $P[|X - 2| < 2]$.

(a) $k = 1$ and $P[|X-2|<2] = \dfrac{1}{2}$

(b) $k = -1$ and $P[|X-2|<2] = \dfrac{1}{4}$

(c) $k = 2$ and $P[|X-2|<2] = \dfrac{3}{5}$

(d) $k = -2$ and $P[|X-2|<2] = \dfrac{2}{3}$

98. A discrete random variable X has the probability mass function as follows :

X	-1	1	2
P_X	$2k$	$3k$	$4k$

Find $E[X]$.

(a) $1/9$

(b) $4/9$

(c) 1

(d) $3/11$

99. There are two telephone lines A and B. Probability of line A being busy is $P(A) = 0 \cdot 55$ and probability of line B being busy is $P(B) = 0 \cdot 65$, and further $P(A \cap B) = 0 \cdot 65$. Find the probability that both lines are free.

(a) $0 \cdot 15$

(b) $0 \cdot 35$

(c) $0 \cdot 85$

(d) $0 \cdot 50$

100. Consider the experiment of rolling two dice. Let the sample space $S = \{(i, j) \mid 1 \le (i, j) \le 6\}$. Also assume each sample point is assigned a probability of $1/36$. Define the events X, Y and Z so that

   X = "first die results in a 1, 2 or 3"

   Y = "second die results in a 4, 5 or 6"

   Z = "the sum of two faces is 7"

Find $P(X \cap Y \cap Z)$.

(a) $1/4$

(b) $1/12$

(c) $1/18$

(d) $1/36$

101. A particle executes a random walk on a set of integers such that probability of moving to right at each step is p and moving to left at each step is $q = 1 - p$. Assuming steps are independent and the particle starts from origin, the probability of finding the particle at position 50 after 101 steps is

(a) 0

(b) $p^{50} q^{51}$

(c) p^{101}

(d) 1

102. The time required X (measured in years) to complete a software project has a probability density function

$$f_X(x) = \begin{cases} kx(1-x), & 0 \le x \le 1 \\ 0, & \text{otherwise} \end{cases}$$

Compute $P\{X < 1/3\}$.

(a) 7/27

(b) 1/3

(c) 1/6

(d) 5/9

103. Let X be normally distributed with parameters μ and σ^2. The p.d.f. is given by

$$f_X(x) = \frac{1}{\sqrt{2\pi}\sigma} - \exp\left[-\frac{(x-\mu^2)}{2\sigma^2}\right], \quad -\infty < X < \infty$$

then $E[X^2]$ is

(a) μ^2

(b) σ^2

(c) $\sigma^2 + \mu^2$

(d) None of the above

104. X is a discrete random variable with probability mass function $p_X(i) = 1/n,\ 1 \le i \le n$. The variance σ_X^2 is

(a) $\dfrac{n+1}{2}$

(b) $\dfrac{n^2-1}{12}$

(c) $\dfrac{n}{3}$

(d) $\dfrac{1}{n^2}$

105. The cyclist pedals from his house to his college at a speed of 10 km per hour and back from the college to his house at 15 km per hour. The average speed in km per hour is

(a) 12·5

(b) 12·0

(c) $\sqrt{150}$

(d) 11

106. A 3×4 matrix has rank 3. Find dim nul A, dim row A and rank A^T.

   (a) 7, 4, 3 respectively

   (b) 4, 4, 4 respectively

   (c) 3, 3, 3 respectively

   (d) 4, 3, 3 respectively

107. Let S_3 denote the set of all permutations on the set $\{1, 2, 3\}$. Then $(S_3, 0)$ is a/an

   (a) Abelian group of order 3

   (b) non-Abelian group of order 6

   (c) Abelian group of order 6

   (d) non-Abelian group of order 3

108. How many elements of S_6 are of the form (a, b, c)?

   (a) 20

   (b) 30

   (c) 40

   (d) 6

109. Estimate the missing term in the following table :

x	0	1	2	3	4
$y = f(x)$	1	3	9	?	81

   (a) 20

   (b) 27

   (c) 30

   (d) 31

110. A curve is drawn to pass through the points given by the following table :

x	1	1·5	2	2·5	3	3·5	4
y	2	2·4	2·7	2·8	3	2·6	2·1

Using Simpson's rule, estimate the area bounded by the curve, the x-axis and the lines $x = 1$, $x = 4$.

   (a) $\approx 6 \cdot 083$

   (b) $\approx 5 \cdot 683$

   (c) $\approx 7 \cdot 783$

   (d) $\approx 8 \cdot 883$

Section—E

(Bioinformatics)

111. A prosthetic group of a protein is a non-protein structure that is

    (a)   a ligand of the protein

    (b)   a part of the secondary structure of the protein

    (c)   a substrate of the protein

    (d)   permanently associated with the protein

112. Which of the following is *not* correct concerning cooperative binding of a ligand to protein?

    (a)   It is usually a form of allosteric·interaction

    (b)   It is usually associated with proteins with multiple subunits

    (c)   It rarely occurs in enzymes

    (d)   It results in non-linear Hill Plot

113. Which one of the following is *not* related to network topology?

    (a)   Degree distribution

    (b)   Centrality

    (c)   Routing

    (d)   Clustering coefficient

114. In the context of genome assembly, the coverage a is given by

$$a = NL / G$$

where N is the number of fragments, L is the fragment length and G is the length of the genome. In general

    (a) $G = L$

    (b) $G \ll L$

    (c) $G \gg L$

    (d) $L = 0$

115. Assume a casino uses both fair and loaded coin and the process is modelled as a Markov process. From the following state transition diagram, the transition probability of switching to a fair die from a loaded die is
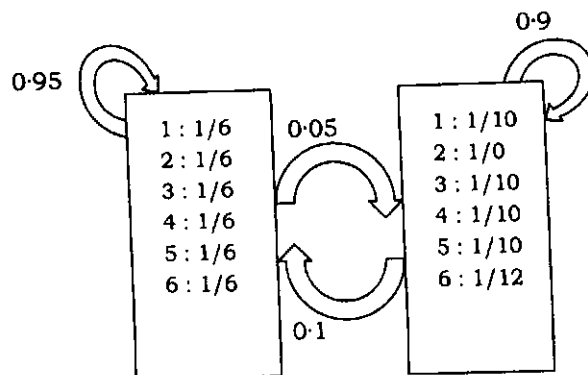
(a) 0·95

(b) 0·1

(c) 0·9

(d) 0·05

116. To obtain a pairwise alignment using dynamic programming strategy, the following scoring function is used

$$F(i, \ j) = \max \begin{cases} F(i-1, \ j-1+S(x_i, \ y_j) \\ F(i-1, \ j)-d \\ F(i, \ j-1)-d \end{cases}$$

The term d in the above expression refers to

(a) math score

(b) cell value

(c) gap penalty

(d) blosum score

117. Which one of the following methods is *not* related to molecular phylogeny?

(a) Parsimony

(b) Distance

(c) Voronoi

(d) Maximum likelihood

118. If we consider a multiple sequence alignment and compute the columnwise Shannon entropy, the value will be maximum, if

(a) the occurrences of all the bases have equal probability

(b) the occurrences of all bases have different probability

(c) the occurrences of purines have zero probability

(d) the occurrences of pyrimidines have zero probability

119. The degree distribution in a scale-free network is approximated by ____ law behavior.

   (a)   Gaussian

   (b)   power

   (c)   exponential

   (d)   gamma

120. Parameter estimation in HMM framework does not include ____ probabilities.

   (a)   emission

   (b)   state transition

   (c)   begin and end

   (d)   state cumulative

121. Which of the following is not used in modelling and analyzing gene networks?

   (a)   Griffith

   (b)   Gillespie

   (c)   Langevin

   (d)   Fokker-Planck

122. Which one of the following terms is not part of RNA secondary structure?

   (a)   Bulge loop

   (b)   Pseudoknot

   (c)   Hairpin loop

   (d)   Double knot

123. On submitting the manuscript involving a high throughput omics-based study to a research journal, reviewers asked to provide MIAMET to facilitate exchange of information and reproducibility. What does MIAMET stand for?

(a) Minimum information about a microarray experiment

(b) Minimum information about a metabolomics experiment

(c) Maximum information about a microarray experiment

(d) Maximum information about metadata of experiment

124. Which of the following statements is true about trEMBL database?

(a) It contains information about only experimentally validated protein sequences

(b) It contains information about automatically translated nucleotide sequences

(c) It serves as a repository for both mass spectrometry and NMR-based proteomics data

(d) It contains raw spectral data only from mass spectrometry experiments

125. PSI-BLAST is used to

(a) detect high similar sequences

(b) check similarity with short (20–40) nucleotide sequences

(c) detect distant evolutionary relationships

(d) estimate evolutionary timescale of life

126. The RNA sequencing performed with library prepared with wild type and diseases samples resulted in 2 million and 4 million reads, respectively. The average raw counts of reads for gene X are 2 in wild type and 4 in diseased tissue. Based on this information, which of the following statements can be made?

(a) Gene X is likely responsible for the disease

(b) Gene X is upregulated in response to disease

(c) Gene X is low-expressed gene

(d) The annotation of gene X is wrong

127. What are the lower case grey letters in the query sequence in BLAST results?

(a) These are low-complexity sequences masked by automatic filtering

(b) These are regions with lowest similarity score

(c) These are regions where sequence identity is 100%

(d) These are conserved sequences with high similarity to transcription factor binding sites

128. On what basis, archaea were classified as a separate kingdom from bacteria and eukaryotes?

(a) Genomic DNA sequence

(b) 16S rRNA gene sequence

(c) Presence of intermediate organelles

(d) Mode of reproduction

129. Torsion angle phi (ϕ) for a polypeptide chain is defined by the atoms

(a) H, N, Cα, Cβ

(b) O, C, N, H

(c) C, C, C, O

(d) C, N, C, C

130. B-DNA converts to Z-DNA at

(a) high salt concentration

(b) low salt concentration

(c) high pressure

(d) Never converts

Section—F

(Computer Science and Engineering)

131. Let G be a complete undirected graph on 6 vertices. If vertices of G are labelled, then the number of distinct cycles of length 4 in G is equal to

   (a) 15

   (b) 30

   (c) 45

   (d) 360

132. Which one of the following is *not* an algorithm related to traversing binary trees?

   (a) Mix-order

   (b) Post-order

   (c) Pre-order

   (d) In-order

133. What data structure is used for depth first traversal of a graph?

   (a) Queue

   (b) Stack

   (c) List

   (d) Shortest distance

134. Which of the following is an example of dynamic programming approach?

   (a) Fibonacci series

   (b) Tower of Hanoi

   (c) Dijkstra shortest path

   (d) All of the above

135. A queue data structure can be used for

   (a) expression parsing

   (b) recursion

   (c) resource allocation

   (d) minimum spanning tree

136. Project scheduling is an example of

   (a) dynamic programming

   (b) integer programming

   (c) divide and conquer

   (d) non-linear programming

137. What is the maximum number of dimensions an array in C may have?

   (a) Two

   (b) Eight

   (c) Twenty

   (d) Theoretically no limit. The only practical limits are memory size and compilers

138. Which one of the following is **not** a formal type of grammar?

    (a) Irregular

    (b) Context-sensitive

    (c) Context-free

    (d) Regular

139. Which one of the following forms of an address scheme is **not** followed for net id's and host id's?

    (a) Class A addresses

    (b) Class B addresses

    (c) Class C addresses

    (d) Class X addresses

140. Which of the following is used to copy a string A to B in C language?

    (a) copy (A, B)

    (b) strcpy (B, A)

    (c) strncpy (A, B)

    (d) strncpy (B, A)

141. What is 'structure' in C language?

    (a) A programmer-defined data type to store multiple variables of the same data type

    (b) A programmer-defined data type to store multiple variables of the same or different data types

    (c) A tree-like data object

    (d) Attributes of a variable

142. Which of the following codes is wrong in C language?

    (a) $x = y * z;$

    (b) $x = y - x;$

    (c) $x+ = 2;$

    (d) None of the above is wrong syntactically

143. Which of the following refers to the authentication type(s) used for developers' access to social media data such as Twitter?

    (a) Oauth   (b) NIS

    (c) LDAP   (d) All of the above

144. Which of the following propositions is tautology?

(a) $(p \vee q) \rightarrow q$

(b) $p \vee (q \rightarrow p)$

(c) $p \vee (p \rightarrow q)$

(d) Both (b) and (c)

145. A mathematical model with a collection of operations defined on that model is called

(a) data structure

(b) abstract data type

(c) primitive data type

(d) algorithm

146. What is the minimum number of two-input NAND gate used to perform the function of two-input OR gate?

(a) 1

(b) 2

(c) 3

(d) 4

147. Hypercube is a topology related to

(a) serial architecture

(b) parallel architecture

(c) bus architecture

(d) point architecture

148. The correct remark is

(a) C++ allows any operator to be overloaded

(b) some of the existing operators cannot be overloaded

(c) operator precedence cannot be changed

(d) All of the above

149. The complexity of bubble sort algorithm is

(a) $O(n\log n)$

(b) $O(\log n)$

(c) $O(n^2)$

(d) $O(n^3)$

150. Let G be a simplex undirected planar graph on 10 vertices with 15 edges. If G is a connected graph, then the number of bounded faces in any embedding of G on the plane is equal to

(a) 3

(b) 4

(c) 5

(d) 6

SPACE FOR ROUGH WORK

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