35

QUESTION PAPER SERIES CODE
A

Registration No. : | | | | | |

Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

ENTRANCE EXAMINATION, 2013

M.Phil./Ph.D. ENVIRONMENTAL SCIENCES

[Field of Study Code : SESP-ONEP (153)/TWOP (154)/THRP (155)/FORP (156)]

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 is divided into two parts : Part—A and Part—B. Both parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose. The answer to each question is to be indicated by darkening the appropriate choice [i.e., (a), (b), (c) or (d)] in the circles, against each question number on the Answer Sheet.

(iv) Part—A consists of 95 questions. Answer any 60 questions. Each question carries $\frac{1}{2}$ mark. **There will be negative marking and $\frac{1}{8}$ mark will be deducted for each wrong answer.**

(v) Part—B consists of 100 questions. Answer any 40 questions. Each question carries 1 mark. **There will be negative marking and $\frac{1}{4}$ mark will be deducted for each wrong answer.**

(vi) Calculators/Log Tables may be used.

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

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

(ix) 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 don't 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.**

PART—A

Answer *any* **sixty** questions

1. $\begin{vmatrix} x & y & z \\ x^2 & y^2 & z^2 \\ yz & zx & xy \end{vmatrix}$ is equal to

   (a) $(x-y)(y-z)(z-x)$

   (b) $(x-y)(y-z)(z-x)(x+y+z)$

   (c) $(x-y)(y-z)(z-x)(xy+yz+zx)$

   (d) 0

2. The length of the latus rectum of the ellipse $3x^2+4y^2=48$ is equal to

   (a) 8

   (b) $4\sqrt{3}$

   (c) 6

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

3. If $y=\tan^{-1}\left[\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right]$, then $\frac{dy}{dx}$ is equal to

   (a) $\frac{-x}{\sqrt{1-x^4}}$

   (b) $\frac{x}{\sqrt{1-x^4}}$

   (c) $\frac{1}{\sqrt{1-x^4}}$

   (d) $\frac{-1}{\sqrt{1-x^4}}$

4. $\lim_{x\to 0}\left[\tan\left(\frac{\pi}{4}+x\right)\right]^{\frac{1}{x}}$ is equal to

   (a) e

   (b) e^2

   (c) $\frac{1}{e}$

   (d) $\frac{1}{e^2}$

5. A and B throw a coin alternately till one of them gets a head and wins the game. Assuming the coin to be unbiased, the probability that A wins the game is equal to

(a) $\frac{2}{3}$

(b) $\frac{1}{3}$

(c) 0

(d) Cannot be determined

6. The equation of a plane passing through the point (1, – 1, – 1) and perpendicular to each of the planes $x-2y-8z=0$ and $2x+5y-z=0$ is

(a) $5x-3y+7z-16=0$

(b) $3x+7y-9z+16=0$

(c) $14x-5y+3z-16=0$

(d) $7x-5y+9z+16=0$

7. $(\sqrt{3}+i)^6$ is equal to ——, if it is given that $i^2=-1$.

(a) 64

(b) –64

(c) $64i$

(d) $-64i$

8. The series

$$f(x)=1-\frac{x^2}{2!}+\frac{x^4}{4!}-\frac{x^6}{6!}+\ldots$$

represents

(a) $\sec x$

(b) $\cos x$

(c) $\sin x$

(d) $\tan x$

9. In 50 sec, 300 c.c. of oxygen diffuses through a porous plate. How long will it take 300 c.c. of chlorine to diffuse through the same plate? [Take molecular weight of oxygen and chlorine as 32 and 72 respectively]

(a) 50 sec

(b) 75 sec

(c) 60 sec

(d) 85 sec

10. The unit of magnetic induction is

(a) weber

(b) henry per meter

(c) tesla

(d) farad per meter

11. What will be the terminal velocity in air of an oil drop of radius 10^{-5} m? [Given, $g = 9{\cdot}8\ \text{m/sec}^2$, viscosity of air = $1{\cdot}8 \times 10^{-5}\ \text{kg m}^{-1}\ \text{sec}^{-1}$ and density of oil = $900\ \text{kg/m}^3$; the upthrust of air may be neglected]

(a) 3·59 cm/sec

(b) 1·08 cm/sec

(c) 0·63 cm/sec

(d) 2·48 cm/sec

12. Water flows through a horizontal pipe of varying cross-section at the rate of 10 cubic meter/min. What is the velocity of water at a point where the radius of the pipe is 10 cm?

(a) 7·5 m/sec

(b) 6·3 m/sec

(c) 5·3 m/sec

(d) 4·5 m/sec

13. A wire, 50 cm long and $1\ \text{mm}^2$ in cross-section, has Young's modulus $1{\cdot}24 \times 10^{12}\ \text{dyne/cm}^2$. How much work is done in stretching it through 1 mm?

(a) 0·124 joule

(b) $0{\cdot}248 \times 10^5$ erg

(c) $0{\cdot}124 \times 10^5$ erg

(d) 0·248 joule

14. How far from the earth does acceleration due to gravity become one percent of its value at the earth's surface? [Assume the earth to be a sphere of radius $6{\cdot}38 \times 10^8$ cm]

(a) $6{\cdot}75 \times 10^{10}$ cm

(b) $6{\cdot}75 \times 10^9$ m

(c) $5{\cdot}74 \times 10^9$ m

(d) $5{\cdot}74 \times 10^9$ cm

15. A body weighs 900 gm on the surface of the earth. How much will it weigh on the surface of the Mars whose mass is one-ninth and radius one-half that of the earth?

(a) 200 gm

(b) 300 gm

(c) 400 gm

(d) 500 gm

16. Molar internal energy of a monoatomic ideal gas as a function of absolute temperature is

(a) $\frac{\sqrt{3}}{2}RT$

(b) $\frac{3}{2}RT^2$

(c) $\frac{3}{2}RT$

(d) $\frac{3}{\sqrt{2}}RT$

17. Which of the following types of cloud occurs at the highest altitude?

(a) Cumulus

(b) Stratus

(c) Cirrus

(d) Cumulonimbus

18. A closed bottle containing water at 30 °C is carried to the moon in a spaceship. It is placed on the surface of the moon. What will happen to the water as soon as the lid is opened?

(a) Water will freeze

(b) Water will boil

(c) Water will decompose into H_2 and O_2

(d) Nothing will happen

19. Which of the following surfaces shows the maximum variation in albedo during the daytime?

(a) Vegetation

(b) Sand

(c) Snow

(d) Water

20. Which of the following is a correct statement?

(a) $\frac{dT}{dZ} = 0$ in the stratosphere

(b) $\frac{dT}{dZ} > 0$ in the troposphere

(c) $\frac{dT}{dZ} < 0$ in the thermosphere

(d) $\frac{dT}{dZ} < 0$ in the mesosphere

21. pH of 0·15 M NH_4Cl(aq) solution is [Given, $K_a = 5{\cdot}6 \times 10^{-10}$]

(a) 1·5

(b) 5·04

(c) 9·44

(d) >10

22. A certain system absorbs 3×10^{18} quanta of light per second. On irradiation for 20 minutes, 0·003 mole of reactant was found to have reacted. The quantum yield (ϕ) for the process is [Avogadro's number = $6{\cdot}023 \times 10^{23}$]

(a) >1

(b) 0·5

(c) 1·0

(d) <0·5

23. Which of the following statements is true about a pure substance above its critical point?

(a) One fluid phase is present

(b) Solid, liquid and gas are in equilibrium

(c) Only liquid and gas are in equilibrium

(d) A liquid forms

24. The enthalpy change during the formation of 1·00 mole NH_3(g) from its elements at 298 K is –46·1 kJ. The change in internal energy during this process is equal to [Given, $RT = 2{\cdot}48$ kJ mol^{-1} at 298 K]

(a) –48·58 kJ

(b) –43·6 kJ

(c) –46·1 kJ

(d) 48·58 kJ

25. Which of the following electrolytes will have maximum flocculation value for $Fe(OH)_3$ sol?

(a) NaCl

(b) K_2SO_4

(c) Na_2S

(d) $(NH_4)_3PO_4$

26. Which of the following compounds will develop a blue colour on successive treatment with aqueous KI containing KIO_3 and starch solution?

(a) Ethanol

(b) Phenol

(c) Benzoic acid

(d) Ethyl acetate

27. Which of the following organic compounds have more than one NMR signal?

(i) $(CH_3)_4C$ (ii) C_3H_6 (iii) $C_3H_6O_2$
(iv) C_2H_6O (v) $C_3H_8O_2$

(a) (i) and (ii)

(b) (iii) and (v)

(c) (iii), (iv) and (v)

(d) (ii) and (iv)

28. The number of *d* electrons in Fe^{+2} ($Z = 26$) is ***not*** equal to that of

(a) *p* electrons in Ne ($Z = 10$)

(b) *s* electrons in Mg ($Z = 12$)

(c) *d* electrons in Fe ($Z = 26$)

(d) *p* electrons in Cl ($Z = 17$)

29. Which of the following is true for hexagonal crystal system?

(a) $\alpha = \beta = \gamma = 90°$

(b) $\alpha = \beta = 90° \quad \gamma \neq 90°$

(c) $\alpha = \beta = 90° \quad \gamma = 120°$

(d) $\alpha = \beta = \gamma \neq 90°$

30. Na_2SO_3 and Na_2SO_4 can be distinguished from each other by using

(a) BaCl and HCl

(b) $AgNO_3$ and NH_3

(c) Na_2CO_3 and NaOH

(d) NH_3

31. The following carbocations in order of increasing stability (least → most) is

$CH_3\overset{+}{C}HCH_3$ (1) $\quad CH_3\overset{+}{C}HCH{=}CHCH_3$ (2) $\quad (CH_3)_3C\overset{+}{C}H_2$ (3)

(a) 1 < 2 < 3

(b) 3 < 1 < 2

(c) 2 < 3 < 1

(d) 2 < 1 < 3

32. Phytane is a naturally occurring alkane produced by the alga Spirogyra and is a constituent of petroleum. The IUPAC name for phytane is

(a) 2,4,6,10-tetramethylhexadecane

(b) 2,6,10,14-tetramethylhexadecane

(c) 2,6,10,12-tetramethylhexadecane

(d) 2,4,6,8-tetramethylhexadecane

33. How many grams of sulphuric acid are contained in 3·00 litre of 0·500 *N* solution? [MW of H_2SO_4 = 98·1]

(a) 73·6 g

(b) 98·1 g

(c) 196·2 g

(d) 496·3 g

34. A 25·0 mL sample of a basic solution of unknown concentration is titrated with 0·100 mole/L hydrochloric acid. A total of 20·0 mL of acid is required to neutralize the base. The concentration of the base will be

(a) 0·040 mole/L

(b) 0·080 mole/L

(c) 0·120 mole/L

(d) 0·160 mole/L

35. The condensation of a gas to a liquid would most likely have

(a) positive ΔH and positive ΔS

(b) negative ΔH and positive ΔS

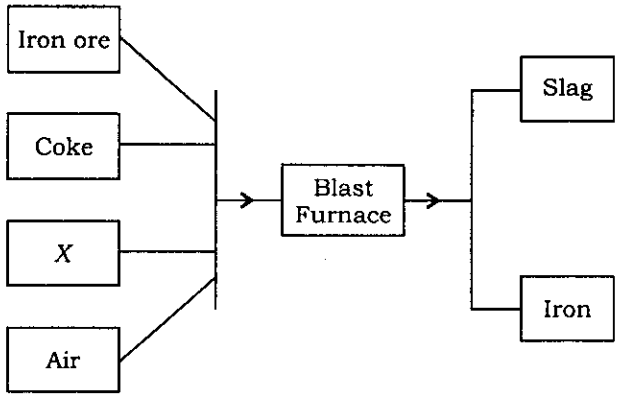
(c) positive ΔH and negative ΔS

(d) negative ΔH and negative ΔS

36. How many millilitres of a 50·0% (by mass) HNO_3 solution with a density of 2·00 gram per millilitre are required to make 500 mL of a 2·00 *M* HNO_3 solution?

(a) 50·0 mL
(b) 63·0 mL
(c) 100 mL
(d) 200 mL

37. The diagram below represents the manufacture of iron :



What is *X*?

(a) Bauxite
(b) Limestone
(c) Mild steel
(d) Sand

38. Climate change assessment is derived from the analysis of global average temperature records. Meaningful climate change estimates require the analysis of data record over time span

(a) ≥ 24 hours
(b) ≥ 30 years
(c) ≥ 10 years
(d) ≥ 1 year

39. The average thickness of glass lens used in spectacles will stop

(a) solar UV-B
(b) visible radiation
(c) IR radiation
(d) radio waves

40. Which of the following is ***not*** a criterion for air pollution?

(a) Pb
(b) O_3
(c) CO_2
(d) NO_x

41. If a cricket ball is dropped in a tunnel made along the diameter of the earth, then the ball will

(a) not enter the tunnel

(b) stop at the centre

(c) escape into space from other side

(d) oscillate in simple harmonic motion

42. Molecule having zero polarizability will manifest

(a) strong Rayleigh scattering

(b) strong dynamic light scattering

(c) absorption plus light scattering

(d) no light scattering

43. The area of the segment enclosed by the curve $y = x(2 - x)$ and the line $y = \frac{x}{2}$ is equal to

(a) 0

(b) 1

(c) 7

(d) $\frac{9}{16}$

44. Which of the following is true for an isothermal expansion process?

(a) $\Delta E = 0, \quad \Delta H = 0$

(b) $\Delta E \neq 0, \quad \Delta H = 0$

(c) $\Delta E = 0, \quad \Delta H \neq 0$

(d) $\Delta E \neq 0, \quad \Delta H \neq 0$

45. The total energy radiated per unit surface area of a blackbody across all wavelengths per unit time is directly proportional to the fourth power of the blackbody's thermodynamic temperature. This statement is known as

(a) Kirchhoff's law

(b) Joule's law

(c) Stefan's law

(d) Newton's law

46. The following data is given :

x	2	6	4	7	5
y	8	8	5	6	2

A line of best fit is drawn considering y as the dependent variable. Its slope and intercept are

(a) 0·129 and 6·83

(b) 0·216 and 5·54

(c) –0·129 and 6·83

(d) –0·216 and 6·83

47. Which of the following statements is ***not*** correct?

(a) The union of two closed sets is a closed set.

(b) The union of any finite collection of closed sets is a closed set.

(c) The union of an infinite number of closed sets need not be a closed set.

(d) The intersection of two closed sets need not be a closed set.

48. Which of the following is a correct statement?

(a) A sequence $\{a_n\}$ is said to be strictly monotonically increasing, if $a_{n+1} \geq a_n \ \forall \ n \in N$.

(b) A sequence $\{a_n\}$ is said to be strictly monotonically increasing, if $a_{n+1} > a_n \ \forall \ n \in N$

(c) A sequence $\{a_n\}$ is said to be strictly monotonically decreasing, if $a_{n+1} \leq a_n \ \forall \ n \in N$

(d) A sequence $\{a_n\}$ is said to be monotonically decreasing, if $a_{n+1} > a_n \ \forall \ n \in N$

49. If $f(x)$ be a function such that—

(i) it is continuous in the closed interval $[a, b]$;

(ii) it is derivable in the open interval (a, b);

then there exists at least one point $c \in (a, b)$ such that $\frac{f(b) - f(a)}{b - a} = f'(c)$.

The above statement is called as

(a) Rolle's theorem

(b) Lagrange's mean value theorem

(c) Cauchy's mean value theorem

(d) intermediate mean value theorem

50. $\lim\limits_{x \to 0}\left(\frac{3^{2x} - 1}{2^{3x} - 1}\right)$ is equal to

(a) $\frac{\log^9}{\log^8}$

(b) $\frac{\log^8}{\log^9}$

(c) $\frac{2}{3}$

(d) $\frac{3}{2}$

51. If $y = \left(1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots \infty\right)$, then $\frac{dy}{dx}$ is equal to

(a) ∞

(b) Cannot be determined

(c) y

(d) $\log y$

52. Consider the earth to be a blackbody with an average temperature of 15·0 °C and surface area equal to $5{\cdot}1 \times 10^{14}$ m^2. What is the rate at which energy is radiated by the earth? [Given, Stefan-Boltzmann constant = $5{\cdot}67 \times 10^{-8}$ $W/m^2\text{-}K^4$]

(a) $4{\cdot}0 \times 10^6$ W approximately

(b) $4{\cdot}0 \times 10^{17}$ W approximately

(c) $2{\cdot}0 \times 10^{17}$ W approximately

(d) $2{\cdot}0 \times 10^6$ W approximately

53. Excess pressure inside a drop of mercury of diameter 4 mm at 20 °C will be

(a) 5 N m^{-2}

(b) 50 N m^{-2}

(c) 465 N m^{-2}

(d) 46·5 N m^{-2}

54. The atmospheric pressure on a day when the height of mercury in barometer is 76 cm will be

(a) 101300 N m^{-2}

(b) 101·300 N m^{-2}

(c) $1{\cdot}013 \times 10^5$ N m^{-2}

(d) $1{\cdot}013 \times 10^3$ N m^{-2}

55. In the first second of its flight, a rocket ejects $\frac{1}{60}$ of its mass with relative velocity of 2400 ms^{-1}. The acceleration of the rocket will be

(a) 9·8 ms^{-2}

(b) 31·2 ms^{-2}

(c) 19·6 ms^{-2}

(d) 62·4 ms^{-2}

56. Geological formation in sedimentary rocks is shaped by soluble

(a) magnesite or siderite

(b) limestone or dolomite

(c) siderophile or magnesite

(d) glauconite or siderite

57. —— leads to lengthening or stretching of the crest.

(a) Confining stress

(b) Tensional stress

(c) Compressional stress

(d) Shear stress

58. A —— is a circular upwardly displaced fold.

(a) plunging basin

(b) dome

(c) converging basin

(d) depression

59. Which of the following minerals are silicates?

(i) Calcite *(ii)* Hornblende

(iii) Malachite *(iv)* Biotite

(a) *(i)* and *(ii)*

(b) *(ii)* and *(iii)*

(c) *(ii)* and *(iv)*

(d) *(i)* and *(iv)*

60. Glaciers move by —— where the entire glacier slides over bedrock.

(a) plastic flow

(b) subduction slip

(c) saltation flow

(d) basal slip

61. —— runs down the centre of many parts of the ridge and valley, and both are offset by numerous ——.

(a) Midoceanic ridge, island arcs

(b) Rift valley, transform faults

(c) Oceanic ridge, transform faults

(d) Rift valley, oceanic trenches

62. —— pattern is developed when bedrock exerts strong control over stream flow because of the structure of the underlined geology.

(a) Dendritic

(b) Radial

(c) Rectangular

(d) Trellis

63. —— dunes are shaped like a crescent moon except that horns point upward and regular, occur in more sand supply region with sufficient vegetation.

(a) Longitudinal

(b) Star

(c) Parabolic

(d) Barchan

64. A bowl-shaped depression carved by the glacier on the side of mountain is

(a) cinder

(b) chert

(c) clast

(d) cirque

65. Removal of ice at the toe of the glacier by melting and sublimation is

(a) snout

(b) calving

(c) ablation

(d) moraine

66. Breccia is produced in

(a) fault zone

(b) folded rocks

(c) unconformity

(d) fractured rocks

67. Kimberlites are the source rocks for

(a) gold

(b) diamond

(c) petroleum

(d) silver

68. QAPF system is ***not*** suitable for classification of

(a) granite

(b) dolerite

(c) quartzite

(d) carbonatite

69. A cumulative effect of impacts of hypervelocity particles from outer space is known as

(a) cosmic erosion

(b) wind erosion

(c) stellar erosion

(d) outer spacial erosion

70. A —— is a broad depositional surface found by merging alluvial fans.

(a) bajada

(b) pediment

(c) playa

(d) mesa

71. The isotopic composition of —— in —— and —— are used to estimate the time of ore deposition and information about the crustal history.

(a) zinc, corundum, pyrite

(b) lead, cuprite, galena

(c) lead, pyrite, galena

(d) lead, zincovite, corundum

72. The evidence of the oldest life existence in the earth is

(a) 2·5 billion years

(b) 3·2 billion years

(c) 3·8 billion years

(d) 2·8 billion years

73. Monazite is commonly found in the —— of India.

(a) beach placers

(b) fluvial placers

(c) colluvial placers

(d) lacustrine placers

74. Hardness of gypsum is more than

(a) fluorite

(b) apatite

(c) talc

(d) calcite

75. Algal bloom is a sudden growth on the surface of a lake, pond or stream, and occurs due to enrichment of

(a) phosphorus

(b) calcium

(c) iron

(d) magnesium

76. Which of the following types of bonds or interactions are least likely to be involved in stabilizing the three-dimensional folding of most proteins?

(a) Hydrogen bonds
(b) Hydrophobic interactions
(c) Disulphide bonds
(d) Ester bonds

77. In reversed-phase HPLC

(a) a hydrophobic stationary phase is combined with a nonpolar mobile phase
(b) a hydrophilic stationary phase is combined with a polar mobile phase
(c) a hydrophilic stationary phase is combined with a nonpolar mobile phase
(d) a hydrophobic stationary phase is combined with a polar mobile phase

78. In primary succession, plant's demand for nutrients is high during

(a) pioneer stage
(b) early successional stage
(c) climax stage
(d) None of the above

79. Cellular proteins destined for secretion are sorted and packaged in

(a) lysosomes
(b) endoplasmic reticulum
(c) trans-Golgi network
(d) endosomes

80. The amount of living matter present at any point of time in an ecosystem is called

(a) net productivity
(b) gross productivity
(c) standing crop biomass
(d) food chain

81. According to classical model of transcription, given by Jacob and Monad, a repressor protein binds to

(a) an operator
(b) an AUG sequence
(c) an enhancer
(d) TATA binding site

82. Virus-mediated transfer of cellular genetic material from one bacterial cell to another by means of virus particles is called

(a) induction
(b) transfection
(c) transformation
(d) transduction

83. Artificial immunity can be acquired from

(a) serious illness

(b) vaccination

(c) repeated exposure to the same microbe

(d) treatment with antibiotic

84. Which of the following regulates the cell division in shoot and root of plants?

(a) Gibberellin

(b) Auxin

(c) Abscisic acid

(d) Cytokinin

85. Which of the following is secreted by exocrine cell of pancreas?

(a) Carboxypeptidase

(b) Gastrin

(c) Enteropeptidase

(d) Aminopeptidase

86. Which of the following is a polar amino acid?

(a) Isoleucine

(b) Proline

(c) Glycine

(d) Serine

87. Which of the following is unsaturated fatty acid?

(a) Palmitic acid

(b) Stearic acid

(c) Lauric acid

(d) Oleic acid

88. A biome is distinguished by its

(a) unique soil type

(b) unique ecosystem processes

(c) unique climate and vegetation

(d) unique soil type and unique ecosystem processes

89. The process of methanogenesis is carried out by

(a) bacteria

(b) fungi

(c) archaea

(d) protozoa

90. Which of the following can act as an electron donor in photosynthesis?

(a) H_2

(b) H_2O

(c) H_2S

(d) All of the above

91. The site of origin of life is

(a) the ocean's edge

(b) under frozen oceans

(c) near deep-sea vents

(d) the desert area

92. Rainfall in Mediterranean region occurs

(a) throughout the year

(b) in summer

(c) in winter

(d) never

93. Which one of the following statements is ***not*** correct?

(a) Rhizobium is an example of mutualism

(b) Epiphytes like many orchids growing on trees illustrate an example of commensalism

(c) Lichens offer an example of mutualism

(d) Commensalism is a positive interaction found only in terrestrial ecosystem

94. —— is the greatest nitrogen reservoir in the biosphere.

(a) Atmosphere

(b) Ocean

(c) Organism

(d) Rock

95. An ecological pyramid of energy flow is often an inverted pyramid in

(a) desert ecosystem

(b) rainforest ecosystem

(c) tundra ecosystem

(d) ocean ecosystem

PART—B

Answer *any* **forty** questions

96. A lamp is hanging at a height of 40 cm from the centre of a table. If its height is increased by 10 cm, the illuminance on the table will decrease by

(a) 10%

(b) 20%

(c) 27%

(d) 36%

97. The statistical distributions of many atmospheric variables are distinctly asymmetric. They are skewed to the right and constrained by physical limit on the left, close to the range of data. Such distributions can best be represented by

(a) gamma distribution

(b) normal distribution

(c) Poisson distribution

(d) binomial distribution

98. Ignoring the time dependence observed in meteorological data leads to the underestimation of the variance of sampling distributions of test statistics. The time dependence can be detected by calculating

(a) segmented means

(b) normalized sample mean with variance

(c) lag-1 autocorrelation

(d) χ^2-test

99. A plano-convex lens when silvered in the plane side behaves like a concave mirror of focal length 30 cm. However, when silvered on the convex side it behaves like a concave mirror of focal length 10 cm. Then the refractive index of its material is

(a) 3·0

(b) 1·5

(c) 1·0

(d) 2·0

100. What should be the length of a closed organ pipe to produce resonance with an open organ pipe of length 40 cm?

(a) 40 cm

(b) 20 cm

(c) 10 cm

(d) None of the above

101. Of the following series of the hydrogen spectrum, the one which lies partly in the visible region is

(a) Lyman series

(b) Balmer series

(c) Paschen series

(d) Brackett series

102. Eigenvalues of a matrix

$$[A] = \begin{bmatrix} 185{\cdot}47 & 110{\cdot}84 \\ 110{\cdot}84 & 77{\cdot}58 \end{bmatrix}$$

are

(a) 13·76, 110·84

(b) 87·34, 120·56

(c) 47·34, 254·00

(d) 254·76, 8·29

103. Which of the following is a type–I superconductor?

(a) Hg

(b) NbN

(c) V_3Si

(d) $SrTiO_3$

104. Regardless of the nature of the substance or crystal, the specific heat capacity (c) of a solid substance (measured in joule per kelvin per kilogram) is equal to $\frac{3R}{M}$, where R is the gas constant and M is the molar mass.

The above statement is known as

(a) Debye's law

(b) Dulong and Petit law

(c) Curie-Weiss law

(d) law of mass action

105. When an atom is placed in an external magnetic field, the spectral lines it emits are split into several polarized components. This phenomenon is called

(a) Franck-Condon principle

(b) Raman effect

(c) Zeeman effect

(d) Tyndall effect

106. Which of the following statements is correct about diamagnetism?

(a) The magnetic moment is weak and aligned in the direction of the applied magnetic field

(b) Adjacent magnetic moments are equal and opposite to each other

(c) A very strong effect that arises when the adjacent magnetic moments align themselves in the same direction

(d) A weak effect in which magnetic moment is always directed opposite to the applied magnetic field

107. A certain stimulus is administered to 12 patients to investigate the effect on their blood pressure levels. Which of the following statistical tests will be the most appropriate?

(a) χ^2-test

(b) F-test

(c) Paired t-test

(d) Kolmogorov-Smirnov test

108. $L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_1 + \beta_2 X_i$, where $P_i = \frac{1}{1+e^{-Z_i}}$ represents

(a) Logit model

(b) Probit model

(c) Tobit model

(d) Poisson model

109. If $\overline{X}$ is the mean of a sample of size n taken from a population having the mean μ and finite variance σ^2, then

$$Z = \frac{\overline{X} - \mu}{\sigma / \sqrt{n}}$$

is a random variable whose distribution function approaches the standard normal distribution as $n \to \infty$. This statement is called as

(a) Chebyshev's theorem

(b) central limit theorem

(c) Bayes' theorem

(d) binomial theorem

110. The function $f(x) = \begin{cases} \frac{1}{\sqrt{2\pi}\beta} x^{-1} e^{-(\ln x - \alpha)^2 / 2\beta^2} & \text{for } x > 0, \beta > 0 \\ 0 & \text{elsewhere} \end{cases}$

represents

(a) normal distribution

(b) beta-distribution

(c) Weibull distribution

(d) log-normal distribution

111. A type–II error occurs when

(a) we accept the null hypothesis, when it is true

(b) we reject the null hypothesis, when it is true

(c) we accept the null hypothesis, when it is false

(d) we reject the null hypothesis, when it is false

112. The peak emission of electromagnetic radiation from the earth's surface takes place at about

(a) 1 μm

(b) 3 μm

(c) 10 μm

(d) 50 μm

113. Which of the following plume behaviours is expected in an unstable atmosphere?

(a) Looping plume

(b) Fanning plume

(c) Coning plume

(d) None of the above

114. Vegetation shows maximum reflectance in which of the following regions of electromagnetic spectrum?

(a) Blue region

(b) Green region

(c) Red region

(d) Near-infrared region

115. Which of the following statements about the 'Coriolis Force' is ***not*** correct?

(a) It is an apparent force

(b) It occurs due to rotation of the earth

(c) Its value is maximum at the equator

(d) It deflects objects to their left in the southern hemisphere

116. The formula of the complex *tris*-(ethylene diamine)-chromium(III) sulphate is

(a) $[Cr(en)_3]_2(SO_4)_3$

(b) $[Cr(en)_2SO_4]$

(c) $[Cr(en)_3SO_4]$

(d) $[Cr(en)_3]_2SO_4$

117. At a given Henry constant $1{\cdot}38 \times 10^{-3}$ mole/litre per atom at 20 °C, the concentration of oxygen at 20 °C at partial pressure of 0·21 atm is

(a) $0{\cdot}9 \times 10^{-4}$ moles per litre

(b) $2{\cdot}9 \times 10^{-4}$ moles per litre

(c) $2{\cdot}0 \times 10^{-4}$ moles per litre

(d) $1{\cdot}9 \times 10^{-4}$ moles per litre

118. Which of the following metal complexes ***does not*** have metal-metal bond?

(a) $Re_2(CO)_{10}$

(b) $Re_2(Cl_{10})^{4-}$

(c) $[Ru_2(NH_3)_{10}(Pyz)]^{5+}$

(d) $Co_3(CH)(CO)_9$

119. Ambidentate ligand gives rise to the possibility of

(a) enantiomers

(b) linkage isomerism

(c) optical isomerism

(d) diastereomers

120. Amount of electricity required to get 108 gm Ag from $AgNO_3$ solution is

(a) 1 amp

(b) 10 amp

(c) 1 faraday

(d) 10 faraday

121. Oceanic productivity in mid-oceans is primarily (besides solar radiation) dependant on solubility of

(a) phosphorous

(b) nitrogen

(c) iron

(d) calcium

122. Regarding mass spectrometry analysis of CH_3Cl, which one of the following statements is correct?

(a) The M^{+2} peak is three times of M^+ peak

(b) The M^{+2} peak is equal to M^+ peak

(c) The M^{+2} peak is $\frac{1}{3}$ of M^+ peak

(d) The M^{+2} peak is absent and has no role in fragment identification

123. The atmospheric concentration of oxygen, which is 21% at present, will be critical for the survival of Homo sapiens, if it reaches

(a) 20%

(b) 18%

(c) 14%

(d) 21·5%

124. According to 'nitrogen rule' the compounds having even number of molecular ions will have

(a) even number of nitrogen atoms

(b) odd number of nitrogen atoms

(c) any number of nitrogen atoms

(d) zero nitrogen atom

125. Change of α-sulphur to β-sulphur is an example of

(a) enantiotropy

(b) monotropy

(c) dynamictropy

(d) All of the above

126. The d^6-complex $[Fe(CN)_6]^{3-}$ is

(a) low-spin because of strong field ligand

(b) high-spin because of weak field ligand

(c) low-spin because of weak field ligand

(d) high-spin because of strong field ligand

127. How many signals would you expect to see in ^{13}C NMR spectrum of propylbenzene?

(a) 2

(b) 3

(c) 5

(d) 7

128. Gas *A* is decomposed according to the following reaction :

$$A(g) \rightarrow B(g) + C(g)$$

A student conducted an experiment and determined that the equilibrium pressure of gas *A* was 0·20*P*, where *P* was the total pressure of the system.

What is the equilibrium constant K_p for this reaction?

(a) 0·10*P*

(b) 0·20*P*

(c) 0·40*P*

(d) 0·80*P*

129. The rate of the chemical reaction between substances A and B is found to follow the rate law

$$\text{rate} = k[A]^2[B]$$

where k is the rate constant.

The concentration of A is reduced to half of its original value. To make the reaction occur at 50% of its original rate, the concentration of B should be

(a) halved

(b) kept constant

(c) doubled

(d) increased by a factor of 4

130. Given that the first, second and third dissociation constants for H_3PO_4 are $7{\cdot}0\times10^{-3}$, $6{\cdot}0\times10^{-4}$ and $5{\cdot}0\times10^{-13}$ respectively, the k for the complete dissociation of H_3PO_4 is

(a) $2{\cdot}10\times10^{-32}$

(b) $2{\cdot}10\times10^{-28}$

(c) $2{\cdot}10\times10^{-22}$

(d) $2{\cdot}10\times10^{-11}$

131. A $0{\cdot}15\ M$ solution within a 1 cm path length placed within a UV-visible spectrophotometer shows an absorbance of 0·62. The molar absorptivity of this compound will be

(a) 0·09 mol dm^{-3} cm^{-1}

(b) 0·24 mol dm^{-3} cm^{-1}

(c) 2·13 mol dm^{-3} cm^{-1}

(d) 4·13 mol dm^{-3} cm^{-1}

132. The law which states that the amount of gas dissolved in a liquid is proportional to its partial pressure is

(a) Dalton's law

(b) Gay Lussac's law

(c) Henry's law

(d) Raoult's law

133. Catalytic convertor is used in vehicles for

(a) oxidation of CO and NO

(b) oxidation of CO and reduction of NO

(c) reduction of CO and NO

(d) reduction of CO and oxidation of NO

134. What will be the coordination number of cation and structure of solid having radius of cation and anion equal to 33 pm and 77 pm respectively?

(a) 6, octahedral

(b) 4, tetrahedral

(c) 8, cubic

(d) 3, triangular

135. With the increase in temperature, the viscosities of

(a) both gases and liquids increase

(b) gases increase and that of liquids decrease

(c) both gases and liquids decrease

(d) gases decrease and that of liquids increase

136. The root-mean-square speed $v_{r.m.s.}$ is defined by

$$v_{r.m.s.} = \left[\frac{\int d^3v \cdot v^2 \cdot f_0(\vec{v})}{\int d^3v\, f_0(\vec{v})}\right]^{1/2}$$

A plot of $4\pi v^2 f_0(\vec{v})$ against v indicates that $f_0(\vec{v})$ does not vanish when $v > c$ (velocity of light). This is because we have ***not*** accounted for

(a) phase velocity

(b) refractive index of matter

(c) relativistic dynamics

(d) Curie temperature

137. Which of the following molecules will exhibit pure rotational spectra?

(a) H_2

(b) CO_2

(c) CH_4

(d) HCl

138. At the same energy, the particle spectrum has a higher density of states than photon or phonon spectrum. Consequently there are

(a) more excitation modes and greater specific heat

(b) less excitation modes and smaller specific heat

(c) less excitation modes and greater specific heat

(d) more excitation modes and smaller specific heat

139. Bose-Einstein condensation is a phase transition of

(a) second order

(b) third order

(c) $\frac{3}{2}$ order

(d) first order

140. Most of the substances become crystalline solids near absolute zero. Only known substance that remains a liquid at absolute zero is helium. It suggests that for helium qualitatively

(a) third law does not hold

(b) there is no Curie temperature

(c) liquid state is same as crystalline

(d) it may acquire crystalline state if absolute zero is reached

141. At absolute zero of temperature a system is in its ground state, i.e., a state of lowest energy. It implies that at absolute zero, entropy $S = k \log G$, where G stands for

(a) degeneracy of ground state

(b) Gibbs' free energy

(c) molar Gibbs' free energy

(d) degeneracy of excited state

142. Some metals manifest spontaneous polarization of spins in same direction, thereby displacing macroscopic magnetic field. This occurs when temperature is lowered below

(a) 0 °C

(b) 100 °C

(c) Boltzmann temperature

(d) Curie temperature

143. The diameter of aerosols obtained by averaging the maximum distance from edge to edge of each particle is called

(a) Feret's diameter

(b) Martin's diameter

(c) aerodynamic diameter

(d) Stokes' diameter

144. For a fluid flowing inside a pipe, the flow would be turbulent if Reynolds number is

(a) 1500

(b) 2000

(c) 3000

(d) 4500

145. Atmospheric absorption of sound is

(a) more effective at low frequencies

(b) more effective at middle frequencies

(c) more effective at high frequencies

(d) the same at all frequencies

146. From a point source of noise, the sound pressure level decreases at the rate of

(a) 2 dB per doubling of distance

(b) 3 dB per doubling of distance

(c) 6 dB per doubling of distance

(d) 8 dB per doubling of distance

147. The noise level at 10 m from a long pipe carrying high-velocity steam is 95 dBA. What is the noise level at 100 m?

(a) 90 dBA

(b) 85 dBA

(c) 80 dBA

(d) 75 dBA

148. Which of the following gases absorbs electromagnetic radiation significantly in the atmospheric window of 8 μm to 11 μm?

(a) CH_4

(b) CO_2

(c) O_3

(d) Water vapour

149. A system is changed from an initial state to a final state by a manner such that $\Delta H = q$. If the change from the initial state to the final state was made by a different path, then

(a) ΔH and q will be same as initial path

(b) ΔH will be same and q will be different than that of initial path

(c) both ΔH and q will be different than initial path

(d) q will be same and ΔH will be different than that of initial path

150. Assuming $\Delta H°$ and $\Delta S°$ to be independent of temperature, at what temperature will the reaction given below become spontaneous?

$$N_2(g) + O_2(g) \rightarrow 2NO(g); \quad \Delta H° = 180{\cdot}8\ kJ\ mol^{-1}$$

$S°/5\ K^{-1}\ mol^{-1}$	191·4	204·9	210·5

(a) >7320 K

(b) <7320 K

(c) >750 K

(d) <750 K

151. The most exothermic 'ordinary' chemical reaction for a given mass of reactants is

$$2H \rightarrow H_2; \qquad \Delta E = -103 \text{ kcal}$$

The theoretical decrease in mass after the combination of 2·0 mol of hydrogen atoms to form 1·0 mol of hydrogen molecules is

(a) $-4 \cdot 79 \times 10^{-12}$ kg

(b) $-4 \cdot 79 \times 10^{-12}$ g

(c) $-1 \cdot 6 \times 10^{-12}$ kg

(d) $-1 \cdot 6 \times 10^{-12}$ g

152. At its melting point 0 °C, the enthalpy of fusion of water is 1·435 kcal/mol. What is the molar entropy change for the melting of ice at 0 °C?

(a) 52·6 cal/mol K

(b) 5·26 cal/mol K

(c) 5·26 kcal/mol K

(d) 52·6 kcal/mol K

153. An electron in a hydrogen atom in its ground state absorbs 1·50 times as much energy as the minimum required (13·6 eV) for it to escape from the atom. What is the wavelength of the emitted electron?

(a) $4 \cdot 70 \times 10^{-10}$ m

(b) $4 \cdot 70 \times 10^{-8}$ m

(c) $4 \cdot 70 \times 10^{-6}$ m

(d) $4 \cdot 70 \times 10^{-7}$ m

154. If the energy difference between the ground state of an atom and its excited state is $4 \cdot 4 \times 10^{-19}$ J, what is the wavelength of the photon required to produce this transition?

(a) $4 \cdot 5 \times 10^{-7}$ m

(b) $4 \cdot 5 \times 10^{-7}$ cm

(c) $4 \cdot 0 \times 10^{-7}$ m

(d) $4 \cdot 0 \times 10^{-7}$ cm

155. Which of the following sound waves will be attenuated the least while travelling through the atmosphere?

(a) Ultrasonics

(b) Infrasonics

(c) Sound waves in the frequency range 200 Hz to 1000 Hz

(d) Sound waves in the frequency range 8000 Hz to 10000 Hz

156. When epidote reacts with silica it forms

(a) marble

(b) anorthite and grossularite

(c) phyllosilicate

(d) orthosilicate

157. Disappearance of andalusite and appearance of sillimanite in rocks denote

(a) progressive metamorphism

(b) asbestos mineralization

(c) skarn deposit

(d) contact of igneous rocks with sedimentary rocks

158. High-temperature polymorphs of quartz are known as

(a) coesite

(b) stishovite

(c) coesite and stishovite

(d) azurite

159. A single-chain tetrahedron with repeat structure, separated by 5·3 Å, is known as

(a) amphibole

(b) pyroxene

(c) olivine

(d) quartz

160. A sandstone containing less than 10 percent mud matrix over 25 percent rock particles and less than 10 percent feldspar is known as

(a) lithic tuff

(b) lithic arenite

(c) lithic breccia

(d) lithic conglomerate

161. The moon was formed out of the debris left over from a collision between the earth and a body of the size of the Mars is known as

(a) Gya hypothesis

(b) giant impact hypothesis

(c) solar system formation hypothesis

(d) Howel's magnetic theory

162. An oceanographic phenomenon that involves wind-driven motion of dense, cooler and usually nutrient-rich water towards the ocean surface, replacing the warmer water, is known as

(a) thermocline
(b) halocline
(c) upwelling
(d) downwelling

163. Supergene sulphide enrichment of mineralized veins can be inferred as

(a) low reflectance in near-infrared region
(b) high reflectance in near-infrared region
(c) high reflectance in thermal region
(d) high reflectance in microwave region

164. Monchiquite is

(a) an alkaline variety of lamprophyre
(b) a variety of feldspar
(c) a variety of quartz
(d) a variety of olivine

165. Emissivity of basalt rock is higher than

(a) clear water
(b) wet snow
(c) human skin
(d) granite rock

166. Chandrayan-1 satellite is equipped with sensor

(a) Mini-SAR
(b) LISS-III
(c) LISS-IV
(d) PAN

167. Spectral bands more than 100 in a sensor can be classed as

(a) panchromatic
(b) hyperspectral
(c) multispectral
(d) spectral

168. What is the name of the radar technique that makes it possible to make surface elevation models?

(a) Interferometric SAR
(b) ISAR
(c) GPS
(d) Elevated SAR

169. —— has significant role in supplying the world's ocean with iron.
(a) Fly ash
(b) Cosmic dust
(c) Volcanic ash
(d) Mineral dust

170. If a fault plane is inclined with an angle of 30°, then the hade will be
(a) 120°
(b) 140°
(c) 60°
(d) 45°

171. The asthenosphere is made up of
(a) lower crust and upper mantle
(b) entire crust and mantle
(c) upper crust and upper mantle
(d) core and mantle

172. Average depth of the global ocean is approximately
(a) 2 km
(b) 3 km
(c) 4 km
(d) 5 km

173. Angiosperm plants originated in
(a) Archaean
(b) early Cretaceous
(c) Holocene
(d) early Triassic

174. The two major sources of mineral dust transport originate from which of the following two regions?
(a) Thar and Sahara
(b) Sahara and Gobi
(c) Sahara and Atacama
(d) Thar and Takla Makan

175. The biggest reservoir of carbon is
(a) atmosphere
(b) ocean
(c) soil
(d) vegetation

176. An oligotrophic system is characterized by

(a) low planktonic activity with low nutrients
(b) high planktonic activity with nutrients
(c) high productivity with high nutrients
(d) high concentration of nutrient dissolved in water

177. During transcription, the movement of RNA polymerase along the DNA duplex is facilitated by

(a) gyrase
(b) DNA polymerase
(c) single-strand binding protein
(d) sigma factor

178. What percent of the human genome is composed of mobile genetic elements?

(a) Less than 1%
(b) 10% to 20%
(c) 20% to 30%
(d) Greater than 30%

179. Histones are basic proteins which associate with DNA to form chromatin. Which modification of histones is generally associated with the promoter of an actively transcribing gene?

(a) Acetylation
(b) Deacetylation
(c) Octamer formation
(d) Tetramer formation

180. The enzyme reverse transcriptase is associated with

(a) bacteriophages
(b) retroviruses
(c) tobacco mosaic virus
(d) Ti plasmid

181. Absence of which of the following regions on an eukaryotic chromosome will ***not*** allow its proper segregation during cell division?

(a) Telomere
(b) Centromere
(c) Cohesion
(d) Microtubule

182. The ribosome is involved in all of the following, *except*

(a) peptide bond formation
(b) binding of elongation factors
(c) binding of mRNA at an initiation codon
(d) aminoacylation of tRNA

183. 'Zinc fingers' are important in cellular regulation, because they are
(a) at the catalytic site of many kinases
(b) the structures with high redox potential
(c) structural motifs in many DNA-binding proteins
(d) characteristic of palindromic stretches of unique-sequence DNA

184. Lymphocytes that cause the formation of holes in plasma membranes are
(a) B cells
(b) killer T cells
(c) suppressor T cells
(d) helper T cells

185. Which one of the following can be considered as an ecosystem service?
(a) Albedo
(b) Mutation
(c) Fertilization
(d) Pollination

186. UN-REDD$^+$ programme addresses the problem of
(a) deforestation
(b) climate change mitigation
(c) both deforestation and climate change mitigation
(d) pollution of red soils

187. Clean coal technology is a solution to mitigation of
(a) emission of only carbon dioxide
(b) emission of CO_2 and water vapour
(c) emission of CO_2 and O_3
(d) emission of greenhouse gases, sulphur and ash

188. An element (nutrient) with the ability to transform a community or ecosystem is termed as
(a) ultimate limiting nutrient
(b) transit limiting nutrient
(c) proximate limiting nutrient
(d) All of the above

189. The catalyst nitrogenase involved in biological N-fixation gets denatured in the presence of
(a) oxygen
(b) phosphorus
(c) nitrate
(d) ammonium

190. The archaeal and the bacterial domains share which of the following characteristics?

(a) Peptidoglycan cell walls

(b) Ester-linked lipids

(c) Lack nuclear membrane

(d) Sensitive to antibiotics

191. Which of the following carries out oxygenic photosynthesis?

(a) Green sulphur bacteria

(b) Green nonsulphur bacteria

(c) Purple sulphur bacteria

(d) Cyanobacteria

192. —— are well-adapted to warm, wet climates but not well-adapted to other types of climate.

(a) Insects

(b) Birds

(c) Reptiles

(d) Amphibians

193. A bacterium is divided in every 20 minutes. Beginning with a single bacterium, how many bacteria will be there in the population if there is exponential growth for 3 hours?

(a) 1024

(b) 512

(c) 256

(d) 128

194. An essential nutrient for all nitrogen-fixing organisms is

(a) selenium

(b) molybdenum

(c) chromium

(d) cadmium

195. The most acceptable theory for origin of life is

(a) RNA theory

(b) DNA theory

(c) protein theory

(d) vitamin theory

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