7 Set FIB 500 HB

HB 500



35

Total Pages : 108

**ENTRANCE EXAMINATION, 2012**

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 |
|---|---|---|---|---|
| ● ⓑ ⓒ ● | Ø ⓑ ⓒ ⓓ | Ø ⓑ ⓒ Ø | ◉ ⓑ ⓒ ● | ⓐ ⓑ ⓒ ● |

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. The ionization potential of hydrogen is 13·6 V. The energy required to remove an electron from the second orbit of hydrogen is
   (a) 3·4 eV
   (b) 6·8 eV
   (c) 27·2 eV
   (d) 54·4 eV

2. Which of the following infinite series is divergent?
   (a) $\sum \sin \frac{1}{n}$
   (b) $\sum \frac{1}{n} \sin \frac{1}{n}$
   (c) $\sum \cot^{-1} n^2$
   (d) $\sum \frac{1}{\sqrt{n}} \tan \frac{1}{n}$

3. $\int_0^\infty \frac{x \tan^{-1} x}{(1+x^2)^2} dx$ is equal to
   (a) 0
   (b) $\frac{\pi}{8}$
   (c) $\frac{\pi}{4}$
   (d) $\frac{\pi}{2}$

4. If $y = x^x$, then $\frac{dy}{dx}$ is equal to
   (a) $x \log x + 1$
   (b) $x^x(1 + \log x)$
   (c) $x \log x + x$
   (d) $x^x \log x + 1$

5. $\left(\frac{d^3y}{dx^3}\right)^2 + 7\left(\frac{dy}{dx}\right)^3 + x^2 - y^2 = 0$

   The order and degree of the above differential equation are
   (a) order = 2, degree = 3
   (b) order = 3, degree = 3
   (c) order = 3, degree = 2
   (d) order = 2, degree = 2

6. $\begin{vmatrix} a+b+c & -c & -b \\ -c & a+b+c & -a \\ -b & -a & a+b+c \end{vmatrix}$ is equal to

(a) 0

(b) 1

(c) $(a+b)(b+c)(c+a)$

(d) $2(a+b)(b+c)(c+a)$

7. $\lim_{x \to 1} \frac{x^2 - x\log x + \log x - 1}{x-1}$ is equal to

(a) 0

(b) 1

(c) 2

(d) $\infty$

8. Coordinates can be rotated by matrix multiplication in which premultiplier is $2 \times 2$ matrix as

(a) $\begin{bmatrix} \cos^2\theta & \sin^2\theta \\ \sin^2\theta & \cos^2\theta \end{bmatrix}$

(b) $\begin{bmatrix} \cos^4\theta & \sin^4\theta \\ -\sin^4\theta & \cos^4\theta \end{bmatrix}$

(c) $\begin{bmatrix} \cos^2\theta & \sin\theta\cos\theta \\ \sin\theta\cos\theta & \sin^2\theta \end{bmatrix}$

(d) $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

9. To test the significance of a difference of means, using conventional statistics, one uses

(a) $F$-test

(b) $\chi^2$-test

(c) Phi statistics

(d) Student's $t$-test

10. A wave whose frequency $f = 5$ Hz propagates in space with a velocity $v = 3$ m/s. What is the phase difference of the wave at two points separated in space by a distance $l = 20$ cm and located on the straight line coinciding with the direction of propagation of the wave?

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

(b) $\frac{\pi}{4}$

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

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

**11.** The terminal velocity of a spherical ball with density $\rho_s$ and radius $r_s$ through a fluid of density $\rho$ and viscosity $\eta$, is given by

(a) $v = \frac{2}{9}\frac{r_s}{\eta}(\rho_s - \rho)g$

(b) $v = \frac{2}{9}\frac{\eta}{r_s}(\rho_s - \rho)g$

(c) $v = \frac{2}{9}\frac{\eta}{r_s^2}(\rho_s - \rho)g$

(d) $v = \frac{2}{9}\frac{r_s^2}{\eta}(\rho_s - \rho)g$

**12.** What increase in radiative power results when the temperature of a blackbody is increased from 7 °C to 287 °C?

(a) 41 times

(b) 16 times

(c) 8 times

(d) 2 times

**13.** Unit of irradiance is

(a) watt per steradian

(b) watt per steradian per square meter

(c) watt per square meter

(d) watt per square meter per unit time

**14.** Dimensions of the 'moment of inertia' are

(a) $L^2 M$

(b) $L^2 MT^{-1}$

(c) $LMT^{-1}$

(d) $L^2 MT^{-2}$

**15.** When we combine horizontal and vertical simple harmonic motions having equal amplitude, but horizontal having phase difference with respect to vertical, to get circular vibration the phase difference should be

(a) even multiple of $\pi$

(b) odd multiple of $\pi/2$

(c) even multiple of $\pi/2$

(d) odd multiple of $\pi$

**16.** One gram of water (1 $cm^3$) becomes 1671 $cm^3$ of steam when boiled at a pressure 1 atm. The heat of vaporization at this pressure is 2256 $J\text{-}g^{-1}$. External work and increase in internal energy, respectively, will be

(a) 169 J and 2087 J

(b) 84·5 J and 2087 J

(c) 169 J and 1671 J

(d) 0 and 2087 J

**17.** Solution of the differential equation $dy/dx = y^2/(xy - x^2)$ is

(a) $y = ce^{y/x}$

(b) $\log y = c + \frac{y}{x}$

(c) Both (a) and (b)

(d) None of the above

**18.** In a $\Delta ABC$, the value of $a^2(\sin^2 B - \sin^2 C) + b^2(\sin^2 C - \sin^2 A) + c^2(\sin^2 A - \sin^2 B)$ is equal to

(a) $2\Sigma a^2 b^2$

(b) $2(a^2 + b^2 + c^2)$

(c) $(a + b + c)^2$

(d) 0

**19.** One gram of matter is completely transformed into energy. Energy released will be

(a) $9 \times 10^{20}$ kWh

(b) $2{\cdot}5 \times 10^7$ kWh

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

(d) $4 \times 10^{13}$ kWh

**20.** A radioisotope has a half-life of 5 years. The fraction of atoms of this material that would decay in 15 years will be

(a) 1

(b) 3/4

(c) 7/8

(d) 5/8

5/85

**21.** The relation among Faraday constant $F$, electron charge $e$ and Avogadro's number $N$ is given by

(a) $F = \frac{N}{e}$

(b) $F = Ne$

(c) $N = Fe^2$

(d) $F = N^2e$

**22.** For the hydrogen atom, the transition from $n = 2 \rightarrow n = 3$ represents

(a) an emission line of the Paschen series

(b) an emission line of the Balmer series

(c) an absorption line of the Paschen series

(d) an absorption line of the Balmer series

**23.** The relation $PV = RT$ can describe the behaviour of a real gas at

(a) high temperature and high density

(b) high temperature and low density

(c) low temperature and low density

(d) low temperature and high density

**24.** In a semiconductor, the forbidden energy gap between the valence band and the conduction band is of the order of

(a) 1 eV

(b) 50 eV

(c) 1 keV

(d) 1 MeV

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

(a) 3·0

(b) 1·5

(c) 1·0

(d) 2·0

**26.** Two spheres of the same size are made of the same material but one is hollow and the other is solid. These are heated to the same temperature. Select the correct statement about both the spheres.

(a) Both the spheres will expand equally

(b) The hollow sphere will expand more

(c) The solid sphere will expand more

(d) It is difficult to predict their relative expansion

**27.** Given that $U$ and $V$ as square matrices of size $n \times n$. If they are orthogonal, then their inverses are equal to

(a) transpose

(b) matrices of the reciprocal of the elements

(c) matrices of the reciprocals of diagonal elements

(d) null matrices

**28.** Series, $\frac{1}{10}+\frac{1}{10^2}+\frac{1}{10^6}+\frac{1}{10^{24}}+\frac{1}{10^{120}}+\cdots$ in which exponents are successive factorials $[2 = 1\times2,\ 6 = 1\times2\times3,\ 24 = 1\times2\times3\times4,\ 120 = 1\times2\times3\times4\times5, \cdots]$ defines some definite number which is less than

(a) 0·12

(b) 0·24

(c) 0·36

(d) 0·48

**29.** If $x + y + z = xyz$, then $\sum\left(\frac{2x}{1-x^2}\right) =$

(a) $xyz$

(b) $\pi\{2x/(1-x^2)\}$

(c) $1/xyz$

(d) None of the above

**30.** Secchi disk is used to measure

(a) water pollution

(b) air pollution

(c) soil pollution

(d) soil depth

31. Mean depth of the ocean is

(a) 6·0 km

(b) 4·8 km

(c) 3·8 km

(d) 2·0 km

32. Iridium, a siderophile element, occurs in

(a) alluvial aggregates of recent age

(b) boundary of Cretaceous and Tertiary periods

(c) deserts

(d) ocean floor

33. Lithium with chemical composition of (Li, Na) $Al(PO_4)(F, OH)$ is found in

(a) limestone

(b) phosphorite

(c) pegmatite

(d) sandstone

34. Placing geologic events in sequential or chronological order as determined by their position in the geologic records is known as

(a) absolute dating

(b) relative dating

(c) historical dating

(d) canonical dating

35. All the oxygen atoms of the tetrahedra are shared in

(a) quartz

(b) olivine

(c) muscovite

(d) beryl

**36.** The thickness of oceanic crust generally ranges between

(a) 0–30 km

(b) 0–6 km

(c) 6–30 km

(d) 0–100 km

**37.** Monazite is a

(a) carbonate

(b) sulfate

(c) silicate

(d) phosphate

**38.** Equatorial radius of the earth is

(a) 2890 km

(b) 6371 km

(c) 1216 km

(d) 5155 km

**39.** Erosional remnants of a shoreline rising above a wave-cut platform are called

(a) embayments

(b) headlands

(c) tombolos

(d) sea stacks

**40.** The accumulation of calcium carbonate around hot springs/geysers is generally known as

(a) travertine

(b) dolomite

(c) gypsum

(d) limestone

**41.** The characteristic landform of effusive eruptions is

(a) volcanic domes

(b) cinder cones

(c) stratovolcano

(d) shield volcano

42. Vesicular rich basalt is known as

(a) pumice
(b) scoria
(c) breccia
(d) dolerite

43. Which one of the following structures is developed during delta formation?

(a) Graded bedding
(b) Cross-bedding
(c) Pools and riffles
(d) Ripple marks

44. Subaqueous basaltic eruptions develop a distinctive structure known as

(a) columnar jointing
(b) sheet structure
(c) pillow structure
(d) vesicular structure

45. Dissolved inorganic carbon (DIC) in an aquifer is influenced by

1. rainfall and dissolution of limestone
2. in situ aerobic microbial activity and plant and soil respiration

Which of the above is/are correct?

(a) 1 only
(b) 2 only
(c) 1 and 2 both
(d) None of the above

46. Point bar and cutbank are the areas of

(a) turbidity and deposition respectively
(b) deposition and erosion respectively
(c) erosion and flooding respectively
(d) inundation and accumulation respectively

47. In oceans, the rate of dissolution of calcite increases dramatically below

(a) halocline
(b) lysocline
(c) thermocline
(d) mesocline

**48.** Limestones are undergoing dolomitization in

(a) estuaries
(b) beaches
(c) tidal flats
(d) deltas

**49.** Charge development on silicate clays is mainly due to

(a) atomic substitution
(b) isomorphous substitution
(c) dimorphic substitution
(d) substitution pseudomorph

**50.** Given the following heats of formation :

| *Substance* | $\Delta H_f^\circ$ |
|---|---|
| Acetic acid | -120 kcal/mole |
| Carbon dioxide | -95 kcal/mole |
| Water | -60 kcal/mole |

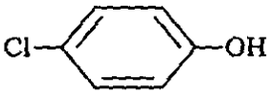
Find $\Delta H^\circ$ of combustion for acetic acid ($CH_3COOH$).

(a) -430 kcal/mole
(b) -190 kcal/mole
(c) -45 kcal/mole
(d) 45 kcal/mole

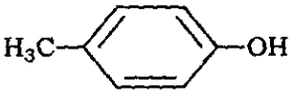
**51.** Which of the following violates the octet rule?

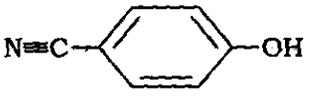
(a) $NF_3$
(b) $IF_3$
(c) $PF_3$
(d) $SbF_3$

**52.** Which one of the following phenols has the largest $pK_a$ value (i.e., least acidic)?

(a) 


(b) 


(c) 


(d) 


**53.** What is the purpose of the salt bridge in an electrochemical cell?

(a) It allows ion migration
(b) It allows electron migration
(c) It prevents ion migration
(d) It allows neutron migration

**54.** Which of the following aqueous solutions has a molarity of 1·0 *M*?

(a) 73 grams of HCl dissolved to make 2·0 litres of solution

(b) 94 grams of $K_2O$ dissolved to make 0·75 litres of solution

(c) 24 grams of LiOH dissolved to make 1·25 litres of solution

(d) 40 grams of HF dissolved to make 2·50 litres of solution

**55.** Which of the following solutions has the lowest freezing point?

(a) 0·50 *M* $K_2CrO_4$

(b) 0·50 *M* $KNO_3$

(c) 0·50 *M* $MgSO_4$

(d) 0·50 *M* $Na_3PO_4$

**56.** For the reaction $2NH_3 \rightleftharpoons N_2(g) + 3H_2(g)$ the value of $K_p = 2 \cdot 8 \times 10^{-2}$ at 400 K. The $K_c$ at 400 K for the above reaction is

(a) $1 \cdot 3 \times 10^{-5}$

(b) $2 \cdot 6 \times 10^{-5}$

(c) $8 \cdot 5 \times 10^{-4}$

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

**57.** Substance *X* has three isotopes—*X*-48, *X*-49 and *X*-51. Relative abundance of *X*-48 is 42%, *X*-49 is 38% and *X*-51 is 20%. The atomic mass of the substance *X* is

(a) 49·33

(b) 48·62

(c) 50·67

(d) 48·98

**58.** Based on *s*, *p*, *d* and *f* electronic configuration, select the odd element out from the following :

Na, K, Ti, Co, Cr, Zn

(a) Na

(b) K

(c) Cr

(d) Zn

**59.** Which of the following bond orders is ***not*** correct?

| | | *Bond order* |
|---|---|---|
| (a) | $O_2^+$ | 2½ |
| (b) | $O_2$ | 2 |
| (c) | $O_2^-$ | 1½ |
| (d) | $O_2^{2-}$ | ½ |

**60.** Acids *HA* and *HB* have their dissociation constants $1 \times 10^{-2}$ and $1 \times 10^{-6}$ respectively in water at 25 °C. The strength of *HA* with respect to *HB* is

(a) 10

(b) 100

(c) 1000

(d) 10000

**61.** Precipitation reactions occur when the solubility product is

(a) equal to the ionic product

(b) exactly double of the ionic product

(c) lower than the ionic product

(d) higher than the ionic product

**62.** Group IVA elements tend to hybridize in which of the following ways?

(a) $sp$

(b) $sp^2$

(c) $sp^3$

(d) $s^2p^2$

**63.** Which of the following sequences of decays might lead to the creation of $^{234}_{91}Pa$ from $^{238}_{92}U$?

(a) Alpha then gamma decay

(b) Alpha then beta decay

(c) Alpha decay only

(d) Beta decay only

**64.** Calculate the volume of a 36% solution of hydrochloric acid (density = 1·50 g/mL, MM ≈ 36 g/mol) required to prepare 9 litres of a 5 molar solution.

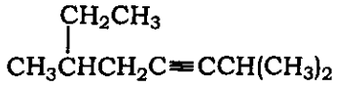
(a) 1 litre

(b) 2 litres

(c) 3 litres

(d) 4 litres

**65.** The IUPAC name for the compound shown



is

(a) 2,6-dimethyl-3-octyne

(b) 6-ethyl-2-methyl-3-heptyne

(c) 2-ethylpropyl isopropyl acetylene

(d) 2-ethyl-6-methyl-4-heptyne

**66.** A mesocompound

(a) is an achiral molecule that contains stereogenic centres

(b) contains a plane of symmetry or a centre of symmetry

(c) is optically inactive

(d) is characterized by all of these

**67.** Resistance of an $N/10$ KCl solution is $2 \times 10^2$ ohm. At a cell constant value 1·2, it will show specific conductance of

(a) 6·0 $ohm^{-1} cm^{-1}$

(b) 0·6 $ohm^{-1} cm^{-1}$

(c) 0·006 $ohm^{-1} cm^{-1}$

(d) 0·0006 $ohm^{-1} cm^{-1}$

**68.** Isochoric process involves

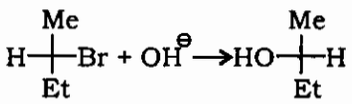
(a) constant weight

(b) constant volume

(c) constant number

(d) constant density

**69.** The type of the following reaction



is

(a) $S_N1$

(b) E1

(c) E2

(d) $S_N2$

**70.** The redox potential is a measure of

(a) molecular oxygen content

(b) the tendency of a substance to accept or donate electrons

(c) carbon dioxide content

(d) the balance between hydrogen and hydroxyl ions in solution

**71.** Animals which ***cannot*** regulate body temperature are known as

(a) homeothermic

(b) poikilothermic

(c) homeothermic and poikilothermic

(d) herbivory

72. Bacteria and blue-green algae are the modern representatives of

(a) Protista

(b) Monera

(c) Metaphyta

(d) Metazoa

73. In Dischidia, the pitcher is a modification of

(a) leaf base

(b) petiole

(c) leaf

(d) flower

74. Gram-positive bacteria retain Gram's stain owing to high percentage of —— than Gram-negative bacteria.

[Fill in the blank]

(a) lipoproteins

(b) lipopolysaccharides

(c) peptidoglycan

(d) outer membrane proteins

75. The most abundant protein in biosphere is

(a) keratin

(b) glycoprotein

(c) rubisco

(d) collagen

76. An oligotrophic system is characterized by

(a) low planktonic activity

(b) high planktonic activity

(c) high productivity

(d) high concentration of nutrient dissolved in water

77. The Earth Summit held at Rio de Janeiro resulted into

(a) United Nations Environment Programme

(b) Biosphere Reserves

(c) Convention on Biological Diversity

(d) Montreal Protocol

78. Which one of the following can bind several times more strongly to the haemoglobin than oxygen?

(a) CO

(b) $CO_2$

(c) $SO_2$

(d) $H_2CO_3$

79. Coconut water is rich in

(a) auxin

(b) gibberellin

(c) abscisic acid

(d) cytokinin

80. Plants which grow only by means of rhizomes

(a) are similar to apomictic plants

(b) do not possess clones

(c) are never found in alpine habitats

(d) are always haploids

81. Lymphocytes that cause formation of holes in plasma membranes are called

(a) B cells

(b) cytotoxic (or killer) T cells

(c) helper T cells

(d) suppressor T cells

82. Which one of the following measures single-gene diversity?

(a) Phycochips

(b) T-RFLP

(c) Microelectrodes

(d) Radioisotopes

83. A bacterium should be considered a new species if its 16S rRNA gene sequence differs by more than —— from that of the other organisms.

[Fill in the blank]

(a) 95%

(b) 3%

(c) 70%

(d) 20%

**84.** Species occurring in different geographical areas is called as

(a) sympatric

(b) allopatric

(c) sibling

(d) neopatric

**85.** A competitive enzyme inhibitor

(a) increases $K_m$ without affecting $V_{max}$

(b) decreases $K_m$ without affecting $V_{max}$

(c) increases $V_{max}$ without affecting $K_m$

(d) decreases $V_{max}$ and $K_m$ both

**86.** Which one of the following moves regularly from the nucleus to the cytoplasm?

(a) RNA

(b) DNA

(c) Glycogen

(d) Cholesterol

**87.** Which one of the following cellular organelles extracts energy from carbohydrates and forms ATP molecules?

(a) Chloroplast

(b) Chromoplast

(c) Lysosome

(d) Mitochondrion

**88.** Some organisms can tolerate wide range of salinity. These organisms are called

(a) euryhaline

(b) stenohaline

(c) eurythermal

(d) stenothermal

**89.** Which one of the following is ***not*** a typical transport even?

(a) Uniport

(b) Symport

(c) Cytoport

(d) Antiport

**90.** The procedure of obtaining culture of microbes was first developed by

(a) Robert Hooke

(b) Anton van Leeuwenhoek

(c) Ferdinand Cohn

(d) Robert Koch

**91.** Which of the following is indicative of the process which describes the oxidation of $NH_3$ or $NH_4^{\oplus}$ to $NO_2^{\ominus}$ or $NO_3^{\ominus}$ by organisms?

(a) Ammonia assimilation

(b) Denitrification

(c) Nitrification

(d) Assimilatory nitrate reduction

**92.** The BIS permissible limit for total arsenic in drinking water is

(a) 50 ppb

(b) 25 ppb

(c) 10 ppb

(d) 1 ppb

**93.** Delhi falls on active seismic zone

(a) one

(b) two

(c) three

(d) four

**94.** Clay is

(a) non-colloidal

(b) negatively charged

(c) particles > 0·01–0·1 mm size

(d) All of the above

**95.** A nanometer is equal to a

(a) zillionth of a meter

(b) millionth of a meter

(c) billionth of a meter

(d) trillionth of a meter

## PART—B

Answer *any* **forty** questions

**96.** Potential energy of an alpha particle $10^{-14}$ m away from a gold nucleus is

(a) 22·7 MeV

(b) 227·0 MeV

(c) 21·8 MeV

(d) 218·0 MeV

**97.** Assuming aluminium has a free electron density $n_e = 4 \cdot 08 \times 10^{27}$ electrons/$m^3$ and effective mass = $9 \cdot 11 \times 10^{-31}$ kg, its plasma oscillation frequency is

(a) $2 \cdot 6 \times 10^{15}$ Hz

(b) $3 \cdot 6 \times 10^{15}$ Hz

(c) $4 \cdot 6 \times 10^{15}$ Hz

(d) $5 \cdot 0 \times 10^{15}$ Hz

**98.** A conduction electron in a quantum dot emits a photon with a frequency of 600 THz as it drops to the valence band. Its band gap is

(a) 1·0 eV

(b) 1·5 eV

(c) 2·5 eV

(d) 3·0 eV

**99.** As the mass number *A* increases, which of the following quantities related to the nucleus does ***not*** change?

(a) Binding energy

(b) Charge

(c) Volume

(d) Density

**100.** Which of the following statements about molecular spectra is correct?

(a) Rotational spectra is observed in the ultraviolet region

(b) Rotational spectra is observed in the visible region

(c) Rotational spectra is observed in the microwave region

(d) Rotational spectra is observed in all the regions of electromagnetic spectrum

**101.** The average number of phonons in a vibrational mode is given by

(a) $\bar{n} = \dfrac{1}{\exp\left(\dfrac{\hbar}{k_B T}\right) - 1}$ (b) $\bar{n} = \dfrac{1}{\exp\left(\dfrac{\hbar\omega}{k_B T}\right) - 1}$

(c) $\bar{n} = \dfrac{1}{\exp\left(\dfrac{\hbar^2\omega}{k_B T}\right) - 1}$ (d) $\bar{n} = \dfrac{1}{\exp\left(\dfrac{\hbar^2\omega^2}{k_B T}\right) - 1}$

**102.** If the wavelength of the first line of the Lyman series of hydrogen is 1215 Å, what is the wavelength of the second line of the series?

(a) 911 Å

(b) 986 Å

(c) 1025 Å

(d) 1115 Å

**103.** Which of the following statements is correct?

(a) With increasing mass number, the Rydberg constant decreases linearly

(b) With increasing mass number, the Rydberg constant decreases exponentially

(c) The Rydberg constant decreases very sharply for elements with small mass numbers

(d) The Rydberg constant increases very sharply for elements with small mass numbers

**104.** The ratio of the electrical conductivity to the thermal conductivity is constant for all metals at constant temperature. This represents

(a) Wiedemann-Franz law

(b) Bragg's law

(c) Debye's law

(d) Curie-Weiss law

**105.** Noise associated with power spectrum varies with frequency. Noise power often varies as $1/f^{\alpha}$. Brownian motion or Brown noise can be represented when $\alpha$ takes the value

(a) 0

(b) 2

(c) 1

(d) 3

**106.** Total power in a signal is the same whether we compute it in the time domain or frequency domain. The result is known as

(a) Padé approximation

(b) Lagrange formula

(c) Parseval's theorem

(d) Neville's algorithm

**107.** A membership function specified by four parameters $\{a, b, c, d\}$ is given as follows :

$$f(x : a, b, c, d) = \begin{cases} 0 & \forall\ x < a \\ (x-a)/(b-a) & \forall\ a \le x < b \\ 1 & \forall\ b \le x < c \\ (d-x)/(d-c) & \forall\ c \le x < d \\ 0 & \forall\ x \ge d \end{cases}$$

The above function is the example of

(a) triangular membership function

(b) trapezoidal membership function

(c) Gaussian membership function

(d) sigmoidal membership function

**108.** If a probability distribution has mean $\mu$ and standard deviation $\sigma$, the probability of getting a value which deviates from $\mu$ by at least $k\sigma$ is at most $\frac{1}{k^2}$. This is called as

(a) law of large numbers

(b) Bayes' theorem

(c) law of multiplication of probabilities

(d) Chebyshev's theorem

**109.** In a classical linear regression model, which of the following is ***not*** a valid assumption?

(a) The conditional mean of error terms is zero

(b) There is autocorrelation present between the error terms

(c) All the conditional variances of error terms are equal

(d) There is zero covariance between error terms and independent variable

**110.** For testing the independence of attributes of a population, which test is useful?

(a) *t*-test

(b) *F*-test

(c) Chi-square test

(d) Kolmogorov-Smirnov test

**111.** Which of the following is ***not*** a nonparametric statistical test?

(a) Chi-square test

(b) Wilcoxon test

(c) Mann-Whitney test

(d) Kruskal-Wallis test

**112.** For a normal distribution with mean $\mu$ and standard deviation $\sigma$, which of the following is ***not*** true?

(a) About 68% area under the normal curve is bound between the limits $\mu - \sigma$ and $\mu + \sigma$

(b) About 99% area under the normal curve is bound between the limits $\mu - 2\sigma$ and $\mu + 2\sigma$

(c) The normal curve has zero skewness

(d) There are points of inflexion on the normal curve

**113.** Considering the earth to be a blackbody with average temperature 15 °C, the wavelength of peak power emission would be equal to

(a) 1 μm

(b) 10 μm

(c) 0·1 μm

(d) 50 μm

**114.** The wind power law is given by $\frac{u_1}{u_2} = \left(\frac{z_1}{z_2}\right)^p$, where $u_1$ and $u_2$ are wind speeds at the higher and lower elevation respectively and $z_1$ and $z_2$ are the higher and lower elevation respectively. Which of the following statements is correct?

(a) The value of exponent $p$ is generally less than zero

(b) The value of exponent $p$ is generally equal to one

(c) The value of exponent $p$ is generally greater than one

(d) The value of exponent $p$ is generally lies between zero and one

**115.** The centre frequency of an octave band with lower band limit 1414 Hz and an upper band limit of 2828 Hz would be

(a) 2121 Hz

(b) 2000 Hz

(c) 2200 Hz

(d) 2100 Hz

**116.** $\frac{dp}{dz} = -\rho g$, where $p$ is the pressure, $z$ is the altitude, $\rho$ is density of air and $g$ is the acceleration due to gravity. The above equation represents

(a) geostrophic wind

(b) gradient wind

(c) vertical mixing height

(d) hydrostatic equilibrium

**117.** Which of the following statements is correct?

(a) Mean of Poisson distribution is greater than its variance

(b) Mean of Poisson distribution is less than its variance

(c) Mean of Poisson distribution is equal to its variance

(d) Mean of Poisson distribution may either be less than or greater than its variance

**118.** Which of the following statistical techniques involves the use of more than one dependent variable?

(a) Canonical correlation analysis

(b) Linear regression analysis

(c) Logit regression

(d) Probit regression

**119.** The unit root test is used for testing

(a) stationarity in a time series

(b) autocorrelation in a time series

(c) presence of homoscedasticity

(d) presence of heteroscedasticity

**120.** Attenuation of sound due to ground effect mainly occurs

(a) in the low frequency range of the audible spectrum

(b) in the middle frequency range of the audible spectrum

(c) in the high frequency range of the audible spectrum

(d) uniformly throughout the audible spectrum

**121.** In the Gaussian model of plume dispersion, which of the following is ***not*** a valid assumption?

(a) The rate of emission from the source is constant

(b) The terrain is relatively flat

(c) The wind speed is variable both in time and with elevation

(d) The pollutant is not lost by decay, chemical reaction or deposition

**122.** Dry adiabatic lapse rate $P$ is expressed as a function of $g$ (gravitational acceleration) and $C_p$ (specific heat of air at constant pressure) as

(a) $\frac{1}{2}g^2 / C_p$

(b) $g / C_p$

(c) $C_p / g$

(d) $\frac{1}{2}g / C_p^2$

**123.** Saturated vapor pressure $e_s$ above a liquid with temperature $T$, having latent heat of vaporization $\lambda$ is expressed as

(a) $e_s(T) = e_0 \exp(-\lambda M_w / RT)$

(b) $e_s(T) = \frac{e_0}{T}\exp(-\lambda M_w / RT)$

(c) $e_s(T) = \frac{e_0}{T^2}\exp(-\lambda M_w / RT)$

(d) $\frac{e_s(T)}{T} = e_0 \exp(-\lambda M_w / RT)$

**124.** Most dominant long-term changes in earth's climate is explained by theory proposed by

(a) Stefan-Boltzmann

(b) Fourier

(c) Benjamin Franklin

(d) Milutin Milankovitch

**125.** The rift zones are generally expected to have the following assemblages of igneous rocks

(a) Granulite and granodiorite

(b) Granite and syenite

(c) Rhyolite and basalt

(d) Pegmatite and dolerite

**126.** A noodle or concretion of calcium carbonate found in loess is known as

(a) calcite

(b) aragonite

(c) loess männchen

(d) silt

**127.** Which one of the following rock types would make the best aquifer?

(a) Shale

(b) Mudstone

(c) Sandstone

(d) Basalt

**128.** Bowen's discontinuous series do ***not*** contain

(a) plagioclase

(b) pyroxene

(c) hornblende

(d) muscovite

**129.** Composition of olivine basalt is essentially

(a) quartz–microcline–olivine

(b) pyroxene–plagioclase–olivine

(c) muscovite–microcline–olivine

(d) biotite–hematite–olivine

**130.** Water trapped in the pore space of sediment at the time of deposition is known as

(a) connate water

(b) juvenile water

(c) magmatic water

(d) metamorphic water

**131.** Post-tectonic helicitic texture is also known as

(a) snowball texture

(b) poikioblastic texture

(c) cleavage in rocks

(d) conchoidal texture

**132.** Which of the following statements about volcanism is false?

(a) Descending magma carries subterranean rock fragments to the surface

(b) Volcanic activity gives us a glimpse of actual rocks from the earth's interior

(c) Volcanic terrains often become prime agricultural lands

(d) Volcanic landscapes often contain a source of inexpensive clean energy

133. The most resistant quartz mineral is affected by

(a) acidic solutions

(b) neutral solutions

(c) alkaline solutions

(d) humic acid solutions

134. A block of rock suddenly crushing downward along steep slopes is called

(a) slump

(b) debris slide

(c) rock fall

(d) rock slide

135. The movement is distributed throughout the displaced mass in the case of

(a) subsidence

(b) earthflow

(c) landslides

(d) debris slide

136. The problem arising from pumping out water from wells in coastal areas is known as

(a) dripstone deposition

(b) saltwater intrusion

(c) permeability decrease

(d) artesian recharge

137. Water vapour can be detected by using following spectral band

(a) 4·4 μm to 4·5 μm

(b) 6·5 μm to 6·8 μm

(c) 11·7 μm to 12·27 μm

(d) 3·6 μm to 3·8 μm

138. Pyrite ($FeS_2$) is dimorphous with

(a) azurite

(b) marcasite

(c) chalcopyrite

(d) malachite

**139.** Celsian and hyalophane are varieties of

(a) olivine

(b) feldspar

(c) copper mineral

(d) gold mineral

**140.** Palaeocurrent direction can be determined by

(a) heavy mineral distribution

(b) fossil assemblages

(c) percentage of quartz in sediments

(d) unconformity layers

**141.** Which of the following structures is a protective measure to a road running along a valley from avalanches?

(a) Retaining wall

(b) Rock bolting

(c) Bridge

(d) Trench

**142.** In which one of the following conditions, siliceous ooze accumulates on the ocean floor?

(a) Dissolution of silica and opaline remains

(b) Saturation of quartz and oolitic diatoms

(c) Saturation of silica and opaline remains

(d) Saturation of quartzite and pegmatite

**143.** Drainable porosity is also known as

(a) safe yield

(b) maximum porosity

(c) inclusive porosity

(d) specific yield

**144.** Which of the following is formed under extremely constant physicochemical conditions over thousands of years outside the cave region?

(a) Speleothems

(b) Opaline limestone

(c) Sphalerite

(d) Calcite deposits

**145.** Which of the following compounds is formed frequently around fossils due to the migration of organic phosphate during diagenesis?

(a) Organic calcium phosphate

(b) Inorganic orthophosphate

(c) Organic oolitic limestone deposit

(d) Phosphorous compound

**146.** On a standard false colour composite (FCC), healthy vegetation on land appears in

(a) green colour

(b) blue colour

(c) red colour

(d) black colour

**147.** Given the values of ion product $Q$ and solubility product $K_{sp}$, saturated solutions have

(a) $Q > K_{sp}$ (b) $Q < K_{sp}$

(c) $Q = 3K_{sp}$ (d) $Q = K_{sp}$

**148.** Based on increasing order of global warming potential (GWP), which one of the following orders is correct?

(a) $CH_4 < CO_2 < N_2O$ (b) $N_2O < CH_4 < CO_2$

(c) $CO_2 < N_2O < CH_4$ (d) $CO_2 < CH_4 < N_2O$

**149.** Considering the increasing order of acid dissociation constant ($K_a$), which one of the following orders is correct?

(a) Phenol $< NH_4^+ < HNO_2 < HSO_4^-$

(b) Phenol $< HCN < NH_4^+ < HF$

(c) $NH_4^+ <$ HOCl $<$ Phenol $< HSO_4^-$

(d) $NH_4^+ < HF < CH_3COOH < HClO_2$

**150.** Which one of the following combinations plays an important role in the formation of tropospheric ozone?

(a) $SO_2$ and $H_2S$

(b) $NO_2$ and $N_2O$

(c) VOCs and $NO_2$

(d) Carbon soot and $HNO_3$

**151.** Which of the following is a criteria pollutant?

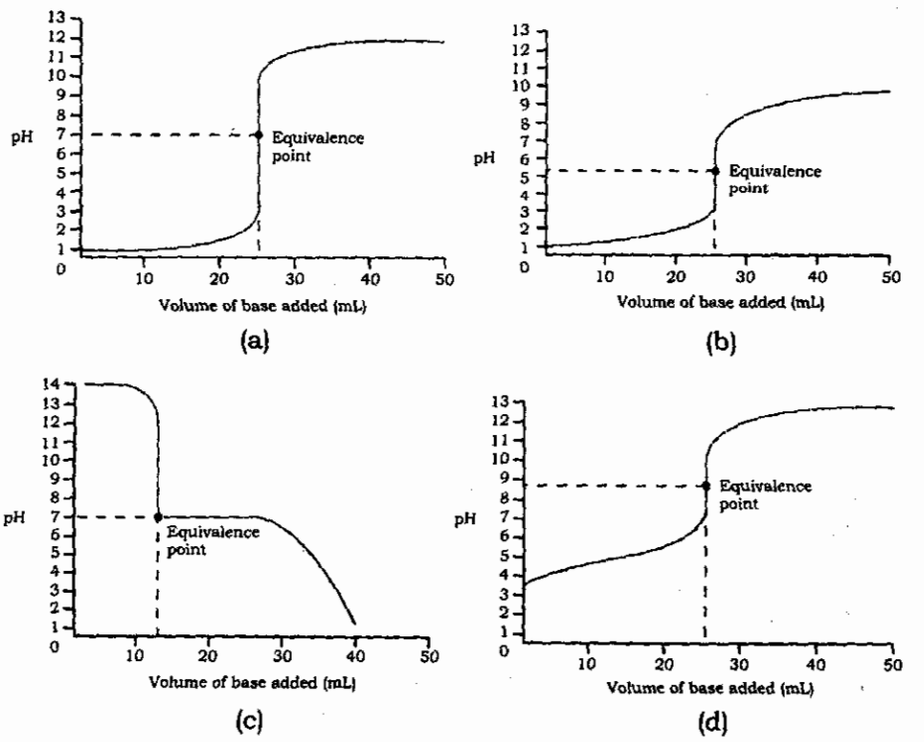
(a) VOCs

(b) RSPM

(c) PAH

(d) POPs

**152.** Which one of the following figures shows the titration curve of a weak acid vs. a strong base?




**153.** At any given temperature, AgCl is most soluble in

(a) water

(b) liquid $SO_2$

(c) benzene

(d) liquid ammonia

**154.** Regarding $Cr^{+3}$ and $Cr^{+6}$, the correct statement is

(a) $Cr^{+3}$ is more toxic and less soluble in water

(b) $Cr^{+6}$ is more toxic and less soluble in water

(c) $Cr^{+3}$ is less toxic and more soluble in water

(d) $Cr^{+6}$ is more toxic and more soluble in water

**155.** Macromolecules

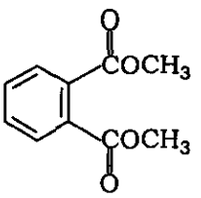
(a) do not yield colloidal solution directly

(b) have their diameter above 10000 Å

(c) behave like lyophilic sols

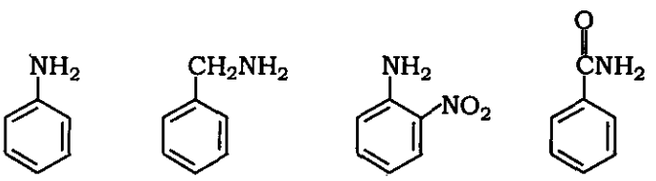
(d) carry electric charge in solution and show electrophoresis

**156.** How many signals are expected in the $^{13}$C-NMR spectrum of the following substance?



(a) 5
(b) 6
(c) 8
(d) 10

**157.** Rank the following compounds in order of increasing basicity (weakest → strongest) :



(1) (2) (3) (4)

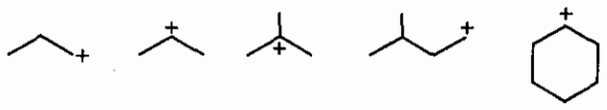
(a) 4 < 2 < 1 < 3
(b) 4 < 1 < 3 < 2
(c) 4 < 3 < 1 < 2
(d) 2 < 1 < 3 < 4

**158.** Arrange the ions $Se^{2-}$, $Br^-$, $Rb^+$ and $Sr^{2+}$ in order of decreasing size.
(a) $Se^{2-} > Br^- > Rb^+ > Sr^{2+}$
(b) $Sr^{2+} > Rb^+ > Br^- > Se^{2-}$
(c) $Br^- > Rb^+ > Se^{2-} > Sr^{2+}$
(d) $Sr^{2+} > Se^{2-} > Rb^+ > Br^-$

**159.** Which of the following would be expected to give a positive test with Benedict's reagent?
(a) D-galactitol
(b) L-arabinose
(c) D-fructose
(d) Lactose

**160.** The part of DNA molecule responsible for UV light absorption is
(a) deoxyribose
(b) nitrogen base
(c) phosphodiester bond
(d) phosphate group

**161.** What is the decreasing stability order (more stable → less stable) of the following carbocations?



(1) (2) (3) (4) (5)

(a) 3 > 2 > 1 > 4 > 5

(b) 1 ≈ 4 > 2 ≈ 5 > 3

(c) 3 > 2 ≈ 5 > 1 ≈ 4

(d) 3 > 1 ≈ 4 > 2 ≈ 5

**162.** 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 proceed at 50% of its original rate, the concentration of *B* should be

(a) decreased by 1/4

(b) kept constant

(c) doubled

(d) increased by a factor of 4

**163.** A student placed three moles of hydrogen gas and three moles of iodine gas into a 1-litre flask and heated the flask to 300 °C. The equilibrium expression would be equal to

(a) $K_c = \dfrac{(2x)^2}{(3-x)^2}$ (b) $K_c = \dfrac{(2x)^2}{(2-x)^3}$

(c) $K_c = \dfrac{x^2}{(2-x)^2}$ (d) $K_c = \dfrac{(2x-2)^2}{(3-x)}$

**164.** Rank the following in order of increasing boiling point (lowest → highest) :

$CH_3CH_2CH_2CH_2OH$ (1) $(CH_3)_2CHOCH_3$ (2) $(CH_3)_3COH$ (3) $(CH_3)_4C$ (4)

(a) 1 < 3 < 2 < 4

(b) 2 < 4 < 3 < 1

(c) 4 < 2 < 3 < 1

(d) 2 < 3 < 1 < 4

**165.** Consider the reaction between pyridine and heptyl bromide to make 1-heptylpyridinium bromide. It is an equilibrium reaction with an equilibrium constant $K = 40$. What is the rate constant of back reaction $k_{-1}$ if the value of the forward rate constant $k_1 = 2{\cdot}4 \times 10^3\ dm^3\ mol^{-1}\ s^{-1}$ ?

(a) $20\ dm^3\ mol^{-1}\ s^{-1}$ (b) $40\ dm^3\ mol^{-1}\ s^{-1}$

(c) $60\ dm^3\ mol^{-1}\ s^{-1}$ (d) $80\ dm^3\ mol^{-1}\ s^{-1}$

**166.** What is the transmittance $T$ of the sample which is strongly colored to the extent that six photons are absorbed out of every seven in the incident light?

(a) 7% (b) 14%

(c) 21% (d) 28%

**167.** A certain metal crystallizes in a face-centered cube measuring $4 \times 10^2$ picometers on each edge. What is the radius of the atom? [1 picometer (pm) = $1 \times 10^{-12}$ meter]

(a) 141 pm

(b) 173 pm

(c) 200 pm

(d) 282 pm

**168.** Which of the following statements pertaining to an $S_N2$ reaction is true?

1. The rate of reaction is independent of the concentration of the nucleophile.
2. The nucleophile attacks carbon on the side of the molecule opposite the group being displaced.
3. The reaction proceeds with simultaneous bond formation and bond rupture.
4. Partial racimization of an optically active substrate takes place.

(a) 1 and 4

(b) 1, 3 and 4

(c) 2 and 3

(d) All of the above

**169.** The first RNA genome to be sequenced was that of

(a) MS 2

(b) Haemophilus influenzae

(c) FX 174

(d) Paramecium

**170.** Diaminopimelic acid (DAP) is part of the

(a) outer membrane

(b) cytoplasmic membrane

(c) cell wall

(d) ribosomes

**171.** Which of the following sequences is ***not*** represented in the transcribed sequence of a typical eukaryotic messenger RNA?

(a) Promoter

(b) Intron

(c) 5′-untranslated region

(d) 3′-untranslated region

**172.** Mutations in gene-regulatory regions of DNA, to which protein factors bind, belong to which category?

(a) Deletions

(b) Insertions

(c) *cis*-acting

(d) *trans*-acting

**173.** According to the central dogma of molecular biology, which of the steps in information flow is thought to be valid and unidirectional?

(a) DNA → RNA

(b) RNA → DNA

(c) DNA → Protein

(d) RNA → Protein

**174.** From the information revealed in the human genome sequence, which of the following occupies the least space in the genome?

(a) Introns

(b) Exons

(c) Transposable elements

(d) Intergenic regions

**175.** The same DNA sequence can sometimes code for more than one protein. Which of the following is ***not*** responsible for this?

(a) Codon bias

(b) Ribosomal frameshifting

(c) Exon skipping

(d) Alternative translation initiation

**176.** During translation initiation in bacteria the initiator tRNA binds to which site of the 30S ribosomal subunit?

(a) A site

(b) E site

(c) M site

(d) P site

**177.** Which of the following is true for the 16S ribosomal RNA of bacteria?

(a) It has peptidyl transferase activity

(b) It interacts with mRNA

(c) It is part of the 50S ribosomal subunit

(d) Its sequence is highly divergent

**178.** The role of protein chaperones is to ensure correct

(a) initiation of translation

(b) termination of translation

(c) folding of proteins

(d) subcellular localization of proteins

**179.** After the transcription reaction has initiated, which of the following is released from DNA in a bacterial system?

(a) Sigma factor

(b) Rho factor

(c) Alpha subunit of RNA polymerase

(d) Beta subunit of RNA polymerase

**180.** DNA replication proceeds in a discontinuous manner on the lagging strand. The fragments so formed (Okazaki pieces) are joined by the action of

(a) DNA polymerase I

(b) helicase

(c) primase

(d) ligase

**181.** Which of the following is most likely to happen every time a transposon moves to a new genomic location?

(a) Insertion mutation in a gene

(b) Short direct repeat of target site

(c) Gene silencing by heterochromatin formation

(d) Rearrangement of neighbouring sequences

**182.** If $n_i$ is the density of $i$th species and $N$ the sum of density values of all the species constituting a community, then $\sum_{i=1}^{n}\left(\frac{n_i}{N}\right)^2$ is an index of

(a) diversity

(b) species richness

(c) species evenness

(d) dominance

**183.** High rates of phosphorus fixation in a soil indicate

(a) high concentration of phosphorus in root biomass

(b) fast conversion of available forms of phosphorus to non-available forms of phosphorus

(c) rapid uptake of phosphorus by microbes

(d) rapid uptake of phosphorus by scavengers

**184.** Biodiversity hot spots are characterized by

(a) large number of introduced species, tropical humid climate and high levels of species richness

(b) high levels of threats of destruction but low levels of endemism in mangrove ecosystems

(c) high levels of endemism but low levels of threats of destruction

(d) high levels of species richness, high levels of endemism and high levels of threats of destruction

**185.** Lipid raft is a microdomain or platform found in cell membrane, mainly contains

(a) lipid and protein

(b) cholesterol and sphingolipid

(c) cholesterol and phosphatidylcholine

(d) phosphatidylcholine and sphingolipid

**186.** The most abundant phospholipid in staphylococcal membrane is

(a) phosphatidyl glycerol

(b) phosphatidylcholine

(c) phosphatidylserine

(d) ergosterol

**187.** Which of the following is ***not*** a tumor-suppressor gene?

(a) P-53

(b) Cyclin-dependent kinase inhibitors

(c) Rb

(d) CMyC

**188.** Alkaptonuria is caused by the defective enzyme of

(a) phenylalanine hydroxylase

(b) tyrosine aminotransferase

(c) homogentisate 1,2-dioxygenase

(d) fumarylacetoacetase

**189.** Cellulose is a linear polymer of
(a) α-D-glucose
(b) α-D-fructose
(c) β-D-glucose
(d) β-L-glucose

**190.** Organophosphate pesticides inhibit
(a) oxidative phosphorylation
(b) transamination
(c) acetylcholine esterase
(d) digestive enzymes

**191.** Cold vapor atomic absorption spectroscopy is commonly used for the analysis of
(a) $Cr^{6+}$
(b) $Cr^{3+}$
(c) Hg
(d) Ag

**192.** Methemoglobinemia is principally a potential threat to
(a) babies drinking water high in sulfate
(b) babies drinking water high in nitrate
(c) babies drinking water high in fluoride
(d) babies drinking water high in iron

**193.** Which of the following type of clouds is associated with thunderstorm?
(a) Stratus cloud
(b) Cirrus cloud
(c) Cumulonimbus cloud
(d) Altostratus cloud

**194.** Which of the following represents same group of colloidal systems?
(a) Butter, paint and milk
(b) Shaving cream, foam rubber and colloidal gold
(c) Fog, mist and clouds
(d) Milk, ink and soda water froth

**195.** The fine-grained sedimentary rock contains a large proportion of solid organic matter that can be distilled by heating to yield oil is
(a) tar sands
(b) coal
(c) oil shale
(d) China clay

125

**ENTRANCE EXAMINATION, 2011**

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. The wavelength of sound from a tuning fork of frequency 330 hertz is nearly
   (a) 100 cm
   (b) 10 cm
   (c) 1 cm
   (d) 330 cm

2. The plate resistance of a triode valve is $3\times10^{3}\,\Omega$ and its mutual conductance is $1{\cdot}5\times10^{-3}$ amp/volt. The amplification factor of the triode is
   (a) $5\times10^{-6}$
   (b) 4·5
   (c) 45
   (d) $2\times10^{4}$

3. The term 'sextant' is called so because
   (a) it was invented by Sextant
   (b) it has six components
   (c) its scale is 1/6 of a circle
   (d) None of the above

4. At 300 K, the wavelength of a neutron with kinetic energy $\frac{3}{2}k_BT$ is
   ($k_B = 1{\cdot}38\times10^{-16}$ erg/K)
   (mass of neutron = $1{\cdot}67492729\times10^{-27}$ kg)
   (a) 0·146 nm
   (b) 1·46 nm
   (c) 1·56 nm
   (d) 1·84 nm

5. If the atomic mass of $^{197}_{79}Au$ is 196·96 u, the binding energy per nucleon is
   (a) 7·94 MeV
   (b) 1·78 MeV
   (c) 2·78 MeV
   (d) 8·94 MeV

6. If a mass of 3·6 g is fully converted into electrical energy, the electrical energy (in kWh), thus obtained, will be

(a) $9 \times 10^6$

(b) $9 \times 10^7$

(c) $9 \times 10^8$

(d) $9 \times 10^9$

7. A sound pressure of 2 Pa is equivalent to a sound pressure level of

(a) 20 db

(b) 60 db

(c) 100 db

(d) 140 db

8. Unit of radiance is

(a) watt per steradian per square metre

(b) candela per square metre

(c) watt per steradian

(d) candela per square metre per steradian

9. 'Ultraviolet catastrophe' is explained by

(a) Planck's quantum theory

(b) Wien's displacement law

(c) Rayleigh-Jeans law

(d) Maxwell's distribution law

10. Ultraviolet light (280 nm) generates photoelectron from lithium cathode (work function $\phi = 2 \cdot 5$ eV). The maximum kinetic energy of photoelectron will be

(a) 0 eV

(b) 0·9 eV

(c) 1·9 eV

(d) 2·9 eV

11. Two simple harmonic motions along the same line with equal amplitude and frequency superimpose on each other. If the resultant amplitude is equal to amplitude of either of the motions, the phase difference between the individual motions will be

(a) 0

(b) $\pi/2$

(c) $\pi/3$

(d) $2\pi/3$

12. The ratio of sine angle of incidence to the sine angle of refraction for any two media is constant for a light of definite colour. This is explained by

(a) Fermat's principle

(b) Huygens' principle

(c) Snell's law

(d) Rayleigh's law

13. Neutrinos differ from antineutrinos in terms of

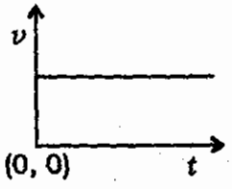
(a) charge

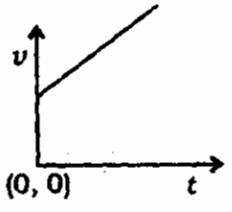
(b) mass

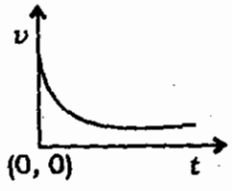
(c) spin

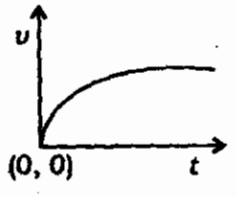
(d) range

14. Which among the following curves shows variation of the velocity $v$ with time $t$ for a small-size spherical body falling vertically in a long column of viscous liquid?

(a)



(b)



(c)



(d)



15. For a particle executing simple harmonic motion (SHM), the phase difference between displacement and velocity is

(a) 0

(b) $\pi/2$

(c) $\pi$

(d) $2\pi$

16. A wedge-shaped film is illuminated by light of wavelength 5700 Å. The angle of wedge is 40″. The separation between two consecutive fringes will be

(a) 1·2 mm

(b) 1·5 mm

(c) 1·8 mm

(d) 2·4 mm

17. The lowest three energy levels (in eV) of singly ionized helium are

(a) −54·4, −13·6, −6·04

(b) −13·6, −6·04, −3·05

(c) −6·04, −3·05, −1·05

(d) −3·05, −11·2, −5·6

18. For a thermodynamical system, the Helmholtz free energy is

(a) $U - TS$

(b) $U - TS - PV$

(c) $U - TS + PV$

(d) $U + TS$

19. In an experiment with Michelson's interferometer, the scale readings for a pair of portions of maximum indistinctness were found to be 0·6939 mm and 0·9884 mm. If the mean wavelength of the two components of the sodium D-light which was used, be 5893 Å, what is the difference between wavelengths of the components?

(a) 2·896 Å

(b) 5·896 Å

(c) 8·896 Å

(d) 9·896 Å

20. For a car travelling at a constant speed of 20 m $s^{-1}$ around a curved road of radius 100 m, the radial acceleration will be

(a) 2 m $s^{-2}$

(b) 40 m $s^{-2}$

(c) 0·2 m $s^{-2}$

(d) 4 m $s^{-2}$

21. For what value of $k$ will the line $4x + 3y + k = 0$ will touch the circle $2x^2 + 2y^2 = 5x$?

(a) −1, −5

(b) $-1, \frac{5}{4}$

(c) $-5, \frac{5}{4}$

(d) $-\frac{45}{4}, \frac{5}{4}$

22. The eccentricity of a parabola is equal to

(a) 0

(b) 1

(c) $< 1$ (less than 1)

(d) $> 1$ (greater than 1)

23. The matrix $\begin{bmatrix} 1 & 1-i & 2+3i \\ 1+i & 0 & 5-7i \\ 2-3i & 5+7i & 6 \end{bmatrix}$ is an example of

(a) symmetric matrix

(b) skew-symmetric matrix

(c) Hermitian matrix

(d) skew-Hermitian matrix

24. Which of the following is **not** a convergent infinite series?

(a) $\sum_{n=1}^{\infty} \frac{1}{n^2+1}$

(b) $\sum_{n=1}^{\infty} \frac{1}{2n+3}$

(c) $\sum_{n=1}^{\infty} \frac{1}{n(n+1)}$

(d) $\sum_{n=1}^{\infty} \frac{1}{(n+1)^2}$

25. Evaluate the following :

$$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \log\left(\frac{2-\sin x}{2+\sin x}\right) dx$$

(a) 1

(b) 2

(c) $\pi$

(d) 0

42/35

**26.** Evaluate $\frac{d^2y}{dx^2}$, if $y = x^x$.

(a) $x\left[(1+\log x)^2 + \frac{1}{x}\right]$

(b) $x^x\left[(1+\log x)^2 + \frac{1}{x}\right]$

(c) $x\left[(1+\log x) + \frac{1}{x}\right]$

(d) Zero

**27.** If $f(x) = x^x$, then $\lim_{x\to 0} f(x)$ is

(a) indeterminate

(b) 0

(c) 1

(d) $-1$

**28.** Evaluate $\int e^{2x}\left(\frac{1+\sin 2x}{1+\cos 2x}\right)dx$.

(a) $e^x \tan x + c$

(b) $\frac{1}{2}e^{2x}\tan x + c$

(c) $e^{3x}\tan x + c$

(d) $\frac{1}{2}e^x \tan x \sec x + c$

**29.** The volume of the solid generated by revolving the finite region bounded by the curves $y = x^2 + 1$ and $y = 5$ about the line $x = 3$ is

(a) $\frac{312\pi}{5}$

(b) $\frac{16\pi}{5}$

(c) $16\pi$

(d) $64\pi$

**30.** The solution of the differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 2y = 0$ is

(a) $(A\cos x + B\sin x)e^{-x}$

(b) $A\cos x + B\sin x$

(c) $(A\cos x + B\sin x)e^x$

(d) $\cos 2x \sin 2x$

where $A$ and $B$ are constants.

31. Intrusive rocks are

(a) plutonic

(b) rhyolitic

(c) pyroclastic

(d) volcanic

32. The final product after chemical weathering of granitic rock is

(a) quartz

(b) orthoclase

(c) biotite

(d) pyroxene

33. Chert is mainly composed of

(a) $CaCO_3$

(b) $SiO_2$

(c) $Fe_2O_3$

(d) $MgCO_3$

34. Coarse sediment particles settling before fine particles in river suspension form

(a) cross-beds

(b) graded beds

(c) ripple marks

(d) conglomerates

35. Limestone recrystallizes into

(a) quartzite

(b) hornfels

(c) marble

(d) gneiss

36. Which one of the following is ***not*** of marine origin?

(a) Phosphorite

(b) Calcrete

(c) Fe-Mn nodule

(d) Siliceous ooze

37. An apron of fallen rock fragments that accumulates at the base of a cliff is called

(a) bedrock

(b) sediment

(c) soil

(d) talus

38. Compaction and cementation are the two common processes of

(a) erosion

(b) transportation

(c) deposition

(d) lithification

39. Physical separation of crystals and liquid which prevents equilibrium between the phases is known as

(a) frictional crystallization

(b) fractional crystallization

(c) fractus crystallization

(d) solidus crystallization

40. The general process by which rock, soil or unconsolidated material moves downhill is known as

(a) debris sliding

(b) mass wasting

(c) weathering

(d) flooding

41. Which of the following textures is found due to differential cooling where phenocrysts set in aphanitic groundmass?

(a) Poikilitic

(b) Porphyritic

(c) Porous

(d) Fragmental

42. O-horizon of soil profile consists of

(a) highly decomposed organic matter

(b) aluminium

(c) hardpan

(d) iron

43. Granite, diorite, gabbro and peridotite rocks are

(a) fine grained

(b) light coloured

(c) fine grained and light coloured

(d) coarse grained

44. Bioclastic rocks are

(a) salts containing $NaHCO_3$ found in Sahara desert

(b) biochemical sedimentary rocks consisting of fragmental remains of organisms

(c) calcic rocks found in ocean bottom

(d) quartz-rich rocks found in the moon

45. Old volcanoes sink below the ocean surface forming

(a) continental mount

(b) abyssal plain

(c) seamount

(d) rising ridge

46. Sedimentary structure having regularly spaced ridges on the surface of the bed formed by sand grains deposited by air or water current is

(a) current bedding

(b) graded bedding

(c) ripple mark

(d) point bar

47. A structure in which the beds dip away from a central point is known as

(a) basin

(b) anticline

(c) structural dome

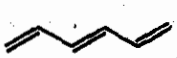
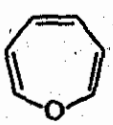
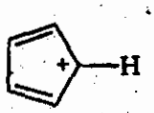
(d) syncline

3. A subsurface zone in which all rock openings are filled with water is called
   (a) saturated zone
   (b) water table
   (c) unsaturated zone
   (d) aquiclude

49. Which of the common minerals is ***not*** a silicate?
   (a) Quartz
   (b) Calcite
   (c) Pyroxene
   (d) Feldspar

50. Predominant carbon species in seawater is
   (a) $CO_2$
   (b) $HCO_3^-$
   (c) $H_2CO_3$
   (d) $CO_3^{2-}$

51. 1 litre of 1·0 *M* NaOH and 2 litres of 2 *M* NaOH are mixed. The molarity of the mixed solution is
   (a) 1·86 *M*
   (b) 1·66 *M*
   (c) 1·0 *M*
   (d) 0·5 *M*

52. Which of the following compounds is aromatic?
   (a) 
   (b) 
   (c) 
   (d) 

53. The IUPAC name of $K_3[Fe(CN)_5(CO)]$ is
   (a) potassium pentacyanocarbonyl ferrate(II)
   (b) potassium carbonyl pentacyanoferrate(III)
   (c) potassium pentacyanocarbonyl iron(II)
   (d) potassium carbonyl pentacyanoferrate(II)

54. The unit of rate constant for a zero-order reaction is

(a) litre $sec^{-1}$

(b) litre $mole^{-1}$ $sec^{-1}$

(c) mole $litre^{-1}$ $sec^{-1}$

(d) mole $sec^{-1}$

55. Vinegar is a 5·0% $(\frac{M}{V})$ aqueous solution of acetic acid ($HC_2H_3O_2$). How much acetic acid is present in one teaspoon (5·0 mL) of vinegar?

(a) 1·000 g

(b) 0·500 g

(c) 0·250 g

(d) 0·125 g

56. Arrange the following bonds in order of increasing polarity :

Cl—Cl, Ca—F, C—O, B—H, P—Br

(a) Cl—Cl < B—H < P—Br < C—O < Ca—F

(b) B—H < P—Br < Cl—Cl < C—O < Ca—F

(c) P—Br < B—H < Ca—F < C—O < Cl—Cl

(d) Cl—Cl < Ca—F < P—Br < B—H < C—O

57. Oil of vitriol is also known as

(a) sulphuric acid

(b) nitric acid

(c) hydrochloric acid

(d) phosphoric acid

58. A rubbing alcohol is a mixture of

(a) 70% isopropyl alcohol and 30% water (by volume)

(b) 30% isopropyl alcohol and 70% water (by volume)

(c) 50% isopropyl alcohol and 50% water (by volume)

(d) 95% isopropyl alcohol and 5% water (by volume)

59. White gold contains

(a) 14 parts Au, 4 parts Cu, 4 parts Ni and 2 parts Zn

(b) 10 parts Au, 8 parts Cu, 4 parts Ni and 2 parts Zn

(c) 8 parts Au, 10 parts Cu, 3 parts Ni and 3 parts Zn

(d) 6 parts Au, 10 parts Cu, 3 parts Ni and 5 parts Zn

60. Which of the following is ***not*** converted into blood sugar by the human body?

(a) Lactose

(b) Dextrose

(c) Cellulose

(d) Glycogen

61. Which one of the following metals is used to recover copper from copper sulphate solution?

(a) Ag

(b) Hg

(c) Fe

(d) Pt

62. The two oxidation states of nitrogen in $NH_4NO_3$ are

(a) +3 and –5

(b) –3 and –5

(c) –3 and +5

(d) +3 and +5

63. The redox reaction always demonstrates the conservation of

(a) charge only

(b) mass only

(c) charge and mass both

(d) neither charge nor mass

64. Which substance is oxidized in the following reaction?

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

(a) Zn(s)

(b) HCl(aq)

(c) $Cl^-(aq)$

(d) $H^+(aq)$

65. Which one of the following combinations leads to a better oxidizing condition?

(a) Low ionization energy, high electronegativity, small radius

(b) Low ionization energy, high electronegativity, bigger radius

(c) High ionization energy, low electronegativity, small radius

(d) High ionization energy, high electronegativity, small radius

66. Carbocations are

(a) neutral species

(b) electrophilic

(c) nucleophilic

(d) stable molecules

67. Which of the following is a strong electrolyte when it is mixed with water?

(a) $HNO_2$

(b) $KNO_3$

(c) $CH_3COOH$

(d) $NH_3$

68. Properties of Zr and Hf are similar because

(a) both belong to *d*-block elements

(b) both have equal radii

(c) both exhibit +4 oxidation state

(d) both belong to the same group

69. Total number of radial nodes present in 3*d* orbital is

(a) 1

(b) 2

(c) 0

(d) 3

70. Oxidation state of Fe in $[Fe(C_5H_5)_2]^+$ is

(a) I

(b) II

(c) III

(d) IV

71. Which of the following steps of translation does ***not*** consume high energy from phosphate bond?

(a) Peptidyltransferase reaction

(b) Aminoacyl tRNA binding to A-site

(c) Translocation

(d) Amino acid activation

72. Hybridomas are result of the fusion of

(a) normal antibody-producing cell with myeloma

(b) abnormal antibody-producing cell with myeloma

(c) male reproductive cell with myeloma

(d) female reproductive cell with myeloma

73. A cytokine that provides non-specific immunity against virus is

(a) interleukin

(b) tumour necrosis

(c) colony stimulating

(d) interferon

74. The cross between $F_1$ individual and recessive parents is known as

(a) test cross

(b) heterozygous cross

(c) homozygous cross

(d) backcross

75. Which one of the following is absent in the phloem of pteridophytes?

(a) Sieve tube

(b) Phloem parenchyma

(c) Companion cell

(d) None of the above

76. Cytokinins

(a) promote formation of abscission layers

(b) help to retain chlorophyll

(c) control water transport

(d) suppress chlorophyll

77. Which of the following is ***not*** found in eukaryotic genes?

(a) Exon

(b) Intron

(c) Shine-Dalgarno sequence

(d) Untranslated region

78. Green photosynthetic roots occur in

(a) *Cuscuta*

(b) *Portulaca*

(c) *Tinospora*

(d) *Pandanus*

79. Species with high rate of population growth are categorized as

(a) *K*-selected

(b) *r*-selected

(c) *C*-selected

(d) *s*-selected

80. The composition (in mole fraction units) of one of the strands of a double-helical DNA is [A] = 0·30 and [G] = 0·24. The value of [T] plus [C] for the same strand will be

(a) 0·54

(b) 0·70

(c) 0·46

(d) 0·76

81. Which one of the following statements is ***not*** true for DNA replication?

(a) It proceeds in the $5' \rightarrow 3'$ direction

(b) It is conservative

(c) It requires a template-primer

(d) It utilizes dNTPs

82. In the lactose operon of *E. coli*, transcription is inhibited when the repressor protein binds to

(a) promoter

(b) operator

(c) lactose

(d) RNA polymerase

83. Which one of the following pairs of diseases is caused by viruses?

(a) Typhoid, Tetanus

(b) AIDS, Syphilis

(c) Rabies, Mumps

(d) Cholera, Tuberculosis

84. Which one of the following does ***not*** play any role in photosynthesis?

(a) Phycocyanin

(b) Xanthophyll

(c) Phycoerythrin

(d) Anthocyanin

85. *Bacillus thuringiensis* is used to control

(a) bacterial pathogen

(b) fungal pathogen

(c) nematodes

(d) insect pests

86. The plot $1/V$ vs. $1/[S]$ is sometimes called a Lineweaver-Burke plot. Another way of expressing the same kinetic data is to plot $V$ vs. $V/[S]$. In such case, the slope of the plot will be

(a) $K_M$

(b) $V_{max}$

(c) $-K_M$

(d) $V_{max} / K_M$

87. Functionally similar organs are called

(a) homologous

(b) analogous

(c) homogeneous

(d) homozygous

88. *Itai-itai* disease is caused due to

(a) lead

(b) mercury

(c) chromium

(d) cadmium

89. Which of the following organelles of the cell does ***not*** have DNA?

(a) Mitochondria

(b) Chloroplast

(c) Lysosomes

(d) Centrioles

90. The development of fruit without fertilization is known as

(a) parthenogenesis

(b) parthenocarpy

(c) apomixis

(d) apogamy

91. Which of the following statements is correct?

(a) $BOD_u > COD > ThOD > BOD_5$

(b) $COD > ThOD > BOD_u > BOD_5$

(c) $ThOD > COD > BOD_u > BOD_5$

(d) $COD > BOD_u > BOD_5 > ThOD$

where

$BOD_5$ = 5-day biochemical oxygen demand
$BOD_u$ = Ultimate biochemical oxygen demand
COD = Chemical oxygen demand
ThOD = Theoretical oxygen demand

92. How much time does it take to disperse $CO_2$ in the atmosphere?

(a) 10 years

(b) 50 years

(c) 100 years

(d) 1000 years

93. Pitcher-like modification of leaves is found in

(a) Ficus

(b) Dischidia

(c) Phoenix

(d) Argemone

94. A gas may be called a vapour

(a) below its enthalpy of fusion

(b) below its critical temperature

(c) below its melting point

(d) above its enthalpy of vaporization

95. If a body is weighed at different latitudes, its weight will be least at

(a) 90°

(b) 23·5°

(c) 40°

(d) 0°

54/35