Section A: English

1. "The train is late again", she said, pointing **………..** the timetable.
    a) at
    b) in
    c) to
    d) that

2. A lot of businesses are going **……………** because of the economic crisis.
    a) underneath,
    b) under,
    c) beneath
    d) above

3. **…………………** is yours.
    a) all I have
    b) all that I have
    c) all what I have
    d) all what you have

4. Amit **………..** really get on your nerves sometimes.
    a) can
    b) may
    c) might
    d) could

5. Arakku valley is a long, beautiful valley **……………** two mountains.
    a) between,
    b) among
    c) in the centre of
    d) above

6. **…………** I opened my eyes, I heard a strange voice.
    a) while
    b) when
    c) as
    d) then

Section B: Logical Reasoning

Directions (Question numbers 41 to 45): For the following questions, look at this series, and identify from amongst the options as to which number(s) should fill up the blank?

41.   Series: 75075, 25025, 5005, 715, _____, 5

(a) 225

(b) 365

(c) 156

(d) 65

42.   Series: 2, 9, 23, 3, 8, 25, 4, _____, 27

(a) 7

(b) 29

(c) 23

(d) 14

43.   Series: QPO, NML, KJI, _____, EDC

(a) HGF

(b) CAB

(c) JKL

(d) GHI

44.   Series: DEF, DEF2, DE2F2, _____, D2E2F3

(a) DEF3

(b) D3EF3

(c) D2E3F

(d) D2E2F2

45.   Series: AJX, BLU, _____, HPO, PRL

(a) DNT

(b) DOR

(c) ENR

(d) DNR

Section C: Mathematical Ability

61. The value of $\lim\limits_{x \to \infty} \left(x - \sqrt{x^2 + x} \right)$ is

a)   0   b) -1

c) $-\dfrac{1}{2}$ d) $\dfrac{1}{2}$

62. Which of the following function is continuous at the origin

a) $f(x) = \begin{cases} \sin\dfrac{1}{x}; & x \neq 0 \\ 0; & x = 0 \end{cases}$

b) $f(x) = \begin{cases} x\cos\dfrac{1}{x}; & x \neq 0 \\ 0; & x = 0 \end{cases}$

c) $f(x) = \begin{cases} x\sin\dfrac{1}{x}; & x \neq 0 \\ 1; & x = 0 \end{cases}$

d) $f(x) = \begin{cases} x\cos\dfrac{1}{x}; & x \neq 0 \\ 1; & x = 0 \end{cases}$

63. If $x^3 - xy^2 + 3y^2 + 2 = 0$, then $\dfrac{dy}{dx}$ at $(1, 1)$ is

a) $-\dfrac{1}{2}$ b) $\dfrac{1}{2}$

c) -1 d)   1

64. The value of the integral

$$\int_{0}^{2\pi} \sqrt{(1 - \cos 2x)}\, dx$$

is

a)   2   b) $2\sqrt{2}$

c)   4   d) $4\sqrt{2}$

Section D: Basic Science (Chemistry, Physics, Life Science)

Chemistry

76. What is the energy and frequency of 656 nm light?
    (a) 30.3×10^{-19} J, 45.7×10^{14} s^{-1}, respectively
    (b) 3.03×10^{-19} J, 4.57×10^{14} s^{-1}, respectively
    (c) 3.03×10^{-19} J, 4.57×10^{17} s^{-1}, respectively
    (d) 3.03×10^{-20} J, 4.57×10^{-14} s^{-1}, respectively

77. What is the volume of 8.61 M solution of H_2SO_4 required for preparing 500 mL of a 1.75M H_2SO_4 solution?
    (a) 10.2 mL
    (b) 8.75 mL
    (c) 102 mL
    (d) None of these

78. If one $[CoL_6]^{3+}$ solution is blue and another is green, which would be expected to have the higher value of Δ_0, the d orbital splitting parameter in crystal field
    (a) Green
    (b) Blue
    (c) Both can have the same Δ_0
    (d) None of these

79. What is the oxidation state of phosphorus in H_3PO_3?
    (a) +5
    (b) +3
    (c) −3
    (d) +6

80. Which one is the one of the correct Lewis dot structures for NO_3^-?
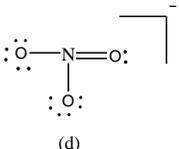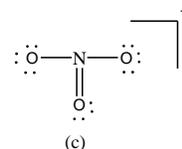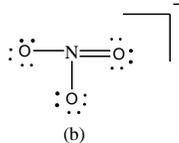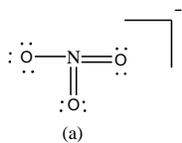
Physics

89. A liquid is kept in a U-shaped tube. If h is the equilibrium height of liquid in both arms and 2d is the separation between the two arms of the U tube then find the angular frequency of vertical oscillation of the liquid surface if it is made to oscillate by a small disturbance.
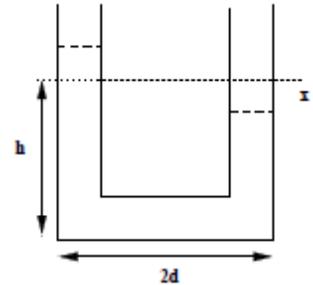
(a) $\sqrt{\dfrac{2g}{h+d}}$
(b) $\sqrt{\dfrac{g}{2(h+d)}}$
(c) $\sqrt{\dfrac{g}{h+d}}$
(d) $\sqrt{\dfrac{2g}{h+2d}}$

90. What is the propagation vector and the angular frequency ω of the electric field of an electromagnetic wave given as:

$$\vec{E} = E_0\left(2\hat{\imath} + 3\hat{\jmath} - 4\hat{k}\right)\cos(3x + 2y + 3z - \omega t)$$

Where x, y, z are in meter and t is in seconds.

(a) $\left(3\hat{\imath} + 2\hat{\jmath} + 3\hat{k}\right) m$ and $3\sqrt{22} \times 10^8 s^{-1}$ (b)) $\left(2\hat{\imath} + 3\hat{\jmath} - 4\hat{k}\right) m$ and $6\sqrt{22} \times 10^8 s^{-1}$

c) $\left(3\hat{\imath} + 2\hat{\jmath} + 3\hat{k}\right) m$ and $9\sqrt{22} \times 10^8 s^{-1}$ (d) $\left(2\hat{\imath} + 3\hat{\jmath} - 4\hat{k}\right) m$ and $12\sqrt{22} \times 10^8 s^{-1}$

91. A Compton Effect experiment is performed in such a way that the scattered photon and the recoil electron are detected only when their paths are at right angles $(\theta + \varphi = \pi/2)$. If λ and λ' are wavelengths of the incident and scattered photon, then

(a) $\lambda' = \dfrac{\lambda}{\sin\theta}$
(b) $\lambda' = \dfrac{\lambda}{\cos\theta}$
(c) $\lambda' = \dfrac{\lambda}{\sin^2\theta}$
(d) $\lambda' = \dfrac{\lambda}{\cos^2\theta}$

92. A parallel beam of electrons accelerated by a potential difference of 25 Volts falls normally on a diaphragm with two narrow slits separated by a distance, 50 μm. Calculate the distance between neighboring maxima of the diffraction pattern on a screen located at a distance, 100 cm from the slits.

(a) 19.2 μm
(b) 14.4 μm
(c) 9.6 μm
(d) 4.8 μm

93. A particle is located in a one dimensional square potential with infinitely high walls. The width of the well is 'a'. Find the normalized ground-stationary-state wave function of the particle taking the midpoint of the well as the origin of the x coordinate.

(a) $\sqrt{\dfrac{2}{a}}\sin\left(\dfrac{\pi x}{a}\right)$
(b) $\sqrt{\dfrac{2}{a}}\cos\left(\dfrac{\pi x}{a}\right)$
(c) $\sqrt{\dfrac{a}{2}}\sin\left(\dfrac{\pi x}{a}\right)$
(d) $\sqrt{\dfrac{a}{2}}\cos\left(\dfrac{\pi x}{a}\right)$

Life Science

101. Apoptotic cells are characterized by which of the following:
     a) Membrane blebbing
     b) Phosphatidylserine flipping to the outer leaflet
     c) Nuclear fragmentation
     d) All of the above

102. ATP is composed of

     a) Ribose, Adenine and 3 phosphate groups
     b) Hexose, Adenine and 3 phosphate groups
     c) Glucose, Adenine and 3 phosphate groups
     d) Fructose, Adenine and 3 phosphate groups

103. The molecule in Krebs cycle that combines with Acetyl CoA is
     a) Citrate
     b) Oxaloacetate
     c) Pyruvate
     d) Isocitrate

104. The degree of inhibition in case of a non-competitive inhibition of an enzyme catalyzed reaction would
     a. Decreases with increase in substrate concentration
     b. Increases with increase in substrate concentration
     c. Reaches a maxima with increase in substrate concentration and then decreases
     d. Does not vary with increase in substrate concentration

105. Ectomycorrhiza form an intercellular network in root cortex called
     a. Haustoria
     b. Arbuscules
     c. Vesicules
     d. Hartig net

106. In relation to photosynthesis one of the following statements is correct
     a. Cyclic photophosphorylation is the process involved with photosystem I
     b. A stack of thylakoids is called stroma
     c. The photosystems are embedded in the stroma
     d. CO_2 is liberated in the process of photosynthesis

107. The five carbon compound that absorbs CO_2 in Calvin Cycle is
     a. Oxaloacetic acid
     b. Malic acid
     c. Alpha ketoglutaric acid
     d. Ribulose bisphosphate

Section E: Legal Aptitude

108. Guidelines on Access and Benefit Sharing of biological resources were notified by the Ministry in:
    a. November 2014
    b. November 2008
    c. August 2002
    d. June 2005

109. A contract can be formed:
    a. Without consideration
    b. Only with consideration
    c. With optional consideration
    d. With consideration having certain exceptions

110. Gambling is an example of a:
    a. Contingent contract
    b. Wagering agreement
    c. Quasi contract
    d. Enforceable contract

111. Quantum of Foreign Direct Investment approved in the insurance sector is:
    a. 26%
    b. 49%
    c. 51%
    d. 100%

112. Under which List of Schedule VII of Indian Constitution levying of income tax falls:
    a. Union List
    b. State List
    c. Concurrent List
    d. All the above.

113. State formation in India is within the purview of:
    a. State government
    b. Central government
    c. Both (a) & (b)
    d. None of the above

114. Article 21 provides:
    a. Right to environment explicitly
    b. Right to environment implicitly
    c. Right to life and liberty
    d. Both (b) & (c)

Section F: Essay
Answer any one
Use only the additional sheet provided   **Maximum 1200 words**

1. Freedom of speech and expression in the social media

OR

2. Whether Intellectual Property regime is serving the cause of public good

Rough Work