Section – English
This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. Select the answer choice that identifies the noun in the sentence.
Sharks and lampreys are not true fish because their skeletons are made of cartilage rather than bone.
   a) True   b) because   c) their   d) bone

2. What does ‘they’ refer to?
Those flowers on the tables look like little trumpets. What are they called?
   a) Flower   b) Tables   c) Trumpets   d) Both Flower and Trumpets

3. Choose the correct order of adjectives to fill the blank.
He recently married a ________ woman.
   a) young beautiful Greek   b) beautiful young Greek
   b) beautiful Greek young   d) young Greek beautiful

4. Which kind of adverb is the word in capitals?
"He is so gentle that he NEVER shoots at animals."
   a) Adverb of Place   b) Adverb of Degree
   c) Adverb of Time/Frequency   d) Adverb of Manner

5. Choose the right option to fill the gap.
At two o’clock tomorrow, she ________ at Golden Hawk Gym.
   a) Exercise   b) will be exercising   c) exercising   d) both b & c

6. Choose the right option to fill the gap.
By the time Mr. Obama arrives, ________ the oration?
   a) Will you have preparing   b) Will you preparing
   c) Will you prepare   d) Will you have prepared

7. Choose the right option to fill the gap.
The panelists ________ Germany a day after tomorrow.
   a) Will reach   b) Shall be reached
   c) Will have been reaching   d) Both a & b

8. Choose the right modal verb.
This is impossible, it ________ be a mistake!
   a) Might   b) must   c) ought to   d) shouldn't

9. Choose the correct use of modal verb.
a) Any child will grow up to become Prime Minister of the country
b) Any child can grow up to become Prime Minister of the country
c) Any child will be grow up to become Prime Minister of the country
d) Any children could be grown up to become Prime Minister of the country

10. Identify the error in the sentence and choose the correct sentence as an option.
    You need not come unless you want to.
a) You did not required to come unless you want to  
b) You don't need to come unless you want to  
c) You come only when you want to  
d) You come unless you don't want to

11. Identify which part of the sentence has the error.  
The teacher says that (1)/ there is (2)/ many important documents (3)/ to assemble before  
this gets over.(4)  
a) 1 b) 2 c) 3 d) 4

12. Pick the right meaning for the following phrase.  
Baker's dozen  
a) Twelve b) Thirteen c) Ten d) Fifteen

13. Identify the correct meaning of the idiom.  
Play devil's advocate  
a) To argue the opposite, just for the sake of argument b) To spoil something  
c) Saving money for later d) Postpone a plan

14. Choose one word for the following.  
A notice of a person's death  
a) Obituary b) Observation c) Ablution d) Death Warrant

15. In the following question, a related pair of words or phrases is followed by five pairs of words  
or phrases. Choose the pair that best expresses a relationship similar to that in the original  
pair.  
Warm is to hot as  
Old is to?  
a) Antique b) Oldest c) New d) Obsolete

16. Choose the correct form of the verb to fill the gap so as to make a meaningful sentence.  
Infant's ___________ when they are hungry.  
a) Cry b) Cries c) Cried d) Are crying

17. Choose the correct form of the verb to fill the gap so as to make a meaningful sentence.  
Johana ___________ her black pants today, but usually she wears a long dress or a skirt.  
a) wears b) wearing c) wear d) is wearing

18. Choose the correct form of the verb to fill the gap so as to make a meaningful sentence.  
___________ you ever been to Newcastle?  
a) are b) were c) do d) have

19. Fill in the blank with correct word.  
She wanted to improve her piano playing ___________ she wanted to win the competition.  
a) because b) so c) but d) therefore

20. Choose the most suitable interjection to complete the sentence.  
___________ that's really great news.  
a) Hey! b) Ah! c) Yay! d) Wow!

21. Fill in the blank with correct word.  
Rahul hates the thought ___________ going back to work.  
a) to b) of c) for d) about

22. Fill in the right verb form.  
They ___________ playing cricket all afternoon.  
a) are b) were c) was d) have
23. Change the voice of following sentence.
   My father wrote this book.
   a) This book is written by my father       b) This book was written by my father
   c) This book has been written by my father d) This book were written by my father

24. Which of these words is most nearly the opposite of the word provided?
   Luminous
   a) clear                      b) dim                   c) brittle               d) clever

25. Which of these words is closest in meaning to the word provided?
   Kin
   a) exult                     b) twist                 c) friend                d) relative

26. What is wrong with this sentence?
   "She was cleaning the garage while she saw a spider."
   a) "cleaning" must be "clean"
   b) "saw" must be "was seeing"
   c) "while" must be "when"
   d) "cleaning" must be "cleaned"

27. Choose the right option to fill the gaps.
   When Yuka _______ washing the dishes, she _______ the TV on.
   a) Finished, had turned       b) Turned, had finished
   c) Had finished, turned      d) Had turned, finished

28. Choose the right option to fill the gaps.
   What __________ you __________ last weekend?
   a) were / do                 b) did / did            c) did / do             d) do / did

29. Select the answer choice that identifies the noun in the sentence.
   Many of these people have been ignored.
   a) many                     b) these                c) people              d) ignored

30. Choose the right personal pronoun to correctly finish this sentence.
    They have taken the money. Please run after ________.
    a) they                     b) she                  c) we                  d) them
Section – Physics

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. A bead of mass 1/2kg starts from rest from A to move in a vertical plane along a smooth fixed quarter ring of radius 5 m, under the action of constant horizontal force F=5N as shown in the figure. The speed of the bead as it reaches the point B is \( g = 10 \text{ ms}^{-2} \)

![Diagram of a bead moving in a vertical plane](image)

a) 14.14 ms\(^{-1}\)  b) 7.07 ms\(^{-1}\)  c) 10 ms\(^{-1}\)  d) None of these

2. A man of mass m has fallen into a ditch of width d. Two of his friends are slowly pulling him out using a light rope and two fixed pulley as shown in figure. Both the friends exert force of equal magnitude F. when the man is at a depth h the value of F is

\[ F = \frac{mg}{2h} \sqrt{h^2 + d^2} \]

a) \( \frac{mg}{4h} \sqrt{d^2 + 4h^2} \)  b) hmg  c) dmg  d) \( \frac{mg}{2h} \sqrt{h^2 + d^2} \)

3. A solid sphere is rotating about a diameter at an angular velocity \( \omega \). If it cools so that its radius reduces to \( \frac{1}{n} \) of its original value, its time period of rotation is

a) \( T = \frac{2\pi}{n^2 \omega} \)  b) \( T = \frac{2\pi n^2}{\omega} \)  c) \( T = \frac{n^2}{2\omega} \)  d) \( T = \frac{\pi}{n^2 \omega} \)

4. Two discs have same mass and thickness. Their materials have densities \( d_1 \& d_2 \). The ratio of their moments of inertia about central axis will be:

a) \( d_1:d_2 \)  b) \( d_1:d_2:1 \)  c) \( 1:d_1:d_2 \)  d) \( d_2:d_1 \)

5. The period of a body under SHM is \( T = P^a D^b S^c \), where P is pressure, D is density and S is surface tension. The value of a, b, c are

a) \( \frac{3}{2}, \frac{1}{2}, -1 \)  b) \( -1, -2, 3 \)  c) \( \frac{1}{2}, -\frac{3}{2}, -\frac{1}{2} \)  d) 1, 2, \( \frac{1}{3} \)

6. The initial velocity of a particle is \( u \) [at \( t=0 \)] and the acceleration \( f \) is given by at. Which of the following relations valid?

a) \( v = u + at^2 \)  b) \( v = u + \frac{at^2}{2} \)  c) \( v = u + at \)  d) \( v = u \)

7. An electric fan has blades of length 30cm as measured from the axis rotation. If the fan is rotating at 1200rpm. The acceleration of a point on the tip of the blade is about.

a) 1600 m/s\(^2\)  b) 4740 m/s\(^2\)  c) 2370 m/s\(^2\)  d) 5055 m/s\(^2\)
8. A particle of mass m is placed at the center of a uniform spherical shell of mass 3m and radius R. The gravitational potential on the surface of the shell is:

a) \( \frac{Gm}{R} \)  
b) \( \frac{3Gm}{R} \)  
c) \( \frac{4Gm}{R} \)  
d) \( \frac{2Gm}{R} \)

9. Two pendulums of time period 3 s and 7 s respectively start oscillating simultaneously from two opposite extreme positions. After how much least time they will be in phase?

a) \( \frac{21}{8} \) s  
b) \( \frac{21}{2} \) s  
c) \( \frac{21}{4} \) s  
d) \( \frac{21}{10} \) s

10. A wire of 10^{-2} kg m^{-1} passes over a frictionless light pulley fixed on the top of a frictionless inclined plane which makes an angle of 30° with the horizontal. Masses m and M tied at two ends of wire such that m rests on the plane and M hangs freely vertically downwards. The entire system is in equilibrium and a transverse wave propagates along the wire with a velocity of 100 m s^{-1}. Then

a) M=5kg  
b) \( \frac{m}{M} = \frac{1}{4} \)  
c) m=20kg  
d) \( \frac{m}{M} = 4 \)

11. The velocity of the liquid coming out of a small hole at the bottom of a vessel containing two different liquids of densities \( 2 \rho \) and \( \rho \) as shown in the figure is

![Diagram of two liquids](image)

a) \( \sqrt{6gh} \)  
b) \( \sqrt{2gh} \)  
c) \( 2\sqrt{2gh} \)  
d) \( 2\sqrt{gh} \)

12. The force required to separate two glass plates of area 10^{-2} m^{2} with a film of water 0.05 mm thick between them, is (surface tension of water is 70x10^{-3} N/m)

a) 28 N  
b) 14 N  
c) 50 N  
d) 38 N

13. A refrigerator absorbs 2000 calories of heat from ice trays. If the coefficient of performance is 4, then work done by the motor is

a) 2100 J  
b) 8000 J  
c) 33600 J  
d) 500 J

14. In an ideal gas at temperature T, the average force that a molecule applies on the walls of a closed container depends on T as T^{q}. A good estimate for q is:

a) 2  
b) 1  
c) 1/4  
d) 1/2

15. Two spherical conductors A and B of radii 1mm and 2mm are separated by a distance of 5cm and are uniformly charged. If the spheres are connected by a conducting wire then in equilibrium condition, the ratio of the magnitude of the electric fields at the surfaces of spheres. A and B is

a) 4:1  
b) 1:2  
c) 2:1  
d) 1:4

16. There is a uniform electrostatic field in a region. The potential at various points on a small sphere centred at P, in the region is found to vary between in the limits 589.0V to 589.8V.
What is the potential at a point on the sphere whose radius vector makes an angle of $60^\circ$ with the direction of the field?

17. When a current $I$ is passed through a wire of constant resistance, it produces a potential difference $V$ across its ends. The graph drawn between log $I$ and log $V$ will be

![Graph Options]

18. Wires 1 and 2 carrying currents $i_1$ and $i_2$ respectively are inclined at an angle $\theta$ to each other. What is the force on a small element $dl$ of wire 2 at a distance of $r$ from wire 1 (as shown in figure) due to the magnetic field of wire 1?

![Diagram]

$\mu_0 i_1 j \mu_0 = \frac{\mu_0 i_1}{2\pi r} i_2 dl \tan \theta$  
$\frac{\mu_0 i_1}{2\pi r} i_2 dl \sin \theta$  
$\frac{\mu_0 i_1}{2\pi r} i_2 dl \cos \theta$  
$\frac{\mu_0 i_1}{4\pi r} i_2 dl \sin \theta$

19. The material of a bar magnet has coercively of $2 \times 10^3$ A/m. In order to demagnetize it by inserting it inside a solenoid 12m long having 6000 turns, the current should be sent through the solenoid

a) 4A  
b) 8A  
c) 2A  
d) 6A

20. Which of the following graphs represents the variation of particle momentum and the associated de Broglie wavelength?

![Graph Options]

21. A radioactive nucleus can decay by two different processes. The half-life for the first process is $2t$ and that for the second process is $t$. Then effective disintegration constant of the nucleus is

a) $\frac{3}{2r \ln 2}$  
b) $\frac{3\ln 2}{2r}$  
c) $\frac{\ln 2}{3t}$  
d) $\frac{3\ln 2}{t}$

22. Light from a discharge tube containing hydrogen atom falls on the surface of a piece of sodium. The KE of photoelectrons emitted from sodium is 0.73 eV. The work function for
sodium is 1.82 eV. Find the recoil speed of the emitting atom assuming it is to be at rest before the transition.

a) 4 m/s  b) 0.404 m/s  c) 8.14 m/s  d) 0.814 m/s

23. A thin plano-convex lens acts like a concave mirror of radius of curvature 20 cm when its plane surface is silvered. The radius of curvature of the curved surface if index of refraction of its material is 1.5 will be

a) 40 cm  b) 30 cm  c) 10 cm  d) 20 cm

24. Two Polaroid's are placed in the path of un-polarised beam of intensity $I_0$ such that no light is emitted from the second Polaroid. If a third Polaroid whose polarization axis makes an angle $\theta$ with the polarization axis of first Polaroid is placed between these Polaroids's then the intensity of light emerging from the last Polaroid will be

a) $\left(\frac{I_0}{8}\right)\sin^2 2\theta$  
b) $\left(\frac{I_0}{4}\right)\sin^2 2\theta$  
c) $\frac{I_0}{2}\cos^4 \theta$  
d) $I_0\cos^4 \theta$

25. A thin non-conducting ring of mass $m$ carrying a charge $q$ can freely rotate about its axis. Initially the ring is at rest and no magnetic field was present. When a uniform magnetic field is switched on, perpendicular to the plane of the ring, and increased with time according to the relation $\frac{dB}{dt} = k$, the angular velocity of the ring as a function of $k$ is

a) $\frac{kmt}{2q}$  
b) $\frac{2kt}{qm}$  
c) $\frac{kqt}{2m}$  
d) $\frac{2mt}{kq}$

26. In the circuit given below, $V(t)$ is the sinusoidal voltage source, voltage drop $V_{AB}(t)$ across the resistance $R$ is

![Circuit Diagram](image)

a) Is half wave rectified  
b) Is full wave rectified  
c) Has the same peak value in the positive and negative half cycles  
d) Has different peak values during positive and negative half cycle

27. The combination of gates shown below produces

![Gates Diagram](image)

a) AND gate  b) XOR gate  c) NOR gate  d) NAND gate

28. A minimum horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is
29. The amplifiers X, Y and Z are connected in series. If the voltage gains of X, Y and Z are 10, 20 and 30 respectively and input signal is 1mv peak value, then the output signal voltage(peak) when dc voltage 5v is applied
a) 6 V  
 b) 60 V  
 c) 5 V  
 d) 0.5 V

30. When a galvanometer is shunted with a 4Ω resistance, the deflection is reduced to one-fifth. If the galvanometer is further shunted with 2Ω wire, the further reduction in the deflection will be (the main current remains same)

a) \( \frac{8}{13} \) of the deflection when shunted with 4Ω only

b) \( \frac{5}{13} \) of the deflection when shunted with 4Ω only

c) \( \frac{3}{4} \) of the deflection when shunted with 4Ω only

d) \( \frac{3}{13} \) of the deflection when shunted with 4Ω only
Section – Chemistry

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. The ratio between number of atoms in equal masses of Helium and Hydrogen is
   a) 1 : 4  
   b) 4 : 1  
   c) 1 : 2  
   d) 2 : 1

2. Solid AB has rock salt structure edge length of its unit cell is 200 pm. Nearest distance between A&B is, if radius of A is 30 pm
   a) 70 pm  
   b) 140 pm  
   c) 60 pm  
   d) 100 pm

3. Longest wavelength occurs for
   a) Lyman series  
   b) Balmer series  
   c) Paschen series  
   d) Brackett series

4. The formal charge of the O atoms in the ion \( \overset{+}{\text{N}}\overset{\cdot}{\text{O}}\overset{\cdot}{\text{O}}\overset{\cdot}{\text{O}}\overset{\cdot}{\text{O}}\overset{\cdot}{\text{N}} \) is
   a) -2  
   b) -1  
   c) 0  
   d) +1

5. The difference between the reaction enthalpy change (\( \Delta H \)) and reaction internal energy change (\( \Delta U \)) for the reaction: \( 2C_2H_2(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l) \) at 300 K is \( R = 8.314 \text{J mol}^{-1} \text{K}^{-1} \)
   a) 0 J mol\(^{-1}\)  
   b) -7482 J mol\(^{-1}\)  
   c) 2490 J mol\(^{-1}\)  
   d) -2490 J mol\(^{-1}\)

6. A mixture contains 1 mole volatile liquid \( A \left( P_A^0 = 100 \text{mmHg} \right) \) and 3 moles volatile liquid \( B \left( P_B^0 = 80 \text{mm} \right) \). If solution behave ideally, total vapour pressure of the distillate is approximately
   a) 85 mmHg  
   b) 86 mmHg  
   c) 90 mmHg  
   d) 92 mmHg

7. A definite amount of solid \( \text{NH}_4\text{HS} \) is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure. \( \text{NH}_4\text{HS} \) decomposes to give \( \text{NH}_3 \) and \( \text{H}_2\text{S} \) and at equilibrium total pressure in flask is 0.84 atm. The equilibrium constant for the reaction is:
   a) 0.30  
   b) 0.18  
   c) 0.17  
   d) 0.11

8. The resistance of a conductivity cell containing 0.001 M KCl solution at 298K is 1500 \( \Omega \). What is the cell constant (in \( \text{mm}^3 \))? If the conductivity of 0.001 M KCl solution is \( 2 \times 10^{-3} S \text{ mm}^{-1} \)
   a) 1  
   b) 2  
   c) 3  
   d) 4

9. The half-life of \( ^{236}\text{Ra} \) is 1600 yrs. How many disintegration per second would be undergone by 1.0 g of the reactant?
   a) \( 2.15 \times 10^{18} \)  
   b) \( 3.15 \times 10^{18} \)  
   c) \( 2.25 \times 10^{18} \)  
   d) \( 1.15 \times 10^{18} \)
10. $10^{-4}$ g of gelatine is required to be added to 10 cm$^3$ of a standard gold solution to just prevent precipitation by addition of 1 cm$^3$ of 10% $NaCl$ solution to it. Hence the gold number of gelatine is
a) 10  b) 1.0  c) 0.1  d) 0.01

11. What is the atomic number of last member of the seventh period of the extended form of periodic table?
a) 116  b) 118  c) 120  d) 122

12. Match items of Column-I with the items of Column-II and assign the correct code.

<table>
<thead>
<tr>
<th>Column-I</th>
<th>Column-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) sapphire</td>
<td>1) $Al_2O_3$</td>
</tr>
<tr>
<td>B) sphalerite</td>
<td>2) $NaCN$</td>
</tr>
<tr>
<td>C) depressant</td>
<td>3) $Co$</td>
</tr>
<tr>
<td>D) Corundum</td>
<td>4) ZnS</td>
</tr>
<tr>
<td></td>
<td>5) $Fe_2O_3$</td>
</tr>
</tbody>
</table>

a) A-3, B-4, C-2, D-1  b) A-5, B-4, C-3, D-2  c) A-2, B-3, C-4, D-5  d) A-1, B-2, C-3, D-4

13. Incorrect statement about H$_2$O$_2$ is
a) Urea acts as stabilizes in the storage of H$_2$O$_2$

b) H$_2$O$_2$ acts as bleaching agent because of its oxidizing nature

c) H$_2$O$_2$ is prepared from BaO$_2$ and not from MnO$_2$ and PbO$_2$

d) When CO$_2$ is bubbled through cold solution of BaO$_2$, H$_2$O$_2$ is not formed.

14. On dissolving moderate amount of sodium metal in liquid NH$_3$ at low temperature, which one of the following does not occur?
a) Blue coloured solution is obtained

b) Na$^+$ ions are formed in the solution

c) Liquid NH$_3$ becomes good conductor of electricity

d) Liquid ammonia remains diamagnetic

15. $CH_3Cl + Si \xrightarrow{Co, 570 K} A \ 'A' \ 'A' \ 'A$ on hydrolysis followed by polymerization gives

a) Si(CH$_3$)$_3$  b) $O \left( CH_3 \right) \left( Si \right) \left( O \right) n$

c) $O \left( CH_3 \right) \left( Si \right) \left( O \right) n$

d) $HO \left( Si \right) \left( Si \right) \left( OH \right) CH_3$
16. Match column I with column II and select the correct answer using the codes given below the Column

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. XeF\textsubscript{4}</td>
<td>1. Distorted octahedral</td>
</tr>
<tr>
<td>B. XeF\textsubscript{6}</td>
<td>2. Tetrahedral</td>
</tr>
<tr>
<td>C. XeO\textsubscript{3}</td>
<td>3. Square planar</td>
</tr>
<tr>
<td>D. XeO\textsubscript{4}</td>
<td>4. Pyramidal</td>
</tr>
</tbody>
</table>

a) A-1, B-2, C-3, D-4  b) A-3, B-1, C-4, D-2  
c) A-1, B-3, C-2, D-4  d) A-2, B-4, C-1, D-3

17. Misch metal is

a) an alloy of lanthanide and copper  b) an alloy of lanthanide and nickel  
c) an alloy of lanthanide, iron and carbon  d) an alloy of calcium and copper

18. If excess of AgNO\textsubscript{3} solution is added to 100 mL of a 0.024M solution of dichlorobis (ethylenediamine) Cobalt (III) chloride. How many moles of AgCl be precipitated?

a) 0.0212  b) 0.016  c) 0.0024  d) 0.024

19. The laundry, the bleaching agent which gives better results and makes use of lesser amount of water is

a) CCl\textsubscript{2} = CCl\textsubscript{2}  b) H\textsubscript{2}O\textsubscript{2}  
c) CO\textsubscript{2} liquid  d) Bleaching powder

20. Which one of the following can be purified by sublimation?

a) F\textsubscript{2}  b) Cl\textsubscript{2}  c) Br\textsubscript{2}  d) I\textsubscript{2}

21. Which is the decreasing order of acidity in, HCOOH (I), CH\textsubscript{3}COOH (II), CH\textsubscript{3}CH\textsubscript{2}COOH (III) AND C\textsubscript{6}H\textsubscript{5}COOH (IV)

a) I > II > III > IV  b) IV > III > II > I  
c) IV > I > II > III  d) I > IV > II > III

22. In S\textsubscript{N}2 reactions, the correct order of reactivity for the following compounds: CH\textsubscript{3}Cl, CH\textsubscript{3}CH\textsubscript{2}Cl, (CH\textsubscript{3})\textsubscript{2}CHCl, and (CH\textsubscript{3})\textsubscript{3}CCl

a) (CH\textsubscript{3})\textsubscript{2}CHCl > CH\textsubscript{3}CH\textsubscript{2}Cl > CH\textsubscript{3}Cl > (CH\textsubscript{3})\textsubscript{3}CCl  
b) CH\textsubscript{3}Cl > (CH\textsubscript{3})\textsubscript{2}CHCl > CH\textsubscript{3}CH\textsubscript{2}Cl > (CH\textsubscript{3})\textsubscript{3}CCl  
c) CH\textsubscript{3}Cl > CH\textsubscript{3}CH\textsubscript{2}Cl > (CH\textsubscript{3})\textsubscript{2}CHCl > (CH\textsubscript{3})\textsubscript{3}CCl  
d) CH\textsubscript{3}CH\textsubscript{2}Cl > CH\textsubscript{3}Cl > (CH\textsubscript{3})\textsubscript{2}CHCl > (CH\textsubscript{3})\textsubscript{3}CCl

23. The product (Y) of the following sequence of the reactions would be

\[
\begin{align*}
\text{Me} & \quad \text{O} \\
\text{O} & \quad \text{Me} \\
\end{align*}
\xrightarrow{(i) \text{CHCl}_2/\text{NaOH}} X \xrightarrow{\text{Br}_2/\text{Fe}} Y
\]
24. $^{14}CH_3-CH=CH_2$ reacts with $Cl_2$ at $500^\circ$C. Find out no. of possible products.
   a) 1  b) 2  c) 3  d) 4

25. An amine on treatment with $HNO_2$ evolved $N_2$, the amine on exhaustive methylation with $CH_3I$ formed a quaternary salt containing 59.07% iodine. The amine is likely to be
   a) $CH_3NH_2$  b) $(CH_3)_2NH$  c) $C_2H_5NH_2$  d) $(CH_3)_3N$

26. The correct order of increasing intermolecular forces of polymers
   a) Buna-S, Polythene, Nylon-6, 6  b) Nylon-6, 6, Polythene, Buna-S
   c) Polythene, Nylon-6,6, Buna-S  d) Buna-S, Nylon-6, 6, Polythene

27. The mixture of compounds formed when glucose undergoes reversible isomerisation with sodium hydroxide solution
   a) D-Glucose, D-mannose and D-fructose  b) D-Glucose, D-galactose and D-fructose
   c) D-Galactose, D-glucose and L-fructose  d) D-Glucose, L-fructose and D-galactose

28. An antibiotic contains nitro group attached to aromatic nucleus in its structure. It is
   a) penicillin  b) streptomycin  c) tetracycline  d) chloramphenicol

29. Which of the following vitamins is water soluble?
   a) Vitamin E  b) Vitamin D  c) Riboflavin  d) Vitamin K

30. Butyne-1 and Butyne-2 can be distinguished by
   a) $Br_2/CCl_4$  b) $H_2/Lindlar’s$ catalyst
   c) dilute $H_2SO_4$  d) Ammonical cuprous chloride
Section – Mathematics

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. If A, B and C are three sets such that \( A \cap B = A \cap C \) and \( A \cup B = A \cup C \), then
   a) \( A = C \)  b) \( B = C \)  c) \( A \cap B = \emptyset \)  d) None

2. If \( n(A) = 4 \), then number of symmetric relations that can be defined on \( A \) is
   a) \( 2^{10} \)  b) \( 2^6 \)  c) \( 2^8 \)  d) \( 2^{16} \)

3. \[ \lim_{x \to \pi/2} \frac{1 - \tan \left( \frac{x}{2} \right)}{1 + \tan \left( \frac{x}{2} \right)} \frac{[1 - \sin x]}{[\pi - 2x]} = \]
   a) \( \infty \)  b) \( 1/8 \)  c) 0  d) \( 1/32 \)

4. If \( a^2 + b^2 + c^2 = 1 \) and \( b + ic = (1 + a)z \) then \( \frac{1+iz}{1-iz} = \)
   a) \( \frac{a+ib}{1+c} \)  b) \( \frac{a+ib}{1-c} \)  c) \( \frac{a-ib}{1-c} \)  d) \( \frac{a-ib}{1+c} \)

5. Let \( \alpha, \beta \) be the roots of the equation \( x^2 - px + r = 0 \) and \( (\alpha/2), 2\beta \) be the roots of the equation \( x^2 - qx + r = 0 \) then the value of ‘r’ is
   a) \( \frac{2}{9} (p-q)(2q-p) \)  b) \( \frac{2}{9} (q-p)(2p-q) \)
   c) \( \frac{2}{9} (q-2p)(2q-p) \)  d) \( \frac{2}{9} (2p-q)(2q-p) \)

6. In a G.P. if the first term is 3, nth term is 96 and the sum of n terms is 189, then the number of terms is
   a) 6  b) 6  c) 8  d) 9

7. Matrix A has x rows and x+4 columns and another matrix B has y rows and 2y-10 columns. If both AB and BA exist then x and y are
   a) 3,8  b) 8,3  c) 6,2  d) 2,6

8. If a, b, c are integers such that b is always twice the sum of a and c and lies between 1 and
   9 and \( 6a^2, 5b^2, 4c^2 \) are three digit numbers then the value of \( \begin{bmatrix} 6 & 6a^2 & b \\ 5 & 5b^2 & b \\ 4 & 4c^2 & c \end{bmatrix} \) is
   a) \( a + b + c \)  b) \( a - b + c \)  c) \( 2a - b + c \)  d) 0
9. If the vectors \( \vec{a} \) and \( \vec{b} \) are linearly independent satisfying
\[
(\sqrt{3} \tan \theta + 1)\vec{a} + (\sqrt{3} \sec \theta - 2)\vec{b} = 0
\]
then the most general value of \( \theta \) is equal to:

a) \( n\pi - \frac{\pi}{6}, n \in \mathbb{Z} \)

b) \( 2n\pi \pm \frac{11\pi}{6}, n \in \mathbb{Z} \)

c) \( n\pi \pm \frac{\pi}{6}, n \in \mathbb{Z} \)

d) \( 2n\pi + \frac{11\pi}{6}, n \in \mathbb{Z} \)

10. The symbolic form of logic of the circuit given below is

a) \( \left( (p \land q') \lor p' \right) \land q \)

b) \( p \lor (q' \land p') \lor q \)

c) \( (p \land p') \lor q' \lor q \)

d) \( p \lor (q' \lor p') \lor q \)

11. Number of ways of arranging 4 subjects in 6 periods of a day

a) 1080

b) 480

c) 1560

d) 1140

12. The interior angles of regular polygon are measured as 150° each, then number of diagonals of polygon are

a) 35

b) 54

c) 45

d) 50

13. If the sum of \( n \) terms of an A. P is \( \frac{4n^2 - 3n}{4} \), then \( n \)th term of A. P is

a) \( \frac{5n - 3}{4} \)

b) \( \frac{8n - 7}{4} \)

c) \( \frac{3n^2 - 2}{4} \)

d) \( \frac{8n + 7}{4} \)

14. The value \( \sum_{r=0}^{20} r(20 - r)(20C_r)^2 \) =

a) 400

b) 400.38C_{20}

c) 38C_{20}

d) 0

15. Let \( f(x) = 1 + |x - 2| + |\sin x| \), then Lagrange’s mean value theorem is applicable for \( f(x) \) in

a) \( [0, \pi] \)

b) \( [\pi, 2\pi] \)

c) \( \left[ \frac{\pi}{2}, \frac{3\pi}{2} \right] \)

d) \( \left[ -\frac{\pi}{2}, \frac{\pi}{2} \right] \)

16. Increasing interval of \( \cos h(\cos x) \) is

a) \( \left( 2n\pi - \frac{\pi}{2}, 2n\pi + \frac{\pi}{2} \right) \)

b) \( \left( 2n\pi + \frac{\pi}{2}, 2n\pi + \pi \right) \cup \left( 2n\pi + \frac{3\pi}{2}, 2n\pi + 2\pi \right) \)

c) \( (2n\pi, 2n\pi) \)

d) \( \left( 2n\pi - \frac{\pi}{2}, 2n\pi + \pi \right) \)
17. \[ \int e^x \left( \frac{1-x}{1+x^2} \right)^2 \, dx = \]
\[ \frac{e^x}{1+x^2} + c \]
a) \[ \frac{e^x}{1+x^2} + c \]
b) \[ \frac{e^x + x + c}{1+x^2} \]
c) \[ \frac{e^x + x + c}{1+x^2} \]
d) \[ \frac{e^x}{1+x^2} - x + c \]

18. If \[ \int \frac{2x+3}{x(x+1)(x+2)(x+3)+1} \, dx = c - \frac{1}{f(x)} \]
and \[ f(x) = ax^2 + bx + c \]
then \[ a + b + c = \]
\[ a) \ 4 \]
b) \[ 3 \]
c) \[ 6 \]
d) \[ 5 \]

19. \[ \int \left( [x-4] + [10-x] \right) \, dx = \ldots \ldots \text{ (where } [x] \text{ is the greatest integer not exceeding } x \). \]
a) \[ 10 \]
b) \[ 20 \]
c) \[ 30 \]
d) \[ 40 \]

20. The solution of \[ x \, dx + y \, dy = x^2 \, y \, dy - xy^2 \, dx \]
is
\[ a) \ x^2 - 1 = c(1 + y^2) \]
\[ b) \ x^2 + 1 = c(1 - y^2) \]
\[ c) \ x^3 + 1 = c(y^3 + 1) \]
\[ d) \ x^3 + 1 = c(1 - y^2) \]

21. In \( \Delta ABC \), \( A = (1, 2) \); \( B = (5, 5) \), \( \angle ACB = 90^\circ \). If area of \( \Delta ABC \) is to be 6.5 sq. units, then
the possible number of points for \( C \) is
a) \[ 1 \]
b) \[ 2 \]
c) \[ 0 \]
d) \[ 4 \]

22. If \[ \frac{2}{1!9!} + \frac{2}{3!7!} + \frac{1}{5!5!} = \frac{2^n}{n!} \]
then orthocenter of the triangle having sides \( x-y+1=0 \), \( x+y+3=0 \) and \( 2x+5y-2=0 \) is
\[ a) \ (2m-2n, m-n) \]
\[ b) \ (2m-2n, n-m) \]
\[ c) \ (2m-n, m+n) \]
\[ d) \ (2m-n, m-n) \]

23. The number points \((x, y)\) having integral co-ordinates satisfying the condition \( x^2 + y^2 < 25 \) is
a) \[ 69 \]
b) \[ 77 \]
c) \[ 79 \]
d) \[ 80 \]

24. \( P \) is a point on the ellipse \[ \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \] with foci at \( S, S' \). Normal at \( P \) cuts the x-axis at \( G \). If
\[ \frac{SP}{S'P} = \frac{2}{3} \]
then \[ \frac{SG}{S'G} = \]
a) \[ \frac{4}{9} \]
b) \[ \frac{3}{2} \]
c) \[ \frac{2a}{3b} \]
d) \[ \frac{2}{3} \]

25. The vertices of the triangle \( PQR \) are \((2, 1, 1)\), \((3, 1, 2)\) and \((-4, 0, 1)\). The area of the triangle
is equals to:
a) \[ \sqrt{38} \]
b) \[ \sqrt{38} \]
c) \[ 4 \]
d) \[ 2 \]
26. The equation of the plane containing the line $2x - 5y + 2z = 6$, $2x + 3y - z = 5$ and parallel to the line $\frac{x}{1} = \frac{y}{-6} = \frac{z}{7}$ is

a) $6x + y - 10 = 0$ 
   b) $6x + y - 16 = 0$
   c) $12x + 2y - 1 = 0$ 
   d) $6x + y + 16 = 0$

27. Mean deviation of $390, 400, 400, 410, 410, 420, 420, 430, 430, 440, 440, 450$ through median is

a) $420$ 
   b) $15$
   c) $7/2$ 
   d) none

28. Three of six faces of a regular hexagon are chosen at random. The probability that the triangle with three vertices is equilateral equal to

a) $\frac{1}{2}$ 
   b) $\frac{1}{5}$
   c) $\frac{1}{10}$ 
   d) $\frac{1}{20}$

29. Number of solutions of the equation $\tan x + \sec x = 2 \cos x$ lying in the interval $[0, 2\pi]$ is

a) $0$ 
   b) $1$
   c) $2$ 
   d) $3$

30. If $f(x) = \sin^{-1}\left(\frac{\sqrt{3}}{2}x - \frac{1}{2}\sqrt{1-x^2}\right)$, $-\frac{1}{2} \leq x \leq 1$ then $f(x) =$

a) $\frac{\pi}{6} - \sin^{-1}x$ 
   b) $\sin^{-1}x - \frac{\pi}{6}$
   c) $\sin^{-1}x + \frac{\pi}{6}$ 
   d) $\sin^{-1}x + \frac{\pi}{3}$
Section – Biology

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. The principles of Numerical taxonomy was developed by
   a) Bentahm and Hooker  
   b) Engler and Prantl  
   c) Sneath and Sokal  
   d) Takhtajan

2. In animals, the group amniota includes
   a) Birds and reptiles  
   b) Birds and Mammals  
   c) Reptiles and mammals  
   d) Reptiles, birds and mammals

3. What type of epithelium is associated with goblet cells?
   a) Simple squamous epithelium  
   b) Simple cuboidal epithelium  
   c) Simple columnar epithelium  
   d) Stratified squamous epithelium

4. Plasmodesmata are located in narrow areas of __________.
   a) Protoplas  
   b) Cell wall  
   c) Nuclei  
   d) Cellulose

5. Chiral carbon is
   a) Carbon atom with four same groups  
   b) Carbon atom with four different groups  
   c) Carbon atom with two same group  
   d) None of these

6. The transpiration is regulated by the movements of
   a) Subsiary cells of the leaves  
   b) Carriers  
   c) Mesophyll tissue  
   d) Guard cells

7. Man cannot synthesize ________
   a) vitamin A  
   b) vitamin B  
   c) vitamin C  
   d) vitamin D

8. Scientist awarded Nobel prize in 1961 for tracing the path of carbon in photosynthesis was
   a) Calvin  
   b) Ruben  
   c) Blackman  
   d) Hatch

9. In prokaryotes enzymes involved in citric acid cycle are present in
   a) Mitochondrial membrane  
   b) Plasma membrane  
   c) Cytosol  
   d) Peroxisomes

10. An enzyme that can stimulate germination of barley seeds is
    a) Amylase  
    b) Lipase  
    c) Protease  
    d) Invertase

11. If RBCs are placed in distilled water the corpuscles will
    a) Increase in number  
    b) Burst  
    c) Stick to each other  
    d) Shrink

12. Rathke’s pouch is associated in development of which following structure?
    a) Kidney  
    b) Hypothalamus  
    c) Pituitary  
    d) Thyroid
13. Toxic agents present in food which interfere with thyroxine synthesis lead to the development of
   a) Toxic goitre  b) Cretinism  c) Simple goitre  d) thyrotoxicosis
14. The difference in voltage between the inside and outside of a cell is called ______.
   a) Spike potential  b) Action potential  c) Resting potential  d) Reaction potential
15. Apomictic embryos in citrus arise from
   a) Maternal sporophytic tissue in ovule  b) Synergid  c) Diploid egg  d) Antipodal cells
16. Sperm of an animal species ‘X’ is unable to fertilize the egg of ‘Y’ because
   a) fertilisin of ‘X’ and ‘Y’ are compatible  b) antifertilisin of ‘X’ and ‘Y’ are not compatible
   c) fertilisin of ‘X’ and ‘Y’ are not compatible  d) antifertilisin of ‘X’ and ‘Y’ are compatible
17. The most abundant type of RNA that can be found in a cell is ______
   a) mRNA  b) rRNA  c) tRNA  d) siRNA
18. Which of the following is a polysaccharide vaccine
   a) anthrax vaccine  b) rabies vaccine  c) hepatitis A  d) Hib vaccine
19. Weeds effect the plants by
   a) Killing of plants in the field before they grow  b) Dominating the plant to grow
   c) Competing for various resources of crops causing low availability of nutrients  d) All of these
20. Which organism is used for commercial citric acid production?
   a) Saccharomyces cerevisae  b) Aspergillus niger
   c) Streptomyces griseus  d) None of these
21. Vaccine is a
   a) collection of antibiotics  b) collection of life saving drugs
   c) collection of killed disease causing bacteria and virus  d) collection of lysins
22. The trade name for fast acting recombinant human insulin is
   a) Humulin  b) Lispro  c) Humalog  d) Both a and b
23. A high density of elephant population in an area can result in
   a) Predation on one another  b) Interspecific competition
   c) Intraspecific competition  d) Mutualism
24. Fertilizers can be washed into rivers by the rain. This can cause
   a) Bioaccumulation  b) Eutrophication  c) Biodegradation  d) Bio magnification
25. Causes of extinction includes
   a) deforestation     b) overhunting  c) habitat loss   d) all of them

26. Which gas is mainly produced due to incomplete burning of wood?
   a) SO₂     b) NO₂     c) NO₃     d) CO

27. Which of the following is NOT a respiratory organ?
   a) Nose     b) trachea     c) lungs    d) Liver

28. Which of these is not secreted in gastric juices?
   a) Pepsins b) Hemoglobin c) Gastrin d) Intrinsic Factor

29. MAB program stands for
   a) Man and Biotechnology b) Material and Biology
   c) Man and Biosphere d) Man and Biology

30. The highest moisture content is in
   a) Garbage b) Hospital waste c) Agricultural waste d) Rubbish
Question Paper 2

Section – English

This section contains **30 Multiple Choice Questions**. Each question has four choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

1. Select the answer choice that identifies the noun in the sentence.
   Joe, have you met your new boss?
   a) have   b) boss   c) met   d) your

2. Complete this sentence.
   Paul is coming. Don't let _____ see us!
   a) his   b) him   c) he   d) she

3. Choose the correct order of adjectives to fill the blank.
   This is a _________ movie.
   a) New Italian wonderful  b) Wonderful Italian new
   c) Wonderful new Italian  d) Italian wonderful new

4. Which kind of adverb is the word in capitals?
   "The boy ate the chocolates GREEDILY."
   a) Adverb of Place  b) Adverb of Degree
   c) Adverb of Time/Frequency  d) Adverb of Manner

5. Choose the right option to fill the gap.
   By the time you finish your exam tomorrow, your friends _________.
   a) Will be sleeping  b) Will have slept
   c) Won't have slept  d) All of these

6. Choose the right option to fill the gap.
   Professor Brown _________ grading our English papers by Monday.
   a) Will finishing  b) Will have finished
   c) Will have been finishing  d) Will have been finished

7. Choose the right option to fill the gap.
   ____________ to get married?
   a) Did you plan  b) Will you plan
   c) Are you plan  d) Both Did you plan and Will you plan

8. Choose the right modal verb.
   You ____________ borrow keys of this car until you can be more careful with it.
   a) may not  b) might not  c) shall not  d) can not
9. Choose the right modal verb.
   Jim ____________ have seen me because he walked past without saying 'Hello'.
   a) can          b) couldn't        c) have to          d) might

10. The sentence below contains an error. Identify which part has the error and choose the correct sentence from the options.
    I need not offer any explanation regarding this incident - my behavior is speaking itself.
    a) I need not offered any explanation   b) Regarding those incident
    c) My behavior, speaks for itself      d) No error

11. Identify which part of the sentence has the error.
    The three friends(1), Tina included(2), was supposed to meet(3) for dinner later that night.(4)
    a) 1          b) 2          c) 3          d) 4

12. Pick the right meaning for the following phrase.
    Bone of contention
    a) Point of an argument          b) Worthless
    c) Without any hesitation       d) to succeed

13. Identify the correct meaning of the idiom.
    A penny for your thoughts.
    a) Tell me what you're thinking   b) To make a bad situation worse
    c) Make people feel more comfortable d) Very expensive

14. Choose one word for the following.
    A mournful poem or a song
    a) Epic          b) Elegy          c) Ode          d) Hymn

15. In the following question, a related pair of words or phrases is followed by five pairs of words or phrases. Choose the pair that best expresses a relationship similar to that in the original pair.
    Europe is to Spain as North America is to ?
    a) Greece       b) Canada       c) England     d) India

16. Choose the correct form of the verb to fill the gap so as to make a meaningful sentence.
    Jully: "What ________ in the afternoons?"
    Maya: "Usually I watch discovery channel or read a book."
    a) you doing     b) you do       c) do you do      d) are you doing

17. Choose the correct form of the verb to fill the gap so as to make a meaningful sentence.
    Sorry, you can't borrow her pen. She __________ it herself.
    a) was using     b) using        c) use           d) is using

18. Choose the correct form of the verb to fill the gap so as to make a meaningful sentence.
    She is looking for her pencil. She __________ it.
    a) has lost     b) lost         c) did lost      d) was lost

19. Fill in the blank with correct word.
    Tina got good marks ________ she studied hard.
20. Choose the most suitable interjection to complete the sentence.  

___________ what a beautiful dress.  
a) Oh!  
b) Aww!  
c) Hum!  
d) Oops!  

21. Fill in the blank with correct word.  
He felt sorry __________ breaking our window.  
a) of  
b) for  
c) about  
d) any of these  

22. Fill in the right verb form.  
John asked her __________ him.  
a) call  
b) to call  
c) called  
d) calling  

23. Change the voice of following sentence.  
This clock was made in 1750.  
a) Mechanic is making the clock in 1750  
b) Mechanic made the clock in 1750  
c) Mechanic makes the clock in 1750  
d) Mechanic was making the clock in 1750  

24. Which of these words is most nearly the opposite of the word provided?  
Awe  
a) borrow  
b) shallow  
c) low  
d) contempt  

25. Which of these words is closest in meaning to the word provided?  
Pensive  
a) oppressed  
b) caged  
c) thoughtful  
d) happy  

26. Choose the right option to fill the gap.  
_______ they swimming when the phone rang?  
a) were  
b) are  
c) do  
d) did  

27. Choose the right option to fill the gaps.  
When we went to Osaka, my friend _______ a lot about the city because she _______ there many times.  
a) Was, had known  
b) Had known, was  
c) Knew, had been  
d) Had been, knew  

28. Choose the right option to fill the gap.  
The police __________ me on my way home last night.  
a) was stop  
b) stopped  
c) stops  
d) stopping  

29. Identify the correct meaning of the idiom.  
On thin ice.  
a) On probation  
b) Ignore someone  
c) Get out of control  
d) Money you save today you can spend later  

30. Choose one word for the following.  
Having superior or intellectual interests and tastes  
a) Highbrow  
b) Elite  
c) Sophisticated  
d) Fastidious
Section – Physics

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. A ball of mass m moving with velocity \( \nu_0 \) collides a wall as shown in figure. After impact it rebounds with a velocity \( \frac{3\nu_0}{4} \). The impulse acting on ball during impact is

\[
\frac{-m}{2} \nu_0 \hat{i} \quad \text{a)} \quad \frac{-3}{4} m \nu_0 \hat{i} \quad \text{b)} \quad \frac{-5}{4} m \nu_0 \hat{i} \quad \text{c)} \quad \frac{-3}{4} m \nu_0 \hat{i} + \frac{m}{2} \nu_0 \hat{i} \quad \text{d)} \quad \frac{3}{4} m \nu_0 \hat{i}
\]

2. A ball impinges directly on a similar ball at rest. The first ball is brought to rest by the impact, if half of the kinetic energy is lost by impact the value of coefficient of restitution is

\[
a) \quad \frac{1}{\sqrt{2}} \quad \text{b)} \quad \frac{1}{\sqrt{3}} \quad \text{c)} \quad \frac{1}{\sqrt{2}} \quad \text{d)} \quad \frac{\sqrt{3}}{2}
\]

3. A uniform meter stick of mass M is hinged at one end and supported in a horizontal direction by a string attached to the other end. What should be the initial acceleration of the stick if the string is cut?

\[
a) \quad \frac{3}{2} g \text{ rads}^{-2} \quad \text{b)} \quad g \text{ rads}^{-2} \quad \text{c)} \quad 3g \text{ rads}^{-2} \quad \text{d)} \quad 4g \text{ rads}^{-2}
\]

4. A thin rod of length L and mass m is bent at the middle point ‘O’ at an angle of 60°. The moment of inertia of the rod about an axis passing through ‘O’ and perpendicular to the plane of the rod will be

\[
a) \quad \frac{ML^2}{6} \quad \text{b)} \quad \frac{ML^2}{12} \quad \text{c)} \quad \frac{ML^2}{24} \quad \text{d)} \quad \frac{ML^2}{3}
\]

5. Electric displacement is given by \( D = \varepsilon_{F} \), where \( \varepsilon_{F} \) = electric permittivity

\[
E = \text{Electric field strength}
\]

\[
a) \quad [\text{M L}^2 \text{ T}^{-1} \text{ A}] \quad \text{b)} \quad [\text{L}^2 \text{ T}^{-1} \text{ A}] \quad \text{c)} \quad [\text{L}^2 \text{ T A}] \quad \text{d)} \quad \text{None of these}
\]

6. A man in a car at location Q on a straight highway moving with speed \( V \). He decides to reach a point pin a field at a distance \( d \) from the highway [point M] as shown in the figure. Speed of the car in the field is half to that on the highway. What should be the distance \( RM \). So that the time taken to reach \( p \) is minimum?
7. A boat moves relative to water with a velocity which is \( n \) times less than a river flow velocity. At what angle to the stream direction must the boat move to minimizing drifting [ \( u \) is velocity of water].

a) \( \theta = \sin \left( \frac{v}{u} \right) \) From normal direction  
b) \( \theta = \cos^{-1} \left( \frac{v}{u} \right) \) From normal direction  
c) \( \theta = \tan^{-1} \left( \frac{v}{u} \right) \) From normal direction  
d) \( \theta = \sin^{-1} \left( \frac{v}{u} \right) \) From normal direction

8. Figure shows a planet in an elliptical orbit around the sun S. Where is the kinetic energy of the planet maximum?

a) \( P_1 \)  
b) \( P_2 \)  
c) \( P_3 \)  
d) \( P_4 \)

9. Find the angular frequency \( \omega \) (in rad/s) of mass \( M \) when displaced from its equilibrium position and then released for the system shown in figure. Consider pulley and string to be ideal.  
[Given : \( M = 25 \text{ kg} \) & \( k = 100 \text{ N/m} \)]

a) \( 1 \)  
b) \( 1/2 \)  
c) \( 4 \)  
d) \( 2 \)

10. A string vibrates with one loop between the fixed points A and B. The ratio of magnitudes of maximum velocities of P and Q is [The shape of string when P and Q having zero speeds as shown]
11. The edge of an aluminium cube is 10 cm long. One face of the cube is firmly fixed to a vertical wall. A mass of 100 kg is then attached to the opposite face of the cube. The shear modulus of aluminium is 25 GPa. Then the vertical deflection of this face is
   a) $3 \times 10^{-7}$ m  
   b) $4 \times 10^{-7}$ m  
   c) $8 \times 10^{-7}$ m  
   d) $2 \times 10^{-7}$ m

12. The figure shows a system of two concentric sphere of radii $r_1$ and $r_2$ and kept at temperatures $T_1$ and $T_2$ respectively. The radial rate of flow of heat in a substance between the two concentric spheres is proportional to:

\[
\frac{\eta r_2}{(r_2-r_1)} \quad \text{b) } (r_2-r_1) \quad \text{c) } \frac{(r_2-\eta)}{\eta r_2} \quad \text{d) } log \left(\frac{r_2}{\eta}\right)
\]

13. A system goes from A to B by two different paths in the P-V diagram as shown in figure. Heat given to the system in the path 1 is 1100 J, the work done by the system along path 1 is more than path 2 by 150 J. The heat exchanged by the system in path 2 is
   a) 800 J  
   b) 750 J  
   c) 1050 J  
   d) 950 J

14. Using equipartition of energy, the specific heat (in Jkg$^{-1}$K$^{-1}$) of aluminum at room temperature can be estimated to be (atomic weight of aluminium = 27)
   a) 25  
   b) 410  
   c) 925  
   d) 1850

15. Four positive charges $(2\sqrt{2}-1)Q$ are arranged at the four corner of a square. Another charge $q$ is placed at the centre of the square. Resulting force acting on each corner charge is zero if $q$ is
   a) $\frac{-7Q}{4}$  
   b) $\frac{-4Q}{4}$  
   c) $-Q$  
   d) $-(\sqrt{2}+1)Q$
16. An electron enters the region between the plates of a parallel plate capacitor at an angle \( \theta \) to the plates. The plate width is \( l \). The plate separation is \( d \). The electron follows the path shown, just missing the upper plate. Neglect gravity. Then

\[
\tan \theta = \frac{2d}{l} \quad \text{b) } \tan \theta = \frac{4d}{l} \\
\tan \theta = \frac{8d}{l} \quad \text{d) The data given is insufficient to find a relation between } d, l \text{ and } \theta
\]

17. A cylindrical conductor has uniform cross-section. Resistivity of its material increase linearly from left end to right end. If a constant current is flowing through it and at a section distance \( x \) from left end, magnitude of electric field intensity is \( E \), which of the following graphs is correct

![Graphs](image)

a) \( \frac{\mu_0 I}{4\pi a} (\sin \theta_1 - \sin \theta_2) \)  \quad b) \( \frac{\mu_0 I}{4\pi a} (\sin \theta_1 + \sin \theta_2) \)

\[
c) \frac{\mu_0 I}{4\pi a} (\cos \theta_1 - \cos \theta_2) \quad \text{d) } \frac{\mu_0 I}{4\pi a} (\cos \theta_1 + \cos \theta_2)
\]

19. If earth is considered as a short magnet with its centre coinciding with the centre of earth, then the angle of dip at a place when magnetic latitude 45° is given by

\[
a) \tan^{-1} \left( \frac{1}{2} \right) \quad \text{b) } \tan^{-1} (3) \quad \text{c) } \tan^{-1} (2) \quad \text{d) } \tan^{-1} \left( \sqrt{2} \right)
\]
20. The wavelength of de Broglie wave associated with a thermal neutron of mass \( m \) at absolute temperature \( T \) is given by (here \( K \) is the Boltzmann constant):

\[
\begin{align*}
\text{a)} & \quad \frac{1}{\sqrt{mKT}} \\
\text{b)} & \quad \frac{h}{\sqrt{2mKT}} \\
\text{c)} & \quad \frac{h}{\sqrt{3mKT}} \\
\text{d)} & \quad \frac{h}{2\sqrt{mKT}}
\end{align*}
\]

21. \( T \) is the mean life of a radio-active sample. 75% of the active nuclei present in the sample initially will decay in time.

\[
\begin{align*}
\text{a)} & \quad 2T \\
\text{b)} & \quad \frac{T \ln 2}{2} \\
\text{c)} & \quad 4T \\
\text{d)} & \quad 2T \ln 2
\end{align*}
\]

22. In a photoelectric experiment, the collector plate is at 2V with respect to the emitter plate made of copper of work function 4.5eV. The emitter is illuminated by a source of monochromatic light of wavelength 200nm. Find the minimum and maximum kinetic energy of the photoelectrons reaching the collector

\[
\begin{align*}
\text{a)} & \quad 2eV, 3.7eV \\
\text{b)} & \quad 3eV, 25eV \\
\text{c)} & \quad 1.7eV, 3.7eV \\
\text{d)} & \quad 0eV, 1.7eV
\end{align*}
\]

23. A point object \( O \) is placed at a distance of 20 cm from a convex lens of focal length 10 cm as shown in the figure. At what distance \( x \) from the lens should a convex mirror of focal length 60 cm, be placed so that final image coincide with the object?

\[
\begin{align*}
\text{a)} & \quad 10 \text{ cm} \\
\text{b)} & \quad 40 \text{ cm} \\
\text{c)} & \quad 20 \text{ cm} \\
\text{d)} & \quad \text{None of these}
\end{align*}
\]

24. When the angle of incidence on a material is 60°, the reflected light is completely polarized. The velocity of the refracted ray inside the material is (in m/sec^{-1})

\[
\begin{align*}
\text{a)} & \quad 3 \times 10^8 \\
\text{b)} & \quad \left( \frac{3}{\sqrt{2}} \right) \times 10^8 \\
\text{c)} & \quad \sqrt{3} \times 10^8 \\
\text{d)} & \quad 0.5 \times 10^8
\end{align*}
\]

25. Figure shows a circular area of radius \( R \) where a uniform magnetic field \( \mathbf{B} \) is going into the plane of paper and increasing in magnitude at a constant rate. In that case, which of the following graphs, drawn schematically, correctly shows the variation of the induced electric field \( E(r) \)?

\[
\begin{align*}
\text{a)} & \quad \text{Graph a} \\
\text{b)} & \quad \text{Graph b} \\
\text{c)} & \quad \text{Graph c} \\
\text{d)} & \quad \text{Graph d}
\end{align*}
\]
26. In the following circuits PN-junction diodes $D_1$, $D_2$ and $D_3$ are ideal for the following potential of $A$ and $B$, the correct increasing order of resistance between $A$ and $B$ will be

(i) $-10 \ V, -5 \ V$  
(ii) $-5 \ V, -10 \ V$  
(iii) $-4 \ V, -12 \ V$

a) (i) < (ii) < (iii)  
b) (iii) < (ii) < (i)  
c) (ii) = (iii) < (i)  
d) (i) = (iii) < (ii)

27. The shows two NAND gates followed by a NOR gate. The system is equivalent to the following logic gate

A ——— X

B

C ——— Y

Z

a) OR  
b) AND  
c) NAND  
d) None of these

28. A solid sphere is rolling on a frictionless surface, shown in figure with a translational velocity $v$ m/s. If it is to climb the inclined surface then $v$ should be:

$v \geq \sqrt{\frac{10}{7} gh}$

a) $\geq \sqrt{\frac{10}{7} gh}$  
b) $\geq \sqrt{2gh}$  
c) $2gh$  
d) $\frac{10}{7} gh$

29. In a CE amplifier having voltage gain $G$, the transistor has trans conductance 0.03mho and current gain 25. If it is replaced with another of trans conductance 0.02mho and current gain 20, then voltage gain

a) $\frac{2}{3} G$  
b) $1.5 \ G$  
c) $\frac{1}{3} \ G$  
d) $\frac{5}{4} \ G$

30. A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz. The frequencies of the resultant signal is/are:

a) 2 MHz only  
b) 2005 kHz and 1995 kHz  
c) 2005 kHz, 200 kHz and 1995 kHz  
d) 2000 kHz and 1995 kHz
Section – Chemistry

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. During electrolysis of water the volume of O\textsubscript{2} liberated is 2.24 dm\textsuperscript{3}. The volume of hydrogen liberated, under same conditions will be _____ dm\textsuperscript{3}
   a) 2.24  
   b) 1.12  
   c) 0.56  
   d) 4.48

2. Behaviour of temporary gases like CO\textsubscript{2} approaches that of permanent gases like N\textsubscript{2}, O\textsubscript{2}, etc as we go
   a) below critical temperature  
   b) above critical temperature  
   c) above absolute zero  
   d) below absolute zero

3. Ratio of ionization energies of Li\textsuperscript{2+} and Be\textsuperscript{3+} is
   a) \(rac{2}{3}\)  
   b) \(rac{3}{2}\)  
   c) \(rac{3}{4}\)  
   d) \(rac{9}{16}\)

4. Molecular shapes of SF\textsubscript{4}, CF\textsubscript{4} and XeF\textsubscript{4} are
   a) the same, with 2,0 and 1 lone pair of electrons respectively  
   b) the same with 1,1 and 1 lone pair of electrons respectively  
   c) different with 0,1 and 2 lone pair of electrons respectively  
   d) different with 1,0 and 2 lone pair of electrons respectively

5. One mole of an ideal gas is expanded isothermally and reversibly to half its initial pressure.
   \(\Delta S\) for the process in JK\textsuperscript{-1}mol\textsuperscript{-1} is [ In 2=0.693 and R=8.314, J/(mol K) ]
   a) 6.76  
   b) 8.03  
   c) 5.76  
   d) 10.76

6. Aluminium phosphate is 100% ionized in 0.01 molal aqueous solution. Hence \(\Delta T_b / K_b\) is
   a) 0.01  
   b) 0.015  
   c) 0.0175  
   d) 0.02

7. What is the conc. of Cl\textsuperscript{-} ion in saturated solution. If \(K_{sp}\) of HgCl\textsubscript{2} at 298k is 4 \times 10\textsuperscript{-15}
   a) \(1 \times 10\textsuperscript{-5} M\)  
   b) \(2 \times 10\textsuperscript{-5} M\)  
   c) \(4 \times 10\textsuperscript{-5} M\)  
   d) \(4 \times 10\textsuperscript{-5} M\)

8. The emf of the cell in which of the following reaction,
   \(Zn_{(s)} + Ni^{2+} (0.1 M) \rightarrow Zn^{2+} (1.0 M) + Ni_{(s)}\) occurs is found to 0.5105V at 298K. The standard emf of the cell is:
   a) 0.4810 V  
   b) 0.5696 V  
   c) -0.5105 V  
   d) 0.5400 V

9. Nitrogen monoxide NO, reacts with hydrogen H\textsubscript{2}, according to the following equation
   \(2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)\)
   If the mechanism for this reaction were,
   \(2NO(g) + H_2(g) \rightarrow N_2(g) + H_2O_2(g); \text{ slow}\)
   \(H_2O_2(g) + H_2(g) \rightarrow 2H_2O(g); \text{ fast}\)
Which of the following rate laws would we expect to obtain experimentally?

a) \( \text{Rate} = k[H_2O]^2[H_2] \)  
b) \( \text{Rate} = k[NO]^2[H_2] \)

c) \( \text{Rate} = k[NO]^2[H_2]^2 \)  
d) \( \text{Rate} = k[NO][H_2] \)

10. Smoke precipitator works on the principle of

a) centrifugation  
b) neutralization of charge on colloids  
c) absorption  
d) addition of electrolytes

11. If Aufbau rule is not followed, Calcium will be placed in the block

a) S  
b) P  
c) D  
d) f

12. The function of flux during the smelting of the ore is

a) to make the ore porous  
b) to facilitate reduction  
c) to remove gangue  
d) to facilitate oxidation

13. \( H_2O_2 \rightarrow 2H^+ + O_2 + 2e^-; E^o = -0.68 \, V \)

The above equation represents which of the following behaviour of \( H_2O_2 \)?

a) oxidizing  
b) reducing  
c) acidic  
d) catalytic

14. The alkaline earth metals which do not impart any colour to Bunsenflame are:

a) Be and Mg  
b) Mg and Ca  
c) Be and Ca  
d) Be and Ba

15. Which of the following regarding fullerene (C\(_{60}\)) is/are correct?

I) All carbon atoms are sp\(^2\) hybridized
II) In fullerene the five-membered rings and six-membered rings are in 1 : 2 ratio
III) A five-membered ring may be fused either with another five-membered or with a six-membered ring
IV) It is aromatic

a) Only I is correct  
b) I & IV are correct  
c) I, II, III are correct  
d) All are correct

16. For advertisement the coloured discharged tubes contain

a) He  
b) Ne  
c) Ar  
d) Kr

17. Impure metal forms volatile compound (X) with CO and then (X) gives pure metal on heating. Metal is

a) Cu  
b) Fe  
c) Ni  
d) Pt

18. The correct name of linkage isomer of \( [Co(NH_3)_5(SCN)]SO_4 \)

a) Pentaamminethiocyanato-S-Cobalt (III) sulphate  
b) Pentaamminethiocyanato-N-Cobalt (II) sulphate  
c) Pentaamminethiocyanato-N-Cobalt (III) sulphate  
d) Pentaamminecyanato-N-Cobalt (III) sulphate

19. \( H_2C = CH_2 + O_2 \rightarrow CH_3CHO \); catalyst used in this reaction is

a) Pd(II) /Cu(II) in water  
b) PCC  
c) Fe/H_2O  
d) KMnO\(_4\)/H\(_2\)SO\(_4\)
20. In organic compounds, halogens are estimated by:
   a) Carius method  b) Liebig’s method  c) Kjeldahl’s method  d) Duma’s method

21. The correct structure for (E) 1-bromo 1-chloro–2–fluoro propene is
   a)  
   b)  
   c)  
   d)  

22. The Value of X is:
   a)  
   b)  
   c)  
   d)  

23. The ease of dehydration of the following compounds decreases in the order
   I)  II)  III)  IV) 
   a)  I > II > III > IV  b)  I > IV > III > II  c)  IV > II > I > III  d)  II > III > IV > I

24. Identify the correct statement about the following reaction?
   a)  
   b)  
   c)  
   d)  

   a) The product formed has R-configuration  
   b) The product formed has S-configuration  
   c) The product is formed with retention of configuration  
   d) The reaction takes place by $S_{N1}$ mechanism
25. An aromatic amine (A) was treated with alcoholic potash and another compound ‘Y’ then a foul smelling gas was formed with formula \( C_6H_5NC \), ‘Y’ was formed by reacting a compound ‘Z’ with \( Cl_2 \), in presence of slaked lime. The compound ‘Z’ is
   a) \( C_6H_5NH_2 \)    b) \( CH_3OH \)    c) \( CH_3COCH_3 \)    d) \( CHCl_3 \)

26. Dimethyl terephthalate reacts with ethylene glycol under high temperature and pressure to give a polymer called ‘Dacron’. Identify the correct statements out of the following.
   I) Dacron is polyethylene terphthalate
   II) Dacron is formed by step growth condensation polymerizations
   III) Dacron is a polyester
   IV) Methanol molecules are removed during the polymerization process
   a) Only I and II    b) Only II, III and IV    c) Only III    d) All of these

27. Incorrect statements among the following
   A) Sucrose is reducing sugar
   B) Two \( \alpha \)-D-glucose units in maltose are linked by 1,4 linkage
   C) \( \beta \)– D-glucose and \( \beta \)– D-fructose units are linked by 1,4 – linkage in lactose
   D) All polysaccharides are reducing non-sugars
   a) A and B    b) A, B, C and D    c) A,C,D only    d) A,B,C only

28. Which of the following is used for inducing sleep?
   a) Paracetamol    b) Chloroquine    c) Bithionol    d) Barbituric acid derivatives

29. Thymine is
   a) 5-methyluracil    b) 4-methyluracil    c) 3-methyluracil    d) 1-methyluracil

30. The insecticide, germicide gammaxene is formulation for
   a) DDT    b) Benzene hexachloride    c) Chlora    d) Chloropicrine
Section – Mathematics

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. A survey shows that 63% of the Americans like cheese whereas 76% like apples. If x% of the Americans like both cheese and apples, then
   a) $x = 39$  
   b) $x = 63$  
   c) $39 \leq x \leq 63$  
   d) $30 \leq x \leq 80$

2. Let $N$ be the set of natural numbers and for $a \in N, aN$ denotes the set $\{ax : x \in N\}$. If $bN \cap cN = dN$, where $b, c, d$ are natural numbers greater than 1 and the greatest common divisor of $b$ and $c$ is 1 then $d$ equals
   a) $\text{Max} \{b, c\}$  
   b) $\text{Min} \{b, c\}$  
   c) $bc$  
   d) $bc + 1$

3. The value of $\lim_{n \to \infty} n^2 \left[ \sqrt{1 - \cos \frac{1}{n}} \sqrt{1 - \cos \frac{1}{n}} \sqrt{1 - \cos \frac{1}{n}} \ldots \alpha \right]$ is
   a) $\frac{1}{2}$  
   b) $1$  
   c) $0$  
   d) $2$

4. If $|z| = \text{max} \{|z-1|,|z+1|\}$ then $|z + \bar{z}| = $  
   a) 0  
   b) 1  
   c) 2  
   d) $1/2$

5. For $a \leq 0$, the real roots of the equation $x^2 - 2a|x-a| - 3a^2 = 0$ is
   a) $a \pm a\sqrt{6}$  
   b) $-a \pm a\sqrt{2}$  
   c) $a \pm a\sqrt{2}, -a \pm a\sqrt{6}$  
   d) $a \pm a\sqrt{6}, -a \pm a\sqrt{2}$

6. In a geometrical progression consisting of positive terms, each term equals the sum of the next terms. Then the common ratio of this progression equal to:
   a) $\sqrt{5}$  
   b) $\frac{\sqrt{5} - 1}{2}$  
   c) $\frac{1 - \sqrt{5}}{2}$  
   d) $\frac{\sqrt{5}}{2}$

7. The $f(x) = \frac{1 + x}{1 - x}$ and $A$ is a matrix such that $A^3 = 0$ then $f(A)$ is equals to:
   a) $I + A + A^2$  
   b) $I + 2A + 2A^2$  
   c) $I - A - A^2$  
   d) $I - 2A - 2A^2$

8. Let $x^2 \begin{bmatrix} 2 & 2 \\ x & x \end{bmatrix} = Ax^4 + Bx^3 + Cx^2 + Dx + E$ then the value of $5A + 4B + 3C + 2D + E$ is equals to:
   a) -17  
   b) -14  
   c) -11  
   d) -8

9. If $\vec{u}, \vec{v}, \vec{w}$ be such that $|\vec{u}| = 1, |\vec{v}| = 2, |\vec{w}| = 2$, if the projection of $\vec{v}$ along $\vec{u}$ is equal to that of $\vec{w}$ along $\vec{u}$ and $\vec{v}, \vec{w}$ are perpendicular to each other then $|\vec{u} - \vec{v} + \vec{w}| =$  
   a) 2  
   b) 14  
   c) 3  
   d) 5
10. Negation of the statement \( p \rightarrow (q \land r) \) is
   a) \( \sim p \rightarrow (q \lor r) \)  b) \( \sim p \rightarrow (q \land r) \)  c) \( (q \land r) \rightarrow p \)  d) \( p \land \neg(q \lor \neg r) \)

11. The number of numbers between 2000 and 5000 that can be formed with the digits 0, 1, 2, 3, 4 (repetition of digits is not allowed) and are multiple of 3 is
   a) 30  b) 48  c) 24  d) 36

12. The number of positive integral solutions of \( x\,yz = 2^4 \cdot 3 \cdot 5 \cdot 7 \cdot 11 \) is
   a) \( 15 \times 81 \)  b) \( 4 \times 81 \)  c) 81  d) 16

13. For any integer \( n \geq 1 \), then \( \sum_{k=1}^{n} k(k+2) \) is equal to
   a) \( \frac{n(n+1)(n+2)}{6} \)  b) \( \frac{n(n+1)(2n+1)}{6} \)  c) \( \frac{n(n+1)(2n+7)}{6} \)  d) \( \frac{n(n+1)(2n+9)}{6} \)

14. The coefficient of \( x^{11} \) in \( (x + 25C_1)(x + 25C_2) \ldots \ldots (x + 25C_{12}) \) is
   a) \( 2^{24} \)  b) 0  c) \( 2^{24} - 1 \)  d) \( 2^{25} - 1 \)

15. If \( x = \sec \theta - \cos \theta \), \( y = \sec^n \theta - \cos^n \theta \), then \( \left( \frac{dy}{dx} \right)^2 = \)
   a) \( \frac{y^2 + 4}{x^2 + 4} \)  b) \( \frac{x^2 + 4}{y^2 + 4} \)  c) \( \frac{n^2(y^2 + 4)}{x^2 + 4} \)  d) \( x^2(y^2 + 4) \)

16. Let \( S \) be a square of unit area. Consider any quadrilateral which has one vertex on each side of \( S \). If \( a, b, c, d \) are the length of the sides of the quadrilateral, then \( a^2 + b^2 + c^2 + d^2 \) lies in:
   a) [1,3]  b) [1,4]  c) [2,3]  d) [2,4]

17. If \( \int e^x \left(f(x) - f'(x)\right)dx = g(x) \) then \( \int e^x f(x)dx = \)
   a) \( g(x) + e^x f(x) \)  b) \( \frac{1}{2} \left(g(x) + e^x f(x)\right) \)  c) \( g(x) - e^x f(x) \)  d) \( \frac{1}{2} \left(g(x) - e^x f(x)\right) \)

18. \( \int \frac{dx}{x^4 + x^3} = \frac{A}{x^2} + \frac{B}{x} + \log \left| \frac{x}{x+1} \right| + c \) then \( (A, B) = \)
   a) \( \left(\frac{1}{2}, 1\right) \)  b) \( \left(1, -\frac{1}{2}\right) \)  c) \( \left(-\frac{1}{2}, 1\right) \)  d) \( \left(-\frac{1}{3}, 0\right) \)
19. The value of \[ \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^2 x \frac{dx}{1 + 2x} \] is

\[ a) \frac{\pi}{8} \quad b) \frac{\pi}{2} \quad c) 4\pi \quad d) \frac{\pi}{4} \]

20. The solution of \[ \frac{dy}{dx} + x(x + y) = x^3(x + y)^3 - 1 \] is

\[ a) \frac{1}{(x + y)^2} = x^2 + 1 + c.e^x \quad b) \frac{1}{x + y} = x^2 + 1 + c.e^{x^2} \]

\[ c) \frac{1}{(x + y)^2} = x^2 + 1 + c.e^{x^2} \quad d) \frac{1}{x + y} = x^2 + 1 + c.e^{x^2} \]

21. Given P=(a, 0) and Q=(-a, 0) and R is variable point on one side of the line PQ such that \[ \angle RPQ - \angle RQP = 2\alpha. \] The locus of the point R is

\[ a) x^2 + y^2 + 2xy \cot 2\alpha = a^2 \quad b) x^2 - y^2 + 2xy \tan 2\alpha = a^2 \]

\[ c) x^2 + y^2 - 2xy \tan 2\alpha = a^2 \quad d) x^2 - y^2 + 2xy \cot 2\alpha = a^2 \]

22. If \( f(x+y) = f(x)f(y) \quad \forall x, y \in R \) and \( f(1) = 2 \) then area enclosed by \( 3|x|+2|y| \leq 8 \) is

\[ a) f(4) \text{ sq.units} \quad b) \frac{1}{2} f(6) \text{ sq.units} \quad c) \frac{1}{3} f(6) \text{ sq.units} \quad d) \frac{1}{3} f(5) \text{ sq.units} \]

23. If (2,5) is an interior point of the circle \( x^2 + y^2 - 8x - 12y + p = 0 \) and the circle neither cuts nor touches any one of the axes of co-ordinates then

\[ a) p \in (36,47) \quad b) p \in (16,47) \quad c) p \in (16,36) \quad d) p \in (36,41) \]

24. The minimum area of the triangle formed by any tangent to the ellipse \( \frac{x^2}{16} + \frac{y^2}{81} = 1 \) and the coordinate axes is:

\[ a) 12 \quad b) 18 \quad c) 26 \quad d) 36 \]

25. Consider the triangle AOB in the x-y plane where A \( \equiv (1, 0, 0) \); B \( \equiv (0, 2, 0) \); O\(= (0, 0, 0) \). The new position of O, when triangle is rotated about side AB by 90° can be

\[ a) \left( \frac{4}{5}, \frac{3}{5}, \frac{2}{\sqrt{5}} \right) \quad b) \left( -\frac{3}{5}, \frac{\sqrt{5}}{5}, \frac{2}{\sqrt{5}} \right) \quad c) \left( \frac{4}{5}, \frac{2}{5}, \frac{2}{\sqrt{5}} \right) \quad d) \left( \frac{4}{5}, \frac{2}{5}, \frac{1}{\sqrt{5}} \right) \]
26. The shortest distance between the lines $x = 0, \frac{1}{2} y + \frac{1}{3} z = 1$ and $y = 0, \frac{1}{4} x - \frac{1}{3} z = 1$, is 
equals to:

a) $\frac{24}{\sqrt{57}}$  
b) $\frac{26}{\sqrt{61}}$  
c) $\frac{24}{\sqrt{61}}$  
d) $\frac{26}{\sqrt{57}}$

27. The average marks of boys in a class is 52 and that of girls is 42. The average marks of boys and girls combined is 50. The percentage of boys in the class is:

a) 40  
b) 20  
c) 80  
d) 60

28. If ‘head’ means one and ‘tail’ means two, then coefficient of quadratic equation $ax^2+bx+c = 0$ are chosen by tossing three fair coins. The probability that roots of the equations are imaginary is:

a) $\frac{5}{8}$  
b) $\frac{3}{8}$  
c) $\frac{7}{8}$  
d) $\frac{1}{8}$

29. If $f(x) = \frac{\sin 3x}{\sin x}, x \neq n\pi$ then the range of values of $f(x)$ for real values of $x$ is

a) $[-1, 3]$  
b) $(-\infty, -1)$  
c) $(3, \infty)$  
d) $[-1, 3])$

30. If $x > y > z > 0$ then the value of $\left[ \cot \left( \frac{xy+1}{x-y} \right) + \cot^{-1} \left( \frac{yz+1}{y-z} \right) + \cot^{-1} \left( \frac{zx+1}{z-x} \right) \right]$ where $[.]$ denotes the greatest integer function is equals to:

a) 6  
b) 3  
c) 0  
d) 2
Section – Biology

This section contains 30 Multiple Choice Questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. Binomials with identical genus name and specific epithet are called
   a) Homonym       b) Basionym       c) Tautonym       d) Synonym

2. Epithelial tissues arise from
   a) Endoderm       b) Ectoderm       c) Mesoderm       d) All of these

3. The importance of computers and of computer software to modern cladistics is most closely linked to advances in
   a) Light microscopy      b) Radiometric dating
   c) Fossil discovery techniques     d) Molecular genetics

4. Which of the following organelles is smallest in size?
   a) Lysosome       b) Chloroplast       c) Ribosome       d) Mitochondria

5. Triglyceride is made up of
   a) One glycerol molecule and two fatty acids
   b) Two glycerol molecules and three fatty acids
   c) Three glycerol molecules and one fatty acid
   d) One glycerol molecule and three fatty acids

6. Steroid hormones easily pass through the plasma membrane by simple diffusion because they
   a) Enter through pores       b) Are water soluble
   c) Contain carbon and hydrogen       d) Are lipid soluble

7. Metal in Vitamin B₁₂ is
   a) Copper       b) Cobalt       c) Iron       d) Zinc

8. Sugarcane shows high efficiency of CO₂ fixation because it performs
   a) Calvin cycle       b) EMP pathway       c) Hatch and Slack pathway       d) TCA cycle

9. Respiratory quotient of 1.0 indicates metabolism of which macronutrient?
   a) Carbohydrates       b) Lipids       c) Proteins       d) Mixed diet

10. Which method out of the following renders the seed coat permeable to water so that embryo expansion is not physically retarded?
   a) Scarification       b) Vernalisation       c) Stratification       d) Denudation

11. Which of the following is termed as the ‘grave yard’ of RBC?
    a) Liver       b) Kidney       c) Spleen       d) Bone marrow
12. Which among the following is the excretory organ?
   a) Archaeocyte  b) Pinacocyte  c) Myocyte  d) Solenocyte

13. Cartilage, tendons, joints, ligaments and connective tissues together made up of system known as
   a) nervous system  b) system of glands  c) system of cells  d) locomotors system

14. The protein carrier in the membrane, called "sodium-potassium pump" pumps ______.
   a) Both Na\(^+\) and K\(^+\) in  b) Both Na\(^+\) and K\(^+\) out
   c) Na\(^+\) in and K\(^+\) out  d) Na\(^+\) out and K\(^+\) in

15. Fibrous thickenings of hygroscopic nature are found in this part of the anther wall
   a) Middle layers  b) Endothecium  c) Epidermis  d) Tapetum

16. Hormone that prevents ovulation is
   a) prolacitin  b) progesterone  c) estrogens  d) FSH

17. In Griffith's experiment a bacterial cell was changed from one form into another through a process called ______.
   a) Transduction  b) Conjugation  c) Transformation  d) Twitching

18. Artificial methods of reproduction do not include
   a) Rhizome  b) Cutting  c) Layering  d) Budding

19. Which of these pests attack mustard?
   a) Pod borer  b) Aphids  c) White grub  d) Pyrilla

20. Which of the followings is a biopesticide?
   a) Bacillus thuringiensis  b) Bacillus subtilis
   c) Bacillus anthracis  d) None of these

21. The gene formed by the joining of DNA segments from two different sources are called as
   a) Recombinant gene  b) Joined gene
   c) Both Recombinant gene and Joined gene  d) Chimaera DNA

22. Recombinant flu vaccine is known as
   a) Flublok  b) MMR  c) Vaccinia  d) Zoster

23. A population is a group of
   a) Individuals in a species  b) Species in a community
   c) Communities in an ecosystem  d) Individual in a family

24. Which factor currently threatens most species with extinction?
   a) Habitat loss  b) Exploitation  c) Introduced species  d) All of these

25. Extinction of any animal from ecosystem harms it
   a) Cycle  b) chain  c) stability  d) quality
26. Highest percentage of air consists of
   a) Argon     b) Oxygen     c) Nitrogen     d) Carbon dioxide

27. Alveoli are a part of
   a) Liver     b) Lungs     c) Eyes     d) Stomach

28. Kupffer’s cells occur in
   a) Stomach     b) Lungs     c) Liver     d) Heart

29. Approximately, 50% of total world species are present on
   a) Tropical rain forest     b) Temperate rain forest
   c) Coral reef     d) Desert

30. Sound becomes hazardous noise pollution at decibels
   a) Above 80     b) Above 30     c) Above 100     d) Above 120