

**Section 1: English**

- Choose the correct clipped form of "Demonstration" from the options:
(A) Demon (B) Dems
(C) Demo (D) Destion
- Choose the correct singular word for 'alumni':
(A) alumin (B) alumnus
(C) aluminium (D) alum
- Choose the correct combination for the word 'motel':
(A) moving+hotel (B) mobile hotel
(C) mo+tel (D) motorway+hotel
- Form a new word by adding a suitable suffix to the root word 'develop':
(A) -ment (B) -ness
(C) -tion (D) -ish
- Choose the correct expansion for the acronym SIM:
(A) Subscriber's International Module
(B) Subscriber Identity Module
(C) Subscribers Interconnect Module
(D) Subscriber Identification Member
- Choose the correct question tag to fill up the blank in the sentence:
Students rarely indulge in extra reading these days _____
(A) do they? (B) don't they?
(C) doesn't they? (D) isn't it?
- Choose the part of the sentence which has an error:
The common man can't able to understand this sentence.
(A) The common man
(B) can't able to
(C) understand this sentence
(D) No error
- Choose the appropriate Compound Word for the combination 'Noun+Adjective':
(A) neck-tie
(B) check-out
(C) home-sick
(D) Indian Republic
- Choose the most suitable option to fill up the blank in the given sentence: _____ is no substitute for hard work.
(A) They're (B) Their
(C) Where (D) There
- Fill in the blank in the following sentence with the appropriate preposition:
The doctor spoke gently _____ the patient.
(A) with (B) to
(C) along (D) above

Section 2: Physics

- When 4 minutes and 45 seconds elapses in a clock, the angle subtended at the center of the clock by its minute hand is _____ radians
(A) 0.25 (B) 0.49
(C) 0.75 (D) 0.99
- The displacement of a body is given by $x = 2 + (-3 + 2t)^2$, where x is in meters and t in seconds. The initial velocity and initial position of the body are _____ m and _____ m/s.
(A) (2, -6) (B) (-1, 6)
(C) (-3, 12) (D) (11, -12)

13. A body when projected with an initial velocity u_0 at an angle of 25° to the horizontal, has a range of 90 m. When it is projected with the same velocity at an angle 55° , the range will be:

- (A) 88.02 m
- (B) 92.6 m
- (C) 110.4 m
- (D) 118.14 m

14. A cricketball of mass 400 g moving with a velocity $\hat{i} + 2\hat{j}$ moves off with velocity $-3\hat{i} + 5\hat{j}$ when hit by the bat. The impulse acted is _____ N-s. The velocities are given in meter per second.

- (A) 2.0
- (B) 3.19
- (C) 4.22
- (D) 5.0

15. The ratio of the weight of an object of mass M when it is at a height $h = 0.2R_e$ above the surface of earth to its weight when it is the same distance below the surface is _____ (R_e is the radius of earth.)

- (A) 1.2
- (B) 1
- (C) 0.75
- (D) 0.62

16. **Assertion:** A rigid body fixed at its center of mass does not oscillate when slightly disturbed from its equilibrium state.

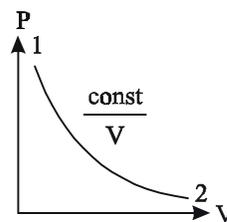
Reason: The torque on the body due to gravitational force is zero

- (A) Both assertion and reason are correct
- (B) Only assertion is correct while reason is wrong
- (C) Assertion is wrong while reason is correct
- (D) Both assertion and reason are wrong

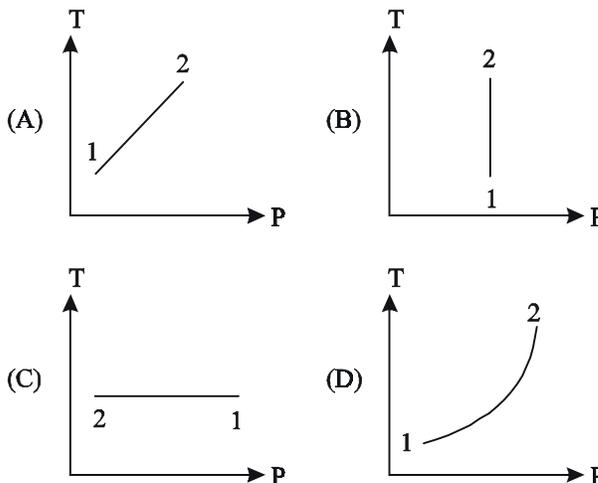
17. The center of mass of a circular disc of radius R rolling without slipping down an inclined plane of vertical height h acquires a velocity v on reaching the ground. The velocity of the center of mass of a solid sphere of the same radius is _____

- (A) v
- (B) $1.414v$
- (C) $1.731v$
- (D) $1.313v$

18. The PV diagram of an ideal gas is shown in figure.



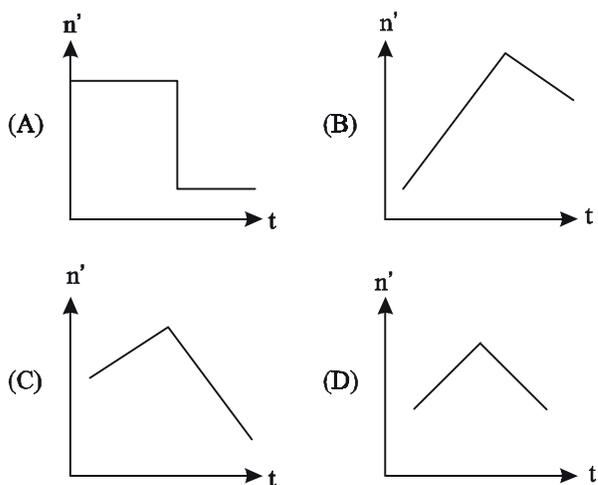
Its TP diagram is:



19. If the motion of a particle is given by the equation $y(t) = 3 \sin \omega t - 4 \sin^3 \omega t$, the motion is

- (A) Simple harmonic with a period of $\frac{2\pi}{3\omega}$
- (B) Simple harmonic with a period of $\frac{2\pi}{\omega}$
- (C) Non-periodic
- (D) Periodic but not simple harmonic

20. A train moving with a constant speed whistles at a constant frequency n . The frequency n' heard by a stationary observer as the train crosses him is represented by the figure



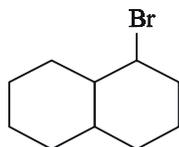
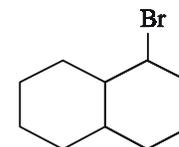
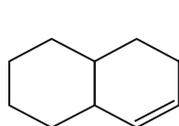
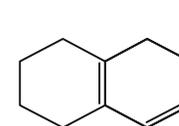
21. A metallic bar of Young's modulus $0.5 \times 10^{11} \text{ Nm}^{-2}$ and coefficient of linear thermal expansion $10^{-5} \text{ }^\circ\text{C}^{-1}$, length 1 m and area of cross-section 10^{-3} m^2 is heated from 0°C to 100°C without expansion or bending. The compressive force developed in it is:
- (A) $100 \times 10^3 \text{ N}$ (B) $2 \times 10^3 \text{ N}$
 (C) $5 \times 10^3 \text{ N}$ (D) $50 \times 10^3 \text{ N}$
22. A metal wire has mass $(0.4 \pm 0.002) \text{ g}$, radius $(0.3 \pm 0.001) \text{ mm}$ and length $(5 \pm 0.02) \text{ cm}$. The maximum possible percentage error in the measurement of density will nearly be:
- (A) 1.2% (B) 1.3%
 (C) 1.6% (D) 1.4%
23. Two pendulums of length 121 cm and 100 cm start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is:
- (A) 8 (B) 11
 (C) 9 (D) 10
24. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of the input energy. How much power is generated by the turbine? ($g = 10 \text{ m/s}^2$)
- (A) 10.2 kW (B) 8.1 kW
 (C) 12.3 kW (D) 7.0 kW
25. Match Column - I and Column - II and choose the correct match from the given choices.

	Column - I		Column - II
(A)	Root mean square speed of gas molecules	(P)	$\frac{1}{3} nm \bar{v}^2$
(B)	Pressure exerted by ideal gas	(Q)	$\sqrt{\frac{3RT}{M}}$
(C)	Average kinetic energy of a molecule	(R)	$\frac{5}{2} RT$
(D)	Total internal energy of 1 mole of a diatomic gas	(S)	$\frac{3}{2} k_B T$

- (A) (A)-(R), (B)-(P), (C)-(S), (D)-(Q)
 (B) (A)-(Q), (B)-(R), (C)-(S), (D)-(P)
 (C) (A)-(Q), (B)-(P), (C)-(S), (D)-(R)
 (D) (A)-(R), (B)-(Q), (C)-(P), (D)-(S)

Section 3: Chemistry

26. Mass of CO_2 obtained on heating 1 kg of 90% pure lime stone (calcium carbonate) is (Atomic masses: $\text{Ca} = 40$; $\text{C} = 12$; $\text{O} = 16$)
- (A) 900 g
 (B) 396 g
 (C) 445 g
 (D) 604 g
27. Which one of the following sets of quantum numbers is correct?
- (A) $n = 4$; $l = 2$; $m = -1$; $s = 1$
 (B) $n = 3$; $l = 1$; $m = 2$; $s = +\frac{1}{2}$
 (C) $n = 2$; $l = 1$; $m = 0$; $s = -\frac{1}{2}$
 (D) $n = 1$; $l = 0$; $m = -1$; $s = +\frac{1}{2}$
28. Assertion - Reason type
- Assertion:** The 19th electron in potassium (${}_{19}\text{K}$) atom enters into the 4s-orbital and not into the 3d-orbital
- Reason:** The sum of $(n+1)$ rule is followed to find the orbital of lowest energy to be filled with electrons.
- (A) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion
 (B) Both Assertion and Reason are correct and Reason is not the correct explanation of Assertion
 (C) Assertion is correct but Reason is wrong
 (D) Assertion is wrong but Reason is correct

29. Which one of the following gases shows a steady increase in the compressibility factor with increase in the pressure?
- (A) H_2
 (B) CO_2
 (C) CH_4
 (D) N_2
30. Which of the following statement/s is/are false?
- (1) Enthalpy of a system is an extensive property
 (2) The heat of formation of an element is zero
 (3) When vapours condense to a liquid, entropy increases
 (4) Initiation is never required for spontaneous reactions
- (A) (1) and (3) only
 (B) (2), (3) and (4) only
 (C) (1), (2) and (4) only
 (D) (3) and (4) only
31. The equilibrium constant for a gaseous reaction $A + 3B \rightleftharpoons C + D$ (all gases) is 10^{-3} at 300 K and 10^{-2} at 320 K. The formation of D is favoured by
- (1) Increase of pressure
 (2) Increase of volume
 (3) Increase of temperature
 (4) Decrease of temperature
- (A) (1) and (2) only
 (B) (1) and (3) only
 (C) (1), (2) and (3) only
 (D) (4) only
32. Which one is the correct match in the following:
- (1) Equilibrium reaction (i) $\Delta H = -ve$
 (2) Spontaneous reaction (ii) $\Delta G = +ve$
 (3) Non-spontaneous reaction (iii) $\Delta G = 0$
 (4) Formation of ammonia (iv) $\Delta G = -ve$
- (A) (1) \rightarrow (ii) (2) \rightarrow (iii) (3) \rightarrow (iv) (4) \rightarrow (i)
 (B) (1) \rightarrow (iii) (2) \rightarrow (ii) (3) \rightarrow (i) (4) \rightarrow (iv)
 (C) (1) \rightarrow (iv) (2) \rightarrow (i) (3) \rightarrow (iii) (4) \rightarrow (ii)
 (D) (1) \rightarrow (iii) (2) \rightarrow (iv) (3) \rightarrow (ii) (4) \rightarrow (i)
33. The mass of glucose in 100 ml of the aqueous solution which is isotonic with 5 g/L of urea (Molar mass = 60) is
- (A) 1.5 g
 (B) 6
 (C) 15
 (D) 30
34. Which of the following will undergo the fastest dehydrobromination?
- (A)  (B) 
 (C)  (D) 
35. Dehydration of the following compound gives
- $$\begin{array}{c} CH_3 \\ | \\ CH_3 - CH - CH_2 - C - CH_2 - CH_3 \\ | \quad | \\ CH_3 \quad OH \end{array}$$
- (A) 2,4-dimethylhex-3-ene
 (B) 3,5-dimethylhex-2-ene
 (C) 2,4-dimethylhex-2-ene
 (D) 2,4-dimethylhex-1-ene
36. In the chemical equation $x As_2 S_3 + y HNO_3 + z H_2O \rightarrow H_3 AsO_4 + H_2SO_4 + NO$ the values of x, y and z respectively are
- (A) 2, 3, 5
 (B) 3, 4, 14
 (C) 9, 15, 22
 (D) 3, 28, 4
37. A 0.5 L flask contains gas 'A' and a 1L flask contains gas 'B' at the same temperature. The density of gas 'A' is 3 g/litre and that of gas 'B' is 1.5 g/litre. The molar mass of 'A' is one half of that of molar mass of gas 'B'. The ratio of pressures $\frac{P_A}{P_B}$ exerted by the gases is
- (A) 2 (B) 4
 (C) 6 (D) 8

38. **Assertion:** Addition of bromine to trans-2-butene, yields meso-2,3-dibromo butane.
Reason: Addition of bromine to an alkene is an electrophilic addition.
- (A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
 (B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
 (C) Assertion is true but Reason is false
 (D) Assertion is false but Reason is true
39. When 2 g of a gas A is introduced into an evacuated flask at 20°C, the pressure is found to be 2 atmosphere. When 4 g of another gas B is introduced into the same flask, the total pressure becomes 3 atmosphere. The ratio of molecular masses of Gases A and B ($M_A : M_B$) is
 (A) 1 : 4 (B) 2 : 3
 (C) 2 : 1 (D) 3 : 2
40. When benzene reacts with excess chlorine in the presence of sunlight gives
 (A) Chlorobenzene
 (B) 1,3-dichlorobenzene
 (C) 1,3,5-trichlorobenzene
 (D) Benzene hexachloride

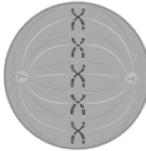
Section 4: Mathematics / Biology

41. A matrix P is decomposed into its symmetric part S and skew symmetric part V , if

$$S = \begin{pmatrix} -4 & 4 & 2 \\ 4 & 3 & 7/2 \\ 2 & 7/2 & 2 \end{pmatrix}, V = \begin{pmatrix} 0 & -2 & 3 \\ 2 & 0 & 7/2 \\ -3 & -7/2 & 0 \end{pmatrix},$$
 then matrix P is
- (A) $\begin{pmatrix} -4 & 6 & -1 \\ 2 & 3 & 0 \\ 5 & 7 & 2 \end{pmatrix}$ (B) $\begin{pmatrix} -4 & 2 & 5 \\ 6 & 3 & 7 \\ -1 & 0 & 2 \end{pmatrix}$
 (C) $\begin{pmatrix} 4 & -6 & 1 \\ -2 & -3 & 0 \\ -5 & -7 & -2 \end{pmatrix}$ (D) $\begin{pmatrix} -2 & 9/2 & -1 \\ -1 & 81/4 & 11 \\ -2 & 45/2 & 73/4 \end{pmatrix}$
42. $\int \sec^3 x \, dx = \underline{\hspace{2cm}}$
 (A) $\frac{\sec x \tan x}{3} + \log (\sec x + \tan x)$
 (B) $\frac{\sec^2 x \tan x}{3} + \frac{1}{3} \log \tan \left(\frac{\pi}{4} + x \right)$
 (C) $\frac{\sec x \tan x}{2} + \frac{1}{2} \log \tan \left(\frac{\pi}{4} + \frac{x}{2} \right)$
 (D) None of these
43. Five balls of different colours are to be placed in three boxes of different sizes. Each box can hold all five balls. In how many different ways can we place the balls so that no box remains empty?
 (A) 450 (B) 350
 (C) 250 (D) 150
44. The value of $2 \sin (12^\circ) - \sin (72^\circ)$ is:
 (A) $\frac{\sqrt{5} (1 - \sqrt{3})}{4}$
 (B) $\frac{1 - \sqrt{5}}{8}$
 (C) $\frac{\sqrt{3} (1 - \sqrt{5})}{2}$
 (D) $\frac{\sqrt{3} (1 - \sqrt{5})}{4}$
45. In a class of 80 students, 48 are boys and the rest of the students are girls. If 10 students shift to the other class room and a student is selected at random find the probability that a girl is selected?
 (A) $\frac{11}{35}$
 (B) $\frac{27}{70}$
 (C) $\frac{11}{40}$
 (D) Can't be determined
46. In a ΔABC , if
 (i) $\sin \frac{A}{2} \cdot \sin \frac{B}{2} \cdot \sin \frac{C}{2} > 0$
 (ii) $\sin A \sin B, \sin C > 0$, then
 (A) Both (i) and (ii) are true
 (B) Only (i) is true
 (C) Only (ii) is true
 (D) Neither (i) nor (ii) is true

47. Consider the following two systems of linear equation $3x + 6y = 9, x + 2y = 3$. Which of the below statement is FALSE?
- (A) The two equations never intersect with each other
 (B) The solution is unique
 (C) They have same slope and different intercepts
 (D) The slope of the two lines are negative
48. If $\log 2, \log(2^x - 1)$ and $\log(2^x + 3)$ are in A.P., then $x =$ _____
- (A) $\frac{2}{5}$ (B) $\log_5 2$
 (C) $\log_2 5$ (D) $\log_3 5$
49. If $f(x) = \begin{cases} 2a - x & \text{for } -a < x < a \\ 3x - 2a & \text{for } x \geq a \end{cases}$, then which one of the following is true?
- (A) $f(x)$ is not differentiable at $x = a$
 (B) $f(x)$ is discontinuous at $x = a$
 (C) $f(x)$ is continuous for all x in R
 (D) $f(x)$ is differentiable for all $x \geq a$
50. If \vec{a} is unit vector making an angle of measure $\frac{\pi}{4}$ with $\vec{b} = \vec{i}$ and perpendicular to $\vec{c} = \vec{k}$, then $\vec{a} =$ _____
- (A) $\frac{1}{\sqrt{2}}\vec{i} - \frac{1}{\sqrt{2}}\vec{j}$ (B) $-\frac{1}{\sqrt{2}}\vec{i} + \frac{1}{\sqrt{2}}\vec{j}$
 (C) $\frac{1}{\sqrt{2}}\vec{j} + \frac{1}{\sqrt{2}}\vec{k}$ (D) $\frac{1}{\sqrt{2}}\vec{j} - \frac{1}{\sqrt{2}}\vec{k}$

Section 4: Biology

41. **Assertion:** Bacteria are the most abundant microorganisms.
Reason: Bacteria alone exhibits autotrophic nutrition.
- (A) Both assertion and reason are true moreover reason explains assertion.
 (B) Both assertion and reason are true but reason does not explain assertion.
 (C) Assertion is true but reason is false.
 (D) Assertion is false but reason is true.
42. Statement- I. Most algae show haplontic type of life cycle.
 Statement -II. they show free living sporophyte.
- (A) Statement I is correct and Statement II is wrong
 (B) Statement I is wrong but Statement II is correct
 (C) Both Statement I and Statement II are correct.
 (D) Both Statement I and Statement II are wrong
43. Identify the true statement from the following.
- (A) Parenchyma is a complex tissue.
 (B) Xylem parenchyma conducts food from the leaves to stem.
 (C) Function of sieve tubes is controlled by the nucleus of companion cells.
 (D) Companion cells help in maintaining the pressure gradient in xylem vessels.
44. Match the following and find the correct answer.
- | | List I | | List II |
|---|------------------|-------|--------------------------------|
| 1 | flagella | (i) | Attachment link to host / rock |
| 2 | polysome | (ii) | Storage reserve material |
| 3 | Inclusion bodies | (iii) | motility |
| 4 | Pili & fimbriae | (iv) | translation |
- | | 1 | 2 | 3 | 4 |
|-----|-------|------|-------|-------|
| (A) | (iv) | (i) | (iii) | (ii) |
| (B) | (iv) | (i) | (ii) | (iii) |
| (C) | (i) | (ii) | (iv) | (iii) |
| (D) | (iii) | (iv) | (ii) | (i) |
45. Identify the cell division stage.
- 
- (A) Prophase of mitosis.
 (B) Leptotene of meiosis
 (C) Diakinesis of meiosis
 (D) Metaphase of mitosis.

55. In a certain code language FRUITS is written as 1920921186. How is PIGEON written in the same code?
 (A) 141568816 (B) 141558916
 (C) 141547616 (D) 141557916
56. Raju starts moving towards North-East and walks 7 km. Then he turns to South and walks 15 km. Now he turns to West and walks 15 km. After taking right turn at this point, he walks 1 km and stops. Then answer the following question. To which direction he is from the origin?
 (A) North-East
 (B) South-West
 (C) South- East
 (D) North-West
57. Study the following information carefully and answer the questions. *P, Q, R, S, T, V* and *W* are seven friends. Each of them likes a particular fruit, viz Apple, Banana, Pear, Guava, Orange, Mango and Watermelon and each of them has a favorite city, viz Mumbai, Pune, Delhi, Kolkata, Chennai, Hyderabad and Cochin. The choices of fruit and favorite city of the seven friends are not necessarily in the same order. *Q* likes Mango and his favorite city is Chennai. The one whose favorite city is Pune likes Watermelon. *T*'s favorite city is Kolkata and likes banana. *R* likes Guava and his favorite city is not Mumbai and Hyderabad. *W*'s favorite city is Cochin and he does not like either banana or Pear. *P*'s favorite city is neither Pune nor Mumbai and he likes Apple. *S*'s favorite city is Mumbai.

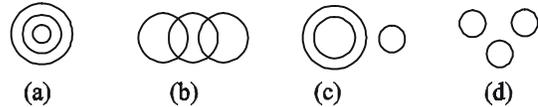
Who likes Watermelon?

- (A) *W* (B) *T*
 (C) *V* (D) *P*

58. The unit digit of $11 \times 12 \times 13 \dots \dots 16 \times 17$ is ____.

- (A) 4 (B) 5
 (C) 0 (D) 8

59. Which of the following diagram represents the relationship among Birds, Kite and Deer?



- (A) *a* (B) *b*
 (C) *c* (D) *d*

60. In the following figures, there is a relationship between first two figures (1) and (2). The same relation is between the next two figures (3) and (4), but one is missing. Find the missing figure from the given alternatives.

