Section 1: Physics

1. If a solid sphere is rolling down an inclined plane of angle of incline 30°, the acceleration of the sphere in terms of the acceleration due to gravity g is

   (A) $\frac{1}{2}g$ (B) $\frac{7}{10}g$

   (C) $\frac{5}{14}g$ (D) $\frac{5}{7}g$

2. The angle of projection of a projectile when its range is 4 times its maximum range is

   (A) 30° (B) 45°

   (C) 60° (D) 75°

3. If 1000 identical water drops each of radius 1 mm, combine to form a single large drop under isothermal condition the amount of work done (approximately) is (Take the surface tension of water as 0.072 N/m)

   (A) $3.0 \times 10^{-4}\,\pi$ J

   (B) $2.6 \times 10^{-4}\,\pi$ J

   (C) $2.0 \times 10^{-4}\,\pi$ J

   (D) $1.6 \times 10^{-4}\,\pi$ J

4. There are three planets in circular orbits around a star at a distance a, $4a$ and $9a$ respectively. At a given time the star and the three planets are in a straight line. If the period of revolution of the closest planet is T, the time after which the planets again be in same straight line is

   (A) $8T$ (B) $27T$

   (C) $216T$ (D) $512T$

5. A wheel is rotating at a frequency f_0 Hz about a fixed vertical axis. If the wheel comes to rest in t_0 seconds under the action of a constant deceleration, the number of rotations before it comes to rest is

   (A) $f_0\, t_0$ (B) $2f_0\, t_0$

   (C) $f_0 \frac{t_0}{2}$ (D) $f_0 \frac{t_0}{\sqrt{2}}$

6. Consider the head-on collision between two bodies. Then

   1. in a perfect elastic collision both the kinetic energy and linear momentum are conserved
   2. in a complete inelastic collision the loss in kinetic energy is maximum
   3. in an elastic collision linear momentum is conserved
   4. in a perfect elastic collision between two bodies of same mass, their velocities get exchanged

   (A) Only (1) is correct
   (B) Only (1) & (2) are correct
   (C) Only (1), (2) & (3) are correct
   (D) All are correct

7. No heat is transferred in

   1. an isothermal expansion of an ideal gas
   2. an adiabatic expansion of an ideal gas
   3. an isothermal compression of an ideal gas
   4. an adiabatic compression of an ideal gas

   (A) All statements are correct
   (B) Only (2) is correct
   (C) Only (2) & (4) are correct
   (D) Only (4) is correct

8. A wire of length L and area of cross section A is hanging from a fixed support. The length of the wire changes to L_1 when mass M is suspended from its free end. The expression for Young's modulus is:

   (A) $\frac{Mg\,(L_1 - L)}{AL}$ (B) $\frac{MgL}{AL_1}$

   (C) $\frac{MgL}{A\,(L_1 - L)}$ (D) $\frac{MgL_1}{AL}$

9. A body is executing simple harmonic motion with frequency 'n', the frequency at which its potential energy varies is:

   (A) n (B) $2n$

   (C) $3n$ (D) $4n$

10. Match Columns:

	Column A		Column B
(a)	Gravitational constant (G)	(i)	$[L^2 T^{-2}]$
(b)	Gravitational potential energy	(ii)	$[M^{-1} L^3 T^{-2}]$
(c)	Gravitational potential	(iii)	$[LT^{-2}]$
(d)	Gravitational intensity	(iv)	$[ML^2 T^{-2}]$

Choose the correct answer from the options given below:

(A) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

(B) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(C) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

(D) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)

Section 2: Chemistry

11. Mass of CO_2 obtained on heating 1 kg of 90% pure lime stone (calcium carbonate) is (Atomic masses: Ca = 40 ; C = 12 ; O = 16)

(A) 900 g (B) 396 g

(C) 445 g (D) 604 g

12. 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) $n = 1\ ;\ l = 0\ ;\ m = -1;\ s = +\frac{1}{2}$

13. Assertion - Reason type

Assertion: The 19th electron in potassium ($_{19}K$) atom enters into the 4s-orbital and not into the 3d-orbital

Reason: The sum of $(n + l)$ 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

14. 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

15. 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

16. 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

17. 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) → (ii) (2) → (iii) (3) → (iv) (4) → (i)

(B) (1) → (iii) (2) → (ii) (3) → (i) (4) → (iv)

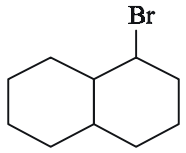
(C) (1) → (iv) (2) → (i) (3) → (iii) (4) → (ii)

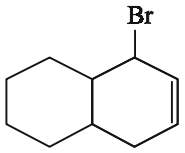
(D) (1) → (iii) (2) → (iv) (3) → (ii) (4) → (i)

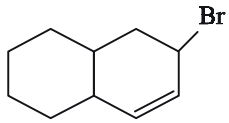
18. The mass of glucose in 100 ml of the aqueous solution which is isotonic with 5 g/L of urea (Molar mass = 60) is

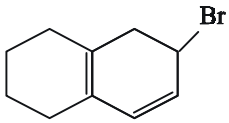
(A) 1.5 g
(B) 6
(C) 15
(D) 30

19. Which of the following will undergo the fastest dehydrobromination?

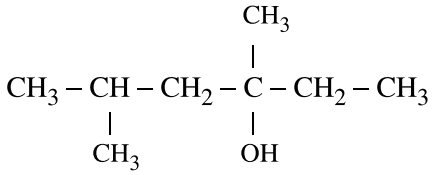
(A) 

(B) 

(B) 

(D) 

20. Dehydration of the following compound gives



(A) 2,4-dimethylhex-3-ene
(B) 3,5-dimethylhex-2-ene
(C) 2,4-dimethylhex-2-ene
(D) 2,4-dimethylhex-1-ene

Section 3: Mathematics

21. 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

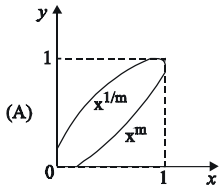
(A) $\begin{pmatrix} -4 & 6 & -1 \\ 2 & 3 & 0 \\ 5 & 7 & 2 \end{pmatrix}$

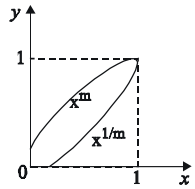
(B) $\begin{pmatrix} -4 & 2 & 5 \\ 6 & 3 & 7 \\ -1 & 0 & 2 \end{pmatrix}$

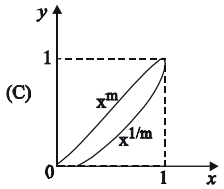
(C) $\begin{pmatrix} 4 & -6 & 1 \\ -2 & -3 & 0 \\ -5 & -7 & -2 \end{pmatrix}$

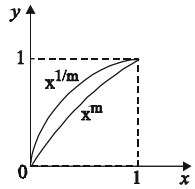
(D) $\begin{pmatrix} -2 & 9/2 & -1 \\ -1 & 81/4 & 11 \\ -2 & 45/2 & 73/4 \end{pmatrix}$

22. Select the graph that schematically represents BOTH $y = x^m$ and $y = x^{1/m}$ properly in the interval $0 \le x \le 1$, for integer values of m, where $m > 1$.

(A) 

(B) 

(C) 

(D) 

23. $\int \sec^3 x \, dx =$ _____

(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

24. If a function is continuous at a point.

(A) The limit of the function may not exist at the point

(B) The function must be derivable at the point

(C) The limit of the function at the point tends to infinity

(D) The limit must exist at the point and the value of limit should be same as the value of the function at the point

25. There are 4 boxes coloured red, yellow, green and blue. If 2 boxes are selected, how many combinations are there for atleast one green box or one red box to be selected?

(A) 1 (B) 6
(C) 9 (D) 5

26. The value of $2\sin(12°) - \sin(72°)$ is:

(A) $\frac{\sqrt{5}\,(1-\sqrt{3})}{4}$

(B) $\frac{1-\sqrt{5}}{8}$

(C) $\frac{\sqrt{3}\,(1-\sqrt{5})}{2}$

(D) $\frac{\sqrt{3}\,(1-\sqrt{5})}{4}$

27. 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

28. 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

29. Consider the following two systems of linear equation $3x + 6y = 9, x + 2y = 3$. Which of the below statement in 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

30. 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) $\log_3 5$

31. $\int \frac{e^x + 1}{e^x - 1}\,dx =$ _____ $+ c$

(A) $2\log\left|e^{\frac{x}{2}} - e^{\frac{-x}{2}}\right|$ (B) $2\log\left|e^{\frac{x}{2}} + e^{\frac{-x}{2}}\right|$
(C) $2\log(e^x - 1)$ (D) $\log|e^x + 1|$

32. $\log_7(\log_7(\sqrt{7\sqrt{(7\sqrt{7})}}))$ is equal to

(A) $3\log_2 7$ (B) $3\log_7 7$
(C) $1 - 3\log_7 2$ (D) $1 - 3\log_2 7$

33. 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 $x \geq a$

34. 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) $\frac{1}{\sqrt{2}}\vec{j} - \frac{1}{\sqrt{2}}\vec{k}$

35. Consider the function $f(x)=\frac{|x|}{x}$:

(a) $\lim_{x \to 0^+} f(x) = 1$

(b) $\lim_{x \to 0^-} f(x) = -1$

(c) $\lim_{x \to 0} f(x)$ does not exist

(A) All (a) and (b) and (c) are true
(B) Both (a) and (b) are false and (c) is true
(C) (c) alone true
(D) (a) and (c) are true

(OR)

BIOLOGY

21. Two observations are given below.
Observation 1: quiescent centre of root promeristem is the site of hormone synthesis.
Observation - 2: quiescent centre of root meristem is the ultimate source of all meristematic cells of the meristem.
In the light of above observations, choose the correct answer from the options given below.

(A) Observation 1 is correct but observation 2 is incorrect.
(B) Observation 1 and 2 are correct.
(C) Observation 1 is incorrect but observation 2 is correct.
(D) Observation 1 and 2 are incorrect.

22. Identify the incorrect statements from the following.

(A) Diffusion is a passive process.
(B) Diffusion is obvious in gases and liquids.
(C) In diffusion the movement of molecules is continuous and random.
(D) Diffusion is slow over shorter distance but extremely rapid over longer distance.

23. What is the percentage of energy released from glucose during glycolysis process?

(A) Approximately 20 – 25%
(B) More than 40%
(C) Less than 5%
(D) About 10%

24. Which one of the following does not occur during meiosis cell division?

(A) Pairing of homologous chromosomes.
(B) Condensation of chromosomes
(C) Exchange of chromosomal materials between sisteral chromatids.
(D) Assembling of chromosomes at equatorial line.

25. Read the following statements about xylem.

(i) In roots of pteridophytes xylem tracheids are absent.
(ii) In dicot roots xylem vessels are present.
(iii) In gymnosperms xylem bundle does not have fibres.
(iv) In angiosperms xylem parenchyma is absent.

Choose the true and false statements from the above list.

(A) (i) and (ii) are true; (iii) and (iv) are false.
(B) (ii) and (iii) are true; (i) and (iv) are false.
(C) (i) and (iv) are true; (ii) and (iii) are false.
(D) (ii), (iii) and (iv) are false; (i) is true

26. Match the list 1 with list 2.

List 1		List 2
(i) Curled leaf margin	-	(a) boron
(ii) Little leaf	-	(b) potassium
(iii) Brown heart of turnip		(c) zinc
(iv) Hoofed leaf tip	-	(d) calcium

(A) (i)-(d), (ii)-(c), (iii)-(b), (iv)-(a)
(B) (i)-(d), (ii)-(b), (iii)-(c), (iv)-(a)
(C) (i)-(b), (ii)-(c), (iii)-(d), (iv)-(a)
(D) (i)-(b), (ii)-(c), (iii)-(a), (iv)-(d)

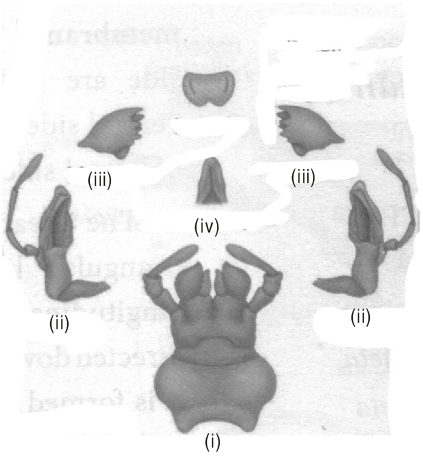
27. Assertion (A): Bacillus vulgaris is involved in ammonification of dead animals.
Reason (R) : in this process ammonia is converted into nitrite.

(A) (A) is true but (R) is false
(B) (A) is false but (R) is true
(C) Both (A) and (R) are true. (R) explains (A)
(D) (A) is true but (R) does not explain (A)

28. Which one of the following is incorrectly matched?

(A) Venus flower of basket - Euplectella
(B) Round worm - Ascaris
(C) Sea anemone - Adamsia
(D) Antedom - sea urchin.

29. Picture of mouth parts of cockroach.



(A) (i) maxilla, (ii) mandible, (iii) labium , (iv) hypopharynx.
(B) (i) mandible, (ii) maxilla, (iii) labium, (iv) hypopharynx.
(C) (i) labium, (ii) maxilla, (iii) mandible, (iv) hypopharynx.
(D) (i) hypopharynx (ii) mandible, (iii) labium, (iv) maxilla

30. Identify the correct equation.

(A) Trypsinogen $\xrightarrow{\text{peptidase}}$ trypsin
(B) Sucrose $\xrightarrow{\text{sucrase}}$ glucose + glucose
(C) Diglycerides $\xrightarrow{\text{lipase}}$ glycerol + fatty acid
(D) Maltose $\xrightarrow{\text{ptyalin}}$ glucose + fructose

31. Which one of the following is incorrect regarding human respiratory system?

(A) Inspiration is caused due to relaxation of diaphragm muscles.
(B) Expiration is caused due to high alveolar pressure.
(C) Under normal physiological condition every 100 ml of blood can deliver about 5 ml of O_2.
(D) The inner wall of alveoli is lined with squamous epithelium.

32. Picture of PQRST wave of ECG.

Find out the correct statement from the following.

(A) The *p* wave is caused due to atrial wall polarization.
(B) The *Q* wave is caused due to ventricle wall polarization.
(C) R wave is caused due to ventricular wall depolarization.
(D) *S* wave is caused due to atrial wall depolarization.

33. Aquaporins are meant for

(A) Water channel of urinary bladder.
(B) Water channels of liver.
(C) Water channels of membrane of nephrons.
(D) Fluid channels of neurons of brain.

34. Match the list 1 with list 2.

List 1	List 2
Name of bone	Number of bones.
(i) Cranium	(a) 5
(ii) Cervical	(b) 1
(iii) Sacral	(c) 8
(iv) Hyoid	(d) 7

(A) (i)-(d), (ii)-(c), (iii)-(b), (iv)-(a)
(B) (i)-(d), (ii)-(b), (iii)-(c), (iv)-(a)
(C) (i)-(b), (ii)-(c), (iii)-(d), (iv)-(a)
(D) (i)-(c), (ii)-(d), (iii)-(a), (iv)-(b)

35. Find out true and false statements from the following.

(i) Gustatory hairs are the sensitive portions of gustatory cells.
(ii) ANS controlling centre is the hypophysis.
(iii) Myelin sheath is responsible for faster conduction of impulses.
(iv) A neuron is polarized when its outer surface of axonal membraneposses a negative charge.

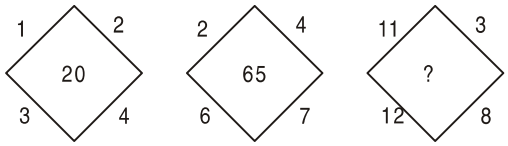
(A) (ii) and (iv) are false; (i) and (iii) are true.
(B) (ii) and (iii) are true; (i) and (iv) are false.
(C) (i) and (iv) are true; (ii) and (iii) are false.
(D) (ii), (iii) and (iv) are false; (i) is true

Section 4: Logical Reasoning

36. In the following question the numbers are arranged in a sequence based on certain principle. Select the answer from the four alternatives for the term marked by '?'
5, 7, 8, 10, 13, ?, ?, 22

(A) 14, 17 (B) 16, 18
(C) 15, 20 (D) 18, 21

37. The diagram and the numbers follow certain principle. Select the missing number indicated by question mark '?'



(A) 78 (B) 65
(C) 55 (D) 25

38. First two terms are connected by some relationship. The same relationship is applicable for the next terms, in which one is blank space. Identify the suitable term from the given four alternatives for the blank space.
5:35 : : 7 : ?

(A) 77 (B) 55
(C) 45 (D) 65

39. Take the given statements as true and decide which of the conclusions logically follow from the statements.
Statements:
(a) All cows are horses
(b) All horses are goats

Conclusions:
(i) All cows are goats
(ii) All goats are cows
(iii) All horses are cows
(iv) Some goats are cows

(A) Only ii and iii follow
(B) Only i and iv follow
(C) Only ii follows
(D) All conclusion follows

40. In a certain code language, 'mie pie' means 'blue light', 'mie tie' means 'blue berry' and 'aie tie' means 'rasp berry'. Which of the following codes stands for 'light fly'?

(A) pie zie (B) pie mie
(C) aie zie (D) aie mie

41. At 5:15 hrs, what will be the angle between the both hands (Minute hand and Hour hand) of clock?

(A) 72.5° (B) 67.5°
(C) 64° (D) 58.5°

42. Read the question carefully and answer according to the given relationship.

If $A+B$ means A is the brother of B. $A-B$ means A is the sister of B. $A\times B$ means A is the father of B. Which of the following means that C is the son of A?

(A) $A-B\times C+B$ (B) $B-C+C\times B$
(C) $A+B-B\times C$ (D) $A\times B-C+B$

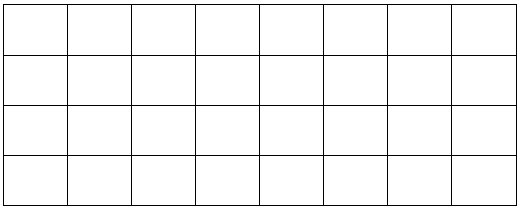
43. Letters are in coded language. Identify the coded letter depending upon the given situation.
If $Z=2197$; $R=729$; $J=?$

(A) 216 (B) 124
(C) 512 (D) 125

44. Five friends A, B, C, D and E are sitting on a bench. A is sitting next to B.C is sitting next to D. D is not sitting with E. E is on the left end of the bench.C is on the second position from the right. A is on the right of B and E. A and C are sitting together. Where A is sitting?

(A) Between B and D (B) Between D and C
(C) Between E and D (D) Between B and C

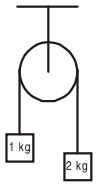
45. The total number squares in the figure is:



(A) 76 (B) 32
(C) 70 (D) 64

Section 5: Extrapolative Questions

46. Two masses 2 kg and 1 kg are connected at the ends of a weightless string of a pulley system as shown in the figure. The acceleration of the 2 kg mass is



(A) $\frac{1}{9}g$ (B) $\frac{1}{3}g$

(C) $\frac{1}{2}g$ (D) zero

47. What is(are) the assumption(s) given below is(are) valid in kinetic theory of gases?

1. Collisions among molecules are perfectly elastic
2. Collisions of molecules with the wall of the container constitute pressure of the gas
3. Volume occupied by gas molecules is equal to the volume of the container
4. The collisions between molecules are instantaneous

(A) Only (1) is correct
(B) Only (1) & (2) are correct
(C) Only (1), (2) and (3) are correct
(D) All are correct

48. In the chemical equation

$x\ As_2S_3 + y\ HNO_3 + z\ H_2O \rightarrow H_3AsO_4 + H_2SO_4 + NO$

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

49. 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

50. **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