



### Class - XI

Date 20-09-2009

Duration : 3 Hours

Max. Marks : 240

### PAPER - I

#### INSTRUCTIONS

##### A. Question paper format:

1. The question paper consists of 3 parts (Chemistry, Mathematics and Physics). Each part has 4 sections.
2. **Section I** contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **only one is correct**.
3. **Section II** contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **one or more is/are correct**.
4. **Section III** contains 2 groups of questions. Each group has 3 questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **only one is correct**.
5. **Section IV** contains 2 questions. Each question has four statements (A, B, C and D) given in column I and five statements (p, q, r, s and t) in Column II. Any given statement in column I can have correct matching with **one or more** statements(s) given in column II. For example, if for a given question, statement B matches with the statements given in q and r, then for that particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.

##### B. Marking scheme:

6. For each question in **Section I** you will be awarded **3 marks** if you darken the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In case of bubbling of incorrect answer, **minus one (-1) mark** will be awarded.
7. For each question in **Section II**, you will be awarded **4 marks** if you darken the bubble(s) corresponding to the correct choice(s) for the answer, and **zero mark** if no bubble is darkened. In all other cases, **Minus one (-1) mark** will be awarded.
8. For each question in **Section III**, you will be awarded **4 marks** if you darken the bubble(s) corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.
9. For each question in **Section IV**, you will be awarded **2 marks** for each row in which you have darkened the bubble(s) corresponding to the correct answer. Thus, each question in this section carries a maximum of **8 marks**. There is **no negative marking** for incorrect answer(s) for this section.

## Useful Data

1) Gravitational Constant	G = $6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$
2) Universal Gas Constant	R = $8.31 \text{ Jmol}^{-1}\text{K}^{-1}$
3) Boltzmann's Constant	k = $1.38 \times 10^{-23} \text{ JK}^{-1}$
4) Stefan's Constant	$\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$
5) Velocity of light in vacuum	c = $3 \times 10^8 \text{ m/s}$
6) Planck's Constant	h = $6.63 \times 10^{-34} \text{ J s}$
7) Rydberg Constant	$R_{\infty} = 1.097 \times 10^7 \text{ m}^{-1}$
8) Atomic mass unit	u = 931 MeV
9) One electron volt	1eV = $1.6 \times 10^{-19} \text{ J}$
10) Mass of electron	$m_e = 0.00055 \text{ u} = 9.1 \times 10^{-31} \text{ kg}$
11) Charge of an electron	e = $1.6 \times 10^{-19} \text{ C}$
12) Mass of proton	$m_p = 1.67 \times 10^{-27} \text{ kg}$
13) Mass of neutron	$m_n = 1.00866 \text{ u}$
14) Wein's constant	b = 0.29 cm K.
15) Permittivity of free space	$\epsilon_0 = 8.8 \times 10^{-12} \text{ F/m}$
16) permeability of free space	$\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$
17) Universal Gas Constant	R = $8.31 \text{ Jmol}^{-1}\text{K}^{-1}$ or $0.0821 \text{ lit atm mol}^{-1}\text{K}^{-1}$
18) Boltzmann's Constant	k = $1.38 \times 10^{-23} \text{ JK}^{-1}$
19) Velocity of light in vacuum	c = $3 \times 10^8 \text{ m/s}$
20) Planck's Constant	h = $6.63 \times 10^{-34} \text{ J s}$
21) Rydberg Constant	$R_{\infty} = 1.097 \times 10^7 \text{ m}^{-1}$
22) Atomic mass unit	u = 931 MeV
23) One electron volt	1eV = $1.6 \times 10^{-19} \text{ J}$
24) Mass of electron	$m_e = 0.00055 \text{ u} = 9.1 \times 10^{-31} \text{ kg}$
25) Atomic mass	Mg = 24
26) ----- " " -----	Fe = 56
27) ----- " " -----	F = 31
28) ----- " " -----	C = 12
29) ----- " " -----	Li = 7
30) ----- " " -----	O = 16

# MATHEMATICS

## SECTION - I

### Straight Objective Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **ONLY ONE** is correct.

1. The first term of an infinite geometric series is 2 and its sum be denoted by S. If  $|S - 2| < 1/10$  then the true set of the range of common ratio of the series is  
 (A)  $\left(\frac{1}{10}, \frac{1}{5}\right)$       (B)  $\left(-\frac{1}{2}, \frac{1}{2}\right) - \{0\}$       (C)  $\left(-\frac{1}{19}, \frac{1}{20}\right) - \{0\}$       (D)  $\left(-\frac{1}{19}, \frac{1}{21}\right) - \{0\}$
2. If a, b, c be the distinct complex roots of the equation  $x^3 + 3x + 4 = 0$  then  $a^3 + b^3 + c^3$  equal to  
 (A) -20      (B) -12      (C) 4      (D) 12
3. If x is real and  $4y^2 + 4xy + x + 6 = 0$ , then the complete set of values of x for which y is real, is  
 (A)  $x \leq 2$  or  $x \geq 3$       (B)  $x \leq -2$  or  $x \geq 3$   
 (C)  $-3 \leq x \leq 2$       (D)  $x \leq -3$  or  $x \geq 2$
4. If A lies in the third quadrant and  $3 \tan A - 4 = 0$ , then  $5 \sin 2A + 3 \sin A + 4 \cos A =$   
 (A) 0      (B)  $-\frac{24}{5}$       (C)  $\frac{24}{5}$       (D)  $\frac{48}{5}$
5. If  $a \cos^3 \alpha + 3a \cos \alpha \sin^2 \alpha = m$  and  $a \sin^3 \alpha + 3a \cos^2 \alpha \sin \alpha = n$ . Then  $(m + n)^{2/3} + (m - n)^{2/3}$  is equal to  
 (A)  $2a^2$       (B)  $2a^{1/3}$       (C)  $2a^{2/3}$       (D)  $2a^3$
6. Let x, y, z be real numbers such that 3x, 4y and 5z form a geometric progression while x, y, z form an H.P. Then the value of  $\frac{x}{z} + \frac{z}{x} = \frac{m}{n}$  where m and n are relatively prime then, (m + n) is equal to  
 (A) 29      (B) 39      (C) 49      (D) 59

(SPACE FOR ROUGH WORK)



**MOE**

Ministry of Education, Government of India

7. Find the sum of the infinite series  $\frac{1}{9} + \frac{1}{18} + \frac{1}{30} + \frac{1}{45} + \frac{1}{63} + \dots$
- (A)  $\frac{1}{3}$                       (B)  $\frac{1}{4}$                       (C)  $\frac{1}{5}$                       (D)  $\frac{2}{3}$
8. The maximum value of the expression,  $f(x, y, z) = xyz(4d - ax - by - cz)$  where  $a, b, c, d$  are positive constants,  $x, y, z$  are positive variables and  $4d - ax - by - cz > 0$  is :
- (A)  $\frac{abc}{d}$                       (B)  $\frac{d^3}{abc}$                       (C)  $\frac{abc}{d^3}$                       (D)  $\frac{d^4}{abc}$

## SECTION - II

## Multiple Correct Answers Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

9. Let  $f(x) = x^3 + x + 1$ . Suppose  $g$  is a cubic polynomial such that  $g(0) = -1$ , and the roots of  $g$  are the square of the roots of  $f$ . Then
- (A)  $g(x^2) = f^2(x)$                       (B)  $g(x^2) = -f(x) \cdot f(-x)$                       (C)  $g(9) = 899$                       (D)  $g(1) = f(1)$
10. If the triplets  $\log a, \log b, \log c$  and  $(\log a - \log 2b)(\log 2b - \log 3c), (\log 3c - \log a)$  are in arithmetic progression then
- (A)  $18(a + b + c)^2 = 18(a^2 + b^2 + c^2) + ab$                       (B)  $a, b, c$  are in G.P.  
(C)  $a, 2b, 3c$  are in H.P.                      (D)  $a, b, c$  can be the lengths of the sides of a triangle  
(Assume all logarithmic terms to be defined)
11. In a  $\Delta ABC$ ,  $\cos 3A + \cos 3B + \cos 3C = 1$  then :
- (A)  $\Delta ABC$  is right angled                      (B)  $\Delta ABC$  is acute angled  
(C)  $\Delta ABC$  is obtuse angled                      (D) One of the angles is  $\frac{2\pi}{3}$
12. Which of the cubic polynomials given below do not have their roots in arithmetic progression?
- (A)  $x^3 + 3x^2 - 2x - 1$                       (B)  $x^3 + 3x^2 - 2x - 2$   
(C)  $x^3 + 3x^2 - 2x - 3$                       (D)  $x^3 + 3x^2 - 2x - 4$

(SPACE FOR ROUGH WORK)



# MOTION

(Where Faith Meets the Success)



## SECTION - III

## Linked Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

## Paragraph Ques. No. 13 to 15

Consider the function  $f(x) = \sin^6 x + \cos^6 x + k(\sin^4 x + \cos^4 x)$  for some real number  $k$ .

13. The number of values of  $k$  for which  $f(x)$  is constant for all values of  $x$  is  
 (A) 1 (B) 2 (C) 3 (D) none of these
14. If  $k = -0.7$  and  $x = c$  is a solution of  $f(x) = 0$  then the number of different values of  $\sin c$  is  
 (A) 2 (B) 3 (C) 4 (D) 6
15. All values of  $k$  for which there exists a real number  $c$  such that  $f(c) = 0$  are  
 (A)  $-1 \leq k \leq \frac{1}{2}$  (B)  $\frac{1}{2} \leq k \leq \frac{\sqrt{3}}{2}$  (C)  $-1 \leq k \leq -\frac{1}{2}$  (D) none of these

## Paragraph Ques. No. 16 to 18

The real roots of the equation  $2x^3 - 19x^2 + 57x + k = 0$  are the first three terms of a geometric progression.

16. The value of  $k$  equals  
 (A) 216 (B) 108 (C) -54 (D) -108
17. If the geometric progression is increasing then the sum of its first  $n$  terms equals  
 (A)  $\left(\frac{3}{2}\right)^n - 1$  (B)  $4\left[\left(\frac{3}{2}\right)^n - 1\right]$  (C)  $6\left[\left(\frac{3}{2}\right)^n - 1\right]$  (D)  $4(2^n - 1)$
18. If the geometric progression is decreasing then the sum of its infinite number of term is  
 (A)  $27/2$  (B) 9 (C)  $9/2$  (D) 12

(SPACE FOR ROUGH WORK)



# MOTION

Where Faith Comes the Success



## SECTION - IV

## Matrix-Match Type

This section contains 2 questions. Each question contains statements given in two columns which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **One OR More** statement(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example if the correct matches are A-p, s and t; B-q and r; C-p and q' and D-s and t; then the correct darkening of bubbles will look like the following.

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. **Column - I** **Column - II**
- (A) If  $f(\theta) = (\sin \theta + \operatorname{cosec} \theta)^2 + (\cos \theta + \sec \theta)^2$ , then  $f(\theta)$  cannot be less than (P) 1
- (B) If  $\sin \alpha - \sin \beta = a$  and  $\cos \alpha + \cos \beta = b$  then  $a^2 + b^2$  cannot exceed (Q) 2
- (C) If  $A + B = \frac{\pi}{2}$ , where A and B are positive then  $(\sin A + \sin B) \cos \frac{\pi}{4}$  is always less than (R) 4
- (D) If  $2\cos x + \sin x = 1$ , then the value of  $7\cos x + 6\sin x$  is equal to (S) 6  
(T) 9
20. **Column - I** **Column - II**
- (A) If  $a^2 - 4a + 1 = 4$ , then the value of  $\frac{a^3 - a^2 + a - 1}{a^2 - 1}$  ( $a^2 \neq 1$ ) is equal to (P) 1
- (B) The value(s) of x satisfying the equation  $\sqrt[4]{|x-3|^{x+1}} = \sqrt[3]{|x-3|^{x-2}}$  is (Q) 2
- (C) The value(s) of x satisfying the equation  $3^x + 1 - |3^x - 1| = 2 \log_5 |6 - x|$  is (R) 4
- (D) If the sum of the first 2n terms of the A.P. 2, 5, 8,..... is equal to the sum of the first n terms of the A.P. 57, 59, 61,....., then n equals (S) 11

(SPACE FOR ROUGH WORK)



# MOTION

(Where Faith Counts the Success)

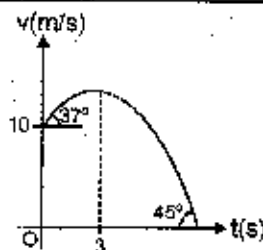
## PHYSICS

## SECTION - I

## Straight Objective Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **ONLY ONE** is correct.

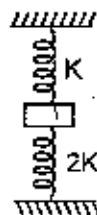
21. A particle starts moving with velocity 10 m/s in a straight line under an acceleration varying linearly with time. Its velocity time graph is as shown in figure. Its velocity is maximum at  $t = 3$  sec. The time (in sec) when the particle stops is ( $\tan 37^\circ = 3/4$ )  
 (A) 6 (B) 8  
 (C) 7 (D) 5



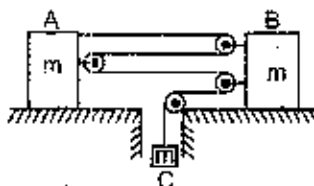
22. A heavy trolley is moving horizontally with a velocity of  $v$  m/s w.r.t. earth. A man starts running from one end of the trolley with a velocity  $1.5v$  m/s w.r.t. the trolley. After reaching the opposite end, the man turns back and continues running with a velocity of  $1.5v$  m/s w.r.t. trolley in the backward direction. If the length of trolley is  $L$  then the maximum displacement of the man with respect to earth will be



- (A)  $2.5L$  (B)  $1.5L$  (C)  $\frac{5L}{3}$  (D)  $2L$
23. A block of mass  $m$  is connected two springs of spring constant  $2k$  and  $k$  respectively as shown in vertical plane. At equilibrium both spring are compressed by same length, if suddenly lower spring is cut then what is acceleration of block just after spring cut.  
 (A)  $2g$  downward (B)  $g$  downward  
 (C)  $g$  upward (D) None of these



24. All the surface are frictionless then acceleration of the block B is  
 (A)  $2g/13$  (B)  $3g/13$   
 (C)  $4g/13$  (D)  $g/13$



(SPACE FOR ROUGH WORK)



# Motion Institute

(Where Faith Meets the Success)

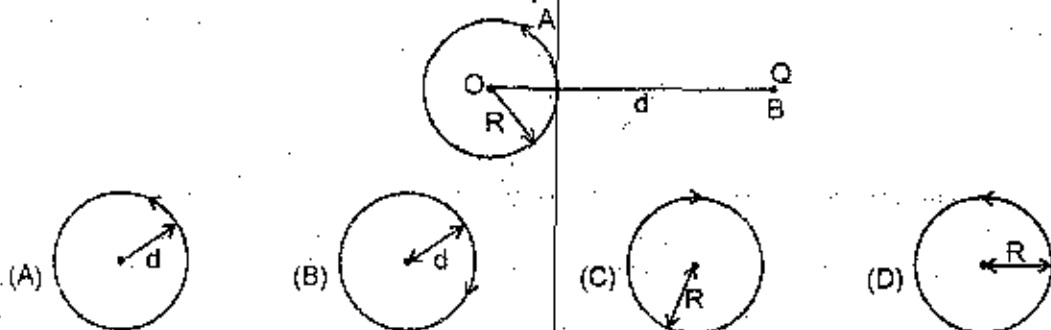


25. **Statement-1** : If a block of mass  $M$  is made to slide along a circular path on a rough horizontal surface then frictional force must be acting in a centripetal direction.

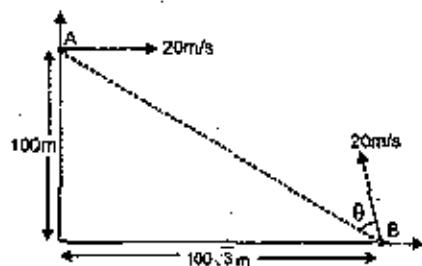
**Because**

**Statement-2** : Kinetic friction acts always opposite to the direction of relative velocity.

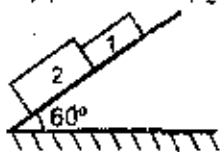
- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1  
 (C) Statement-1 is True, Statement-2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
26. A particle 'A' is rotating in a circle of radius  $R$  with centre at  $O$ . Another particle B in the same plane is resting at point Q which is at a distance  $d$  from  $O$ . The path of B as seen from A is :



27. Two small balls A and B are launched in the same vertical plane simultaneously, with same speed of  $20 \text{ m/s}$  at  $t = 0$ . Ball A has an initial horizontal velocity and ball B has initial velocity at an angle  $\theta$  above the line joining A and B as shown. If the projectiles collide in mid-air at time  $t$ .



- (A)  $t = \frac{20}{\sqrt{3}} \text{ s}$       (B)  $t = \frac{10}{\sqrt{3}} \text{ s}$   
 (C)  $t = \frac{5}{\sqrt{3}} \text{ sec}$       (D) none of these
28. In the figure shown if friction coefficient of block 1 and 2 with inclined plane is  $\mu_1 = 0.5$  and  $\mu_2 = 0.4$  respectively, then find out the correct statement
- (A) both block will move together  
 (B) both block will move separately  
 (C) there is a non-zero contact force between two blocks  
 (D) none of these



(SPACE FOR ROUGH WORK)

**MOTION**  
 (Where Faith Counts the Success)

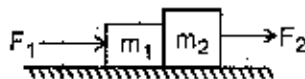


## SECTION - II

## Multiple Correct Answers Type

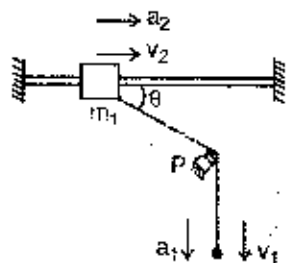
This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

29. Two blocks of masses  $m_1$  and  $m_2$  are placed side by side on a smooth horizontal surface. Two horizontal forces  $F_1$  and  $F_2$  act on  $m_1$  and  $m_2$  respectively. If  $N$  is the normal reaction between the blocks then :



- (A)  $N = 0$  when  $\frac{F_1}{m_1} = \frac{F_2}{m_2}$  (B)  $N = 0$  when  $\frac{F_1}{m_1} < \frac{F_2}{m_2}$  (C)  $N \neq 0$  when  $\frac{F_1}{m_1} \neq \frac{F_2}{m_2}$  (D)  $N \neq 0$  when  $\frac{F_1}{m_1} > \frac{F_2}{m_2}$

30. A bob of mass  $m_1$  hangs by a light inextensible string which passes over a fixed smooth pulley  $P$  and connects a ring of mass  $m_2$ . The ring is constrained to move along a smooth rigid horizontal rod. The instantaneous velocities and acceleration of the bodies are  $v_1, a_1$  and  $v_2, a_2$  respectively then :



- (A)  $v_1 = v_2 \cos \theta$  (B)  $a_2 = a_1 \cos \theta$   
(C)  $v_1 = v_2 \sin \theta$  (D)  $a_1 = a_2 \cos \theta$

31. Which of the following statements is TRUE for a particle moving in a circle with a constant angular speed ?

- (A) The velocity vector is tangent to the circle  
(B) The acceleration vector is tangent to the circle  
(C) The acceleration vector points to the centre of the circle  
(D) The velocity and acceleration vectors are perpendicular to each other.

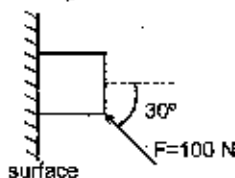
32. A force of 100 N is applied on a stationary block of mass 3 kg as shown in figure. If the coefficient of friction between the surface and the block is 0.25 then :

- (A) the frictional force acting on the block is 20 N downwards

- (B) the friction force acting on the block is  $\frac{25\sqrt{3}}{2}$  N

- (C) the normal reaction on the block is  $50\sqrt{3}$

- (D) if coefficient of friction is changed to 0.35 then the friction force acting on the block is again 20N downwards



(SPACE FOR ROUGH WORK)

**MOTION**  
Where Faith Comes to the Rescue

## SECTION - III

## Linked Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

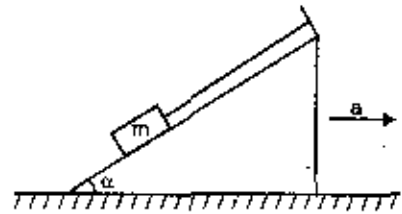
## Paragraph for Ques. No. 33 to 35

To find the speed of a river's current, a boatman decides to carry out the following experiment. He drops a wooden bucket into the water and himself sets off downstream, rowing along the flow of river. After 40 min. he reaches a point A, 1 km from his starting-point and turns back. After travelling some distance upstream, he picks up the bucket, turns round again and, rowing downstream once more, reaches A for the second time 24 min later (after picking the bucket). Assuming that the speeds of both current and boat are constant, and also that no time is wasted on turning round.

33. How long does the boatman spend on rowing upstream to meet the bucket ?  
 (A) 24 min (B) 40 min (C) 84 min (D) 16 min
34. What is the speed of the current  
 (A) 1 km/hr (B)  $\frac{4}{3}$  km/hr (C)  $\frac{3}{4}$  km/hr (D)  $\frac{3}{10}$  km/hr
35. What is the boat's speed relative to the water  
 (A) 1.2 km/hr (B) 1 km/hr (C) 0.75 km/hr (D) none of these

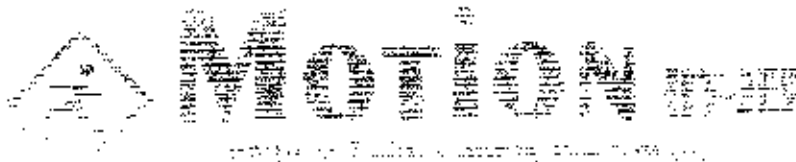
## Paragraph for Ques. No. 36 to 38

A body of mass  $m = 1.8$  kg is placed on an inclined plane, the angle of inclination is  $\alpha = 37^\circ$ , and is attached to the top end of the slope with a thread which is parallel to the slope. Then the slope is moved with a horizontal acceleration of  $a$ . Friction is negligible.



36. Find the acceleration if the body pushes the slope with a force of  $\frac{3}{4}mg$ .  
 (A)  $\frac{5}{3}m/s^2$  (B)  $0.5 m/s^2$  (C)  $0.75 m/s^2$  (D)  $\frac{5}{6}m/s^2$
37. Find the tension in thread :  
 (A) 12 N (B) 10 N (C) 8 N (D) 4 N
38. At what acceleration will the body lose contact with plane.  
 (A)  $\frac{40}{3}m/s^2$  (B)  $7.5 m/s^2$  (C)  $10 m/s^2$  (D)  $5 m/s^2$

(SPACE FOR ROUGH WORK)



**SECTION - IV**  
**Matrix-Match Type**

This section contains 2 questions. Each question contains statements given in two columns which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **One OR More** statement(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example if the correct matches are A-p, s and t; B-q and r; C-p and q; and D-s and t; then the correct darkening of bubbles will look like the following.

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
D	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

39. Four particles move in the paths 1, 2, 3 and 4. If the coefficient of friction between the particle and surface is  $\mu (= \tan \theta)$

(A)  $a_1$

(B)  $a_2$

(C)  $a_3$

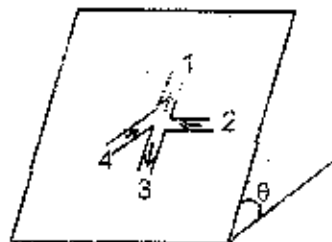
(D)  $a_4$

(P)  $< 2g \sin \theta$

(Q)  $= 2g \sin \theta$

(R)  $g \sin \theta$

(S) zero



40. A particle is projected with a velocity  $\vec{v}_0 = a\hat{i} + b\hat{j}$

(A)  $\frac{v_x}{v_y}$  at  $t = \frac{b}{2g}$

(B)  $h_{\max}$

(C) R (horizontal)

(D)  $\frac{v_{av}}{v_0}$  for  $t = \frac{2b}{g}$

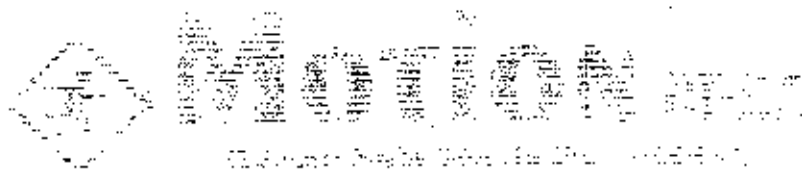
(P)  $\frac{a}{\sqrt{a^2 + b^2}}$

(Q)  $\frac{2a}{b}$

(R)  $\frac{b^2}{2g}$

(S)  $\frac{2ab}{g}$

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## CHEMISTRY

## SECTION - I

## Straight Objective Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), for its answer, out of which **ONLY ONE** is correct.

41. Caffeine has a molecular weight of 194. If it contains 28.9% by mass of nitrogen, number of atoms of nitrogen in one molecule of caffeine is  
(A) 4 (B) 6 (C) 2 (D) 3
42. Which of the following is the correct order according to stability?  
(A)  $\text{BeSO}_4 < \text{MgSO}_4 < \text{CaSO}_4 < \text{SrSO}_4$  (B)  $\text{BeSO}_4 > \text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4$   
(C)  $\text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4 > \text{BeSO}_4$  (D)  $\text{MgSO}_4 < \text{CaSO}_4 < \text{SrSO}_4 < \text{BeSO}_4$
43. 4 mole of  $\text{N}_2\text{O}_4(\text{g})$  at 300 K is kept in a closed container under 1 atmosphere. It is heated upto 600 K when 20% of mass of  $\text{N}_2\text{O}_4$  decomposes to  $\text{N}_2(\text{g})$ . The resultant pressure is  
(A) 1.2 atm (B) 2.4 atm (C) 2 atm (D) 1 atm
44. The correct order of decreasing second ionization enthalpy of Ti(22), V(23), Cr(24) and Mn (25) is  
(A)  $\text{Mn} > \text{Cr} > \text{Ti} > \text{V}$  (B)  $\text{Ti} > \text{V} > \text{Cr} > \text{Mn}$  (C)  $\text{Cr} > \text{Mn} > \text{V} > \text{Ti}$  (D)  $\text{V} > \text{Mn} > \text{Cr} > \text{Ti}$
45. NX is produced by the following step of reactions  

$$\text{M} + \text{X}_2 \longrightarrow \text{MX}_2$$

$$\text{MX}_2 + \text{X}_2 \longrightarrow \text{M}_3\text{X}_8$$

$$\text{M}_3\text{X}_8 + \text{N}_2\text{CO}_3 \longrightarrow \text{NX} + \text{CO}_2 + \text{M}_3\text{O}_4$$
 How much M (metal) is consumed to produce 206 gm of NX. (Take At wt of M = 56, N = 23, X = 80)  
(A) 42 gm (B) 56 gm (C)  $\frac{14}{3}$  gm (D)  $\frac{7}{4}$  gm
46. A 10.0 g of sample of mixture of calcium chloride and sodium chloride is treated with  $\text{Na}_2\text{CO}_3$  to precipitate the calcium as calcium carbonate. This  $\text{CaCO}_3$  is heated to convert all calcium to CaO and final mass of CaO is 1.62 gms. The % by mass of  $\text{CaCl}_2$  in the original mixture is  
(A) 15.2% (B) 32.1% (C) 21.8% (D) 11.07%

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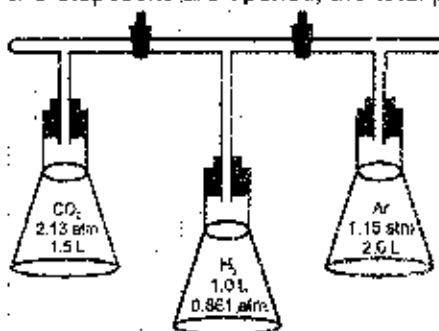
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47. In the shown diagram, three identical containers holds methane, oxygen and  $\text{SO}_2$  gas in the mass ratio of 4 : 2 : 1 respectively, but at the same temperature. The pressure exerted by  $\text{CH}_4$ ,  $\text{O}_2$ ,  $\text{SO}_2$  are in the ratio of



- (A) 1 : 2 : 4      (B) 1 : 1 : 1      (C) 3 : 5 : 15      (D) 16 : 4 : 1
48. In the following figure, when the two stopcocks are opened, the total pressure inside the flask will be



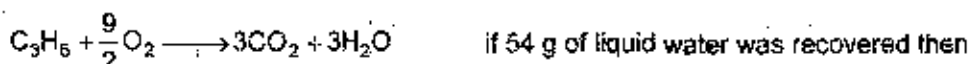
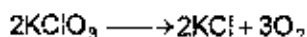
- (A) 1.41 atm      (B) 2.41 atm      (C) 3.41 atm      (D) 1.12 atm

### SECTION - II

#### Multiple Correct Answers Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

49. Oxygen produced from the decomposition of  $\text{KClO}_3$  is used for the complete combustion of  $\text{C}_3\text{H}_6$  according to the following reaction,



- (A) minimum moles of  $\text{KClO}_3$  required is 3      (B) volume of  $\text{CO}_2$  produced at STP is 67.2 lt.  
 (C) volume of  $\text{CO}_2$  produced at STP is 44.8 lt.      (D) mass of hydrocarbon combusted is 42 g.

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50. 3 moles of the gas  $C_2H_6$  is mixed with 60 gm of this gas and  $2.4 \times 10^{24}$  molecules of the gas is removed. The left over gas is combusted in the presence of excess oxygen then  
 ( $N_A = 6 \times 10^{23}$ ) Density of water = 1 gm/ml  
 (A) 2 Moles of  $C_2H_6$  left for combustion  
 (B) Volume of  $CO_2$  at S.T.P. produced after combustion 44.8 litre.  
 (C) Volume of water produced is 54 ml  
 (D) None
51. Equal weight of 'X' (At.wt. = 36) and 'Y' (At. wt. = 24) are reacted to form the compound  $X_2Y_3$ . Then  
 (A) X is the limiting reagent (B) Y is the limiting reagent  
 (C) No reactant is left over (D) Mass of  $X_2Y_3$  formed is double the mass of 'X' taken
52. Consider the following chemical reaction :  
 $Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + 2NaNO_3$   
 [M:  $Pb(NO_3)_2 = 330, Na_2SO_4 = 142$ ]  
 If a series of experiments are run maintaining sum of the weights of two reactant constant but varying the weight of reactants, which of the following statement is (are) true ?  
 (A) Maximum weight of the precipitate ( $PbSO_4$ ) will be formed if equal weights of reactants are taken.  
 (B) Maximum weight of precipitate ( $PbSO_4$ ) will be formed if equal moles of reactants are taken.  
 (C) In the experiment, as the weight of  $Na_2SO_4$  increases weight of precipitate increases.  
 (D) In the experiment, as the weight of  $Pb(NO_3)_2$  increases weight of precipitate increases.

## SECTION - III

## Linked Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

## Paragraph Ques. No. 53 to 55

VSEPR - Theory can be used to describe the shapes of  $SO_3^{2-}$ ,  $SO_3$  and  $SO_4^{2-}$ . From their shapes, it appears that some or all of them are capable of exhibiting the phenomenon of resonance.

53. Which of the following will have the atoms lying in the same plane ?  
 (A)  $SO_3^{2-}$  (B)  $SO_3$  (C)  $SO_4^{2-}$  (D) None of these
54. Which of the following will have the smallest value of O - S - O bond angle ?  
 (A)  $SO_3^{2-}$  (B)  $SO_3$  (C)  $SO_4^{2-}$  (D)  $SO_3^{2-}$  and  $SO_3$
55. Which will have the longest S - O bond ?  
 (A)  $SO_3^{2-}$  (B)  $SO_3$  (C)  $SO_4^{2-}$  (D)  $SO_3^{2-}$  and  $SO_4^{2-}$

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## Paragraph Ques. No. 56 to 58

1.5 g of a hydrated organic compound "A", containing C, H and oxygen, on mild heating rendered anhydrous and leaves behind 1.07 g of solid residue "B". 0.675 g of B on complete combustion produced 0.66 g of  $\text{CO}_2$  gas and 0.135 g of water vapour.

56. Deduce simplest formula of A in the form of  $\text{C}_x\text{H}_y\text{O}_z \cdot p\text{H}_2\text{O}$ , where, x, y, z, and p are simple whole numbers  
 (A)  $\text{CH}_2\text{O} \cdot \text{H}_2\text{O}$       (B)  $\text{CHO}_2 \cdot \text{H}_2\text{O}$       (C)  $\text{CH}_2\text{O} \cdot \text{H}_2\text{O}$       (D)  $\text{CHO} \cdot \text{H}_2\text{O}$
57. If one mole of B on complete combustion produces two moles of  $\text{CO}_2$  gas, deduce the molecular formula of A.  
 (A)  $\text{C}_2\text{H}_6\text{O} \cdot 2\text{H}_2\text{O}$       (B)  $\text{C}_2\text{H}_6\text{O}_4 \cdot 2\text{H}_2\text{O}$       (C)  $\text{C}_2\text{H}_4\text{O}_4 \cdot 2\text{H}_2\text{O}$       (D)  $\text{C}_2\text{H}_2\text{O}_2 \cdot 2\text{H}_2\text{O}$
58. If compound A was burnt in excess of  $\text{O}_2$  (g), what weight of water molecules will be produced ?  
 (A) 0.16 g      (B) 0.32 g      (C) 0.36 g      (D) 0.48 g

## SECTION - IV

## Matrix-Match Type

This section contains 2 questions. Each question contains statements given in two columns which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **One OR More** statement(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example. If the correct matches are A-p, s and t; B-q and r; C-p and q' and D-s and t, then the correct darkening of bubbles will look like the following.

	p	q	r	s	t	u
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
D	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

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- 59.
- | Column I  | Column II                            |
|---|--------------------------------------|
| (A) 4.5 m solution of $\text{CaCO}_3$ density 1.45 gm/ml                                      | (P) mole fraction of solute is 0.2   |
| (B) 3 M 100 ml $\text{H}_2\text{SO}_4$ mixed with 1 M 300 ml $\text{H}_2\text{SO}_4$ solution | (Q) mass of the solute is 360 gm     |
| (C) 14.5 m solution of Ca   | (R) molarity = 4.5                   |
| (D) in 4 M 2 litre solution of NaOH, 40 gm NaOH is added                                      | (S) molarity 1.5                     |
| (E) 5m (molal) NaOH solution  | (T) 16.66% (w/w) of NaOH in solution |

60. Match the following.

Column I	Column II
(A) 10 mL 1.0 M $\text{H}_2\text{SO}_4$ + 15 mL 1.0 M NaOH	(P) Basic
(B) 1.0 g NaOH + 10 mL 1.0 M $\text{H}_2\text{SO}_4$	(Q) Acidic
(C) 1.0 g CaO + 4.57 g HI (M = 128)	(R) Amphoteric
(D) 25 mL 0.8 M $\text{H}_2\text{CO}_3$ + 16 mL 1.25 M KOH	(S) Neutral

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