

## PHYSICS, CHEMISTRY & MATHEMATICS

QP Code:

Common  
Test- 2

Time Allotted: 3 Hours

Maximum Marks: 198

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

### INSTRUCTIONS

**Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.**

#### A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Three Parts: Part-A, B & Part-C** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

#### B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

#### C. Marking Scheme For All Three Parts.

- (i) **Part-A (01-06)** – Contains seven (06) multiple choice questions which have **One or More** correct answer.  
*Full Marks: +4* If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.  
*Partial Marks: +1* For darkening a bubble corresponding to **each correct option**, provided NO incorrect option is darkened.  
*Zero Marks: 0* If none of the bubbles is darkened.  
**Negative Marks: -1 In all other cases.**  
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **-1 marks**, as a wrong option is also darkened.
- (ii) **Part-B (07-12)** contains Six (06) Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive) and each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.
- (iii) **Part-C (13-18)** contains Six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -30, 30.27, -127.30) and each question carries **+4 marks** for correct answer and **there will be no negative marking**.

Name of the Candidate : \_\_\_\_\_

Batch : \_\_\_\_\_ Date of Examination : \_\_\_\_\_

Enrolment Number : \_\_\_\_\_

BATCHES – All 2123 batches (X & A – lot)

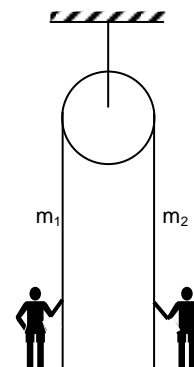
## SECTION-1 : PHYSICS

### PART – A

#### (Multi Correct Choice Type)

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

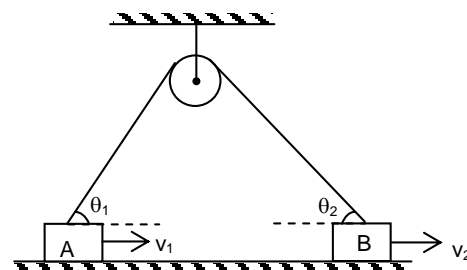
1. Two men of unequal masses hold on to the two sections of a light rope passing over a smooth light pulley. Which of the following are possible
- (A) The lighter man is stationary while the heavier man slides with some acceleration
- (B) The heavier man is stationary while the lighter man climbs with some acceleration
- (C) The two men slide with the same acceleration in the same direction
- (D) The two men slide with acceleration of the same magnitude in opposite direction



1. **ABD**

2. Block are moving as shown. The ratio  $v_1/v_2$  is

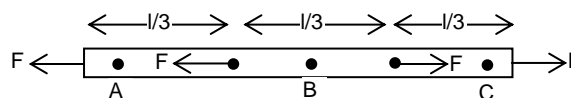
- (A)  $\frac{\sec \theta_1}{\sec \theta_2}$
- (B)  $\frac{\sec \theta_2}{\sec \theta_1}$
- (C)  $\frac{\cos \theta_2}{\cos \theta_1}$
- (D)  $\frac{\cos \theta_1}{\cos \theta_2}$



2. **AC**

3. Four persons are holding a rope of length  $\ell$  at position as shown in figure. All of them are applying equal force  $F$  in the direction as shown in figure. Then the tension

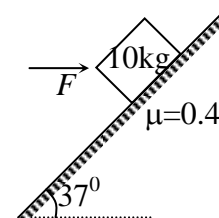
- (A) at point A will be ZERO
- (B) at point B will be  $2F$
- (C) at point C will be  $F$
- (D) at point B will be ZERO



3. **BC**

4. A block of mass  $10\text{ kg}$  is placed on a rough inclined plane of inclination  $37^\circ$  ( $\tan 37^\circ = 3/4$ ). The coefficient of friction between block and surface is  $0.4$ . A horizontal force  $F = 50\text{ N}$  is applied on the block, then ( $g = 10\text{ m/s}^2$ )

- (A) acceleration of block is zero.
- (B) acceleration of block is  $2.4\text{ m/s}^2$  along the inclined plane.
- (C) frictional force between block and surface is  $44\text{ N}$ .
- (D) frictional force between block and surface is  $20\text{ N}$ .

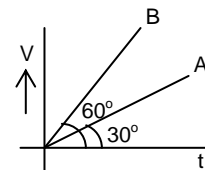


4. **AD**

5. The force exerted by the floor of an elevator on the foot of a person standing there is more than the weight of the person if the elevator is  
 (A) going up and slowing down (B) going up and speeding up  
 (C) going down and slowing down (D) going down and speeding up.

5. **BC**

6. The velocity time graphs for two objects A and B are shown. Then the acceleration of A and B are  
 (A)  $60^\circ$ ,  $30^\circ$  (B)  $30^\circ$ ,  $60^\circ$   
 (C)  $\tan 60^\circ$ ,  $\tan 30^\circ$  (D)  $\tan 30^\circ$ ,  $\tan 60^\circ$

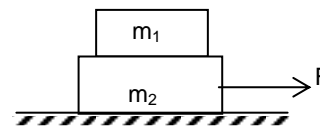


6. **D**

### PART – B Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. Two blocks of masses  $m_1 = 1 \text{ kg}$  and  $m_2 = 2 \text{ kg}$  are placed on each other as shown in the figure. All the surfaces in contact are rough co-efficient of static friction  $\mu_s = 0.6$  and coefficient of kinetic friction is  $\mu_k = 0.5$  for all the surfaces. A force  $F = 24 \text{ N}$  acts on lower block in horizontal direction. Then find out friction force acting on upper block.

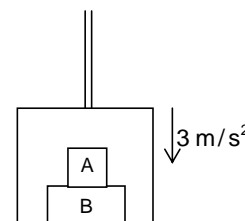


7. **3**

8. A spring of force constant  $K$  is cut into two pieces such that one piece is double the length of the other, then find out the force constant of the longer piece ( $K = 6 \text{ N/m}$ ) in  $\text{N/m}$ .

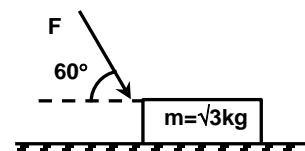
8. **9**

9. The elevator shown in figure is descending with an acceleration of  $3 \text{ m/s}^2$ . The mass of the block  $A = 1 \text{ kg}$ . The force exerted by the block  $B$  on  $A$  is



9. **7**

10. A block of mass  $\sqrt{3} \text{ kg}$  is resting on a horizontal plane (coefficient of static friction  $\mu = 1/2\sqrt{3}$ ). A force  $\vec{F}$  is applied to the block as shown in the figure. The minimum magnitude of  $\vec{F}$  for which the block begins to slide is  $n \text{ mg}$  where  $n$  is equal to



10. **2**

11. A particle moves along  $X$  – axis in such a way that its coordinate  $x$  varies with time  $t$  according to the expression  $x = (2 - 3t + 6t^2) \text{ m}$ . The magnitude of initial velocity of the particle is

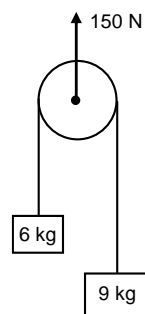
11. **3**

12. A block of mass 1 kg lies on a horizontal surface in a truck. The coefficient of static friction between the block and the surface is 0.6. If the acceleration of the truck is  $5 \text{ m/s}^2$ , then what frictional force acting on the block (in newton).
12. 5

### PART – C (Numerical based)

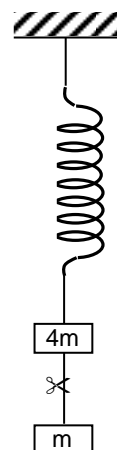
This section contains 6 questions, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. As situation shown in figure, choose the correct option(s) (take  $g = 10 \text{ m/s}^2$  downward), the acceleration of pulley is  $a$  then the value of  $3a$  is



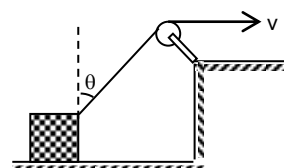
13. 1.25

14. System shown in figure is in equilibrium and at rest. The spring and string are mass less, now the string is cut. The ratio of magnitudes of acceleration of mass  $4m$  and  $m$  just after the string is cut is  $r$ , then  $7r$  is



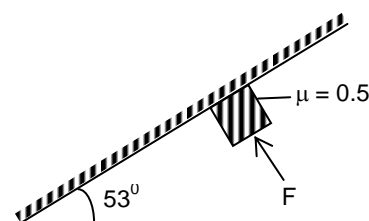
14. 1.75

15. A block is dragged on a smooth plane with the help of a rope which moves with a velocity  $v$  as shown in figure. The horizontal velocity of the block is ( For  $v=2 \text{ m/s}$  and  $\theta = 53^\circ$ )



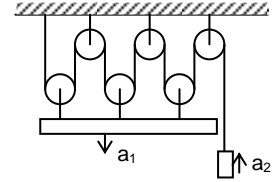
15. 2.5

16. In the figure shown the minimum value of  $F$  (in N) to be applied perpendicular to the inclined so that the block of mass 0.1 kg does not slides and remains in contact with inclined plane is (take  $g = 10 \text{ m/s}^2$ )



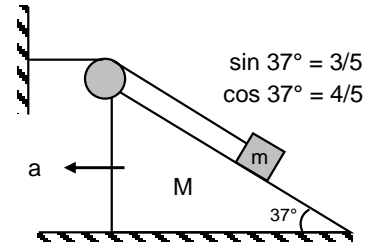
16. 2.2

- 17 Strings and pulley are massless and frictionless. The ratio ( $a_2/4a_1$ ) in acceleration of the block as shown in the figure is



- 17 **1.5**

18. As shown in the figure, if acceleration of  $M$  with respect to ground is  $\frac{7}{5}\sqrt{10} \text{ ms}^{-2}$ , then acceleration of  $m$  with respect to ground is (in  $\text{ms}^{-2}$ )



18. **2.8**

## **SECTION-2 : CHEMISTRY**

### **PART – A**

#### **(Multi Correct Choice Type)**

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

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1. The time required for an electron to make one complete revolution around nucleus of H-atom in a higher orbit  $n_2$  is 8 times to that of a lower orbit  $n_1$ . Therefore  $n_1$  and  $n_2$  are  
(A) 1 and 2 (B) 2 and 3  
(C) 2 and 4 (D) 3 and 6
1. ACD
2. In a H-like sample, electrons make transition from 4<sup>th</sup> excited state up to 2<sup>nd</sup> state. Then  
(A) 10 different spectral lines are observed  
(B) 6 different spectral lines are observed  
(C) number of lines belonging to the Balmer series is 3  
(D) number of lines belonging to paschen series is 2
2. BCD
3. Chlorine atom does not differ from chloride ion in the number of which of the following?  
(A) Electrons (B) Size  
(C) Protons (D) Neutrons
3. CD
4. Which of the following show amphoteric behaviour?  
(A)  $Zn(OH)_2$  (B) BeO  
(C)  $Al_2O_3$  (D)  $Pb(OH)_2$
4. ABCD
5. Which of the following regarding element with atomic number 10 is correct?  
(A) It forms a covalent network solid (B) Element is monoatomic  
(C) It has almost zero EA (D) It has extremely high value of IE
5. BCD
6. Rutherford's  $\alpha$ -scattering experiment led to the following conclusions  
(A) Atom has largely empty space  
(B) The centre of the atom has positively charged nucleus  
(C) The size of the nucleus is very small as compared to the size of the atom  
(D) The electrons revolve around the nucleus
6. ABCD

### **PART – B**

#### **Integer Answer Type**

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

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7. The uncertainties in the velocities of two particles, A and B are  $0.05$  and  $0.02 \text{ ms}^{-1}$  respectively. The mass of B is five times that of the mass of A. What is the ratio of uncertainties  $(\Delta_{x_A} / \Delta_{x_B})$  of their positions?
7. 2
8. If H-atom is supplied with  $12.1 \text{ eV}$  energy and electron returns to the ground state after excitation the number of spectral lines in Balmer series would be:  
(H-atom =  $-13.6 \text{ eV}$ )
8. 1
9. The maximum number of electrons that can have principal quantum number  $n = 3$  and spin quantum number  $m_s = -\frac{1}{2}$  is
9. 9
10. The work function( $\phi$ ) of some metals is listed below. The number of metals which will show photoelectric effect when light of  $300 \text{ nm}$  wavelength falls on the metal is  
( $1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$ )
- | Metal             | Li  | Na  | K   | Mg  | Cu  | Ag  | Fe  | Pt  | W    |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| $\phi(\text{eV})$ | 2.4 | 2.3 | 2.2 | 3.7 | 4.8 | 4.3 | 4.7 | 6.3 | 4.75 |
10. 4
11. An element has its electronic configuration as given  $[\text{Ar}]_{18}3d^54s^1$ . Predict the group number of this element in the long form of periodic table.
11. 6
12. Following is the list of few elements: Fe, Ar, Cs, Ca, Ge, Ga and Sr. How many element of these belong to s-block?
12. 3

### PART – C (Numerical based)

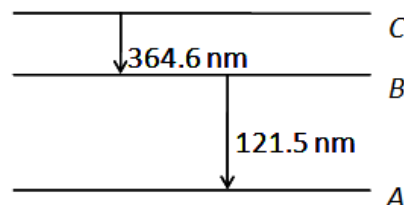
This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. The first and second ionization potentials of an element M(atomic weight = 25) are  $800$  and  $1500 \text{ kJ mol}^{-1}$  respectively. Calculate the percentage of  $\text{M}^{2+}(\text{g})$  ions formed if  $5 \text{ g}$  of  $\text{M}(\text{g})$  absorbs  $250 \text{ kJ}$  of energy.
13. 30
14. Bohr radius of a shell in H-atom is  $8.46 \text{ \AA}$ . The maximum number of electrons that can be placed in this energy shell is
14. 32

15. An energy of 24.6 eV is required to remove one of the electrons from a neutral helium atom. The energy in eV required to remove both the electrons from a neutral helium atom.
15. 79.0
16. In  $\text{Na}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{O}^{2-}$ ,  $\text{F}^-$ ,  $\text{Cl}^-$  ions. If  $x$  ions have radius larger than that of  $\text{Al}^{3+}$ , then the value of  $x/2$  is

16. 2.5

17. Three atomic states of a hydrogen like atom are shown in the figure. The transition from C to B yields a photon of wavelength 364.6 nm and the transition from B to A yields a photon of wavelength 121.5 nm, Then the transition from C to A will yield a photon of wavelength 'x' nm, then x is:



17. 91.2 (range 91.1 to 91.3)

18. A bulb takes 10 seconds to dissociate all molecules in  $10^{-4}$  moles of chlorine. Bond energy of Cl – Cl bond is  $3.2 \times 10^{-17}$  Joule/molecule. Power of the bulb in watt is:

18. 192.7 (range 192.7 to 192.8)



## **SECTION-3 : MATHEMATICS**

### **PART – A**

#### **(Multi Correct Choice Type)**

This section contains 6 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. If  $2\sin^2\theta + \sin^2 2\theta = 2$  then  $\sin^2\theta$  equal to

- |                   |                   |
|-------------------|-------------------|
| (A) 1             | (B) $\frac{1}{2}$ |
| (C) $\frac{1}{3}$ | (D) $\frac{1}{4}$ |

1. AB

2. Roots of  $4x^2 - 2\sqrt{5}x + 1 = 0$  are

- |                     |                     |
|---------------------|---------------------|
| (A) $\sin 18^\circ$ | (B) $\cos 18^\circ$ |
| (C) $\sin 36^\circ$ | (D) $\cos 36^\circ$ |

2. AD

3. If  $\cos(A - B) = \frac{3}{5}$  and  $\tan A \tan B = 2$ , then

- |                           |                            |
|---------------------------|----------------------------|
| (A) $\cos A \cos B = 1/5$ | (B) $\sin A \sin B = -2/5$ |
| (C) $\cos(A + B) = -1/5$  | (D) $\sin A \cos B = 4/5$  |

3. AC

4. If  $\sin\beta$  is the geometric mean between  $\sin\alpha$  and  $\cos\alpha$ , then  $\cos 2\beta$  is equal to

- |  |  |
|--|--|
| (A) $2\sin^2\left(\frac{\pi}{4} - \alpha\right)$ | (B) $2\cos^2\left(\frac{\pi}{4} - \alpha\right)$ |
| (C) $2\cos^2\left(\frac{\pi}{4} + \alpha\right)$ | (D) $2\sin^2\left(\frac{\pi}{4} + \alpha\right)$ |

4. AC

5.  $\sin 2^\circ + \sin 4^\circ + \sin 6^\circ + \dots + \sin 178^\circ$  equal to

- |                    |                     |
|--------------------|---------------------|
| (A) $\tan 1^\circ$ | (B) $\tan 89^\circ$ |
| (C) $\cot 1^\circ$ | (D) $\cot 89^\circ$ |

5. BC

6.  $\sin^4 x + \cos^4 x = a$  has a real solution for

- |                        |                       |
|------------------------|-----------------------|
| (A) $a \in \mathbb{R}$ | (B) $a = \frac{1}{2}$ |
| (C) $a = \frac{3}{2}$  | (D) $a = \frac{1}{4}$ |

6. BC

**PART – B**  
**Integer Answer Type**

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. The value of  $(\cot 25^\circ \cot 35^\circ + \cot 95^\circ \cot 145^\circ + \cot 85^\circ \cot 155^\circ)$  is equal to

7. 3

8. In triangle ABC, if  $\angle C = \frac{\pi}{2}$  and  $\frac{x}{y} = \frac{\cos A}{\cos B}$  then  $\frac{x \tan A + y \tan B}{x + y} =$

8. 1

9. If  $A = \tan 6^\circ \tan 42^\circ$  and  $B = \cot 66^\circ \cot 78^\circ$ , then  $A - B$  equal to

9. 0

10. If  $4 \sin 27^\circ = \sqrt{\alpha} - \sqrt{\beta}$ , then the value of  $\frac{\alpha + \beta - \alpha\beta + 2}{\sqrt{5}}$  is

10. 2

11. If  $2n \cos 20^\circ = \sin 40^\circ + n \cos 40^\circ$ , then  $\frac{1}{n^2}$  is equal to

11. 3

12.  $(1 + \tan 1^\circ)(1 + \tan 2^\circ)(1 + \tan 43^\circ)(1 + \tan 44^\circ)$  equal to

12. 4

**PART – C**  
**(Numerical based)**

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. If  $\sin 2\theta + \sin 2\phi = \frac{1}{2}$  and  $\cos 2\theta + \cos 2\phi = \frac{3}{2}$  and  $\cos^2(\theta - \phi)$  is equal to k then  $2k =$

13. 1.25

14. If value of  $\sin 10^\circ \sin 30^\circ \sin 50^\circ \sin 70^\circ$  is 'K' then  $100K =$

14. 6.25

15. The value of  $\cos 12^\circ + \cos 84^\circ + \cos 156^\circ + \cos 132^\circ$  is

15. - 0.5

16. If  $\cos(\alpha - \beta) = 3 \sin(\alpha + \beta)$ , then  $\frac{1}{1 - 3 \sin 2\alpha} + \frac{1}{1 - 3 \sin 2\beta}$  is equal to

16. - 0.25

17. If  $\tan(\alpha + \beta) = \frac{5}{12}$  and  $\cot(\alpha - \beta) = \frac{4}{3}$ , then '63 tan 2β' is equal to

17. - 16.00

18. If  $\cos^6 \alpha + \sin^6 \alpha + k \sin^2 2\alpha = 1 \forall \alpha \in \left(0, \frac{\pi}{2}\right)$ , then k is

18. 0.75

# ANSWERS

## **SECTION-1 : PHYSICS**

PART – A

PART – B

## **SECTION – 2 : CHEMISTRY**

PART – A

PART – B

## **SECTION – 3 : MATHEMATICS**

PART – A

PART – B