

# FITJEE – JEE (Main)

## Physics, Chemistry & Mathematics

QP Code: \_\_\_\_\_

Time Allotted: 3 Hours

Maximum Marks: 300

- 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.

### Important 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 **Two Parts: Part-A & B** 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. No candidate is allowed to carry any textual material, printed or written, bits of papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices ext. except the Admit Card inside the examination hall / room.

#### 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 **Blue/Black Ball Point Pen** 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.
4. **Do not fold or make any stray marks on the Answer Sheet.**

#### C. Marking Scheme for All Two Parts:

- (i) **Part-A (01-20)** – Contains Twenty (20) multiple choice objective questions which have four (4) options each and only one correct option. Each question carries **+4 marks** which will be awarded for every correct answer and **-1 mark** will be deducted for every incorrect answer.
- (ii) **Part-B (01-05)** contains five (05) 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 : \_\_\_\_\_

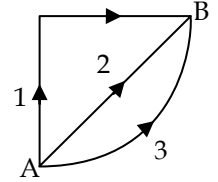
BATCHES – NWCM2022Y1R,A1R-A2R,XA1W-XA2W & A1W-A4W\_PT1

## SECTION – I: PHYSICS

### Part – A: Single Correct Answer Type

This section contains **20 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct**.

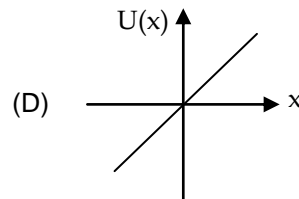
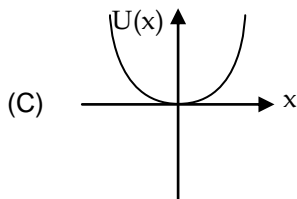
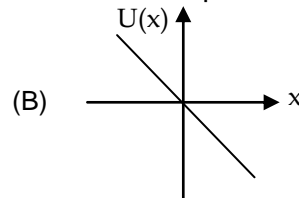
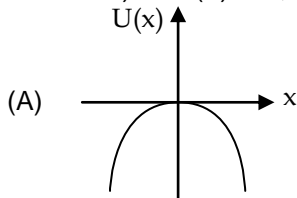
1. If  $W_1, W_2$  and  $W_3$  represent the work done in moving a particle from A to B along three different paths 1, 2 and 3 respectively (as shown) in the gravitational field of a point mass  $m$ . Find the correct relation between  $W_1, W_2$  and  $W_3$  :



- (A)  $W_1 > W_2 > W_3$                       (B)  $W_1 = W_2 = W_3$   
 (C)  $W_1 < W_2 < W_3$                       (D)  $W_2 > W_1 > W_3$

1. **B**

2. A particle is placed at the origin and a spring force  $F = Kx$  is acting on it ( $K$  is a positive constant). If  $U(0) = 0$ , the graph of  $U(x)$  vs  $x$  will be  $U$  is the potential energy function



2. **A**

3. A hemispherical vessel of radius  $R$  moving with a constant velocity  $v_0$  and containing a ball, is suddenly stopped. Find the height by which ball will rise in the vessel, provided the surface is smooth:

- (A)  $\frac{v_0^2}{2g}$                       (B)  $\frac{2v_0^2}{g}$                       (C)  $\frac{v_0^2}{g}$                       (D) none of these

3. **A**

4. A particle of mass  $m$  is projected at an angle with horizontal with kinetic energy  $E$ . The potential energy at the top of its trajectory is  $\frac{E}{2}$ . Find the range:

- (A)  $\frac{E}{mg}$                       (B)  $\frac{E}{2mg}$                       (C)  $\frac{2E}{mg}$                       (D)  $\frac{E}{mg\sqrt{2}}$

4. **C**

5. A body acquires velocity  $v$  in time  $T$  starting its motion from the rest. The work done on the body in time  $t$  will be proportional to:

- (A)  $\frac{vt}{T}$                       (B)  $\frac{vt}{T^2}$                       (C)  $\frac{v^2t^2}{T^2}$                       (D)  $\frac{v^2t}{T^2}$

5. **C**

6. An engine is pumping water continuously. The water passes through a nozzle with a velocity  $v$ . As water leaves the nozzle, the mass per unit length of the water jet is  $m_0$ . Find the rate at which kinetic energy is imparted to the water:

(A)  $\frac{1}{2}m_0v^3$                       (B)  $\frac{1}{2}m_0v^2$                       (C)  $\frac{1}{2}m_0v^{3/2}$                       (D)  $\frac{1}{2}m_0v^{1/2}$

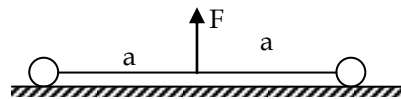
6. **A**

7. A spring has a length  $l_1$  when tension in it is  $n_1$  (in N). It has a length  $l_2$  when tension is  $n_2$  (in N). Find its spring constant:

(A)  $\frac{(n_2l_2 - n_1l_1)}{(l_1 - l_2)}$                       (B)  $\frac{(n_1 - n_2)}{(l_1 - l_2)}$                       (C)  $\frac{(n_2 - n_1)}{(l_1 - l_2)}$                       (D)  $\frac{(n_1l_1 - n_2l_2)}{(l_1 - l_2)}$

7. **B**

8. Two particles of mass  $m$  each are tied at the ends of a light string of length  $2a$ . The whole system is kept on a frictionless horizontal surface with the string held tight so that each mass is at a distance  $a$  from the centre P (as shown). Now, the midpoint of the string is pulled vertically upwards with a small but constant force  $F$ . As a result, the particles move towards each other on the surface. The magnitude of acceleration of masses along line joining them, when the separation between them becomes  $2x$ , is:

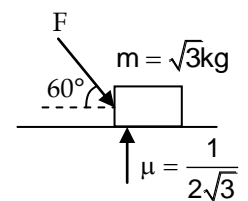


(A)  $\frac{F}{2m} \cdot \frac{a}{\sqrt{a^2 - x^2}}$                       (B)  $\frac{F}{2m} \cdot \frac{\sqrt{a^2 - x^2}}{x}$                       (C)  $\frac{F}{2m} \cdot \frac{x}{\sqrt{a^2 - x^2}}$                       (D)  $\frac{Fx}{2ma}$

8. **C**

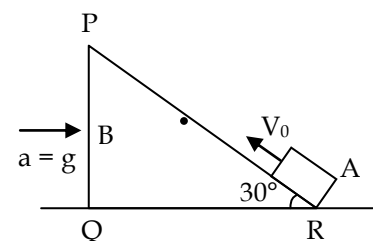
9. What is the maximum value of force  $F$  such that the block shown in the arrangement does not move?

(A) 20 N                      (B) 10 N                      (C) 12 N                      (D) 15 N



9. **A**

10. Block A is placed on a rough wedge B which is placed on a smooth surface. The wedge has angle of inclination of  $30^\circ$  and is imparted a horizontal acceleration  $g$  towards right. Block A is given an initial velocity  $v_0$  from rest. Find the coefficient of friction for which block A moves with constant velocity  $v_0$ : ( $g = 10 \text{ m/s}^2$ )

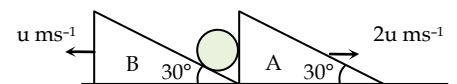


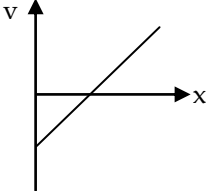
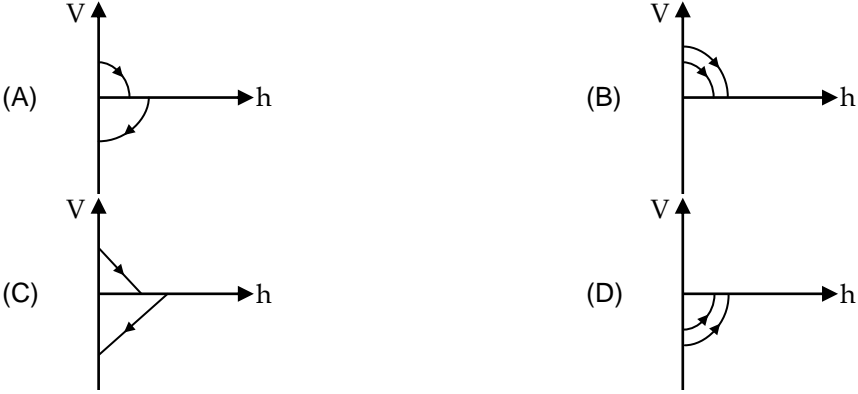
(A)  $\frac{(\sqrt{3}-1)}{(\sqrt{3}+1)}$                       (B)  $\frac{(\sqrt{2}-1)}{(\sqrt{2}+1)}$   
 (C)  $\frac{(2-\sqrt{2})}{(2+\sqrt{2})}$                       (D)  $\frac{(3-\sqrt{3})}{(3+\sqrt{3})}$

10. **A**

11. A system is shown in figure. Assume that the cylinder remains in contact with the two wedges. The velocity of cylinder is

(A)  $\sqrt{19 - 4\sqrt{3}} \text{ ms}^{-1}$                       (B)  $\frac{\sqrt{13}u}{2} \text{ ms}^{-1}$

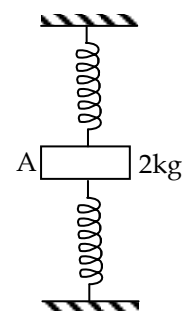
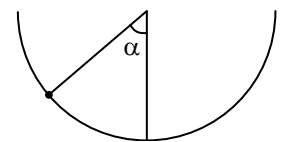


11. (C)  $\sqrt{3} \text{ u ms}^{-1}$  (D)  $\sqrt{7} \text{ ms}^{-1}$   
**D**
12. A block of mass 0.1 kg is held against a wall applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.50, the magnitude of frictional force acting on the block is:  
 (A) 2.5 N (B) 4.9 N (C) 0.49 N (D) 0.98 N  
**D**
13. ( $v - x$ ) curve is shown for a particle moving in a straight line. The acceleration of the particle will:  
 (A) increase with  $x$  parabolically  
 (B) remain constant  
 (C) increase linearly with  $x$   
 (D) none of the above  
  
**C**
14. A ball is dropped vertically from a height  $d$  above the ground. It hits the ground and bounces up vertically to a height  $d/2$ . Neglecting subsequent motion and air resistance, its velocity  $v$  varies with height  $h$  above the grounds as:  
  
**A**
15. A particle is moving eastwards with velocity of 5 m/sec. In 10 seconds, the velocity changes to 5 m/sec northwards. The average acceleration in this time is:  
 (A)  $\frac{1}{\sqrt{2}} \text{ m/sec}^2$  towards north-west (B)  $\frac{1}{\sqrt{2}} \text{ m/sec}^2$  towards north-east  
 (C) zero (D)  $\frac{1}{2} \text{ m/sec}^2$  towards north  
**A**
16. A particle is projected at an angle  $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$ . At a height, velocity of the particle is  $9\hat{i} + 3\hat{j} \text{ (m/s)}$ . Find the height ( $g = 10 \text{ m/s}^2$ ):  
 (A) 1.8 m (B) 0.9 m (C) 0.7 m (D) 0.11 m  
**B**
17. Due to wind which blows horizontally, only the range of the projectile is increased by 40% of its maximum height. Find the acceleration of the wind:  
 (A)  $\frac{g}{2}$  (B)  $\frac{g}{3}$  (C)  $\frac{g}{4}$  (D)  $\frac{g}{10}$   
**D**

18. A particle is projected up on an inclined plane. The component of its velocity perpendicular to the plane when it strikes the plane is 10 m/s. If the particle is projected at an angle of  $30^\circ$  from inclined plane, find the velocity of projection (m/s):  
 (A) 10 (B)  $10\sqrt{2}$  (C) 20 (D)  $20\sqrt{2}$
18. **C**
19. A ball is projected upwards with velocity  $u$  relative to the ground from an open lift moving upwards with velocity 10 m/s and upward acceleration of  $2 \text{ m/s}^2$ . The displacement of the ball at the instant when ball again meets the lift is 24.0 m. Find  $u$ : (in m/sec) ( $g = 10 \text{ m/s}^2$ )  
 (A) 18 (B) 20 (C) 22 (D) 24
19. **C**
20. A body accelerates from rest at a constant rate and then decelerates at a constant rate to come to the rest. The ratio of times of acceleration to deceleration is  $1/3$ . It achieves a maximum velocity of 3 m/sec. If total time elapsed is  $4\sqrt{3}$  seconds, find the rate of deceleration:  
 (A)  $\sqrt{3}$  (B)  $\frac{1}{\sqrt{3}}$  (C)  $2\sqrt{3}$  (D)  $\sqrt{3}/2$
20. **B**

**Part – B**  
**Numerical based questions**

1. A balloon starts rising at an acceleration. After some time, a stone is dropped from it. If the stone reaches the ground in the same time in which balloon reached at this point from where stone is dropped, the acceleration of the balloon is found to be  $g/N$ . What is value of  $N$ ?
1. **3**
2. An insect crawls up a hemispherical surface very slowly (see figure). The coefficient of friction between surface and insect is  $\frac{1}{3}$ . If the line joining the centre of the hemispherical surface to the insect makes an angle  $\alpha$  with the vertical, then for maximum possible value of  $\alpha$  the value of  $\cot \alpha = n$ . Then what is value of 'n'.
2. **3**
3. A block A of mass 2 kg is connected with two springs, as shown. The spring constant of lower spring is thrice the spring constant of upper spring. The system is released from rest with both the springs unstretched. The maximum displacement of block is 0.1 m. The acceleration of the block at its lowest position is  $4n$ . What is the value of 'n'?
3. **2.48 to 2.52**
4. A particle is moving in a straight line under the action of a variable force which supplies power proportional to the displacement, then displacement varies with time  $t$  as  $t^n$ . What is the value of 'n'?
4. **3**
5. A ball is projected upwards from the top of a tower with a velocity of  $50 \text{ ms}^{-1}$  making an angle of  $30^\circ$  with the horizontal. The height of the tower is 70 m. After  $2n$  seconds from the instant of throwing the ball will reach the ground. What is the value of 'n'.
5. **3.48 to 3.52**

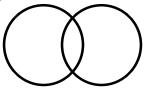
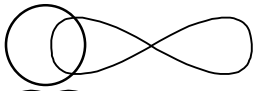
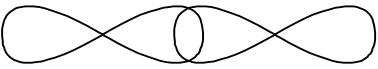
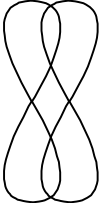


**SECTION – II: CHEMISTRY****Part – A: Single Correct Answer Type**

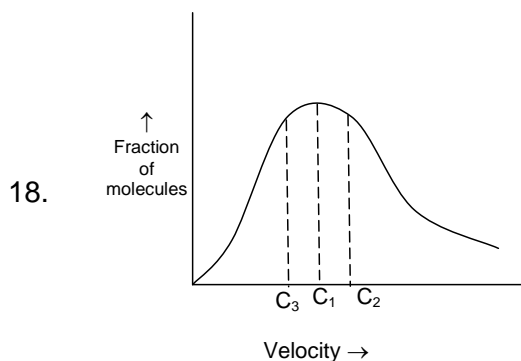
This section contains **20 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct**.

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1. Reaction of  $P_4O_{10}$  with MgO forms only magnesium phosphate. How many moles of MgO can completely react with one mole of  $P_4O_{10}$ ?  
(A) 4 (B) 5  
(C) 6 (D) 8  
1. **C**
  
2. Which of the following atom attains a half-filled electronic configuration by gaining one electron?  
(A) Boron (B) Carbon  
(C) Nitrogen (D) Oxygen  
2. **B**
  
3. Which of the following substance is formed in maximum amount when potassium reacts with oxygen gas?  
(A)  $K_2O$  (B)  $K_2O_2$   
(C) KO (D)  $KO_2$   
3. **D**
  
4. Which of the following species has the largest bond angle?  
(A)  $NH_4^+$  (B)  $NO_2^+$   
(C)  $CH_3^+$  (D)  $PH_4^+$   
4. **B**
  
5. What is the third ionization energy(I.E<sub>3</sub>) of lithium atom in electron volt unit?  
(A)  $\left(\frac{9}{4} \times 13.6\right)$  (B)  $(9 \times 13.6)$   
(C)  $\left(\frac{1}{9} \times 13.6\right)$  (D)  $\left(\frac{4}{9} \times 13.6\right)$   
5. **B**
  
6. Which of the following two elements have maximum number of identical properties?  
(A) Si and Al (B) Mg and K  
(C) Be and Al (D) Na and Mg  
6. **C**
  
7. The formula of the chloride of a normal element(M) is  $MCl_4$ . What is the formula of the peroxide( $O_2^{2-}$ ) of the element?  
(A)  $MO_3$  (B)  $MO_2$   
(C)  $MO_4$  (D)  $MO_8$   
7. **C**

8. How many maximum number of electrons of an atom will have  $n + \ell = 5$ ?  
 $n$  = principal quantum number  
 $\ell$  = azimuthal quantum number  
 (A) 6 (B) 8  
 (C) 10 (D) 18  
 8. **D**
9. Which of the following species has maximum spin value?  
 (A)  $O_2^+$  (B)  $O_2$   
 (C)  $O_2^-$  (D)  $O_2^{2-}$   
 9. **B**
10. The radius of each atom of helium is  $r$ . What would be the excluded volume for an atom of helium which touches other helium atoms in a vessel at high pressure and low temperature.  
 (A)  $\frac{4}{3}\pi r^3$  (B)  $\frac{8}{3}\pi r^3$   
 (C)  $\frac{16}{3}\pi r^3$  (D)  $\frac{32}{3}\pi r^3$   
 10. **C**
11. Which of the following gas reacts with NaOH?  
 (A)  $NH_3$  (B) CO  
 (C)  $H_2$  (D)  $C_2H_4$   
 11. **B**
12. Which of the following electron transition in hydrogen atom emits radiation of largest wavelength?  
 (A)  $n = 3 \rightarrow n = 1$  (B)  $n = 4 \rightarrow n = 3$   
 (C)  $n = 4 \rightarrow n = 1$  (D)  $n = 3 \rightarrow n = 2$   
 12. **B**
13. What is the oxidation number of carbon in  $CH_2Cl_2$ ?  
 (A) +2 (B) -2  
 (C) zero (D) +1  
 13. **C**
14. Which of the following produces a gas when reacts with water?  
 (A)  $Li_3N$  (B)  $NaNO_3$   
 (C)  $K_2SO_4$  (D) MgO  
 14. **A**
15. Which of the following overlap of atomic orbitals takes place in  $F_2$  according to valence bond theory?  
 (A)  (B)   
 (C)  (D)   
 15. **C**

16. Which of the following compound can absorb moisture and  $\text{CO}_2$  from atmosphere?  
 (A)  $\text{NaNO}_3$  (B)  $\text{NaOH}$   
 (C)  $\text{Na}_2\text{SO}_4$  (D)  $\text{NaCl}$
16. B
17. Which is the most thermally stable compound?  
 (A)  $\text{BaCO}_3$  (B)  $\text{BaSO}_4$   
 (C)  $\text{BaSO}_3$  (D)  $\text{Ba}(\text{HCO}_3)_2$
17. B



- What is the velocity( $C_1$ ) of one mole of  $\text{CH}_4$  at 320 K in  $\text{ms}^{-1}$  unit?  
 (A)  $60\sqrt{R}$  (B)  $20\sqrt{R}$   
 (C)  $200\sqrt{R}$  (D)  $\sqrt{40R}$
18. C
19. The outermost electron configuration of four normal elements are given below. Which element has the highest first ionization energy as well as highest electron affinity?  
 (A)  $ns^2np^1$  (B)  $ns^2np^2$   
 (C)  $ns^1$  (D)  $ns^2$
19. B
20. What is the equivalent mass of  $\text{Na}_2\text{S}_2\text{O}_3$  in the following reaction?  
 $\text{Na}_2\text{S}_2\text{O}_3 + 2\text{HCl} \longrightarrow \text{SO}_2 + \text{S} + \text{H}_2\text{O} + 2\text{NaCl}$   
 (A) 31.5 (B) 63  
 (C) 79 (D) 39.5
20. C

### Part – B Numerical based questions

1. Find the wavelength of the electromagnetic radiation in  $\text{\AA}$  unit which can excite the electron on one hydrogen atom from first orbit to the second orbit?
1. 1218  
Range: 1218 to 1218.5
2. How many total number of dipole vector(s) is/are observed in  $\text{NH}_3$ ?
2. 4
3. The kinetic energy of one mole of an ideal gas is 2494.2 Joule at a certain temperature. What is that temperature in degree celsius unit?
3. -73

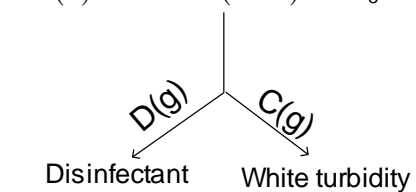


Range -73 to -73.2

4. 400 mL of 0.4 M acidified  $\text{MnO}_4^-$  solution exactly oxidizes 22.4 g of a metal from +2 oxidation state into some higher oxidation state. What is that higher oxidation state of the metal if its atomic mass is  $56 \text{ g mol}^{-1}$ ?

4. 4

5.  $\text{A(s)} \xrightarrow{\text{H}_2\text{O}} \text{B(soln)} + \text{NH}_3 \uparrow$



If gas 'D' is chlorine, how many total number of atom(s) is/are present in (A)?

5. 5

## SECTION – III: MATHEMATICS

### Part – A: Single Correct Answer Type

This section contains **20 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE is correct**.

1.  $\sin 163^\circ \cos 347^\circ + \sin 73^\circ \sin 167^\circ =$ 
  - (A) 0
  - (B)  $\frac{1}{2}$
  - (C) 1
  - (D) none of these
  
1. B
  
2. The diagonal AC and BD of rhombus intersect at (5, 6). If A = (3, 2), then equation of diagonal BD is:
  - (A)  $y - x = 1$
  - (B)  $2y - x = 17$
  - (C)  $y - 2x + 4 = 0$
  - (D)  $2y + x = 17$
  
2. D
  
3. Equation of the circle having centre at (3, -1) and cutting the intercept of length 6 units on the line  $2x - 5y + 18 = 0$  is:
  - (A)  $x^2 + y^2 - 6x + 2y - 18 = 0$
  - (B)  $x^2 + y^2 - 6x + 2y - 38 = 0$
  - (C)  $x^2 + y^2 - 6x + 2y - 28 = 0$
  - (D) none of the above
  
3. C
  
4. The exhaustive set of values of x satisfying the inequality  $\frac{x^4 - 3x^3 + 2x^2}{x^2 - x - 30} > 0$  is
  - (A)  $(-\infty, -5)$
  - (B)  $(1, 2) \cup (6, \infty)$
  - (C)  $(-\infty, -5) \cup (1, 2) \cup (6, \infty)$
  - (D)  $(1, 2)$
  
4. C
  
5. The exhaustive set of real values of x satisfying the inequality  $|x - 1| > 2$  is
  - (A)  $(-\infty, -1)$
  - (B)  $(3, \infty)$
  - (C) R
  - (D)  $(-\infty, -1) \cup (3, \infty)$
  
5. D
  
6. If  $\tan A + \cot A = 4$ , then  $\tan^4 A + \cot^4 A$  is equal to
  - (A) 110
  - (B) 191
  - (C) 80
  - (D) 194
  
6. D
  
7. If the point  $(a^2, a)$  and  $(3, -2)$  lie on opposite side of the line  $x + y + 1 = 0$  then a belongs to the interval
  - (A)  $(-\infty, 1)$
  - (B)  $(1, \infty)$
  - (C)  $(0, 1)$
  - (D) none of these
  
7. D

8. Let  $y = e^{2x}$ . Then  $\left(\frac{d^2y}{dx^2}\right)\left(\frac{d^2x}{dy^2}\right)$  is equal to
- (A) 1 (B)  $e^{-2x}$   
 (C)  $2e^{-2x}$  (D)  $-2e^{-2x}$
8. D
9. The angle between the pair of lines joining origin to the points of intersection of  $7x^2 + 8y^2 - 4xy + 2x - 4y - 8 = 0$  and  $3x - y = 2$  is
- (A)  $\tan^{-1}\sqrt{2}$  (B)  $\frac{\pi}{3}$   
 (C)  $\frac{\pi}{4}$  (D)  $\frac{\pi}{2}$
9. D
10. The expression  $\frac{1 + \sin 2\alpha}{\cos(2\alpha - 2\pi) \cdot \tan\left(\alpha - \frac{3\pi}{4}\right)} - \frac{1}{4} \sin 2\alpha \left[ \cot \frac{\alpha}{2} + \cot\left(\frac{3\pi}{2} + \frac{\alpha}{2}\right) \right]$  when simplified reduces to
- (A) 1 (B) 0  
 (C)  $\sin^2 \frac{\alpha}{2}$  (D) none of these
10. D
11. Maximum value of  $\frac{1}{3\cos x + 4\sin x + 8}$  is
- (A) 3 (B)  $\frac{1}{3}$   
 (C) 8 (D)  $\frac{1}{8}$
11. B
12. If the line  $y - mx + m - 1 = 0$  cuts the circle  $x^2 + y^2 - 4x - 4y + 4 = 0$  at two real points, then the complete set of values of  $m$  is
- (A)  $[-1, 1]$  (B)  $[-2, 2]$   
 (C)  $(-\infty, \infty)$  (D)  $[-4, 4]$
12. C
13. If the tangent at the P on the circle  $x^2 + y^2 + 2x + 2y = 7$  meets the straight line  $3x - 4y = 15$  at a point Q on the x-axis, then length of PQ is
- (A)  $3\sqrt{7}$  (B)  $4\sqrt{7}$   
 (C)  $2\sqrt{7}$  (D)  $\sqrt{7}$
13. C
14. The number of solution of  $\log_4(x - 1) = \log_2(x - 3)$  is
- (A) 3 (B) 1  
 (C) 2 (D) 0
14. B

15. The length of the median through the vertex A of a triangle having vertices  $A(-1, 3)$ ,  $B(1, -1)$  and  $C(5, 1)$ , is  
 (A) 5 (B) 4  
 (C) 1 (D) none of these
15. **A**
16. If  $p_1$  and  $p_2$  are the lengths of the perpendiculars from the origin to the straight lines  $x \sec \theta + y \operatorname{cosec} \theta = a$  and  $x \cos \theta - y \sin \theta = a \cos 2\theta$  respectively, then the value of  $4p_1^2 + p_2^2$  is  
 (A)  $4a^2$  (B)  $2a^2$   
 (C)  $a^2$  (D) none of these
16. **C**
17. If the gradient of one of the lines  $x^2 + hxy + 2y^2 = 0$  is twice that of the other, then  $h =$   
 (A)  $\pm 3$  (B)  $\pm \frac{3}{2}$   
 (C)  $\pm 2$  (D)  $\pm 1$
17. **A**
18. The line joining  $(5, 0)$  and  $(10 \cos \theta, 10 \sin \theta)$  is divided internally in the ratio  $2 : 3$  at the point P. If  $\theta$  varies, the locus of P is  
 (A) a pair of straight lines (B) a circle  
 (C) a straight line (D) none of these
18. **B**
19. If  $\log_2(\sin x) - \log_2(\cos x) - \log_2(1 - \tan x) - \log_2(1 + \tan x) = -1$ , then  $\tan 2x =$   
 (A)  $-1$  (B)  $1$   
 (C)  $\frac{1}{2}$  (D)  $4$
19. **B**
20. The locus of the point such that the tangents drawn from it to the circle  $x^2 + y^2 - 6x - 8y = 0$  are perpendicular to each other, is  
 (A)  $x^2 + y^2 - 6x - 8y - 25 = 0$  (B)  $x^2 + y^2 + 6x - 8y - 5 = 0$   
 (C)  $x^2 + y^2 - 6x + 8y - 5 = 0$  (D)  $x^2 + y^2 - 6x - 8y + 25 = 0$
20. **A**

**Part – B**  
**Numerical based questions**

21. If  $\frac{x}{\cos \theta} = \frac{y}{\cos(\theta - 120^\circ)} = \frac{z}{\cos(\theta + 120^\circ)}$ , then  $x + y + z$  is equal to
21. **0**
22. Let  $\int_0^1 \frac{e^{\sqrt{x}}}{\sqrt{x}} dx = \lambda(e - 1)$ . The value of  $\lambda$  is
22. **2**

23. The area of triangle formed by the line  $x + y = 3$  and the angle bisectors of the pair of straight lines  $x^2 - y^2 + 2y = 1$  is (in sq. units)
23. 2
24. If  $a$  and  $b$  are the largest and smallest distances of  $(2, -7)$  and the circle  $x^2 + y^2 - 14x - 10y - 151 = 0$ , then  $\frac{1}{5}(a + b)$  is equal to
24. 3
25. The value of  $\lambda$  for which  $2x^2 + 7xy + 3y^2 + 8x + 14y + \lambda = 0$  represents a pair of straight line is
25. 8

## **Hints & Solutions**

### **Physics**

#### **Part-A**

**Single Correct Choice Type**

#### **Part-B**

**Numerical Answer Type**

## **Chemistry**

Part - B

## **Mathematics**

Part – B