FIITJEE Phase Test (JEE-Advanced)

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-1 | **QP Code:** | **PAPER - 2**

Time Allotted: 3 Hours **Maximum Marks: 183**

- 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. All the section can be filled in **PART-A** of 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 ***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.

C. Marking Scheme For Only One Part.

(i) **Part-A (01-07) –** Contains seven (07) 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-A (08-14) –** Contains seven (07) multiple choice questions which have ONLY ONE CORRECT answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(iii) **Part-A (15-18) -** This section contains Two paragraphs. Based on each paragraph, there are Two multiple choice questions. Each question has only one correct answer and carries **+3 marks** for the correct answer and **-1 marks** for wrong answer.

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

BATCHES – NWCMPA122N1 & M1_PT1

SECTION-1 : PHYSICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. For a curved track of radius R, banked at angle θ
   (A) A vehicle moving with a speed $\upsilon_0 = \sqrt{Rg\tan\theta}$ is able to negotiate the curve without calling friction into play at all
   (B) A vehicle moving with a speed $\upsilon > \upsilon_0$ is able to negotiate the curve with calling friction into play
   (C) A vehicle is moving with a speed $\upsilon < \upsilon_0$ must also have the force of friction into play
   (D) The maximum value of the angle of banking for a vehicle parked on the banked road can stay there without slipping, is given by $\theta = \tan^{-1}\mu_s$ (μ_s = coefficient of static friction)

1. **ABCD**

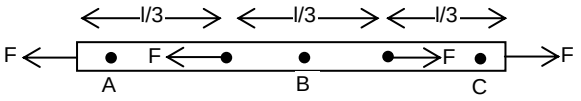
2. The potential energy U for a force field $\vec{F}$ is such that U = –kxy, where k is a constant.
   (A) $\vec{F} = ky\hat{i} + kx\hat{j}$ (B) $\vec{F} = kx\hat{i} + ky\hat{j}$
   (C) The force $\vec{F}$ is a conservative force (D) The force $\vec{F}$ is a non-conservative force

2. **AC**

3. If $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = 2\hat{i} - 3\hat{j} + \hat{k}$ then
   (A) $\vec{A}.\vec{B} = -5$ (B) $\vec{A}.\vec{B} = 5$
   (C) $\left|\vec{A}\times\vec{B}\right| = \sqrt{157}$ (D) $\left|\vec{A}\times\vec{B}\right| = -\sqrt{157}$

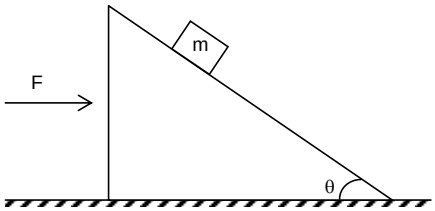
3. **AC**

4. Four persons are holding a rope of length ℓ at position as shown in figure. All of them are applying equal force F in the direction as shown in figure. Then the tension
   Statement 1 – at point A will be F
   Statement 2 – at point B will be 2F
   Statement 3 – at point C will be F
   (A) only statement 1 & 2 is true (B) only statement 2 is true
   (C) all the three statements are true (D) none of the statements are true



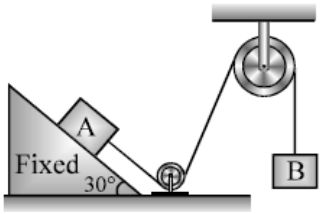
4. **C**

5. A smooth massless wedge is pushed by a horizontal force F, When :
   (A) F = 0, N < mg cosθ; N = Normal reaction received by the block
   (B) F > 0, N = mg cosθ
   (C) a = 0,N = mg cosθ; a acceleration of the wedge
   (D) $F = mg\tan\theta, N = \frac{mg}{\cos\theta}$



5. **ACD**

6. Two blocks A and B of equal mass m are connected through a massless string and arranged as shown in figure. Friction is absent everywhere. When the system is released from rest.



(A) Tension in the string is mg/2
(B) Tension in the string is mg/4
(C) Acceleration of A is g/2
(D) Acceleration of A is 3g/4

6. **BD**

7. A man who can swim at a speed v relative to the water wants to cross a river of width d, flowing with a speed u. The point opposite him across the river is P.

(A) The minimum time in which he can cross the river is $\frac{d}{v}$.

(B) He can reach the point P in time $\frac{d}{v}$.

(C) He can reach the point P in time $\frac{d}{\sqrt{v^2-u^2}}$

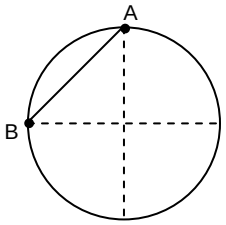
(D) He cannot reach P if u > v.

7. **ACD**

(Single Correct Choice Type)

This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

8. Two beads A and B of equal mass 'm' are connected by a light inextensible cord. They are constrained to move on a frictionless ring in vertical plane. The blocks are released from rest as shown in figure. The tension in the cord just after the release is



(A) $\frac{mg}{4}$ (B) $\sqrt{2}\,mg$

(C) $\frac{mg}{2}$ (D) $\frac{mg}{\sqrt{2}}$

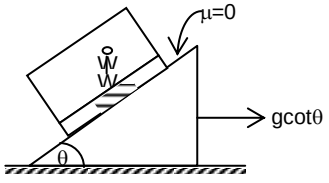
8. **D**

9. A car is moving on a circular horizontal track of radius 10 m with a constant speed of 10m/s. A plumb bob is suspended from the roof of the car by a light rigid rod. The angle made by the rod with the track is

(A) 0^o (B) 30^o (C) 45^o (D) 60^o

9. **C**

10. A large inclined plane of inclination θ is accelerated with an acceleration of g cot θ on the horizontal plane. The apparent weight of the man of mass 10 kg measured by the weighing machine in the box is



(A) zero (B) 400 N

(C) 200√2 N (D) 400√2 N

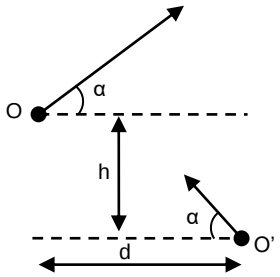
10. **A**

11. A small ball thrown at an initial velocity *u* directed at an angle $\theta = 37°$ above the horizontal collides inelastically ($e = 1/4$) with a vertical massive wall moving with a uniform horizontal velocity $u/5$ towards ball. After collision with the wall, the ball returns to the point from where it was thrown. Neglect friction between ball and wall. The time *t* from beginning of motion of the ball till the moment of its impact with the wall is
($\tan 37° = 3/4$)

(A) $\frac{3u}{5g}$ (B) $\frac{18u}{25g}$ (C) $\frac{54u}{125g}$ (D) $\frac{54u}{25g}$

11. **C**

12. Two particles are projected simultaneously from two points, O and O' such that d is the horizontal distance and h is the vertical distance between them. They are projected at the same inclination α to the horizontal with the same speed v. The time after which their separation becomes minimum is



(A) d/(v cos α) (B) 2d/(v cos α)
(C) d/(2v cos α) (D) d/v

12. **C**

13. If the initial velocity of a particle is $\vec{u} = \hat{i} + \hat{k}\ m/s$ and acceleration $\vec{a} = 2\hat{j}\ m/s^2$, the velocity of the particle after one second is

(A) 4 m/s (B) $\sqrt{6}\ m/s$
(C) $2\sqrt{2}\ m/s$ (D) 1 m/s

13. **B**

14. **Statement-1:**
The driver in a vehicle moving with a constant speed on a straight road is in a non-inertial frame of reference.

Statement-2:
A reference frame in which Newton's laws of motion are not applicable is non inertial.

(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.

14. **D**

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 15 to 16

One particle of mass 1 kg is moving along +ve x-axis with velocity 3 m/s. Another particle of mass 2 kg is moving along y-axis with 6 m/s. At time t = 0, 1 kg mass is at (3m, 0) and 2 kg mass is at (0, 9m). x – y plane is the horizontal plane (surface is smooth for question 15 and rough for questions 16 and 17)

15. The centre of mass of the two particles is moving in a straight line

(A) $y = x + 4$ (B) $y = 4x + 2$
(C) $y = 2x - 4$ (D) $y = 2x + 4$

15. **B**

16. If both the particles have the same value of coefficient of friction μ = 0.2. the centre of mass will stop at time
(A) 1.5 sec (B) 4.5 sec
(C) 3 sec (D) 2.0 sec

16. **C**

Paragraph for Question no. 17 to 18

In a conservative force field we can define the radial component of force from the potential energy function by using $F = -\frac{du}{dr}$. Here, a positive force means repulsion and a negative force means attraction. For the given potential energy function U(r) we can find the equilibrium position where force is zero. We can also find the ionization energy which is the work done to move the particle from a certain position to infinity. Let us consider a case in which a particle is bound to a certain point at a distance 'r' from the centre of the force. The potential energy of the particle is $U = \frac{A}{r^2} - \frac{B}{r}$, where 'r' is the distance from the centre of the force and A and B are +ve constants. Answer the following questions:

17. The equilibrium distance is given by
(A) $\frac{A}{B}$ (B) $\frac{2A}{B}$ (C) $\frac{3A}{B}$ (D) $\frac{B}{2A}$

17. **B**

18. The equilibrium is
(A) stable (B) unstable
(C) neutral (D) cannot be predicted

18. **A**

SECTION-2 : CHEMITRY

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Which of the following electron configuration(s) is/are incorrect?
(A) $[He]2s^1 2p^3$ (B) $[Ar]_{18}4s^1 3d^5$
(C) $[Ne]_{10}3s^1 3p^3$ (D) $[Ar]_{18}4s^2 3d^9$

1. **ACD**

2. The correct statement(s) regarding the structure of SF_6 is/are
(A) sulphur undergoes sp^3d^2 hybridization (B) it has octahedral structure
(C) sulphur contains two lone pairs (D) it contains sigma as well as pi-bonds

2. **AB**

3. The heat of reaction(ΔH) of a chemical reaction can be changed by
(A) using a catalyst
(B) changing activation energy
(C) increasing the potential energy of reactant
(D) decreasing the potential energy of product

3. **CD**

4. $CO_2(g) + C(s) \rightleftharpoons 2CO(g); K_{P_1} = 1 \times 10^{-2}$ atm

$Ni(s) + 4CO(g) \rightleftharpoons [Ni(CO)_4](s);\ K_{P_2} = \left(\frac{1}{16} \times 10^4\right) atm^{-4}$

Choose correct statement(s) regarding the above simultaneous equilibria?
(A) The partial pressure of CO_2 is 4 atm
(B) The concentration of CO in both equilibrium remains constant
(C) More amount of CO_2 will be formed if the pressure at equilibrium is increased
(D) For the top reaction, $K_{P_1} = K_{C_1}$

4. **ABC**

5. The pH of the aqueous solution of which of the following salt(s) does/do not depend on concentration, whatever may be the value of 'h'(degree of hydrolysis)?
(A) NaHS (B) $NaNO_3$
(C) CH_3COONa (D) $KHCO_3$

5. **B**

6. Which of the following property(ies) of group-2 elements decrease(s) on moving down the group?
(A) Solubility of hydroxides (B) Solubility of sulphates
(C) Ease of decomposition of sulphates (D) Reaction with water

6. **BC**

7. Which of the following substance(s) is/are used to remove the hardness of water?
(A) NaOH (B) Na_2CO_3
(C) $NaHCO_3$ (D) NaCl

7. **B**

(Single Correct Choice Type)

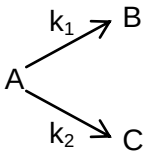
This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

8. Which of the following contains the strongest B – F bond?
(A) BF_3 (B) BF_2Cl
(C) $BFCl_2$ (D) BF_4^-

8. **C**

9. $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
The rate of above reaction is not equal to
(A) $-\frac{1}{5}\frac{d\left[C_2O_4^{2-}\right]}{dt}$ (B) $\frac{1}{2}\frac{d\left[Mn^{2+}\right]}{dt}$
(C) $\frac{1}{10}\frac{d[CO_2]}{dt}$ (D) $\frac{1}{8}\frac{d[H_2O]}{dt}$

9. **D**

10. 

The incorrect expression for the above first order reaction is:
(A) $\frac{-d[A]}{dt} = k_1[B]$ (B) $\frac{d[C]}{dt} = k_2[A]$
(C) $\frac{d[B]}{dt} = k_1[A]$ (D) $\frac{-d[A]}{dt} = (k_1 + k_2)[A]$

10. **A**

11. $2Ca(s) + O_2(g) \rightleftharpoons 2CaO(s)$
The equilibrium constant K_P of above reaction is 0.5 atm^{-1} at a certain temperature. What is the partial pressure at O_2 of equilibrium?
(A) 5 atm (B) 2 atm
(C) 0.5 atm (D) 0.2 atm

11. **B**

12. Which of the following ion will produce maximum heat, when reacts with water?
(A) Na^+ (B) K^+
(C) Be^{2+} (D) Mg^{2+}

12. **C**

13. What is the sum of the principal quantum numbers of two orbits in hydrogen atom, between which the lowest energetic Balmer line is formed due to electron excitation?
(A) 6 (B) 3
(C) 4 (D) 5

13. **D**

14. The solubility of a salt XY in water is 0.2 mol L^{-1}. What will be the solubility product of the salt if it ionizes as X^{3+} and Y^{3-} ions?
(A) 8×10^{-3} (B) 4×10^{-2}
(C) 64×10^{-6} (D) 2×10^{-2}

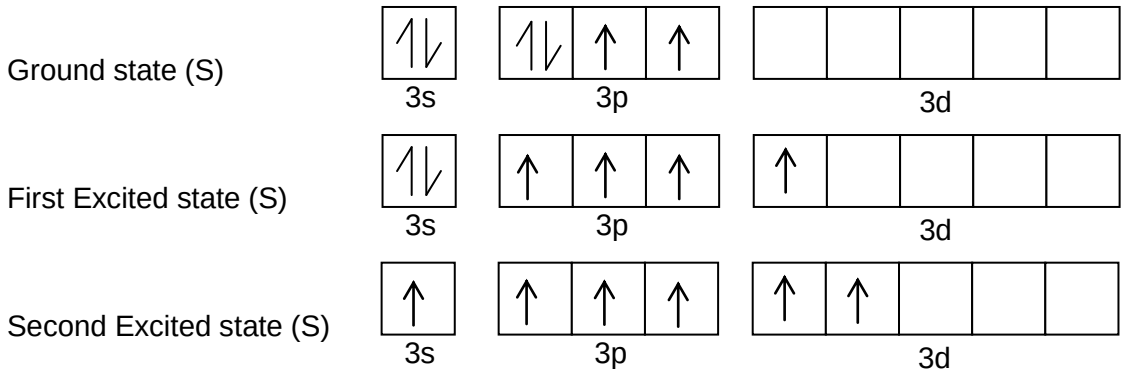
14. **B**

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 15 to 16

The outermost electronic configuration of sulphur atom in ground state as well as excited state is given as follows:



15. Which of the following compound is formed by sulphur in first excited state?
(A) SO_4^{2-} (B) HSO_3^-
(C) SF_2 (D) SF_6

15. **B**

16. Sulphur forms SO_3 in second excited state. How many p-orbital(s) of sulphur form(s) pi(π) bond in it?
(A) Zero (B) 1
(C) 2 (D) 3

16. **B**

Paragraph for Question no. 17 to 18

The solubility of sparingly soluble bases depends on temperature and pH of the solutions. $Mg(OH)_2$ is a sparingly soluble base as equilibrium exists between the dissociated ions and undissociated molecules. The solubility product of $Mg(OH)_2$ at a certain temperature is 4×10^{-6}.

Answer the following questions on the basis of above write up.

17. What is the solubility of $Mg(OH)_2$ in water in presence of 0.2 M NaCl?
(A) 2×10^{-2} mol L^{-1} (B) 10^{-3} mol L^{-1}
(C) 10^{-2} mol L^{-1} (D) 2×10^{-3} mol L^{-1}

17. **C**

18. If the solubility of $Mg(OH)_2$ in water is X mol L^{-1}, what will be its solubility at pH = 10?
(A) Less than X (B) Greater than X
(C) Equal to X (D) Unpredictable

18. **B**

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. The $\lim\limits_{x\to 0} x^8\left[\frac{1}{x^3}\right]$ (where $[x]$ is greatest integer function) is

(A) a nonzero real number (B) a rational number
(C) an integer (D) zero

1. BCD

2. If $\int \frac{\sin x}{\sin\left(x-\frac{\pi}{4}\right)}dx = A\left(f(x)+\log|\sin x-\cos x|\right)+C$ then

(A) $A=\sqrt{2}$ (B) $A=\frac{1}{\sqrt{2}}$
(C) $f(x)=\sin x$ (D) $f(x)=x$

2. BD

3. If $I=\int \frac{5x^8+7x^6}{\left(x^2+1+2x^7\right)^2}dx$ then I is equal to

(A) $\frac{x^7}{2x^7+x^2+1}+C$ (B) $\frac{x^5}{x^2+1+2x^7}+C$
(C) $\frac{-1}{2x^7+x^2+1}+C$ (D) $\frac{p(x)}{q(x)}$, $\deg p(x)=\deg q(x)=7$

3. AD

4. $\lim\limits_{n\to\infty}\left(\frac{1}{\sqrt{n^2}}+\frac{1}{\sqrt{n^2-1^2}}+\frac{1}{\sqrt{n^2-2^2}}+\ldots+\frac{1}{\sqrt{n^2-(n-1)^2}}\right)$ is equal to

(A) $\frac{\pi}{2}$ (B) $\sin^{-1}0$
(C) $\cos^{-1}1$ (D) $2\tan^{-1}1$

4. A, D

5. If tangent at point (1, 2) on curve $y=ax^2+bx+\frac{7}{2}$ be parallel to normal at (–2, 2) on the curve $y=x^2+6x+10$, then

(A) $a=1$ (B) $a=-1$
(C) $b=\frac{-5}{2}$ (D) $b=\frac{5}{2}$

5. AC

6. The function $f:[0,1]\to[0,1]$ is continuous and has the property f(f(x)) = 1 – x and J = $\int_0^1 f(x)\,dx$ then

(A) $f\left(\frac{1}{4}\right)+f\left(\frac{3}{4}\right)=1$ (B) the value of J = $\frac{1}{2}$

(C) $f\left(\frac{1}{3}\right)+f\left(\frac{2}{3}\right)=2$ (D) $\int_0^{\pi/2}\frac{\sin x dx}{(\sin x+\cos x)^3}=J$

6. ABD

7. The value of the integral $\int_0^1 e^{x^2}dx$ is

(A) less then e (B) greater than e
(C) less then e-1 (D) greater than 1

7. ACD

(Single Correct Choice Type)

This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

8. $f(x)=\frac{x}{\log_e x}$, $x\neq 1$, is decreasing in interval

(A) (0, e) (B) (1, e)
(C) (e, ∞) (D) none of these

8. B

9. If $\frac{(x^2-1)(x+2)(x+1)^2}{(x-2)}<0$, then x lies in the interval

(A) (–2, –1) ∪ (1, 2) (B) (–∞, –2) ∪ (2, ∞)
(C) (–2, –1) ∪ (2, ∞) (D) (–2, –1) ∪ (1, ∞)

9. A

10. Let T > 0, be a fixed real number. Suppose f is a continuous function such that for all x ∈ R, f(x +T) = f(x). If $I=\int_0^T f(x)dx$, then value of $\int_3^{3+3T} f(2x)dx$ is

(A) $-\frac{3}{2}I$ (B) 2I
(C) 3I (D) 6I

10. C

11. $\lim_{x\to 2}\frac{\tan\left(e^{x-2}-1\right)}{\ln(x-1)}$

(A) 2 (B) –2
(C) 1 (D) –1

11. C

12. If f(x) = $\begin{cases} \dfrac{\sin\{x\}}{\{x\}}, & \{x\} \neq 0 \\ k, & \{x\} = 0 \end{cases}$, where {x} denotes fractional part of x, then f(x) will be continuous

(A) if k = 0 (B) if k = sin1

(C) if k = 1 (D) for no value of k

12. D

13. If $h(x) = \int_1^x \sin^4 t\,dt$, then $h(x+\pi)$ equals

(A) $h(x)+h(\pi)$ (B) $h(x)h(\pi)$

(C) $h(x)-h(\pi)$ (D) $\dfrac{h(x)}{h(\pi)}$

13. A

14. The point(s) on the curve $y^3+3x^2=12y$ where the tangent is vertical is (are)

(A) $\left(\pm\dfrac{4}{\sqrt{3}}-2\right)$ (B) $\left(\pm\sqrt{\dfrac{11}{3}},1\right)$

(C) $(0,0)$ (D) $\left(\pm\dfrac{4}{\sqrt{3}},2\right)$

14. D

(Paragraph Type)

This section contains **2 paragraphs**. Based upon the paragraphs **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Question no. 15 to 16

If $y=\int_{u(x)}^{v(x)} f(t)\,dt$, let us define $\dfrac{dy}{dx}$ in a different manner as

$$\frac{dy}{dx}=v'(x)f(v(x))-u'(x)f(u(x))$$

15. If $F(x)=\int_1^x e^{t^2/2}(1-t^2)\,dt$, then $\dfrac{d}{dx}F(x)$ at x = 1 is

(A) 0 (B) 1

(C) 2 (D) –1

15. A

16. $f(x)=\int_0^x e^t(t-1)^{2019}(t-2)^{2017}\,dt$, is increasing in the interval

(A) $(-\infty,1)\cup(2,\infty)$ (B) $(1,2)$

(C) $(-\infty,\infty)$ (D) $(-\infty,2)$

16. A

Paragraph for Question no. 17 to 18

A cubic $f(x) = ax^3 + bx^2 + cx + d$ vanishes at x = -2 and has local minimum/maximum at x = -1 and x = $\frac{1}{3}$ and if $\int_{-1}^{1} f(x)\,dx = \frac{14}{3}$.

17. The function f(x) is
(A) $x^3 + x^2 + x - 2$ (B) $x^3 - x^2 + x - 2$
(C) $x^3 - x^2 - x + 2$ (D) $x^3 + x^2 - x + 2$

17. **D**

18. f(x) decreases in the interval
(A) $\left(-\frac{1}{3},1\right)$ (B) $\left(-\frac{1}{3},-1\right)$
(C) $\left(-1,\frac{1}{3}\right)$ (D) $\left(1,\frac{3}{2}\right)$

18. **C**

ANSWERS

SECTION-1 : PHYSICS

PART – A

Paper – 2 : CHEMISTRY

PART – A

SECTION – 3 : MATHEMATICS

PART – A