FIITJEE INTERNAL TEST

COMMON TEST – I

Batches: One Year CRP(2122)

IIT- JEE 2022

Time: ***3 hours*** **Maximum Marks: 186**

- ***Please read the instructions carefully. You are allotted 5 minutes specially for this purpose.***
- ***You are not allowed to leave the examination hall before end of the test.***
- ***Use Blue/Black Ball Point Pen only*** *for writing particulars on* ***Side–1 and Side–2*** *of the Answer Sheet.* ***Use to Pencil is strictly prohibited.***

Instructions

Note:

1. The question paper contains 3 sections (Sec-1, Physics, Sec-II, Chemistry & Sec-III, Mathematics.)
2. Each section is divided into two parts, **Part-A and Part-B**.
3. **Part – A** contains 13 questions which are further divided as follows:

❖ **Q. 1 – 5** are multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which **only one is correct**.

❖ **Q. 6 – 13** are multiple correct answer type questions. Each question has four choices (A), (B), (C) and (D), out of which **one or more answer(s) is/are correct**.

4. **Part – B** contains 5 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).

Marking Scheme

1. For each question in the group **Q. 1 – 5** to **Part – A** you will be awarded **3 marks** if you have darkened only the bubble corresponding to the answer and zero marks if no bubble is darkened. In all other cases, **minus one (–1) mark will be awarded.**
2. For each question in the group **Q. 6 – 13** of **Part – A** contains 8 Multiple Choice Questions which have One or More Correct answer. Each question carries **+4 marks** for correct answer and **– 1 marks** for wrong answer.
   For each question in the group **Q. 6 – 13** of **PART – A** you will be awarded
   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.
3. **Part-B (01-05)** contains Six (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 **+3 marks** for correct answer and **there will be no negative marking.**

Name of the Candidate **:** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Enrolment Number **:** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Section – I (Physics)

PART – A

(Single Correct Choice Type)

This section contains 5 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which only **ONE** option is be correct.

1. A train passes an observer standing on a platform. The first carriage of the train passes the observer in time t_1 = 1sec and the second carriage in t_2 = 1.5 sec. Find its acceleration assuming it to be constant. The length of each carriage is ℓ = 12 m.

   (A) $3.3\ m/sec^2$ (B) $-3.2\ m/sec^2$ (C) $24\ m/sec^2$ (D) $-24\ m/sec^2$

1. **B**

2. If $\vec{R}_1 = \vec{A} + \vec{B}$ and $\vec{R}_2 = \vec{A} - \vec{B}$, then $\frac{\vec{R}_1 + \vec{R}_2}{|\vec{R}_1 + \vec{R}_2|}$ will be along

   (A) $\vec{A}$ (B) $\vec{B}$ (C) $\vec{A} + \vec{B}$ (D) $\vec{A} - \vec{B}$

2. **A**

3. A point moves in xy plane according to equation x = at, y = at(1-bt) where a and b are positive constants and t is time. The instant at which velocity vector is at $\pi/4$ with acceleration vector is given by

   (A) $\frac{1}{a}$ (B) $\frac{1}{b}$ (C) $\frac{1}{a} + \frac{1}{b}$ (D) $\frac{a+b}{a^2+b^2}$

3. **B**

4. If $|\vec{A}| = |\vec{B}|$ and $\vec{A} \neq \pm\vec{B}$ then angle between the vectors $(\vec{A} + \vec{B})$ and $(\vec{A} - \vec{B})$ is

   (A) 0 (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{2}$

4. **D**

5. A vector of magnitude a is turned through angle θ. The magnitude of change in the vector is given by

   (A) $|2a\sin\theta|$ (B) $|2a\sin(\theta/2)|$ (C) $\left|\frac{a}{2}\sin\theta\right|$ (D) $\left|\frac{a}{2}\sin\left(\frac{\theta}{2}\right)\right|$

5. **B**

(Multiple Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

6. A particle of mass m moves on the x axis as follows. It starts from rest at t = 0 from the point x = 0 and comes to rest at t = 1 at the point x = 1. No other information is available about its motion at intermediate times (0<t<1). If α denotes the instantaneous acceleration of the particle, then

   (A) α cannot remain positive for all t in the interval $0 \le t \le 1$

   (B) $|\alpha|$ can not exceed 2 at any point in its path

   (C) $|\alpha|$ must be ≥ 4 at some point or points in its path

   (D) α must change sign during the motion, but no other assertion can be made with the information given.

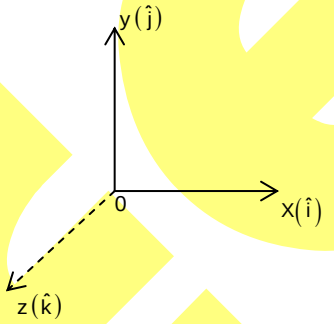
6. **AC**

7. 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) $\left|\vec{A} \times \vec{B}\right| = -\sqrt{157}$

7. **AC**

8. A particle is projected from origin with velocity $\vec{u} = \left(\hat{i} + \hat{j} + \sqrt{2}\hat{k}\right)$ m/s. Horizontal surface lies in X – Y plane, then (take g = 10 m/sec^2)



(A) Time of flight = $\frac{\sqrt{2}}{5}$ sec

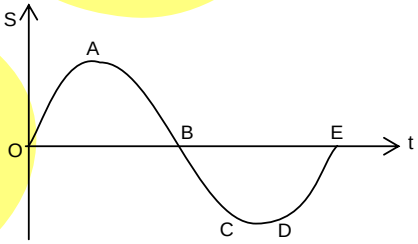
(B) horizontal range = $\frac{2}{5}$ m

(C) Maximum height $\frac{1}{10}$ m

(D) Maximum height = $\frac{1}{5}$ m

8. **ABC**

9. A particle has a rectilinear motion and the figure gives its displacement as a function of time. Which of the following statements are true with respect to the motion.



(A) in motion between 0 to A, the velocity is positive and acceleration is negative

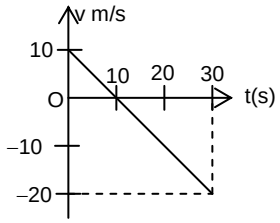
(B) between A and B, the velocity and acceleration are positive

(C) between B and C, the velocity is negative and acceleration is positive

(D) between D and E, the acceleration is positive

9. **ACD**

10. The velocity-time graph for a particle moving on a straight line is shown in figure.



(A) the particle has constt. acceleration

(B) the particle has never turned around

(C) the particle has zero displacement

(D) the average speed in the interval 0 to 10 s is the same as the average speed in the interval 10 s to 20 s.

10. **AD**

11. It $\vec{A} = \sqrt{3}\hat{i} + \hat{j}$

& $\vec{B} = \sqrt{3}\hat{i} - \hat{j}$

and angle between $\vec{A}$ & $\vec{B}$ is θ then

(A) $\theta = 60°$ (B) $\theta = 90°$

(C) $\vec{A}.\vec{B}$ (D) Component of $\vec{A}$ along $\vec{B}$ = 1

11 **AD**

12. Two particles A and B are projected from the same point with the same speed but at different angles α and β with the horizontal, such that the maximum height of A is two third of the horizontal range of B. Then which of the following relations are true?
(A) range of A = maximum height of B (B) $3(1-\cos 2\alpha) = 8 \sin 2\beta$
(C) maximum value of β is $\sin^{-1}(3/4)$ (D) maximum horizontal range of A = u^2/g

12. **BD**

13. 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.

13. **ACD**

PART – B

This section contains 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)

1. A man is going up in an air balloon going up with an acceleration 2 m/s^2. When he reaches to a ht. 100 m from ground, he drops a ball. The time taken by the ball to reach the ground is $x\left(1+\sqrt{6}\right)$. Value of x is

1. **2**

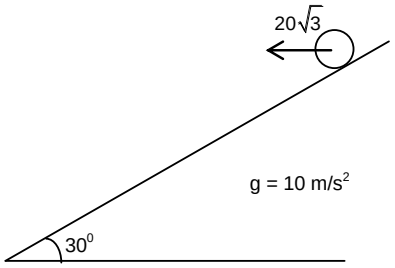
2. A passenger is standing 20 m behind from a bus. The bus begins to move with constant acceleration 0.9m/s^2. To catch the bus, the passenger runs at a constant speed v towards the bus. The minimum speed (in m/s) of the passenger so that he may catch the bus is 4n. Find the value 'n'.

2. **1.50**

3. Two particles having position vectors $\vec{r}_1 = \left(3\hat{i}+\hat{5}\right)$ metres and $\vec{r}_2 = \left(-5\hat{i}-3\hat{j}\right)$ metres are moving with velocities $\vec{v}_1 = \left(4\hat{i}+3\hat{j}\right)$ and $\vec{v}_2 = \left(a\hat{i}+7\hat{j}\right)$ m/s. If they collide after 2 seconds, the value of a is

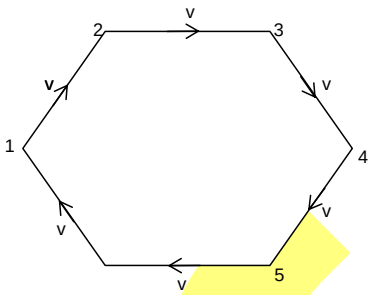
3. **8**

4. A particle is thrown horizontally with relative velocity 40 m/s from an inclined plane, which is also moving with acceleration 10 m/s^2 vertically upward. The time in sec. after which it lands on the plane is 4n. Find the value of 'n'. (take g = 10 m/s^2)



4. **0.50**

5. Six particles move in a cyclic manner along the sides of a regular hexagon of side ℓ as shown in the figure, when the speed of each particle is V the particles lie always at the vertices of a hexagon. When will the side of the hexagon be halved ? ℓ = 1 m, v = 1 m/sec



5. **1**

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Section – II (Chemistry)

PART – A

(Single Correct Choice Type)

This section contains 5 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which only **ONE** option is be correct.

1. Which of the following electron transition between the second orbit and third orbit is not allowed in H^- ion according to selection rule?
(A) $2s \rightarrow 3p$ (B) $2p \rightarrow 3d$ (C) $2p \rightarrow 3s$ (D) $2s \rightarrow 3d$

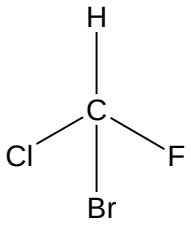
1. **D**

2. Which of the following molecule has angular shape?
(A) $BeCl_2$ (B) XeF_2 (C) SF_2 (D) CO_2

2. **C**

3. If the radius of the first orbit of hydrogen atom is 'a_0'. What will be the wavelength(λ) of the electron motion along the fourth orbit of hydrogen atom?
(A) $2\pi a_0$ (B) $4\pi a_0$ (C) $8\pi a_0$ (D) $16\pi a_0$

3. **C**

4. 

Which covalent bond in the above molecule contains the least amount of s-orbital character of the central atom?
(A) C – H (B) C – Cl (C) C – F (D) C – Br

4. **C**

5. Orientation of atomic orbitals is governed by
(A) principal quantum number (B) azimuthal quantum number
(C) magnetic quantum number (D) spin quantum number

5. **C**

(Multiple Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

6. Which of the following electron transition(s) in hydrogen atom belong(s) to Balmer series?
(A) $n = 2 \rightarrow n = 1$ (B) $n = 3 \rightarrow n = 2$ (C) $n = 4 \rightarrow n = 2$ (D) $n = 3 \rightarrow n = 1$

6. **BC**

7. Which of the following molecule(s) has/have larger bond angle than CF_4?
(A) BF_3 (B) NF_3 (C) BeF_2 (D) OF_2

7. **AC**

8. The correct statement(s) regarding phosphorus atom is/are: [At. No. of P = 15]
(A) it's total spin value is $\pm\frac{3}{2}$
(B) the unpaired electrons have same azimuthal quantum number
(C) all the p-orbitals of the atom contains same number of electrons
(D) in the excited state it contains five unpaired electrons

8. **ABD**

9. Which molecular orbital(s) of O_2 molecule is/are completely filled with electrons?
(A) σ^*_{2s} (B) π^*_y (C) σ_{1s} (D) $\sigma^*_{2p_x}$

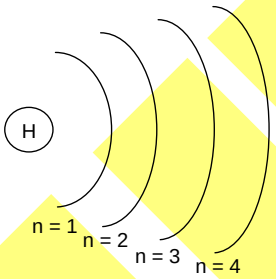
9. **AC**

10. Which of the following quantum number(s) has/have zero values for the valence electron of sodium?
(A) Principal quantum number (B) Azimuthal quantum number
(C) Magnetic quantum number (D) Spin quantum number

10. **BC**

11. Which of the following statement(s) is/are correct for PCl_5?
(A) In solid state it contains ion pairs like $[PCl_6]^-$ and $[PCl_4]^+$
(B) Three different bond angles are observed in the molecule
(C) The bond energy of $[PCl_4]^+$ is higher than that of $[PCl_6]^-$
(D) Phosphorus uses 3d orbitals for hybridization in PCl_5

11. **ABCD**

12. 

Which of the following characteristic(s) of the orbits of hydrogen atom decreases on moving from n = 1 to n = 4?
(A) Energy (B) Velocity (C) Angular momentum (D) Radius of orbit

12. **B**

13. Which of the following molecule(s) contain(s) dative or co-ordinate covalent bonds?
(A) NH_4Cl (B) NO_2BF_4 (C) KNO_3 (D) HNC

13. **ABCD**

PART – B

This section contains 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)

1. What is the bond order of KO_2?

1. **1.5**

2. How many electron(s) does O_2 lose in order to form a species which bond order will be three?

2. **2**

3. How many sets of photons of different wavelengths are emitted if the electron(s) in a sample of hydrogen atoms de-excite(s) from fourth orbit(n = 4) to the ground state(n = 1).

3. **6**

4. If x= the number of radial nodes of $4p_x$ orbital, y = the number of angular nodes of d_{xy} orbital and z = total number of nodes of 5s orbital. Then $\left(\frac{x+y+z}{5}\right)$ is

4. **1.6**

5. BF_3, CO_2, SO_2, OF_2, CH_4, NH_3, SO_3, NO_2 and H_2O
How many of the above molecule(s) has/have bond order greater than one?

5. **5**

space for rough work

Section – III (Mathematics)

PART – A

(Single Correct Choice Type)

This section contains 5 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which only **ONE** option is be correct.

1. The domain of the function $f(x)=\sin^{-1}\left(\log_2 \frac{x^2}{2}\right)$ is

   (A) $[-2,2]-(-1,1)$ (B) $[-1,2]-\{0\}$

   (C) $[1,2]$ (D) $[-2,2]-\{0\}$

1. **A**

2. Let function $f:R\to R$ be defined by $f(x)=2x+\sin x$ for $x\in R$. Then f is

   (A) one to one and onto (B) one to one but NOT onto

   (C) onto but NOT one to one (D) neither one to one nor onto

2. **A**

3. For $a\in R^+$ such that $\lim\limits_{x\to 0}\frac{1-\cos ax}{x^2}=\lim\limits_{x\to \pi}\frac{\sin x}{\pi-x}$, then the value of a is

   (A) 1 (B) $\sqrt{2}$

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

3. **B**

4. $\lim\limits_{x\to\infty}\left(\frac{x^2-2x+1}{x^2-4x+2}\right)^x=$

   (A) 1 (B) 2

   (C) e^2 (D) e

4. **C**

5. If $f(x)=\frac{x^2-bx+25}{x^2-7x+10}$ for $x\neq 5$ and f is continuous at x = 5, then f(5) has the value equal to

   (A) 0 (B) 5

   (C) 10 (D) 25

5. **A**

(Multiple Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

6. Which of the following is not an indeterminate form?

   (A) 0^∞ (B) ∞^∞

   (C) $\frac{0}{\infty}$ (D) $\infty\times\infty$

6. **ABCD**

7. Let $f(x)=\dfrac{x-1}{2x^2-7x+5}$. Then:

(A) $\underset{x\to 3}{\text{Limit}}\, f(x)=1$ (B) $\underset{x\to 0}{\text{Limit}}\, f(x)=-\dfrac{1}{5}$

(C) $\underset{x\to \infty}{\text{Limit}}\, f(x)=0$ (D) $\underset{x\to 5/2}{\text{Limit}}$ does not exist

7. **ABCD**

8. If the function f(x) = ax + b is its own inverse then the ordered pair (a, b) can be

(A) (1, 0) (B) (–1, 0)

(C) (–1, 1) (D) (1, 1)

8. **ABC**

9. Which of the following pairs of functions are identical?

(A) $f(x)=\log_x e;\ g(x)=\dfrac{1}{\log_e x}$

(B) $f(x)=\text{sgn}(x^2+1);\ g(x)=\sin^2 x+\cos^2 x$

(C) $f(x)=\sec^2 x-\tan^2 x;\ g(x)=\text{cosec}^2 x-\cot^2 x$

(D) $f(x)=\dfrac{1}{|x|};\ g(x)=\sqrt{x^{-2}}$

9. **ABD**

10. If $f(x)$ is a polynomial function satisfying the condition $f(x).f\left(\dfrac{1}{x}\right)=f(x)+f\left(\dfrac{1}{x}\right)$ and $f(2)=9$ then:

(A) $2f(4)=3f(6)$ (B) $14f(1)=f(3)$

(C) $9f(3)=2f(5)$ (D) $f(10)=f(11)$

10. **BC**

11. If S is the set of all real x such that $\dfrac{2x-1}{2x^3+3x^2+x}$ is positive, then S contains

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

(C) $\left(-\dfrac{1}{4},\dfrac{1}{2}\right)$ (D) $\left(\dfrac{1}{2},3\right)$

11. **AD**

12. The points at which the function, $f(x)=|x-0.5|+|x-1|+\tan x$ does not have a derivative in the interval (0, 2) are:

(A) 1 (B) $\dfrac{\pi}{2}$

(C) $\dfrac{\pi}{4}$ (D) $\dfrac{1}{2}$

12. **ABD**

13. If $3^x = 4^{x-1}$, then x =

(A) $\frac{2\log_3 2}{2\log_3 2 - 1}$ (B) $\frac{2}{2 - \log_2 3}$

(C) $\frac{1}{1 - \log_4 3}$ (D) $\frac{2\log_2 3}{2\log_2 3 - 1}$

13. **ABC**

PART – B

This section contains 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)

1. Let f be differentiable at $x = 0$ and $f'(0) = 1$, then $\lim_{h \to 0} \frac{f(h) - f(-2h)}{h}$ is equal to

1. **3**

2. The number of solution of the equation $x^2 - 12x + 35 = [x] + [-x]$ is (where [x] denotes largest integer less than or equal to x)

2. **2**

3. If $f(x) = \begin{cases} \frac{x^3 + x^2 - 16x + 20}{(x-2)^2}, & x \neq 2 \\ k, & x = 2 \end{cases}$ is continuous at $x = 2$, then the value of k is equal to

3. **7**

4. Consider the function $f(x) = \begin{cases} a^2 + e^x, & -\infty < x < 0 \\ x + 2, & 0 \le x \le 3 \\ c - \frac{b^2}{x}, & 3 < x < \infty \end{cases}$

If $f(x)$ is differentiable for every $x \in R$, then find the number of ordered triplets (a, b, c) of real numbers.

4. 4

5. The value of $6 + \log_{3/2}\left(\frac{1}{3\sqrt{2}}\sqrt{4 - \frac{1}{3\sqrt{2}}\sqrt{4 - \frac{1}{3\sqrt{2}}\sqrt{4 - \frac{1}{3\sqrt{2}}}..}}\right)$ is

5. **4**

space for rough work

FIITJEE INTERNAL TEST

COMMON TEST – I

Batches:

IIT- JEE 2022

ANSWERS

SECTION – I (Physics)

Part – A

Part – B

SECTION – II (Chemistry)

Part – A

Part – B

SECTION – III (Mathematics)

Part – A

Part – B