VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Booster Test - 4 | 2024

Date: 21/11/2022 **Maximum Marks: 177**

Timing: 04:00 PM - 07:00 PM **Duration: 3.0 Hrs**

General Instructions

1. The question paper consists of 3 Subjects (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Subject has **two** sections (Section 1 & Section 2).

2. **Section 1** contains **3 types** of questions **[Type A, Type B and Type C].**

   Type A contains **Five (05) Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

   Type B contains **Five (05) Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

   Type C contains **ONE (01) paragraph**. Based on the paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

3. **Section 2** contains **6 Numerical Value Type Questions**. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

4. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

Syllabus

Physics: Dynamics of a Particle, Energy & Momentum

Chemistry: Chemical Bonding, States of Matter

Mathematics: Sequence and Series, Complex Number

MARKING SCHEME

SECTION-1 | Type A

- This section contains **Five (05)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the answer. For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +3 If ONLY the correct option is chosen;
  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
  Negative Marks : –1 In all other cases.

SECTION-1 | Type B

- This section contains **Five (05)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +4 If only (all) the correct option(s) is(are) chosen;
  Partial Marks : +3 If all the four options are correct but ONLY three options are chosen;
  Partial Marks : +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;
  Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;
  Zero Marks : 0 If unanswered;
  Negative Marks : –2 In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get +4 marks; choosing ONLY (A) and (D) will get +2 marks;
  choosing ONLY (A) will get +1 mark;
  choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
  choosing any other option(s) will get –2 marks.

SECTION-1 | Type C

- This section contains **ONE paragraphs**. Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme;

  Full Marks : +3 If ONLY the correct option is chosen;
  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);
  Negative Marks : –1 In all other cases.

SECTION - 2

- This section contains **6 Integer Type Questions**. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)
- Answer to each question will be evaluated according to the following marking scheme:

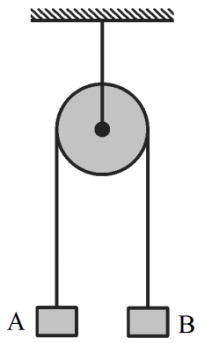
  Full Marks: +3 If ONLY the correct Integer value is entered. There is **NO negative marking.**
  Zero Marks: 0 In all other cases.

SUBJECT I : PHYSICS 59 MARKS

SECTION-1 | Type A

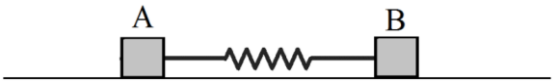
This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Two blocks A and B of mass 6 kg and 2 kg respectively are hung from a massless pulley using a massless string. The pulley is suspended using another string from the roof of a lift moving upwards with a constant acceleration. Initially, the blocks are held in equilibrium relative to the lift. The string connecting the blocks, and the string connecting the pulley to the ceiling of the lift can respectively bear a maximum tension 60 N and 90 N. The maximum allowed acceleration (in m/s^2) of the lift, such that after the blocks are released with the string tight, none of the strings break, is: $(g = 10\ \text{m/s}^2)$



(A) 5 **(B)** 10 **(C)** 15 **(D)** 20

2. Two identical blocks *A* and *B* of mass 1 kg each are connected by an ideal spring of spring constant 200 N/m, and placed on a smooth horizontal surface. Initially, the system is in equilibrium. Now, two constant forces F_A and F_B start acting on the blocks *A* and *B* simultaneously, in the horizontally leftward and rightward direction respectively. The magnitude of each force is 10 *N*. If at a particular instant, the elongation in the spring is 5 cm, the speed of each block (in cm/s) at this instant is:



(A) 50 **(B)** $50\sqrt{2}$ **(C)** $50\sqrt{3}$ **(D)** 100

SPACE FOR ROUGH WORK

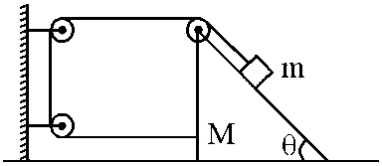
3. A particle starts from rest and moves in a circular path with constant angular acceleration α. The time, after which the angle between the net force on the particle and the velocity of the particle is θ, is:

(A) $\sqrt{\alpha \tan\theta}$ **(B)** $\dfrac{1}{\sqrt{\alpha \tan\theta}}$ **(C)** $\sqrt{\dfrac{\alpha}{\tan\theta}}$ **(D)** $\sqrt{\dfrac{\tan\theta}{\alpha}}$

4. Two blocks *A* and *B* of mass 3 kg and 2 kg respectively are connected by a uniform rope of mass 1 kg and placed a smooth horizontal floor. Two forces of magnitude *F* and 2*F* are applied on the blocks as shown. The tension at the mid-point of the rope is:

(A) $\dfrac{17}{12}F$ **(B)** $\dfrac{19}{12}F$ **(C)** $\dfrac{5}{3}F$ **(D)** $\dfrac{4}{3}F$

5. A block and a wedge are arranged with a massless string and massless pulleys as shown. The wedge rests on a horizontal surface, and friction is absent everywhere. The system is released from rest with the string tight. If the acceleration of the wedge is *a*, the acceleration of the block is:



(A) $\dfrac{a}{2}\sqrt{5-4\cos\theta}$ **(B)** $\dfrac{a}{2}\sqrt{5+4\cos\theta}$

(C) $a\sqrt{5-4\cos\theta}$ **(D)** $a\sqrt{5+4\cos\theta}$

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

6. A car of mass *m* is taking a turn on a rough road banked at an angle θ without slipping, moving in a circle of radius *r* in the horizontal plane. The car is travelling at speed *v*. Let the normal force and the friction force exerted by the road on the car be denoted by *N* and *f* respectively. Which of these options is/are correct?

(A) $N = mg\cos\theta + \frac{mv^2}{r}\sin\theta$ **(B)** $N = mg\cos\theta - \frac{mv^2}{r}\sin\theta$

(C) $f = \left|mg\sin\theta - \frac{mv^2}{r}\cos\theta\right|$ **(D)** $f = \left|mg\cos\theta - \frac{mv^2}{r}\sin\theta\right|$

7. A small ball is tied to one end of a massless string of length *L* and the other end of the string is pivoted at a point. Now, with the string tight and making an angle $\theta = \cos^{-1}\left(\frac{4}{5}\right)$ with the vertical, the ball is given a velocity v_0 perpendicular to the length of the string as shown in the figure. Which of these options is/are correct?

(A) If $v_0 = \sqrt{2gL}$ **,** the velocity of the ball at the lowest point in its path is $\sqrt{\frac{12gL}{5}}$

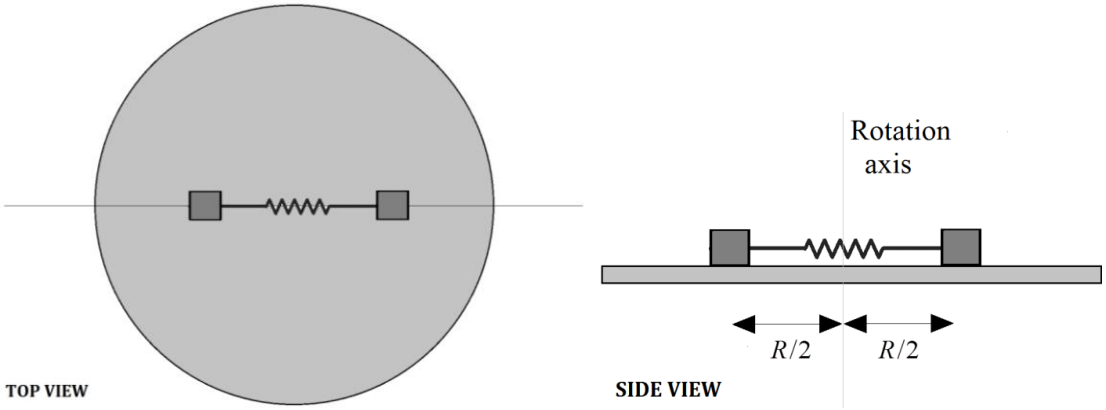
(B) If $v_0 = \sqrt{3gL}$ **,** the velocity of the ball at the instant the string is horizontal is $\sqrt{\frac{7gL}{5}}$

(C) If $v_0 = \sqrt{\frac{24gL}{5}}$ **,** the ball completes the circle and its velocity at the highest point in its path is $\sqrt{\frac{6gL}{5}}$

(D) If $v_0 = \sqrt{6gL}$ **,** the ball completes the circle and its velocity at the highest point in its path is $\sqrt{\frac{12gL}{5}}$

SPACE FOR ROUGH WORK

8. Two small blocks, each of mass *m*, are connected by an ideal spring of spring constant *k* and natural length *R* and placed on a circular disc of radius *R* pivoted at its centre such that it can rotate in the horizontal plane. The surface of the disc is uniformly rough. Neglect the size of the blocks relative to the disc and spring. Initially the disc is at rest. It is observed that the maximum separation between the blocks for which they can remain in equilibrium with the disc stationary is $\frac{5R}{3}$. Now, the blocks are placed such that they are equidistant from the centre, the length of the spring is along a diameter of the disc, and the spring is in its natural length. This situation is shown in the two figures. Now, the spring length is changed by $\Delta\ell$ such that the blocks remain equidistant from the centre, and then the disc is rotated with angular velocity ω. Positive values of $\Delta\ell$ denote elongation and negative values of $\Delta\ell$ denote compression. For a particular value of $\Delta\ell$, let ω_M be the maximum angular velocity of the disc at which the blocks can remain in equilibrium relative to the disc. Which of these options is/are correct?



(A) For $\Delta\ell = \frac{R}{3}$, $\omega_M = \sqrt{\frac{3k}{2m}}$

(B) For $\Delta\ell = \frac{R}{2}$, $\omega_M = \sqrt{\frac{5k}{9m}}$

(C) For $\Delta\ell = -\frac{R}{3}$, $\omega_M = \sqrt{\frac{k}{m}}$

(D) For $\Delta\ell = -\frac{R}{2}$, $\omega_M = \sqrt{\frac{2k}{3m}}$

SPACE FOR ROUGH WORK

9. Two constant horizontal forces F_1 and F_2 of magnitude 20 N and 15 N respectively start acting at $t = 0$ on a block of mass 2 kg, which is kept on a smooth horizontal surface and was initially at rest. The angle between the directions of action of the forces is $\theta = \cos^{-1}\left(\frac{3}{5}\right)$. Let the total work done on the block by the forces F_1 and F_2 until t = 2 s be W_1 and W_2 respectively. Which of these options is/are correct?

(A) $W_1 = 620\ J$ **(B)** $W_1 = 580\ J$ **(C)** $W_2 = 405\ J$ **(D)** $W_2 = 425\,J$

10. A small block is placed at the top of a fixed plane inclined at angle θ with the horizontal, such that $\tan\theta = 0.6$ and allowed to slide down. The inclined plane consists of two parts: its top half has coefficient of friction μ_1 and its bottom half has coefficient of friction μ_2. The block slides down and comes to rest at the bottom of the plane. This is possible in which of the following cases?

(A) $\mu_1 = 0.5$ and $\mu_2 = 0.7$ **(B)** $\mu_1 = 0.4$ and $\mu_2 = 0.8$

(C) $\mu_1 = 0.4$ and $\mu_2 = 0.7$ **(D)** $\mu_1 = 0.3$ and $\mu_2 = 0.9$

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

PARAGRAPH FOR Q-11 & 12

A girl sitting inside the cabin of a rising airplane knows that the plane's velocity and acceleration vectors make a constant angle α with the horizontal and that the magnitude of the acceleration is constant. She performs a small experiment with a pendulum hung from the ceiling of the cabin. She observes that in equilibrium relative to the plane, the string of the pendulum makes an acute angle θ with the ceiling, the ceiling being parallel to the direction of motion of the plane. Knowing the value of α beforehand, she makes calculations and obtains the acceleration of the plane.

11. During her calculations, the girl notices that she can comment on the direction of the acceleration of the plane by a simple inspection. Which of these options describes this correct conclusion drawn by her?

(A) $\theta > \frac{\pi}{2} - \alpha$ implies the plane is speeding up and $\theta < \frac{\pi}{2} - \alpha$ implies the plane is slowing down

(B) $\theta > \frac{\pi}{2} - \alpha$ implies the plane is slowing down and $\theta < \frac{\pi}{2} - \alpha$ implies the plane is speeding up

(C) $\theta > \alpha$ implies the plane is speeding up and $\theta < \alpha$ implies the plane is slowing down

(D) $\theta > \alpha$ implies the plane is slowing down and $\theta < \alpha$ implies the plane is speeding up

12. If $\alpha = \cos^{-1}\left(\frac{24}{25}\right)$ and $\theta = \cos^{-1}\left(\frac{3}{5}\right)$, then the girl correctly concludes that the plane is:

(A) Speeding up at rate $\frac{9}{25}g$ **(B)** Speeding up at rate $\frac{11}{25}g$

(C) Slowing down at rate $\frac{8}{25}g$ **(D)** Slowing down at rate $\frac{12}{25}g$

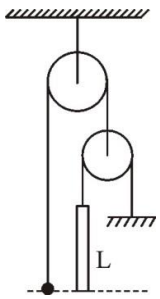
SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, ⊖ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. A sheet of metal and a sheet of wood are fixed parallel to each other. The thicknesses of the sheets are in the ratio $\frac{t_{\text{metal}}}{t_{\text{wood}}}=\frac{1}{3}$. A small bullet is fired with speed v_0 into the metal sheet, and it emerges with speed $\frac{v_0}{3}$. Then, it enters the wooden sheet and comes out with speed $\frac{v_0}{6}$. If the average force of resistance offered by the sheets is F_{metal} and F_{wood} respectively, then $\frac{F_{\text{metal}}}{F_{\text{wood}}}$ is _____.

2. In the arrangement shown, the mass of the ball is $\frac{3}{2}$ times the mass of the rod. The length of the rod is L. The masses of the pulleys and threads are negligible. The ball is set on the same horizontal level as the lower end of the rod and then the system is released from rest. The time after which the ball is on the same horizontal level as the upper end of the rod is $\left(X\left(\frac{L}{g}\right)\right)^{1/2}$, where X is _____.



SPACE FOR ROUGH WORK

3. Starting from rest, a particle moves under the influence of a force whose direction remains constant, and whose magnitude is proportional to $x^{1/2}$, where x is the distance travelled by the particle. If the total work done by the force on the particle until time t from the start is proportional to t^N, then N is _____.

4. A boy performs an experiment with a block attached to a spring placed on a rough horizontal surface with the other end of the spring fixed. From the initial situation, in which the spring is in its natural length, he compresses the spring by a distance x_0 and releases the block. He does the same for various values of x_0 and records:

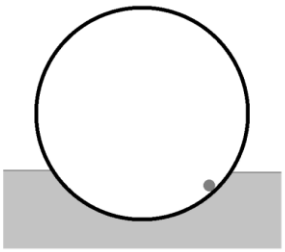
(i) The maximum value of x_0 for which after the block is released, it does not move at all, as x_1, and

(ii) The maximum value of x_0 for which after the block is released, it moves and after it comes to rest for the first time, it does not move again, as x_2.

The ratio $\frac{x_2}{x_1}$ is _____.

5. A force $\vec{F} = 12xy^2\hat{i} + 6y\hat{j}$ acts on a particle moving along the curve $y = x^2$ in the X-Y plane. Here, the force is in Newton, and all distances are in metres. The work done (in Joule) by the force on the particle, during the time the particle moves from the origin to the point P (1, 1), is _____.

6. A small ball of mass m moves inside a fixed smooth circular hoop of radius R, and the ball completes the circle. If the ratio of the maximum and minimum speed of the ball is $\frac{v_{MAX}}{v_{MIN}} = \sqrt{3}$, and the force (in Newton) exerted by the hoop on the ball at the lowest point in its path is $n(mg)$, then n is_____.



SPACE FOR ROUGH WORK

SUBJECT II : CHEMISTRY 59 MARKS

SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Shape of cation and anion in molecule $[N_2F][SbF_6]$ respectively are:

(A) Linear, Distorted octahedral **(B)** V-shape, Octahedral
(C) Linear, Octahedral **(D)** V-shape, Distorted octahedral

2. Rate of effusion of ozonised oxygen is 0.95 times the rate of effusion of pure oxygen. The percentage of ozone by volume in the ozonised sample is:

(A) 21.62 **(B)** 10.46 **(C)** 39.81 **(D)** 6.25

3. If all bond angles in AX_3 molecule are the same, then which of the following conclusions is correct about AX_3?

(A) AX_3 must be polar
(B) AX_3 must be planar
(C) AX_3 must have at least 5 valence electrons
(D) X must connect from central atom with either single bond or double bond

4. Which of the following is not correct for critical temperature?

(A) It is the highest temperature at which liquid and vapour can coexist
(B) Beyond this temperature, there is no distinction between the two phases and a gas cannot be liquified by compression
(C) At this temperature, the gas and the phases have different critical densities
(D) Ideal gas can't be liquified below critical temperature of H_2 gas

5. Which of the following orders of bond angle is correct?

(A) $N(CH_3)_3 < N(SiH_3)_3$ (XNX, where X = C, Si)

(B) $NH_4^+ < NH_3$ (HNH)

(C) $BF_3 < BCl_3$ (XBX)

(D) $SiCl_4 < CCl_4$ (ClACl, where A = Si, C)

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

6. Select the correct observation(s) for a 8.21 litre container, filled with 2 moles of Ar at 300K.
[R = 0.0821 atm-L/mole-K]

(A) It has pressure equal to 6 atm if Ar behaves as an ideal gas and walls of container are rigid

(B) If the gas obeys the equation P (V – nb) = nR then molar compressibility factor of the gas is greater than 1

(C) If Ar behaves as a non-ideal gas and volume of gas is negligible compared to the total volume occupied by gas, it would have pressure greater than 6 atm

(D) If it is in closed non-rigid (like thin balloon) container and Ar gas behaves an ideal gas, its volume increases to 16.42 litre on heating to 600K

7. Which of the following statements is/are not correct for following compounds?

(I) XeF_5^+ **(II)** XeF_5^-

(A) Both are planar

(B) Only two F-atoms occupy equatorial position in case of (I) and all F-atoms occupy equatorial position in case of (II)

(C) Three F-atoms occupy axial position in case of (I) and one F-atoms occupy axial position in case of (II)

(D) Both have same number of electron pairs on central atom

8. Which of the following is/are correct?

(A) Gases should be cooled below their critical temperature for liquification

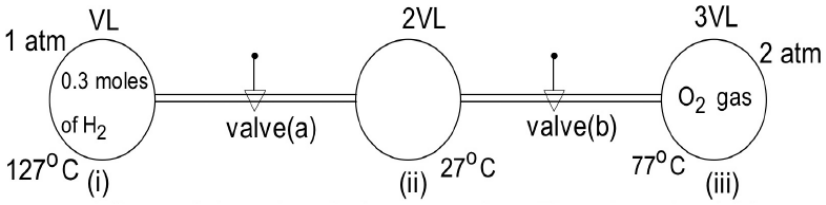
(B) Liquification of permanent gases requires only cooling not compression

(C) A gas below the critical temperature is called vapour of the substance

(D) Out of H_2 and He, critical temperature of H_2 is higher than critical temperature of He

SPACE FOR ROUGH WORK

9. Three bulbs (I), (II) and (III) of volume V litres, 2V litres and 3V litres are connected by tubes of negligible volume fitted by stopping valve (as shown in figure). The bulb (I) is at 1 atm containing 0.3 moles of H_2 gas at temperature 127°C. Bulb (III) contains O_2 gas at 77°C and pressure of 2 atm. Bulb (II) is vacuum and maintained at temperature 27°C.



The valve (b) is opened first and then closed after some time "t". Then the valve (a) is opened and closed after same time "t". The number of moles of O_2 diffused into bulb (II) is 0.1 mole. Which of the following observation(s) is/are correct? [R = 0.0821 atm-L/mole-K, Rate of diffusion $r \propto \frac{P}{\sqrt{M^\circ T}}$]

(A) The partial pressure of H_2 in bulb (I) after diffusion is 0.38 atm

(B) The partial pressure of O_2 in bulb (III) after diffusion is 1.9 atm

(C) Number of moles of H_2 diffused in bulb (II) is 0.115

(D) Number of moles of O_2 remained in bulb (III) after diffusion is 1.95

10. Select the correct statement(s) from the following in reference to the molecular orbital theory.

(A) Magnetic moment of NO is greater than that of O_2

(B) The bond length of O_2^+ is shorter than that of O_2

(C) The bond energy of N_2 is greater than that of NO^-

(D) H_2^+ is more stable than H_2^- although both have the same bond order

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

PARAGRAPH FOR Q-11 & 12

Molecular orbital theory is completely based upon the wave mechanical approach. The MO diagram gives the energy comparison between different orbitals.

11. Choose the correct ionization energy order from the following options.

(A) $F_2 > F$ **(B)** $O_2 < O$ **(C)** $N_2 < N$ **(D)** $B_2 < B$

12. Which of the following molecular orbital is having maximum number of nodal planes?

(A) σ^*_{p-p} **(B)** π_{d-d} (2 lobes interaction)

(C) π^*_{p-p} **(D)** π_{d-p}

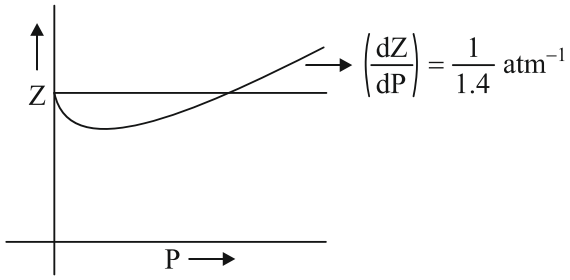
SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, ⊖ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. The graph of compressibility factor (Z) vs. P for one mole of a real gas is shown in following diagram. The graph is plotted at constant temperature 273 K. If the slope of graph at very high pressure $\left(\frac{dZ}{dP}\right)$ is $\left(\frac{1}{1.4}\right)\text{atm}^{-1}$, then volume of one mole of real gas molecules (in L/mol) is _____.

[Given that : $R = \frac{22.4}{273}\text{L atm K}^{-1}\text{mol}^{-1}$]



SPACE FOR ROUGH WORK

2. The total number of species(s) among the following containing all covalent bond, coordinate bond and ionic bond is/are _____.

CO, NH_4I, $NaBF_4$, KHF_2, KI_3, O_3

3. A 10 L box contains 56.8 g of mixture of gases C_xH_8 and C_xH_{10}. The pressure of the gas mixture at 300 K is 2.46 atm. The analysis of the gas mixture shows that carbon is 84.5%, by mass. The value of x is _____. (Round off to nearest integer)

4. Collapsible balloon is inflated to a volume of 10 L at a pressure of 1 atm. When the balloon is immersed to the bottom of a lake, its volume reduce to 2.5 L. Assuming atmospheric pressure to be equivalent to 10 m column of water and no change in temperature. If the depth of the lake is $x \times 10^3 cm$, then the value of x is _____.

5. In the compound $PCl_k F_{5-k}$, possible values of k are 0 to 5. Then sum of all possible value of k for the compounds having zero dipole moment is _____.

6. At moderate pressure, the molar compressibility factor for a gas is given as : $Z = 1 + 0.48P - \frac{168}{T}P$, where P is in bar and T is in Kelvin. The Boyle's temperature of the gas is T_B. The value of $\frac{5T_B}{70}$ is_____. (in Kelvin)

SPACE FOR ROUGH WORK

SUBJECT III : MATHEMATICS 59 MARKS

SECTION-1 | Type A

This section consists of 5 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

1. Let a_n be sequence in geometric progression with first term 16 and common ratio of $\frac{1}{4}$. Let P_n be the product of first *n* terms of the given geometric progression. The value of $\sum_{n=1}^{\infty} P_n^{1/n}$, is:

(A) 16 **(B)** 32 **(C)** 64 **(D)** 68

2. The 1st, 2nd and 3rd terms of an arithmetic series are a, b and a^2, where *a* is negative then sum of an infinite geometric series whose first three terms are a, a^2 and b respectively, is:

(A) $\frac{-1}{2}$ **(B)** $\frac{-3}{2}$ **(C)** $\frac{-1}{3}$ **(D)** –1

SPACE FOR ROUGH WORK

3. Let $a=\sum_{r=1}^{\infty}\frac{1}{r^2}$ and $b=\sum_{r=1}^{\infty}\frac{1}{(2r-1)^2}$. Then the value of $\frac{3a}{b}$ is equal to:

(A) 2 **(B)** 3 **(C)** 4 **(D)** 6

4. If z and ω are complex numbers satisfying $\bar{z}+i\bar{\omega}=0$ and $arg(z\omega)=\pi$, then $arg(z)$ is equal to:

(A) $\frac{\pi}{4}$ **(B)** $\frac{-\pi}{2}$ **(C)** $\frac{\pi}{2}$ **(D)** $\frac{3\pi}{4}$

5. Number of common roots of the equations $z^3+2z^2+2z+1=0$ and $z^{1985}+z^{100}+1=0$, z being a complex number, is:

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3

SPACE FOR ROUGH WORK

SECTION-1 | Type B

This section consists of 5 Multiple Correct Answers Type Questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

6. If $a_1, a_2, ..., a_n$ is a sequence of positive numbers which are in A.P. with common difference d and $a_1 + a_4 + a_7 + ... + a_{16} = 147$ then $a_1 + a_{16} = M$ and $a_1 + a_6 + a_{11} + a_{16} = N$.

Maximum value of $a_1 a_2 .... a_{16} = \left(\frac{S}{W}\right)^{16}$ (where S and W are coprime), then:

(A) $M = 49$ **(B)** $N = 98$ **(C)** $S = 49$ **(D)** $W = 2$

7. If $z \neq 0$ is a complex number, then $z, iz, -z$ and $-iz$ are the vertices of a :

(A) Square **(B)** Rectangle

(C) Rhombus **(D)** Parallelogram, which is not a rectangle

8. If z_1 and z_2 are two complex numbers such that $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2$ then:

(A) $\frac{z_1}{z_2}$ is purely real **(B)** $\frac{z_1}{z_2}$ is purely imaginary

(C) $z_1 \bar{z}_2 + \bar{z}_1 z_2 = 0$ **(D)** $\arg\left(\frac{z_1}{z_2}\right) = 0$

SPACE FOR ROUGH WORK

9. If $\left|\frac{2iz_1 - z_1 - z_2}{2iz_1 + z_1 + z_2}\right| = \left|\frac{\cos\theta + i\sin\theta}{\cos\theta - i\sin\theta}\right|$ and z_1, z_2 are non-zero complex numbers, then:

(A) $\frac{z_1 + z_2}{z_1}$ is purely real **(B)** $\frac{z_2}{z_1}$ is purely real

(C) $\frac{z_1 + z_2}{z_1 - z_2}$ is purely real **(D)** $\frac{z_1 - z_2}{z_1 + z_2}$ is purely real

10. Let x, y, z are distinct positive integers and $m = \left(\frac{x^2 + y^2 + z^2}{x + y + z}\right)^{(x+y+z)}$, $n = x^x y^y z^z$, $p = \left(\frac{x + y + z}{3}\right)^{(x+y+z)}$, then:

(A) $m > n$ **(B)** $n > p$ **(C)** $m < n$ **(D)** $n < p$

SPACE FOR ROUGH WORK

SECTION-1 | Type C

This section consists of ONE (01) paragraph. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

PARAGRAPH FOR Q-11 & 12

Consider the equation $(z+1)^7 + z^7 = 0$ has roots $Z_1, Z_2 .... Z_7$.

11. The value of $\sum_{r=1}^{7} \text{Re}(Z_r)$ is :

(A) $\frac{-3}{2}$ **(B)** $\frac{-5}{2}$ **(C)** $\frac{-7}{2}$ **(D)** $\frac{-9}{2}$

12. The value of $\sum_{r=1}^{7} \text{Im}(Z_r)$, is :

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3

SPACE FOR ROUGH WORK

SECTION-2

This section consists of 6 Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer value, then do not add zero in the decimal places. *In the OMR, do not bubble the ⊕ sign for positive values. However, for negative values, ⊖ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. The sum of the infinite series $\frac{1}{9}+\frac{1}{18}+\frac{1}{30}+\frac{1}{45}+\frac{1}{63}+....$ is S then $3S$ =

2. The number of 15^{th} roots of unity which are also the 25^{th} root of unity is: ___

3. If $|z_1|=1, |z_2|=2, |z_3|=3$ and $|z_1+z_2+z_3|=1,$ then $|9z_1z_2+4z_1z_3+z_3z_2|$ is equal to _____.

4. Let z be a complex number such that Re(z) = 2. If area of a triangle whose sides are represented by $i(z^2-2z), (2z-z^2)$ and $(1-i)(2z-z^2)$ is 16 sq. units, then nearest integer greater than $|z|$ is _____.

5. Let $\{a_n\}$ consists of positive numbers and for any positive integer $n, \frac{a_n+2}{2}=\sqrt{2s_n},$ where $s_n=\sum_{i=1}^{n} a_i.$

Then : a_6 = _____.

6. In an infinite G.P., the sum of first three terms is 70. If the first & third terms are multiplied by 4 and the second term is multiplied by 5, the resulting terms form an A.P. then the sum to infinite terms of G.P. is __.

SPACE FOR ROUGH WORK

End of Advanced Booster Test - 4 | JEE-2024