VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main - 4 | JEE 2024

Date: 14/11/2022 **Maximum Marks: 300**

Timing: 04:00 PM to 07:00 PM

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices **(A)**, **(B)**, **(C)** and **(D)**, out of which **ONLY ONE CHOICE** is correct.
4. **Section 2** contains **5 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)
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.
8. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

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

Syllabus

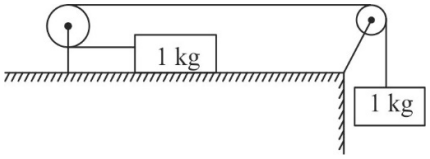
Physics: Dynamics of a Particle, Energy & Momentum (Section 1 to 3)
Chemistry: Chemical Bonding, States of matter
Mathematics: Sequence and Series, Complex Numbers

PART - I : PHYSICS 100 MARKS

SECTION-1

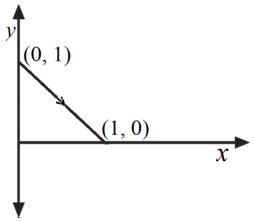
This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. A block of mass 1 kg is placed on a rough horizontal surface connected by a light string passing over two smooth pulleys as shown. Another block of 1 kg is connected to the other end of the string. The acceleration of the blocks is: (coefficient of friction $\mu = 0.2$)



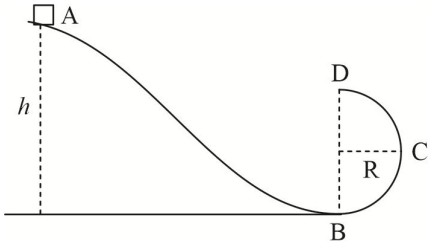
(A) 0.8 g **(B)** 0.4 g **(C)** 0.5 g **(D)** zero

2. A particle moves from the point (0, 1) to the point (1, 0) along a straight line as shown. If one of the forces acting on the particle was $\vec{F} = \left(3\hat{i} - 4\hat{j}\right)\ N$, the work done (in Joules) by $\vec{F}$ is equal to:



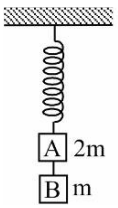
(A) –7 **(B)** 7 **(C)** –1 **(D)** 1

3. In the figure shown, part BCD is semicircular track. A block is released from point A. The block can reach to point D only if: (friction is absent everywhere)



(A) $h \geq \frac{5}{2}R$ **(B)** $h \geq \frac{3}{2}R$ **(C)** $h \geq 2R$ **(D)** $h \geq 3R$

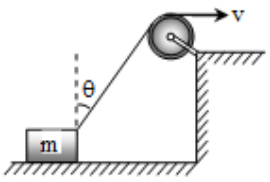
4. Two blocks A and B of masses 2m and m, respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in the figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively:



(A) g, $\frac{g}{2}$ **(B)** $\frac{g}{2}$, g

(C) g, g **(D)** $\frac{g}{2}$, $\frac{g}{2}$

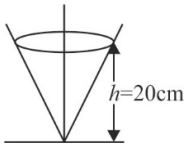
5. A block is dragged on a smooth plane with the help of a rope which moves with a velocity v as shown in figure. The horizontal velocity of the block is:



(A) v **(B)** $\frac{v}{\sin\theta}$

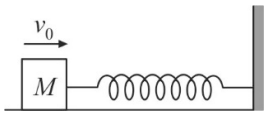
(C) $v\sin\theta$ **(D)** $\frac{v}{\cos\theta}$

6. A right circular cone is fixed with its axis vertical and vertex down. A particle in contact with its smooth inside surface describes circular motion in a horizontal plane at a height of 20 cm above the vertex. Its velocity in m/s is : ($g = 9.8$ m/s^2)



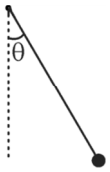
(A) 1 **(B)** 1.2 **(C)** 1.4 **(D)** 1.6

7. 1 kg block collides with a horizontal weightless spring of force constant 100 N/m, as shown in the figure. The block compresses the spring by 0.4 m from the rest position. Assuming that the coefficient of kinetic friction between the block and the horizontal surface is 0.9, the speed of the block at the instant of collision is approximately ($g = 10$ m/s^2) :



(A) 4.8 m/s **(B)** 5.6 m/s **(C)** 1.4 m/s **(D)** 5.8 m/s

8. A small particle of mass *m* is tied to a massless thread and the other end of the thread is fixed at a point. The particle is released from rest with the string being tight and making an angle $\theta = 30^o$ with the vertical as shown. The acceleration of the particle when it is at the lowest point in its path is:

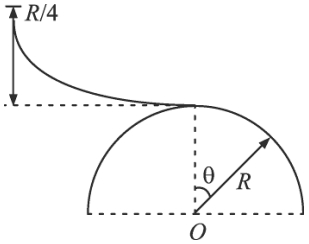


(A) $(2\sqrt{3}-1)g$ **(B)** $(\sqrt{3}-1)g$ **(C)** $(4-2\sqrt{3})g$ **(D)** $(2-\sqrt{3})g$

9. A body of mass m is projected vertically up with a speed v_0. If it passes through the point of projection with a speed $\frac{v_0}{2}$, the work done by air resistance is :

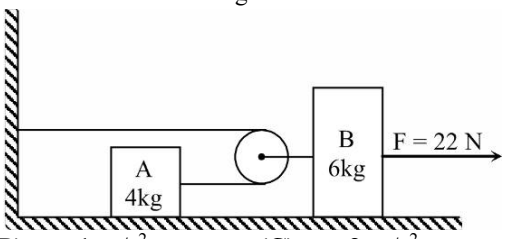
(A) zero **(B)** $\frac{-3mv_0^2}{4}$ **(C)** $\frac{3mv_0^2}{4}$ **(D)** $\frac{-3mv_0^2}{8}$

10. A skier plans to ski a smooth fixed hemisphere of radius *R*. He starts form rest on a curved smooth surface of height $\left(\frac{R}{4}\right)$ above the hemisphere. The angle θ at which he leaves the hemisphere is :



(A) $\cos^{-1}\left(\frac{2}{3}\right)$ **(B)** $\cos^{-1}\frac{5}{\sqrt{3}}$ **(C)** $\cos^{-1}\left(\frac{5}{6}\right)$ **(D)** $\cos^{-1}\left[\frac{5}{2\sqrt{3}}\right]$

11. Two blocks are connected by a massless string through an ideal pulley as shown. A force of 22N is applied on block B. Find acceleration of the 4 kg block. The surface is smooth.

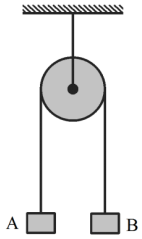


(A) 1.1 m/s^2 **(B)** 1 m/s^2 **(C)** 2 m/s^2 **(D)** 2.2 m/s^2

12. Two small blocks *A* and *B* having masses 2 kg and 3kg respectively are kept on a rough turntable that is rotating at an unknown constant angular speed. The distance of blocks *A* and *B* from center of the table are $r_A = 25\,\text{cm}$ and $r_B = 50\,\text{cm}$ respectively, whereas coefficient of friction for the blocks are $\mu_A = 0.4$ & $\mu_B = 0.9$ respectively. The force of friction on *B*, if A is on the verge of slipping, will be:

(A) 27 *N* **(B)** 8 *N* **(C)** 24 *N* **(D)** 16 *N*

13. Two blocks *A* and *B* of mass 2 kg and 3 kg respectively are hung from a massless pulley using a massless string. The pulley is suspended from a fixed ceiling by another massless string. After the blocks are released, the tension (in Newton) in the string connecting the pulley to the ceiling becomes: $(g = 10\ \text{m/s}^2)$



(A) 16 **(B)** 24 **(C)** 32 **(D)** 48

14. A particle is moving in the X-Y plane. Its momentum as a function of time is given by: $\vec{p}(t) = A\cos(\omega t)\,\hat{i} + B\sin(\omega t)\,\hat{j}$. Here *A*, *B* and ω are constants. The net force acting on the particle at $t = \frac{2\pi}{3\omega}$ is:

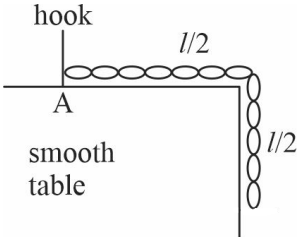
(A) $\frac{\sqrt{3}}{2}A\omega\hat{i} - \frac{1}{2}B\omega\,\hat{j}$ **(B)** $-\frac{\sqrt{3}}{2}A\omega\hat{i} - \frac{1}{2}B\omega\,\hat{j}$

(C) $\frac{1}{2}A\omega\hat{i} + \frac{\sqrt{3}}{2}B\omega\,\hat{j}$ **(D)** $-\frac{1}{2}A\omega\hat{i} + \frac{\sqrt{3}}{2}B\omega\,\hat{j}$

15. A particle is projected from the ground at a certain angle from the horizontal. Then, the instantaneous power delivered to the particle by the force of gravity is:

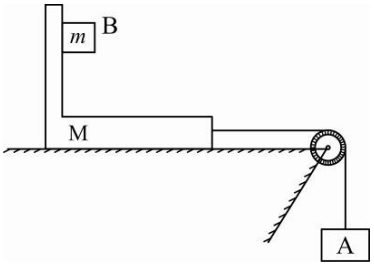
(A) Positive throughout the particle's flight
(B) Positive during the upward journey, and negative during the downward journey of the particle
(C) Negative during the upward journey, and positive during the downward journey of the particle
(D) Negative throughout the particle's flight

16. A chain of length l hangs with its half length hanging. It is hooked at end A. Now as hook is released it falls. The speed of chain as it falls completely off the table is :



(A) $\sqrt{\frac{3gl}{2}}$ **(B)** $\sqrt{2gl}$ **(C)** $\sqrt{\frac{3gl}{4}}$ **(D)** $\sqrt{\frac{gl}{2}}$

17. In the given situation, what is the minimum mass of block A so that block B remains stationary with respect to the wall? The coefficient of friction is μ between wall and block. All other surfaces are smooth.



(A) $\frac{(M+m)}{\mu+1}$ **(B)** $\frac{M}{\mu-1}$

(C) $\frac{M+m}{\mu}$ **(D)** $\frac{(M+m)}{\mu-1}$

18. Given a force $\vec{F}=3x^2\hat{i}+2y\hat{j}$. The work done by this force as the particle is displaced from (1, 2) to (2, 3) is:

(A) -15J **(B)** 15J **(C)** -12J **(D)** 12J

19. The potential energy of particle of mass 0.1 kg moving along the x-axis is given by $U=5x(x-4)J$, where x is in metre. It can be concluded that :

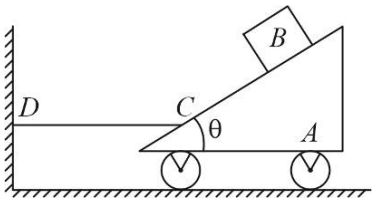
(A) the particle is acted upon by a constant force

(B) the particle is in stable equilibrium at $x=2$

(C) the particle is in unstable equilibrium at $x=2$

(D) the particle is in stable equilibrium at $x=4$

20. Mass of the block B is m and that of the wedge is 3m. When the block is released from rest from the top of the wedge determine the tension in cord CD needed to hold the wedge from moving while B is sliding down. Neglect friction.



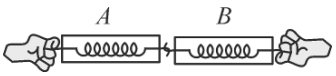
(A) $2mg\cos\theta$ **(B)** $\frac{mg}{2}\cos\theta$ **(C)** $\frac{mg}{2}\sin 2\theta$ **(D)** $mg\sin 2\theta$

SPACE FOR ROUGH WORK

SECTION-2

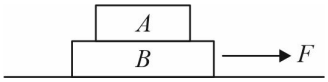
This Section contains Five (05) Numerical Value Type Questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places. If the answer is an Integer 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)

1. Consider two spring balances hooked as shown in the figure. We pull them in opposite directions with equal force. If the reading shown by A is 5 N, reading shown by B will be _____ N.



2. Power supplied to a particle of mass 2 kg varies with time as $P=\frac{3t^2}{2}W$. Here t is in second. If velocity of particle at $t=0$ is $v=0$. The velocity of particle at time $t=2s$ will be _____ (in m/s):

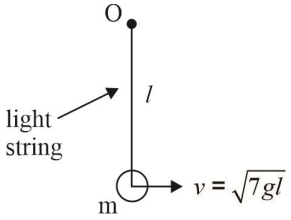
3.



Block A of mass 4 kg is kept on another block B of mass 6 kg, which rests on smooth floor (refer figure). The coefficient of friction between blocks A and B is $\mu=0.6$. The maximum value of force 'F' that can be applied to block B so that there is no slipping between the blocks is 15 n Newtons. The value of n is _____ .

4. A block of mass 1 kg is suspended vertically by an ideal spring of spring constant 100 N/m as shown, and the upper end of the spring is fixed. The block is released from rest when the spring is in its natural length. The velocity of the block after it has moved down by a distance 10 cm is _____ m/s. $(g=10\ \text{m/s}^2)$

5. A bob of pendulum of mass m can rotate in a complete vertical circle. It is given a speed of $\sqrt{7gl}$ at bottom most point as shown. The minimum tension in the string in the circular path is $x\ mg$, where x is_____.



SPACE FOR ROUGH WORK

PART - II : CHEMISTRY 100 MARKS

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

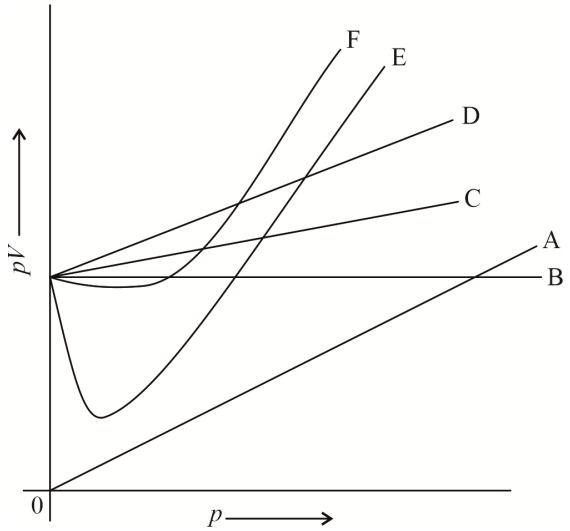
1. Atmospheric pressures recorded in different cities are as follows:

Cities	**Shimla**	**Bangalore**	**Delhi**	**Mumbai**
p in N/m^2	1.01×10^5	1.2×10^5	1.02×10^5	1.21×10^5

Consider the above data and mark the place at which liquid will boil first.

(A) Shimla **(B)** Bangalore **(C)** Delhi **(D)** Mumbai

2. Which curve in figure represents the curve of ideal gas?



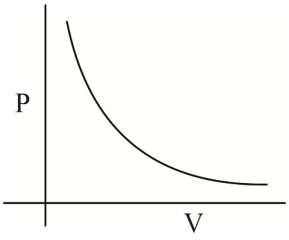
(A) B only **(B)** C and D only **(C)** E and F only **(D)** A and B only

3. An open vessel at 27°C is heated until $3/8^{th}$ of the air in it has been expelled. Assuming that the volume remains constant, calculate the temperature at which the vessel was heated.

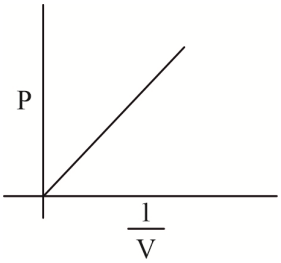
(A) 307°C **(B)** 107°C **(C)** 480°C **(D)** 207°C

4. Which of the following graph represent Boyle's law?

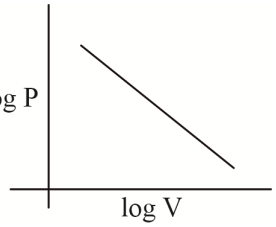
(a)



(b)



(c)



(A) Only (a) **(B)** Only (b) and (c)

(C) Only (a) and (b) **(D)** (a), (b) and (c)

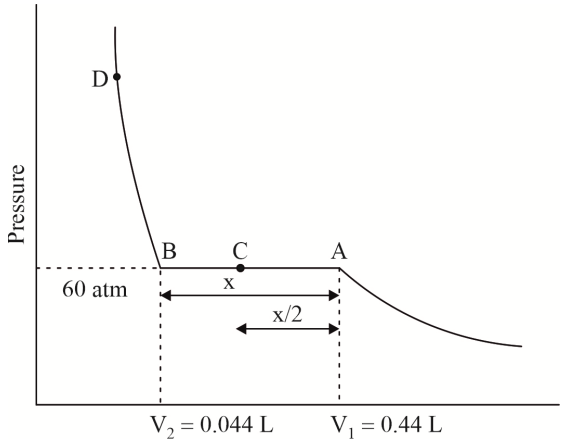
5. 100 ml of $O_2(g)$ effuse from a porous container in 100 sec. 75 ml of unknown gas effuses under the same conditions of temperature and pressure in 150 sec. Calculate vapour density of unknown gas?

(A) 16 **(B)** 32 **(C)** 64 **(D)** 128

6. At what temperature would N_2 molecules have same average speed as CO molecules at 200 K.

(A) –73°C **(B)** 200°C **(C)** 700°C **(D)** 273°C

7. CO_2 gas is liquefied at 27°C. Gas follows the following graph during liquefaction of 1 mole CO_2.



Then which statement is (are) correct in gaseous phase.

(i) The maximum density of gas is 0.1 gm/ml.

(ii) The density of liquid CO_2 is 1 g/ml at 60 atm.

(iii) BD represent vapour phase of CO_2

(iv) The compressibility factor of gas at 27°C is always less than 1.

Which of the following is/are correct?

(A) Only (i) **(B)** (i) and (ii) **(C)** (i), (ii) and (iii) **(D)** All of these

8. Among the following statements:

I. PCl_5 is trigonal bipyramidal whereas IF_5 is square pyramidal.

II. Bond angle of BF_3 is less than that of BCl_3.

III. All carbon atoms have same hybridisation in propyne (C_3H_4)

Find out the correct statements.

(A) I & II only **(B)** II & III only **(C)** I only **(D)** I & III only

9. The polarity of (i) SF_4 and (ii) SiF_4 respectively are?

(A) (i) Non polar (ii) Polar **(B)** (i) Polar (ii) Non polar

(C) (i) Non polar (ii) Non polar **(D)** (i) Polar (ii) Polar

10. Select which type of overlapping is responsible for π - character in Si – N bond of H_3SiNCO?

(A) $3p\pi \rightarrow 2p\pi$ **(B)** $2p\pi \rightarrow 2p\pi$ **(C)** $3d\pi \leftarrow 2p\pi$ **(D)** $3d\pi \leftarrow 2d\pi$

11. Which of the following is increasing bond order?

(A) $C_2 < NO < He_2^+ < O_2^-$ **(B)** $NO < C_2 < O_2^- < He_2^+$

(C) $He_2^+ < O_2^- < NO < C_2$ **(D)** $He_2^+ < O_2^- < C_2 < NO$

12. The set which has all the planar species is:

(A) $I_3^-, CO_2, XeF_4, XeF_5^-$ **(B)** CO_2, SF_4, ClF_3, BrF_5

(C) XeF_4, H_2O, XeO_4, PF_3 **(D)** $ICl_2^+, ICl_2^-, CO_2, XeO_3$

13. The $p\pi - p\pi$ bond is present in:

(a) XeO_3 **(b)** SO_4^{2-} **(c)** SO_2 **(d)** C_2H_4

(A) Only (d) **(B)** (c) and (d) **(C)** (a), (b) and (c) **(D)** (a), (b), (c) and (d)

14. Assuming 2s – 2p mixing is NOT operative, the paramagnetic species among the following is:

(A) Be_2 **(B)** B_2 **(C)** C_2 **(D)** N_2

15. After understanding the assertion and reason, choose the correct option.

Assertion: In the bonding molecular orbital (MO) of H_2, electron density is increased between the nuclei.

Reason: The bonding MO is $\psi_A + \psi_A$, which shows destructive interference of the combining electron waves.

(A) Assertion and Reason are correct, but Reason is not correct explanation for the Assertion

(B) Assertion and Reason are correct and Reason is the correct explanation for the Assertion

(C) Assertion is incorrect, Reason is correct

(D) Assertion is correct, Reason is incorrect

16. Arrange the following gases in increasing order of critical temperature.

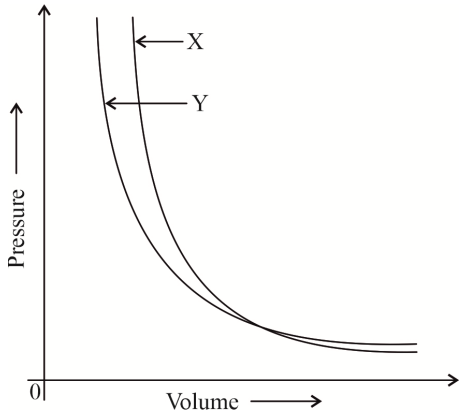
(A) $He < H_2 < N_2 < O_2 < CO_2 < H_2O < NH_3$

(B) $He < H_2 < N_2 < O_2 < CO_2 < NH_3 < H_2O$

(C) $H_2 < He < N_2 < O_2 < CO_2 < H_2O < NH_3$

(D) $H_2 < He < N_2 < O_2 < CO_2 < NH_3 < H_2O$

17. Given isotherm represent a graph for gas X and gas Y.



(A) Graph X represent real gas and graph Y represent ideal

(B) Graph X represent ideal gas and graph Y represent real gas

(C) Both graphs belong to ideal gas

(D) Compressibility factor of gas X and Y is less than 1

18. Which of the following statements are correct about H_2 molecule?

(a) HOMO of H_2 is σ^*_{1s}

(b) Bond energy of H_2 is 4380 kJ mol^{-1}

(c) Bond length of H_2 is 74 pm

(d) H_2 is diamagnetic

Correct statements are:

(A) (a), (b), (c) and (d)

(B) Only (a), (b) and (d)

(C) Only (b), (c) and (d)

(D) Only (c) and (d)

19. Consider Statements-1 and 2.

Statement-1 : Due to H-bonding, boiling point of HF is more than that of H_2O.

Statement-2 : Energy of H-bond varies from 10 – 100 kJ mol^{-1}.

Choose the correct options:

(A) Statement-1 is correct; Statement-2 is incorrect

(B) Statement-1 is incorrect; Statement-2 is correct

(C) Both are correct

(D) Both are incorrect

20. The volumes of two vessels at same temperature are in the ratio of 2 : 3. One vessel contains H_2 and other N_2 at 600 mm and 900 mm respectively. The final pressure when they are connected together is: (Assume that N_2 and H_2 react to form NH_3)

(A) 620 mm **(B)** 760 mm **(C)** 780 mm **(D)** 800 mm

SECTION-2

This Section contains Five (05) 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)

1. The pressure of a 1:4 mixture of dihydrogen and dioxygen enclosed in a vessel is one atmosphere. The partial pressure of dioxygen is $x \times 10^{-1}$. Value of x is _____.
[Assume that H_2 and O_2 do not reacts under these conditions]

2. Determine how many of the following statements are true at very high pressure for a real gas:

(a) Compressibility factor is less than 1.

(b) Compressibility factor varies linearly with pressure.

(c) Molar volume occupied by gas is more as compared to ideal gas at similar pressure and temperature.

(d) Gas is less compressible as compare to ideal gas.

(e) Compressibility factor is given by $Z = 1 + \frac{Pb}{RT}$.

3. The dipole moment of HBr is 1.6×10^{-30} Coloumb-meter and inter-atomic spacing is 1Å. The % ionic character of HBr is:

4. The number of paramagnetic species among the following is:
O_2, CO, N_2, CsO_2, BaO_2, CO_2

5. Number of molecules among the following having non-zero dipole moment is:
O_3, SO_3, SF_4, SF_6, H_2S, CS_2, SO_2, H_2O

SPACE FOR ROUGH WORK

PART - III: MATHEMATICS 100 MARKS

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. If $10\text{-}A.M.'s : a_1, a_2, ... a_{10}$; $10\text{-}G.M.'s: g_1, g_2, ... g_{10}$ and $10\text{-}H.M.'s$ $h_1, h_2 ..... h_{10}$ are inserted between the numbers 2 and 3. Then $\left(\sum_{i=1}^{10} a_i\right)\left(\sum_{i=1}^{10} \frac{1}{h_i}\right) \times \left(g_1 . g_2 .....g_{10}\right)^{1/5}$, is equal to :

(A) 25 **(B)** $\frac{625}{3}$ **(C)** 625 **(D)** 525

2. Consider $S_n = \frac{8}{5} + \frac{16}{65} + ...+ \frac{8n}{4n^4+1}$. Sum of infinite terms of this series will be :

(A) 5/2 **(B)** 11/5 **(C)** 2 **(D)** 3

3. If $a, a_1, a_2, ..., a_{2n}, b$ are in arithmetic progression and $a, g_1, g_2, ..., g_{2n}, b$ are in geometric progression and h is the harmonic mean of a and b, then $\frac{a_1+a_{2n}}{g_1 g_{2n}} + \frac{a_1+a_{2n-1}}{g_1 g_{2n-1}} + ... + \frac{a_n+a_{n+1}}{g_n g_{n+1}}$ is equal to:

(A) $2nh$ **(B)** $\frac{n}{h}$ **(C)** nh **(D)** $\frac{2n}{h}$

4. Let $a_1, a_2, a_3, ...$ be terms of an AP. If $\frac{a_1+a_2+.....+a_p}{a_1+a_2+.....+a_q} = \frac{p^2}{q^2}$, $p \neq q$, then $\frac{a_6}{a_{21}}$ equals :

(A) $\frac{7}{2}$ **(B)** $\frac{2}{7}$ **(C)** $\frac{11}{41}$ **(D)** $\frac{41}{11}$

5. The sum of $\frac{\frac{1}{2}\cdot\frac{2}{2}}{1^3} + \frac{\frac{2}{2}\cdot\frac{3}{2}}{1^3+2^3} + \frac{\frac{3}{2}\cdot\frac{4}{2}}{1^3+2^3+3^3} + ...$ upto n terms is equal to :

(A) $\frac{n-1}{n}$ **(B)** $\frac{n}{n+1}$ **(C)** $\frac{n+1}{n+3}$ **(D)** $\frac{n+1}{n}$

6. If A_1, A_2 ; G_1, G_2 and H_1, H_2 be two AM's, GM's and HM's inserted between two quantities, then the value of $\frac{G_1 G_2}{H_1 H_2}$ is :

(A) $\frac{A_1+A_2}{H_1+H_2}$ **(B)** $\frac{A_1-A_2}{H_1+H_2}$ **(C)** $\frac{A_1+A_2}{H_1-H_2}$ **(D)** $\frac{A_1-A_2}{H_1-H_2}$

7. Let the sequence, $a_1, a_2, a_3, ..., a_{2n}$, form an AP, then $a_1^2 - a_2^2 + a_3^2 - ..... + a_{2n-1}^2 - a_{2n}^2$ is equal to :

(A) $\frac{n}{2n-1}\left(a_1^2 - a_{2n}^2\right)$ **(B)** $\frac{n}{n-1}\left(a_{2n}^2 - a_1^2\right)$

(C) $\frac{n}{n+1}\left(a_1^2 + a_{2n}^2\right)$ **(D)** $\frac{n}{2n+1}\left(a_1^2 + a_{2n}^2\right)$

8. If ω is a complex cube root of unity, then $\sin\left\{\left(\omega^{10}+\omega^{23}\right)\pi-\frac{\pi}{4}\right\}=$

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

9. If $z=\frac{i}{2}$, then the value of the product $(1+z)\left(1+z^2\right)\left(1+z^4\right)\left(1+z^8\right).....\left(1+z^{2^n}\right)$ is equal to : $(n>1)$

(A) $\frac{1-\frac{1}{2^{2n+1}}}{1-\frac{i}{2}}$ **(B)** $\left(\frac{1+\frac{1}{2^{2n+1}}}{1+\frac{i}{2}}\right)$ **(C)** $\frac{1-\left(\frac{i}{2}\right)^{2^{n+1}}}{1-\left(\frac{i}{2}\right)}$ **(D)** -1

10. If $x+\frac{1}{x}=1$, then $x^{20}+x^{30}+x^{40}=$

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

11. If $\left(\frac{1+\cos\phi+i\sin\phi}{1+\cos\phi-i\sin\phi}\right)^n=u+iv$, where u and v are real numbers, then u is :

(A) $n\cos\phi$ **(B)** $\cos n\phi$ **(C)** $\cos\left(\frac{n\phi}{2}\right)$ **(D)** $\sin\left(\frac{n\phi}{2}\right)$

12. If $x_r=\cos\left(\frac{\pi}{2^r}\right)+i\sin\left(\frac{\pi}{2^r}\right)$, then the value of $x_1x_2x_3.....\infty$ is :

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

13. The value of $\frac{(\cos\theta-i\sin\theta)^4}{(\sin\theta+i\cos\theta)^5}$ is :

(A) $\cos\theta-i\sin\theta$ **(B)** $\cos9\theta-i\sin9\theta$

(C) $\sin9\theta-i\cos9\theta$ **(D)** $\sin\theta-i\cos\theta$

14. If $\alpha=e^{i(2\pi/n)}$, then $(11-\alpha)\left(11-\alpha^2\right)....\left(11-\alpha^{n-1}\right)$ is equal to : $[n\in N]$

(A) $\frac{11^{n-1}}{10}$ **(B)** $\frac{11^n-1}{10}$ **(C)** $\frac{11^{n-1}-1}{10}$ **(D)** $\frac{11^{n-1}-1}{11}$

15. If $z=\left(\frac{\sqrt{3}}{2}+\frac{i}{2}\right)^5+\left(\frac{\sqrt{3}}{2}-\frac{i}{2}\right)^5$, then :

(A) $Re(z)=0$ **(B)** $Im(z)=0$

(C) $Re(z)>0,\ Im(z)>0$ **(D)** $Re(z)>0,\ Im(z)<0$

16. Real part of $e^{e^{i\theta}}$ is : $(\theta\in R)$

(A) $e^{\cos\theta}\cdot\{\cos(\sin\theta)\}$ **(B)** $e^{\cos\theta}\cdot\{\cos(\cos\theta)\}$

(C) $e^{\sin\theta}\cdot\{\sin(\cos\theta)\}$ **(D)** $e^{\sin\theta}\cdot\{\sin(\sin\theta)\}$

17. If z and w are two non-zero complex numbers such that $|zw|=1$ and $arg(z)-arg(w)=\frac{\pi}{2}$, then $\bar{z}w$ is equal to:

(A) 1 **(B)** -1 **(C)** i **(D)** $-i$

18. If z_1, z_2 and z_3, z_4 are two pairs of conjugate complex numbers, then $arg\left(\frac{z_1}{z_4}\right)+arg\left(\frac{z_2}{z_3}\right)$ equals:

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

19. If $|z_1|=|z_2|=\ldots=|z_n|=1$, then $\left|\frac{z_1+z_2+\ldots.+z_n}{z_1^{-1}+z_2^{-1}+\ldots.+z_n^{-1}}\right|$ is equal to :

(A) $\frac{1}{n}$ **(B)** n **(C)** 1 **(D)** $|z_1+z_2+\ldots+z_n|$

20. The number of solutions of the system of equations $Re(z^2)=0$ and $|z|=2$, is :

(A) 4 **(B)** 2 **(C)** 3 **(D)** 1

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SECTION-2

This Section contains Five (05) 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)

1. If the equation $x^4 - 4x^3 + ax^2 + bx + 1 = 0$ has four positive roots, then the value of $(a + b)$ is _____ .

2. If sum of n terms of two A.P.'s are $\frac{n}{2}(7n+13)$ and $\frac{n}{2}(313-13n)$ and their nth terms are equal, then the value of n is _____.

3. If a point P denoting the complex number $z = x + iy$ moves in the Argand plane satisfying $Re\left(\frac{z-3}{z+i}\right) = \frac{2}{5}$, if $x^2 + y^2 + ax + by + c = 0$, then the value of $(b - c - a)$ is _____ .

4. If Z is a non-real complex number, then the minimum value of $\frac{Im\left(Z^5\right)}{\left(Im\, Z\right)^5}$ is _____ .

5. Let $a \in R$ such that the equation $(1+2i)x^3 - 2(3+i)x^2 + (5-4i)x + 2a^2 = 0$ has at least one real root. The value of $\sum a^2$ is _____ .

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