VMC Vidyamandir Classes SINCE 1986

IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Booster Test - 6 | 2024

Date: 2/2/2023 **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: Rotational Motion, Gravitation, Liquids

Chemistry: Thermochemistry, Thermodynamics, Chemical equilibrium

Mathematics: Straight Line, Circles, Conic Sections

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. A right cone is placed with its base on a rough inclined plane. As the inclination of the plane is slowly increased it is found that cone starts slipping and toppling over simultaneously. If coefficient of friction between the cone and the plane is $\frac{1}{\sqrt{3}}$, then apex angle of the cone is:

(A) $2\sin^{-1}\left(\frac{1}{2\sqrt{3}}\right)$ **(B)** $\tan^{-1}\left(\frac{1}{2\sqrt{3}}\right)$ **(C)** $\sin^{-1}\left(\frac{1}{2\sqrt{3}}\right)$ **(D)** $2\tan^{-1}\left(\frac{1}{4\sqrt{3}}\right)$

2. With what minimum speed a particle should be projected tangentially from a satellite, which is revolving around earth in an orbit of radius 2R such that it escapes the gravitation field of earth (mass and radius of earth are M and R)?

(A) Zero **(B)** $\sqrt{\frac{GM}{R}}\left(\sqrt{2}-1\right)$ **(C)** $\sqrt{\frac{GM}{2R}}$ **(D)** $\sqrt{\frac{GM}{R}}\left(1-\frac{1}{\sqrt{2}}\right)$

SPACE FOR ROUGH WORK

3. Three particles each of mass m are located at the three corners of an equilateral triangle of side *l*. The force experienced by a fourth particle of same mass if placed at the mid-point of a side, is :

(A) $\frac{2Gm^2}{3l^2}$ **(B)** $\frac{Gm^2}{3l^2}$ **(C)** $\frac{4Gm^2}{3l^2}$ **(D)** $\frac{Gm^2}{l^2}$

4. A hemispherical tank of radius R has a small orifice of area *a* at its base. The time required to empty the tank if initially it is completely filled is:

(A) $\frac{5\sqrt{3}\pi R^{5/2}}{17a\sqrt{g}}$ **(B)** $\frac{7\sqrt{2}\pi R^{5/2}}{15a\sqrt{g}}$ **(C)** $\frac{5\sqrt{2}\pi R^{5/2}}{17a\sqrt{g}}$ **(D)** $\frac{7\sqrt{3}\pi R^{5/2}}{15a\sqrt{g}}$

5. When a glass capillary tube is immersed in a liquid, the liquid rises to a height of 6*mm*. The tube is gradually pressed down, until a length of only 4*mm* projects outside. In this situation the liquid meniscus makes an angle of $\theta°$ with the walls of the capillary. It the angle of contact for the glass and liquid pair is $\cos^{-1}3/4$, find θ.

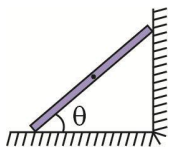
(A) 30° **(B)** 60° **(C)** 37° **(D)** $\cos^{-1}(3/7)$

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. An uniform rod of mass *m* and length *l* is released from rest when rod makes an angle θ infinitesimally less than $\pi/2$. The rod slides against the wall and floor without friction. When it makes an angle $\theta = 30°$ with horizontal:



(A) Angular speed of rod is $\sqrt{\frac{3g}{2l}}$ **(B)** Speed of centre of rod is $\frac{l}{2}\sqrt{\frac{3g}{2l}}$

(C) Angular speed of rod is $\sqrt{\frac{g}{l}}$ **(D)** Speed of centre of rod is $\frac{l}{2}\sqrt{\frac{3g}{l}}$

7. Two particles of mass m and 2*m* separated by distance *r* are describing circular path under mutual gravitational force of attraction, such that speed of mass *m* is v_0, then :

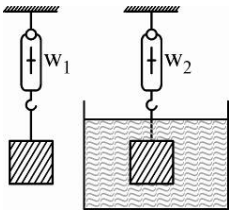
(A) For mass 2*m* radius of circular path is $r/3$

(B) Speed of mass 2*m* is v_0

(C) Speed of mass 2*m* is $v_0/2$

(D) Ratio of time periods of *m* and 2*m* is 2 : 1

8. A spring balance reads w_1 with a block suspended from it. If the block is submerged in a liquid whose density is less than density of block, the spring balance reads w_2. The experiment is repeated twice, once on surface of earth and another time on surface of moon. If acceleration due to gravity on surface of moon is one-sixth of that on surface of earth, then:

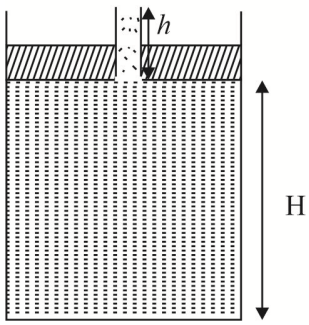


(A) w_1 is same on earth and moon **(B)** w_2 is same on earth and moon

(C) $(w_1 - w_2)$ is same on earth and moon **(D)** $\frac{w_1}{w_2}$ is same on earth and moon

SPACE FOR ROUGH WORK

9. A piston of mass M = 3*kg* and radius R = 4 *cm* has a hole into which a thin pipe of radius *r* = 1 *cm* is inserted. The piston can enter a cylinder tightly and without friction and initially it is at the bottom of the cylinder. 750 *gm* of water is now poured into the pipe so that the piston and pipe are lifted up as shown. The height of water in the cylinder is H and height of water in the pipe is *h*. Then:



(A) $H = \frac{11}{\pi} m$ **(B)** $H = \frac{11}{32\pi} m$

(C) $h = \frac{2}{\pi} m$ **(D)** $h = \frac{2}{3\pi} m$

10. A uniform rod AB of mass M and length L is lying on a horizontal frictionless surface. A particle of mass m traveling along the surface hits the end A with speed v_0 normal to length AB of the rod. The collision is perfectly elastic. After collision particle comes to rest, then:

(A) Ratio of $\frac{m}{M}$ is $\frac{1}{4}$

(B) Angular speed of rod just after collision is $\frac{3v_0}{2L}$

(C) Velocity of centre of the rod just after collision is $\frac{v_0}{4}$

(D) Velocity of a point at a distance $\frac{3L}{4}$ from end A is zero just after collision.

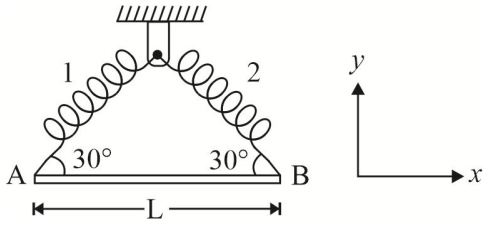
SPACE FOR ROUGH WORK

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 uniform slender bar AB of mass *m* is suspended from two identical springs as shown. Now spring 2 breaks. Answer the following questions considering the instant just after spring 2 breaks at point B.



11. The angular acceleration of the bar is:

(A) $\frac{3g}{2L}$ **(B)** $\frac{3g}{L}$ **(C)** $\frac{3g}{4L}$ **(D)** $\frac{g}{2L}$

12. The acceleration of point A is:

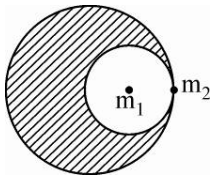
(A) 1.3g **(B)** 2.3g **(C)** 3.3g **(D)** 0.3g

SPACE FOR ROUGH WORK

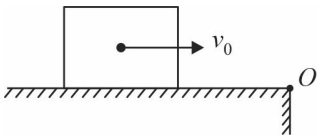
SECTION-2

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, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. A spherical cavity of radius $\frac{R}{2}$ is made in a uniform solid sphere of radius *R*. A point mass m_1 is placed at the centre of cavity and another point mass m_2 is placed at the common point of contact of the sphere and cavity. If $m_1 = 2m_2$, what is the ratio of gravitational force experienced by m_1 to that experienced by m_2 ?

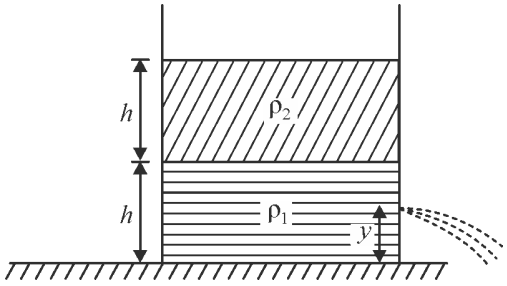


2. An ice cube of mass M and with sides of length *a* is sliding without friction with speed v_0 when it hits a small ridge O at the edge of counter (see figure). This collision causes the cube to rotate up and over the ridge and fall of the table. The minimum value of v_0 needed for the cube to fall off the table is given by $\left(\sqrt{\frac{k}{10}ag}\right)$. Find integer value of *k*.

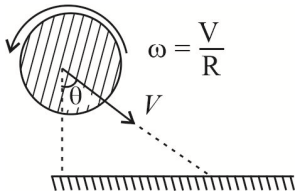


SPACE FOR ROUGH WORK

3. A cylindrical tank having cross-sectional area $A = 0.5m^2$ is filled with two liquids of density $\rho_1 = 900\,kg\,m^{-3}$ and $\rho_2 = 600\,kg\,m^{-3}$, to a height $h = 60\ cm$ each as shown in the figure. A small hole having area $a = 5cm^2$ is made in right vertical wall at a height $y = 20cm$ from the bottom. Take $g = 10\ m/s^2$ and assume velocity at open cylindrical face is negligible in comparison to velocity of efflux at hole. Calculate the velocity of efflux (in *m/s*).



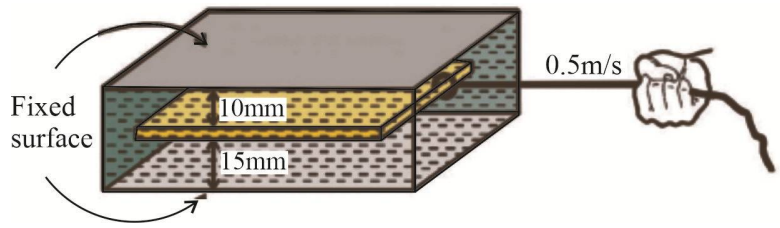
4. A reverse spinning unform solid cylinder of mass m and radius R having velocity V and angular velocity $\frac{V}{R}$ makes an oblique collision with horizontal rough surface of coefficient of friction as μ and comes to complete stop. The ratio of values of μ and θ (in radian) is $\frac{n}{\pi}$. Find value of *n*.



SPACE FOR ROUGH WORK

5. A sphere is made of an alloy of Metal A (density $8\ g/cm^3$) and Metal B (density $6\ g/cm^3$). The sphere floats in mercury (density $13.6\ g/cm^3$) with half its volume submerged. The percentage of the total volume of the sphere that is occupied by metal A is _____ .

6. Glycerin is filled in 25 mm wide space between two large plane horizontal surfaces. A force is required to drag a very thin plate $0.75\ m^2$ in area between the surfaces at a constant speed of $0.5m/s$, if it is at a distance of 10 mm from one of the surfaces in horizontal position. Take coefficient of viscosity $\eta = 0.5Ns/m^2$. The value of force required to drag is _____N.



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. An aqueous mixture of 0.1 M KCN and 0.03 M $AgNO_3$ undergoes a complex formation reaction.

$$Ag^+ + 2CN^- \rightleftharpoons Ag(CN)_2^-$$

K_c for the reaction is 2.5×10^{18}. The molarity of remaining Ag^+ ions in the solution at equilibrium will be:

(A) 7.5×10^{18} M **(B)** 7.5×10^{-18} M **(C)** 7.5×10^{19} M **(D)** 7.5×10^{-19} M

2. Match list I with list II and select the correct options given below.

	List-I		**List-II**
(P)	$K_p > Q$	**(1)**	Non-spontaneous forward reaction
(Q)	$\Delta G^\circ < RT\ln Q,\ \Delta G^\circ > 0$	**(2)**	Equilibrium state
(R)	$K_p = Q$	**(3)**	Spontaneous and endothermic forward reaction
(S)	$T > \frac{\Delta H}{\Delta S}$	**(4)**	Spontaneous forward reaction

Codes:

	P	**Q**	**R**	**S**		**P**	**Q**	**R**	**S**
(A)	1	2	3	4	**(B)**	3	4	2	1
(C)	4	1	2	3	**(D)**	2	1	4	3

SPACE FOR ROUGH WORK

3. If the standard molar enthalpy of combustion of benzene (*l*), carbon (s) and hydrogen (g) are Q_1, Q_2 and Q_3 respectively, what will be the standard molar enthalpy of formation of benzene (*l*)?

(A) $Q_1 + 6Q_2 + Q_3$ **(B)** $6Q_2 + Q_1 + 3Q_3$

(C) $6Q_2 - 3Q_3 - Q_1$ **(D)** $6Q_2 + 3Q_3 - Q_1$

4. What is the change in molar entropy $(\text{in cal mol}^{-1}\text{K}^{-1})$ of an ideal gas $X_2\left(C_{v,m} = \frac{5}{2}R\right)$ in the following process? (Given: $\ln 2 = 0.70; \ln 5 = 1.6, R = 2\,\text{cal mol}^{-1}\text{K}^{-1}$)

$X_2(400\,\text{K}, 1\,\text{bar}) \longrightarrow X_2(100\,\text{K}, 10\,\text{bar})$

(A) –14.4 **(B)** 5.2 **(C)** –5.2 **(D)** 14.4

5. On heating, ammonia decomposes as $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ and it attain equilibrium state at total pressure 20 atm and mole percentage of ammonia in equilibrium mixture is 60%, then equilibrium constant (K_p) of reaction is:

(A) 5 **(B)** 2 **(C)** 3 **(D)** 8

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. The dissociation of ammonium carbamate is represented by the following equation.

$$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$

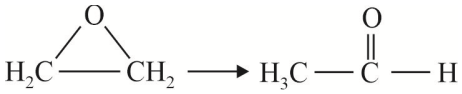
$\Delta H°$ for the backward reaction is positive. The equilibrium will shift in backward direction.

(A) Increase in temperature

(B) Decrease in pressure

(C) Increase in concentration of ammonia

(D) Addition of an inert gas at constant pressure into the reaction container

7. 

Given: For ethylene oxide, $\Delta_f H^0$ and S^0 are $-51 kJ\ mol^{-1}$ and $243 J\,mol^{-1}\,K^{-1}$ respectively and for acetaldehyde $\Delta_f H^0$ and S^0 are $-166\,kJ\,mol^{-1}$ and $266\,J\,mol^{-1}\,K^{-1}$ respectively, then select the correct statements:

(A) ΔH^0 for the reaction is $-115\,kJ\,mol^{-1}$

(B) ΔS^0 for the reaction is $0.023 kJ\ mol^{-1}\,K^{-1}$

(C) Reaction is thermodynamically favourable

(D) Low temperature can favour formation of product

SPACE FOR ROUGH WORK

8. Given $\Delta_f H^0(C_2H_6, g) = -85 kJ/mol$, $\Delta_f H^0(C_3H_8, g) = -104 kJ/mol$,

$\Delta_{sub} H^0(C, s) = 718 kJ/mole$ and B.E. of $(H-H) = 436 kJ/mole$

Then, in kJ/mol, the:

(A) C – C bond enthalpy is 218 **(B)** C – H bond enthalpy is 414

(C) C – C bond enthalpy is 345 **(D)** C – H bond enthalpy is 448

9. Which of the following statement(s) is/are correct?

(A) All reversible adiabatic processes are isoentropic

(B) The heat of vaporization of water at 100°C is 40.6 kJ/mol. When 9g of water vapour condenses to liquid at 100°C and 1 atm, then $\Delta S_{system} = -54.42 J/K$

(C) When $(\Delta G_{system})_{T,P} < 0$; the reaction must be exothermic

(D) All isothermal processes are isoentropic

10. Two equilibria are simultaneously existing in a vessel at 25°C.

$NO(g) + NO_2(g) \rightleftharpoons N_2O_3(g)$; $K_{P_1}(atm^{-1})$

$2NO_2(g) \rightleftharpoons N_2O_4(g)$; $K_{P_2} = 8 atm^{-1}$

If initially only NO(g) and $NO_2(g)$ are present in 3 : 5 mole ratio. The total pressure at equilibrium is 5.5 atm and the partial pressure of NO_2 at equilibrium is 0.5 atm.

The incorrect statement(s) regarding the above equilibria is/are

(A) K_{P_1} for the equilibrium is $0.4 atm^{-1}$

(B) Partial pressure of N_2O_4 at equilibrium is 1.6 atm

(C) Partial pressure of N_2O_3 at equilibrium is 2 atm

(D) Partial pressure of NO at equilibrium is 2.5 atm

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

Concrete is produced from a mixture of cement, water, sand and small stones. It consists primarily of calcium silicates and calcium aluminates formed by heating and grinding of clay and limestone. In later steps of cement production a small amount of gypsum, $CaSO_4.2H_2O$ is added to improve subsequent hardening of concrete. The use of elevated temperatures during the final production may lead to formation of unwanted hemihydrate, $CaSO_4 \cdot \frac{1}{2}H_2O$. Consider the following reaction.

(Given : Atomic mass of $Ca = 40\,u$, $S = 32\,u$, $O = 16\,u$, $H = 1u$ and $R = 8.314\,JK^{-1}\,mol^{-1}$)

$$CaSO_4 \cdot 2H_2O(s) \longrightarrow CaSO_4 \cdot \frac{1}{2}H_2O(s) + \frac{3}{2}H_2O(g)$$

The following thermodynamic data apply at 25°C, standard pressure: (in 1 bar)

Compound	$\Delta_f H^0 (kJ\,mol^{-1})$	$S^0 (J\,mol^{-1}\,K^{-1})$
$CaSO_4 \cdot 2H_2O(s)$	–2021.0	194.0
$CaSO_4 \cdot \frac{1}{2}H_2O(s)$	–1575.0	130.5
$H_2O(g)$	–241.8	188.6

11. ΔH for the formation of $CaSO_4 \cdot \frac{1}{2}H_2O(s)$ from 1 kg of $CaSO_4 \cdot 2H_2O(s)$ is:

(A) + 446 kJ **(B)** + 484 kJ **(C)** – 446 kJ **(D)** – 484 kJ

12. Temperature at which the vapour pressure of H_2O is 1.00 bar?

(A) 107°C **(B)** 380°C **(C)** 215°C **(D)** 240°C

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, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. For the reversible process $H_2O(\ell) \rightleftharpoons H_2O(g)$, $K_P = P_{H_2O}(\text{bar})$. Value of this K_P is equal to the atmospheric pressure at the boiling point. Calculate the boiling point of water (in nearest integer) at 380 mm of Hg. The heat of vaporisation of water is 540 cal/g, universal gas constant R is 2 cal/mole-K. Boiling point of water at 760 mm of Hg is 373 Kelvin. [Take : 1 bar equal to 760 mm of Hg]

2. 2 mole of $NH_4HS(s)$ is taken in close container of volume 2 litre. If 1 mole $NH_4HS(s)$ takes part in reaction to attain the equilibrium state and at equilibrium moles of $H_2(g)$ is 0.75. [Take : $\sqrt{3} = 1.73$]

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g) \qquad K_{C_1} = x$$

$$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \qquad K_{C_2} = y$$

At equilibrium $[NH_3] = aM$, $[N_2] = bM$, calculate the value of $\frac{y}{x(a+b)}$ is _____.

3. For the reaction $A(g) \rightleftharpoons B(g) + C(g)$. At 300 K, the average molar mass of the equilibrium mixture is $83\,g\,mol^{-1}$. If molar mass of A, B and C are 100, 60 and $40\,g\,mol^{-1}$ respectively, then the number of moles of 'C' present at equilibrium (in nearest integer) in a reaction starting with 10 moles of A is_____.

SPACE FOR ROUGH WORK

4. 4 mole of $S_2Cl_4(g)$ was introduced into a 10L vessel. The following equilibrium was established $S_2Cl_4(g) \rightleftharpoons 2SCl_2(g)$. At equilibrium 0.2 mol of S_2Cl_4 was present in the vessel. The value of equilibrium constant is: (Nearest integer)

5. 512 gm of HI was heated to attain the equilibrium $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$. The amount of iodine produced at equilibrium is equal to 0.5 mole. Calculate the value of 'y' where $y = \frac{K_p}{9}$, here K_p is equilibrium constant for $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. [Given : Atomic mass of iodine = 127]

6. For the reaction at 300 K.

$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g) \qquad \Delta G° = -191\,kJ/mol$

$S^0_{Cl_2} = 228\,JK^{-1}mol^{-1}$, $S^0_{HCl} = 184\,JK^{-1}mol^{-1}$ and $\Delta_f H^0_{HCl} = -92.5\,kJ/mol.$

What will be the value of $\frac{S^0_{H_2}}{15}(\text{in } JK^{-1}mol^{-1})$ at 300 K.

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. If the line $\sqrt{5}x = y$ meets the lines $x = 1$, $x = 2 \ldots$ $x = n$, at points $A_1, A_2, \ldots . A_n$ respectively then $(OA_1)^2 + (OA_2)^2 \ldots . + (OA_n)^2$ is equal to:

(A) $3n^2 + 3n$ **(B)** $2n^3 + 3n^2 + n$

(C) $2n^3 + 3n^2 + 2$ **(D)** $(3/2)(n^4 + 2n^3 + n^2)$

2. A pair of perpendicular lines passing through P (1, 4) intersect x axis at Q and R, then locus of incentre of ΔPQR is:

(A) $x^2 - y^2 - 2x - 8y + 17 = 0$ **(B)** $x^2 + y^2 - 2x - 8y - 17 = 0$

(C) $x^2 - y^2 - 2x - 8y - 17 = 0$ **(D)** $x^2 + y^2 - 2x - 8y = 0$

3. A(3, 4), B(0, 0) and C(3, 0) are vertices of ΔABC. If P is a point inside ΔABC such that $d(P, BC) \le \min\{d(P, AB), d(P, AC)\}$ then the maximum value of $d(P, BC)$ is $\{d(P, BC)$, represents distance between P and BC$\}$

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

SPACE FOR ROUGH WORK

4. The complete range of values of k for which it is possible to draw the chord $y=\sqrt{k}x+1$ to the curve $x^2+2xy+\left(2+\sin^2\beta\right)y^2=1,$

Which subtends a right angle at the origin for some value of β is:

(A) [1, 3] **(B)** [0, 1] **(C)** [2, 3] **(D)** [0, 3]

5. Coordinates of the point on the straight line $x+y=4,$ which is nearest to the parabola $y^2=4\left(x-10\right)$ is:

(A) $\left(\frac{17}{2},-\frac{9}{2}\right)$ **(B)** (2, 2) **(C)** $\left(\frac{3}{2},\frac{5}{2}\right)$ **(D)** $\left(\frac{13}{2},-\frac{5}{2}\right)$

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. Equation of parabola having the extremities of its latus rectum as (3, 4) and (4, 3) is:

(A) $\left(x-\frac{7}{2}\right)^2+\left(y-\frac{7}{2}\right)^2=\left(\frac{x+y-6}{2}\right)^2$ **(B)** $\left(x-\frac{7}{2}\right)^2+\left(y-\frac{7}{2}\right)^2=\left(\frac{x+y-8}{2}\right)^2$

(C) $\left(x-\frac{7}{2}\right)^2+\left(y-\frac{7}{2}\right)^2=\left(\frac{x+y-5}{2}\right)^2$ **(D)** $\left(x-\frac{7}{2}\right)^2+\left(y-\frac{7}{2}\right)^2=\left(\frac{x+y-9}{2}\right)^2$

7. If from an external point P(-5,5) two tangents are drawn to the circle $x^2+y^2+2x-4y-4=0$ with centre O to meet at points Q & R, then:

(A) Angle between PQ & PR is $\sin^{-1}\left(\frac{24}{25}\right)$

(B) Area of quadrilateral PQOR is 20

(C) Angle between line QP & QR is $\sin^{-1}\left(\frac{4}{5}\right)$

(D) Area of triangle PQR is $\frac{192}{25}$

8. A circle 'S' is described on the focal chord of the parabola $y^2=4x$ as diameter. If the focal chord is inclined at an angle of 45° with axis of x, then which of the following is/are true.

(A) Radius of the circle is 4

(B) Centre of the circle is (3, 2)

(C) The line x + 1 = 0 touches the circle

(D) The circle $x^2+y^2+2x-6y+3=0$ is orthogonal to 'S'

SPACE FOR ROUGH WORK

9. From any point P on the circle $x^2 + y^2 = 1$, tangents are drawn to a variable circle centered at a variable point $C(3+\cos\theta, 4+\sin\theta)$. The tangents touches the variable circle at two variable points A and B. C_1 be the Locus of point C then which of following is/are correct.

(A) Maximum value of diameter of circumcircle of ΔPAB is 7

(B) Minimum value of diameter of circumcircle of ΔPAC is 3

(C) Number of common tangents that can be drawn on C_1 and circle $x^2 + y^2 = 1$ is 4

(D) Length of direct common tangents on $x^2 + y^2 = 1$ and C_1 is 5

10. If one of the lines given by the equation $2x^2 + pxy + 3y^2 = 0$ coincides with one of those given by $2x^2 + qxy - 3y^2 = 0$ and the other lines represented by them be perpendicular, then (p, q) is equal to:

(A) (5, 1) **(B)** (–5, 1) **(C)** (–5, –1) **(D)** (5, –1)

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

t_1, t_2, t_3 are lengths of tangents drawn from point (h, k) to the circles $x^2 + y^2 = 4$, $x^2 + y^2 - 4x = 0$ and $x^2 + y^2 - 4y = 0$ respectively. If $t_1^4 = t_2^2 \cdot t_3^2 + 16$, then locus of the point (h, k) consists of a straight line L_1 and a circle C_1.

11. Circumcentre of the largest triangle formed by L_1 and two other lines which are at an angle of 45° with L_1 and tangent to C_1 is:

(A) (1, 1) **(B)** (0, 0) **(C)** (–1, –1) **(D)** (2, 2)

12. If S_1, S_2 and S_3 are three other circles congruent to C_1 and touch both L_1 and C_1 then the area of triangle formed by joining centres of the circles S_1, S_2 and S_3 is: (in square units)

(A) 2 **(B)** 4 **(C)** 8 **(D)** 16

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, Θ sign should be bubbled*. (Example: 6, 81, 1.50, 3.25, 0.08)

1. Given that $x^2 + y^2 = 14x + 6y + 6,$ what is the largest possible value that $3x + 4y$ can have?

2. Triangle ABC with AB = 13, BC = 5 and AC = 12 slides on the coordinate axes with A and B on the positive *x*-axis and positive y-axis respectively. The locus of vertex C is a line $12x - ky = 0.$ Then the value of $|k|$ is _____.

3. If two circles passing through (0, *a*) and (0, –*a*) touching the line $y = mx + c$ intersect orthogonally then $c^2 = a^2(k + m^2)$, where *k* is equal to _____.

SPACE FOR ROUGH WORK

4. If real numbers x and y satisfy $(x+5)^2+(y-12)^2=196$ then the maximum value of $(x^2+y^2)^{1/3}$ is___.

5. Given a circle $(x+4)^2+(y-2)^2=25.$ Another circle is drawn passing through (– 4, 2) and touching the given circle internally at the point A(–4, 7). AB is a chord of length 8 units of the larger circle intersecting the other circle at the point C. Then AC will be _____.

6. If the line $y=\sqrt{3}x$ cuts the curve $y=x^3+ax^2+bx-72$ at A, B and C, then OA. OB. OC (Where 'O' is origin) is:

SPACE FOR ROUGH WORK

End of Adv. Booster Test - 6 | JEE-2024