VMC Vidyamandir Classes SINCE 1986

IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Main - 5 | JEE 2024

Date: 21/12/2022 **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: Energy & Momentum Rotational Motion (Section 1, 2 & 4 Only)

Chemistry: States of matter, Thermochemistry

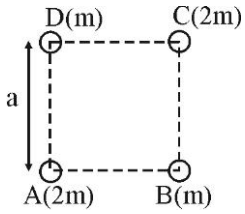
Mathematics: Complex Numbers, Straight Line

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.

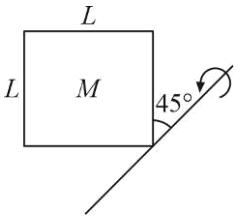
1. Four particles are arranged at the vertices of a square on a horizontal table. The distance of the centre of mass of the particles from A is :



(A) $\frac{a}{2}$ **(B)** $\frac{a}{\sqrt{2}}$

(C) $\frac{3\sqrt{2}}{4}a$ **(D)** $\frac{3a}{4}$

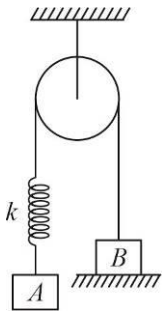
2. The moment of inertia of a thin uniform square plate of mass M and side length L about the specified axis of rotation which is parallel to one of the diagonal is:



(A) $\frac{5}{12}ML^2$ **(B)** $\frac{ML^2}{12}$

(C) $\frac{ML^2}{3}$ **(D)** $\frac{7ML^2}{12}$

3. System shown in the figure consists of an unstretched spring, massless and frictionless pulley, two blocks at rest, all connected together with an inextensible massless string. After the system is released from rest, the block A momentarily comes to rest the moment the block B leaves the contact with ground. The ratio of mass of block A to mass of block B is:

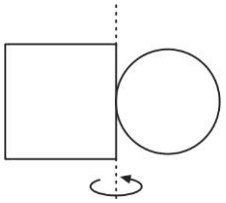


(A) $\frac{1}{2}$ **(B)** $\frac{1}{3}$

(C) $\frac{1}{4}$ **(D)** 1

SPACE FOR ROUGH WORK

4. A uniform disc of mass M and radius a is joined with a uniform square plate of identical mass and side length $2a$ as shown. Moment of inertia of the combined figure about the edge of the square plate in contact with the disc is:



(A) $\frac{31}{12}Ma^2$ **(B)** $\frac{7}{3}Ma^2$

(C) $\frac{7}{12}Ma^2$ **(D)** $\frac{19}{12}Ma^2$

5. A particle is constrained to move under the application of a conservative force whose potential energy is given by $U = x^4 - 2x^2 + 100\,J$, where x is in m. For what value of x, the particle is under unstable equilibrium?

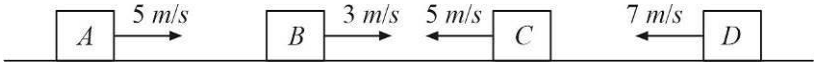
(A) $x = -1\ m$ **(B)** $x = 0$ **(C)** $x = 1\ m$ **(D)** $x = 2\ m$

6. A bob of mass m connected with a light rod of length l is free to rotate in a vertical circle about other end of the rod. What minimum speed should it be imparted at its bottom – most point such that it is just able to complete the circle?

(A) $\sqrt{3gl}$ **(B)** $\sqrt{4gl}$ **(C)** $\sqrt{5gl}$ **(D)** $\sqrt{6gl}$

SPACE FOR ROUGH WORK

7. Four identical blocks each of mass M are moving along a single straight path on a frictionless horizontal table with initial velocity as shown below:



Assuming every collision between any two blocks to be elastic and taking right direction to be positive, velocity of each block after last collision is:

(A) $V_A = -3\,m/s,\ V_B = -7\,m/s,\ V_C = 5\,m/s,\ V_D = 5\,m/s$

(B) $V_A = -7\,m/s,\ V_B = -5\,m/s,\ V_C = 3\,m/s,\ V_D = 5\,m/s$

(C) $V_A = 3\,m/s,\ V_B = 7\,m/s,\ V_C = -5\,m/s,\ V_D = -5\,m/s$

(D) Collisions will keep happening for infinite amount of time

8. Which of the following is true for any collision?

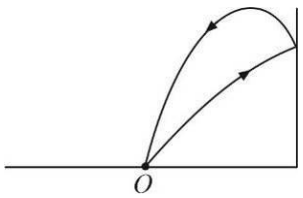
(A) Both linear momentum and kinetic energy are conserved

(B) Neither linear momentum nor kinetic energy may be conserved

(C) Linear momentum is always conserved, however, kinetic energy may or may not be conserved

(D) Kinetic energy is always conserved, but linear momentum may or may not be conserved.

9. A ball is projected towards a frictionless vertical wall from point O as shown. If it hits the wall after t_1 time from the instant it was projected, and it rebounds and returns to the point O after another t_2 time from the instant it rebounded, then the coefficient of restitution of collision between the ball and the wall is:



(A) $e = \frac{t_1}{t_2}$

(B) $e = \frac{t_1}{t_1 + t_2}$

(C) $e = \frac{t_2}{t_1 + t_2}$

(D) Insufficient information

SPACE FOR ROUGH WORK

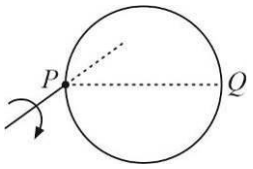
10. A uniform disc of mass M and radius R is free to rotate in a vertical plane about a smooth horizontal axis passing through point P where PQ is a horizontal diameter at the moment. It is then released to rotate.

Statement I: Angular acceleration of the disc at the instant is $2g/3R$.

Statement II: Torque due to weight of the disc about the axis of rotation at the instant is zero.

Statement III: Force on the disc due to hinge at the moment is one-third of its weight.

Choose the CORRECT statement(s).



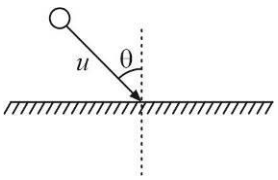
(A) Statement I only

(B) Statement I and II only

(C) Statement I and III only

(D) Statement I, II and III

11. A ball strikes a smooth horizontal surface obliquely as shown. Take the collision to be perfectly inelastic.



Statement I: The ball will stick to the surface after collision.

Statement II: In a perfectly inelastic collision, the coefficient of restitution, $e = 0$.

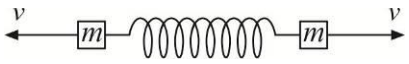
(A) Both statements are correct, and statement II is correct explanation of statement I

(B) Both statements are correct, but statement II is not a correct explanation of statement I

(C) Only statement I is correct

(D) Only statement II is correct

12. Two blocks each of mass m are connected to a spring of spring constant k. If both are given velocity v in opposite directions, then the maximum elongation of the spring is: Using conservation of energy.



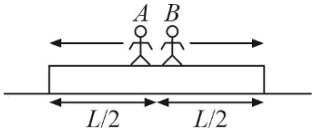
(A) $\sqrt{\frac{mv^2}{k}}$ **(B)** $\sqrt{\frac{2mv^2}{k}}$ **(C)** $\sqrt{\frac{mv^2}{2k}}$ **(D)** $2\sqrt{\frac{mv^2}{k}}$

SPACE FOR ROUGH WORK

13. A cubical block of mass *m* and edge a is kept on a rough inclined plane of inclination θ. The torque of friction acting on the block about its centre after it was released is:
(Given that $\theta = 30°$ and coefficient of friction $\mu = 0.75$).

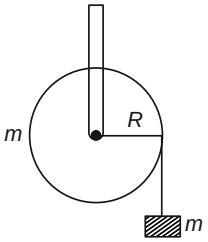
(A) $mg\sin\theta \cdot \frac{a}{2}$ **(B)** $\mu\, mg\cos\theta \cdot \frac{a}{2}$ **(C)** $mg\sin\theta \cdot a$ **(D)** $\mu\, mg\cos\theta \cdot a$

14. Two persons *A* and *B*, of mass 40 *kg* and 60 *kg* respectively, standing together at the centre of a light platform, start walking towards the opposite ends. The platform is kept on a frictionless horizontal surface. When person *A* reaches the left end while person *B* the right end, the platform must have moved by a distance of :



(A) *L*/10 towards right **(B)** *L*/10 towards left
(C) 3*L*/10 towards right **(D)** 3*L*/10 towards left

15. A mass *m* supported by a massless string wound around a uniform hollow cylinder of mass *m* and radius *R*. If the string does not slip on the cylinder, with what acceleration will the mass fall on being released?



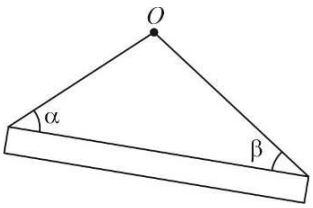
(A) $\frac{2g}{3}$ **(B)** $\frac{g}{2}$
(C) $\frac{5g}{6}$ **(D)** g

16. A bomb of mass 600 *g* moving with negligible speed detonates mid-air into two unequal parts whose masses are in the ratio 1 : 2. If $6 \times 10^3 J$ of energy released during explosion is entirely possessed in the form of kinetic energy of the two moving parts, then the speeds of lighter and heavier mass in the correct order are:

(A) 200 *m*/*s*, 400 *m*/*s* **(B)** 400 *m*/*s*, 200 *m*/*s*
(C) 200 *m*/*s*, 100 *m*/*s* **(D)** 100 *m*/*s*, 200 *m*/*s*

SPACE FOR ROUGH WORK

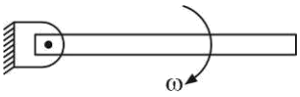
17. A thin uniform rod of mass M and length L is hanging about O with the help of two connecting light strings as shown. The torque due to weight of the rod about point O is:



(A) $Mg\frac{L}{2}\cos(\alpha+\beta)$ **(B)** $Mg\frac{L}{2}\sin(\alpha+\beta)$

(C) $Mg\ L\sin(\alpha+\beta)$ **(D)** Zero

18. A thin uniform rod of mass M and length L is hinged about one of its end and is rotating in vertical plane. It has angular velocity $\omega=\sqrt{g/2L}$ when it is horizontal as shown. The force exerted by hinge at the instant shown will be:



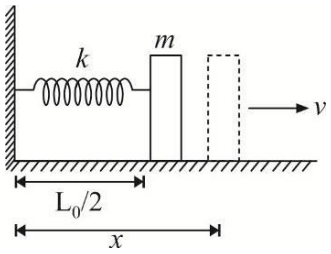
(A) $\frac{\mu g}{2}$ **(B)** $\frac{\mu g}{\sqrt{2}}$ **(C)** $\frac{\mu g}{2\sqrt{2}}$ **(D)** Zero

SPACE FOR ROUGH WORK

19. A uniform ladder of mass 10 kg leans against a smooth vertical wall making an angle of 53° with it. The other end rests on a rough horizontal floor. Find the normal force that the wall exerts on the ladder. (g = 10 m/s^2)

(A) 50 N **(B)** 100 N **(C)** 200/3 N **(D)** 200 N

20. A block of mass m is connected to a spring of spring constant k fixed at one end to a wall. The block can slide on a frictionless table as shown in the figure. The natural length of the spring is L_0 and it is compressed to half its natural length when the block is released. Find the velocity of the block as a function of its distance x from the wall.



(A) $\sqrt{\frac{2k}{m}\left[\frac{L_0^2}{4}-(L_0-x)^2\right]}^{1/2}$ **(B)** $\sqrt{\frac{k}{m}\left[\frac{L_0^2}{4}+(L_0-x)^2\right]}^{1/2}$

(C) $\sqrt{\frac{k}{m}\left[\frac{L_0^2}{4}-(L_0-x)^2\right]}^{1/2}$ **(D)** $\sqrt{\frac{k}{2m}\left[\frac{L_0^2}{4}-(L_0-x)^2\right]}^{1/2}$

SPACE FOR ROUGH WORK

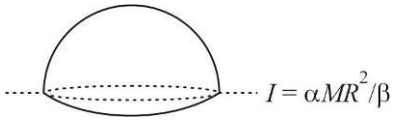
SECTION-2

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. A truck is moving with a constant velocity of 16 *m*/*s* on a horizontal road. Rain drops are falling vertically downward on the truck with speed 12 *m*/*s* at a constant rate of $0.5\,kg.s^{-1}$. The thrust force exerted on the truck due to falling raindrops is _____ newton. (Assume that the raindrops come to rest relative to truck after falling).

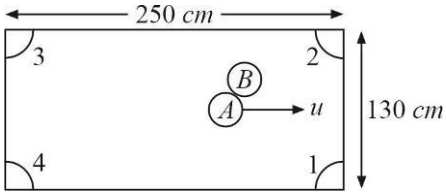
2. Two bodies of the same mass are moving with the same speed, but in different directions in a plane. They have a completely inelastic collision and move together thereafter with a final speed which is half of their initial speed. The angle between the initial velocities of the two bodies (in degree) is _____.

3. Moment of inertia of a solid uniform hemisphere of mass *M* and radius *R* about one of the diameter of its base is given by $\frac{\alpha MR^2}{\beta}$, where α and β are some co-primes. Write $(\alpha+\beta)$ as your answer.



4. A force $\vec{F}=\left(\hat{i}+2\hat{j}+3\hat{k}\right)N$ acts at a point $(4\hat{i}+3\hat{j}-\hat{k})\,m$. Then the magnitude of torque about the point $\left(\hat{i}+2\hat{j}+\hat{k}\right)m$ will be $\sqrt{x}$ N-m. The value of *x* is:_____.

5. There is a 250 *cm* × 130 *cm* horizontal pool table. Ball *A* moving with speed *u* hits another identical ball *B* at rest obliquely. After collision *A* moves to pocket-1 and *B* moves to pocket-2. If A was at a distance 120 *cm* from pocket-1 while *B* was at a distance *x cm* from pocket-2 at the time of collision, then write *x* as your answer. (Assume collision to be elastic and dimensions of balls to be very small compared to size of the table).



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. Equal moles of CO, B_2H_6, H_2 and CH_4 are placed in a container. If a hole was made in container, after 5 min partial pressure of gases in container would be:
(Atomic weight of C, O, B and H are 12, 16, 11 and 1 respectively).

(A) $P_{CO} > P_{B_2H_6} > P_{H_2} > P_{CH_4}$ **(B)** $P_{CO} = P_{B_2H_6} > P_{CH_4} > P_{H_2}$

(C) $P_{CO} > P_{B_2H_6} = P_{H_2} > P_{CH_4}$ **(D)** $P_{B_2H_6} > P_{H_2} > P_{CH_4} > P_{CO}$

2. Air at sea level is dense. This is practical evidence of:

(A) Boyle's law **(B)** Charle's law **(C)** Dalton's law **(D)** Avogadro's

3. The density of steam at 100°C and 2×10^5 Pa is $0.6\,kg/m^3$. The compressibility factor for steam is:

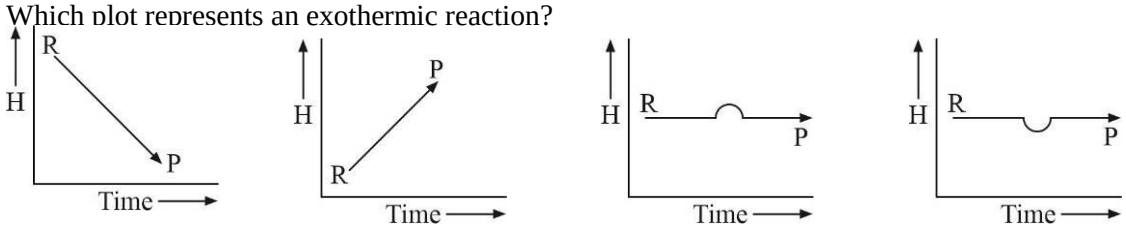
(A) 1 **(B)** 1.94 **(C)** 1.03 **(D)** 0.87

4. The intercept of the line drawn for log P (P in atm) and $\log\frac{1}{V}$ (V in litre) for 1 mole of an ideal gas at 127°C is equal to:

(A) log 2.463 **(B)** log 32.84 **(C)** log 22.4 **(D)** log 2.24

SPACE FOR ROUGH WORK

5. Which plot represents an exothermic reaction?



(A) **(B)** **(C)** **(D)**

6. Which of the following statement about Maxwell Boltzmann law of distribution of molecular speed is/are correct?

(I) As temperature increases, the most probable velocity of molecules increases but a fraction of molecules with that velocity decreases

(II) The average speed is the arithmetic mean of the different speeds of all the molecules present in a given sample of the gas

(III) The speed distribution curve becomes sharper and is more peaked at higher temperature as the average speed increases

(IV) The speed distribution function is used to determine average molecular speeds.

(A) I, II, III **(B)** I, II, IV **(C)** I, III, IV **(D)** II, III, IV

7. Which of the following reaction defines ΔH_f° ?

(A) $C_{(diamond)} + O_2(g) \longrightarrow CO_2(g)$ **(B)** $\frac{1}{2}H_2(g) + \frac{1}{2}F_2(g) \longrightarrow HF(g)$

(C) $N_2(s) + 3H_2(g) \longrightarrow 2NH_3(g)$ **(D)** $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$

SPACE FOR ROUGH WORK

8. One mole of a non-ideal gas undergoes a change of state (2.0 atm, 3.0 L, 95 K) $\rightarrow$ (4.0 atm, 5.0 L, 245 K) with change in internal energy, $\Delta U = 30.0$ L-atm. the change in enthalpy (ΔH) of the process in kJ is:

(A) 4.45 **(B)** 42.3 **(C)** 8.23 **(D)** 82.3

9. A solution of 500 mL of 2M KOH is added to 500 mL of 2M HCl and the mixture is well shaken. The rise in temperature T_1 is noted. The experiment is then repeated using 250 mL of each solution and rise in temperature T_2 is again noted. Assume all heat is taken up by the solution. Which of the following true?

(A) $T_1 = T_2$ **(B)** T_1 is 2 times as larger as T_2

(C) T_2 is twice larger as T_1 **(D)** T_1 is 4 times as larger as T_2

10. The heats of neutralization of four acids A, B, C and D are –13.7, –9.4, –11.2 and –12.4 kcal respectively, when they are neutralized by a common base. The acidic character obeys the order.

(A) A > B > C > D **(B)** A > D > C > B **(C)** D > C > B > A **(D)** D > B > C > A

11. Equal volumes of oxygen gas and a second gas weigh 1.00 and 2.375 grams respectively under the same experimental conditions. Which of the following is the unknown gas?

(A) NO **(B)** SO_2 **(C)** CS_2 **(D)** CO

12. The average kinetic energy per molecule of CH_4 at 27°C is: [$1J = 10^7$ erg]

(A) 6.21×10^{-14} erg **(B)** 6.21×10^{-15} joule

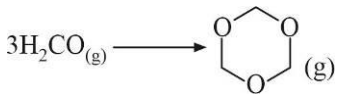
(C) 6.21×10^{-15} calorie **(D)** 6.21×10^{-12} erg

SPACE FOR ROUGH WORK

13. The root mean square speed of a gas at 300 K is $3\sqrt{R}$. The molar mass of gas in $kg\ mol^{-1}$ is:

(A) 1 **(B)** 10 **(C)** 100 **(D)** 1,000

14. The enthalpy of gas phase trimerization of one mole of gaseous formaldehyde in (kJ/mole).



Bond energies (kJ/mole).

Given:

$E_{C=0}$	E_{C-O}	E_{C-H}
700	360	410

(A) –20 **(B)** –60 **(C)** –10 **(D)** –50

15. One gram sample of NH_4NO_3 is decomposed in a bomb calorimeter. The temperature of the calorimeter increases by 6.32 K. The heat capacity of the system is 1.23 kJ/g-deg. The molar heat of decomposition for NH_4NO_3 is:

(A) $-16.1\ kJ\ mol^{-1}$ **(B)** $-7.53\ kJ\ mol^{-1}$ **(C)** $-621.89\ kJ\ mol^{-1}$ **(D)** $-498.1\ kJ\ mol^{-1}$

16. A gas obeys P(V – b) = RT. Select the correct statement about this gas.

(I) Isochoric curves have slope $= \frac{R}{(V-b)}$

(II) Isobaric curves have slope R/P and intercept b

(III) For the gas compressibility factor $= 1 + \frac{Pb}{RT}$

(IV) The attraction forces are overcome by repulsive forces

(A) I, II, III, IV **(B)** I, II, IV **(C)** I, III, IV **(D)** II, III, IV

SPACE FOR ROUGH WORK

17. Determine the enthalpy of formation of $B_2H_6(g)$ in kJ/mol using the following reaction and data.

$$B_2H_6(g) + 3\,O_2(g) \rightarrow B_2O_3(s) + 3H_2O(g)$$

Given: $\Delta_r H° = -1941\,kJ/mol,\ \Delta H_f^\circ(B_2O_3, s) = -1273\,kJ/mol,\ \Delta H_f^\circ(H_2O, g) = -241.8\,kJ/mol$

(A) –75.6 **(B)** +75.6 **(C)** –57.4 **(D)** –28.4

18. Given that: $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}\ ;\ \Delta H° = -P\,kJ$

$$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}\ ;\ \Delta H° = -Q\,kJ$$

The enthalpy of formation of carbon monoxide is:

(A) $\frac{P-Q}{2}$ **(B)** 2Q – P **(C)** P – 2Q **(D)** $\frac{P-2Q}{2}$

19. Heat of neutralization of HF and acetic acid respectively with a strong base are (in kcal).

(A) > –13.7, < –13.7 **(B)** both > –13.7

(C) both < –13.7 **(D)** < –13.7, > – 13.7

20. 200 mL of 0.1 M NaOH is mixed with 100 mL of 0.1 M H_2SO_4 in I experiment. In II experiment 100 mL of 0.1 M NaOH is mixed with 50 mL of 0.1 M H_2SO_4. Select the correct statements:

(I) Heat liberated in each of the two reactions is 274 cal.

(II) Heat liberated in I is 274 cal and in II is 137 cal

(III) Temperature rise in I reaction is more than the temperature rise is II

(IV) Temperature rise in I reaction is equal to the temperature rise in II

(A) I and III **(B)** II and IV **(C)** II and III **(D)** I and IV

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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. The enthalpy of formation of ethane, ethylene and benzene from the gaseous atoms are –2839.2, –2275.2 and $-5536\ \text{kJ mol}^{-1}$ respectively. Calculate the magnitude of resonance energy for benzene, compared with Kekule structure. The bond enthalpy of C–H bond is given as equal to $410.87\ \text{kJ mol}^{-1}$.

2. A closed container of volume $0.02\ \text{m}^3$ contains a mixture of neon and argon gases at a temperature 27°C and pressure $1 \times 10^5\ \text{Nm}^{-2}$. The total mass of mixture is 28 g. If the gram molecular weight of neon and argon are 20 and 40 respectively, find the mass (in gm) of Neon gas in the container, assuming them to be ideal.

3. A swimmer coming out from a pool is covered with a film of water weighing about 80g. How much heat (in kJ) must be supplied to evaporate this water? If latent heat of evaporation for H_2O is $40.79\ \text{kJ mol}^{-1}$ at 100°C.

4. The molar heat of formation of $NH_4NO_{3(s)}$ is –367.54 kJ and those of $N_2O_{(g)}$, $H_2O_{(l)}$ are 81.46 and –285.8 kJ respectively at 25°C and 1 atmosphere pressure. Calculate ΔE of the reaction $NH_4NO_{3(s)} \longrightarrow N_2O_{(g)} + 2H_2O_{(l)}$.

5. If the enthalpy of the reaction, $C_3H_8(g) + H_2(g) \rightarrow C_2H_6(g) + CH_4(g)$, at 25°C using the given heat of combustion values under standard conditions is x kJ/mol. Find the value of *–x*.

Compound:	$H_2(g)$	$CH_4(g)$	$C_2H_6(g)$	C(graphite)
$\Delta_c H°$ (kJ/mol):	–285.8	–890.0	–1560.0	–393.5

The standard heat of formation of $C_3H_8(g)$ is –103.8 kJ/mol.

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. Let z be a complex number satisfying $|z-5i| \le 1$ such that amp(z) is minimum. Then z is equal to:

(A) $\frac{2\sqrt{6}}{5}+\frac{24i}{5}$ **(B)** $\frac{24}{5}+\frac{2\sqrt{6}i}{5}$ **(C)** $\frac{2\sqrt{6}}{5}-\frac{24i}{5}$ **(D)** $\frac{24}{5}-\frac{2\sqrt{6}i}{5}$

2. Let $\frac{(1+i)x-2i}{3+i}+\frac{(2-3i)y+1}{3-i}=i$ then:

(A) $y = 2$ **(B)** $y = -31/23$ **(C)** $y = 0$ **(D)** $y = -1/13$

3. ABC is an isosceles triangle and B = 90°. If B and the midpoint P of AC are represented by $3+2i$ and $1-i$ respectively then the other vertices are:

(A) $4+i,-2-3i$ **(B)** $4-3i,-2+i$ **(C)** $4-i,-2-i$ **(D)** $4+3i,-2-i$

4. If $\left|z^2-1\right|=|z|^2+1$ then z lies on:

(A) Circle **(B)** The imaginary axis
(C) A real axis **(D)** An ellipse

5. If $z^2+z+1=0,$ then the value of $\left(z+\frac{1}{z}\right)^2+\left(z^2+\frac{1}{z^2}\right)^2+\left(z^3+\frac{1}{z^3}\right)^2+\ldots+\left(z^6+\frac{1}{z^6}\right)^2$ is:

(A) 18 **(B)** 54 **(C)** 6 **(D)** 12

SPACE FOR ROUGH WORK

6. If z_1, z_2, z_3, z_4 are the vertices of a square in that order, then incorrect statement is::

(A) $z_1 + z_3 = z_2 + z_4$ **(B)** $|z_1 - z_2| = |z_2 - z_3| = |z_3 - z_4| = |z_4 - z_1|$

(C) $|z_1 - z_3| = |z_2 - z_4|$ **(D)** $\sqrt{2}|z_1 - z_3| = |z_2 - z_4|$

7. If the straight lines $x + 2y = 9, 3x - 5y = 5$ and $ax + by = 1$ are concurrent, then the straight line $5x + 2y = 1,$ passes through the point.

(A) $(a, -b)$ **(B)** $(-a, b)$ **(C)** (a, b) **(D)** $(-a, -b)$

8. Let two vertices of a triangle be (2, 1) and (3, –2), the third vertex lies on $y = x + 3$. Area of triangle is 5 square units, the coordinates of the third vertex can be:

(A) (–1, 2) **(B)** $\left(\frac{3}{4}, \frac{-3}{2}\right)$ **(C)** $\left(\frac{7}{2}, \frac{13}{2}\right)$ **(D)** $\left(\frac{-1}{4}, \frac{11}{4}\right)$

9. Consider the straight lines $L_1 : x + 2y + 4 = 0$ and $L_2 : 4x + 2y - 1 = 0.$ The line $6x + 6y + 7 = 0$:

(A) Is bisector of the angle between L_1 and L_2 that doesn't include origin

(B) Is bisector of acute angle between L_1 and L_2

(C) Forms an isosceles triangle with the two given lines L_1 and L_2

(D) Forms an equilateral triangle with the two given lines L_1 and L_2

SPACE FOR ROUGH WORK

10. If z_1, z_2 are two complex numbers satisfying $\left|\frac{z_1-3z_2}{3-z_1\bar{z}_2}\right|=1$, $|z_1|\neq 3$ then $|z_2|=$.

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

11. If $x+iy=\frac{3}{2+\cos\theta+i\sin\theta}$ then the value of $(x-3)(x-1)+y^2=$.

(A) 0 **(B)** 1 **(C)** –1 **(D)** 2

12. If 1, z_1, z_2, z_3,…z_{n-1} are n^{th} roots of unity then the value of $\frac{1}{3-z_1}+\frac{1}{3-z_2}+\ldots+\frac{1}{3-z_{n-1}}$ is equal to:

(A) $\frac{n\cdot 3^{n-1}}{3^n-1}+\frac{1}{2}$ **(B)** $\frac{n\cdot 3^{n-1}}{3^n-1}-1$ **(C)** $\frac{n\cdot 3^{n-1}}{3^n-1}+1$ **(D)** $\frac{n\cdot 3^{n-1}}{3^n-1}-\frac{1}{2}$

13. The straight line $ax + by + c = 0$ where $abc \neq 0$ will NOT pass through the first quadrant if:

(A) $a > 0$ and $b > 0$ **(B)** $ac > 0$ and $bc < 0$

(C) $bc > 0$ and $ac > 0$ **(D)** $ac < 0$ and $bc < 0$

14. The values of θ and p, if the equation $x\cos\theta+y\sin\theta=p$ is the normal form of the line $\sqrt{3}x+y+2=0$ are:

(A) 210°, 1 **(B)** 210°, 2 **(C)** 30°, 1 **(D)** 30°, 2

SPACE FOR ROUGH WORK

15. A light ray coming along the line $3x+4y=5$ gets reflected from the line mirror $ax+by=1$ and goes along the line $5x-12y=10$. Then:

(A) $a=\frac{64}{115},\ b=\frac{112}{15}$ **(B)** $a=\frac{14}{15},\ b=-\frac{8}{115}$

(C) $a=\frac{64}{115},\ b=-\frac{8}{115}$ **(D)** $a=\frac{64}{15},\ b=\frac{14}{15}$

16. The circumcentre of the triangle formed by the lines $xy+2x+2y+4=0$ and $x+y+2=0$ is:

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

17. If the three lines $x-3y=p,\ ax+2y=q$ and $ax+y=r$ form a right-angled triangle then:

(A) $a^2-9a+18=0$ **(B)** $a^2-6a-12=0$

(C) $a^2-6a-18=0$ **(D)** $a^2-9a+12=0$

18. If in triangle $ABC,\ A\equiv(1,10),$ circumcentre $\equiv\left(-\frac{1}{3},\frac{2}{3}\right)$ and orthocenter $\equiv\left(\frac{11}{3},\frac{4}{3}\right)$ then the co-ordinates of mid-point of side opposite to A is:

(A) $\left(1,-\frac{11}{3}\right)$ **(B)** (1, 5) **(C)** (1, –3) **(D)** (1, 6)

19. A point $P(x, y)$ moves so that the sum of the distances from P from the coordinate axes is equal to the distance from P to the point $A(1, 1)$. The equation of the locus of P in the first quadrant is:

(A) $(x+1)(y+1)=1$ **(B)** $(x+1)(y+1)=2$

(C) $(x-1)(y-1)=1$ **(D)** $(x-1)(y-1)=2$

20. Family of lines represented by the equation $(\cos\theta+\sin\theta)x+(\cos\theta-\sin\theta)y-3(3\cos\theta+\sin\theta)=0$ passes through a fixed point M for all real values of θ. The reflection of M in the line $x-y=0,$ is:

(A) (6, 3) **(B)** (3, 6) **(C)** (–6, 3) **(D)** (3, –6)

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. Let $z = 9 + bi$, where b is non-zero real and $i^2 = -1$. If the imaginary part of z^2 and z^3 are equal, then $b/3$ is _____.

2. Consider the family of lines $5x + 3y - 2 + \lambda(3x - y - 4) = 0$ and $x - y + 1 + \mu(2x - y - 2) = 0$. Equation of straight line that belong to both families is $ax + by - 7 = 0$, then $a + b$ is _____.

3. Let α and β be complex numbers satisfying $|\alpha + 1 + i| = 1$ and $|\beta - 2 - 3i| = 6$ such that $6|\alpha|_{\max} - |\beta|_{\max} = \sqrt{a} - \sqrt{b}$; $a, b \in R^+$ then the value of $\sqrt{b^2 - 2a}$ is _____.

4. If $x + \frac{1}{x} = 1$, $p = x^{4000} + \frac{1}{x^{4000}}$ and q be the digit at the unit's place in the number $(2^{2^n} + 1), n$ being a natural number greater than 1, then the value of $(p + q)$ is _____.

5. If the x-intercept of some line L is double as that of the line, $3x + 4y = 12$ and the y-intercept of L is half as that of same line, then the slope of L is m then $|16m|$ is _____.

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••• End of JEE Main – 5 [JEE - 2024] •••