PYRAMID
IIT-JEE | MEDICAL | FOUNDATION

JEE TEST PAPER

Time : 3 Hrs. **Max. Marks : 300**

Important Instructions :

1. The test is of 3 hour duration and Test Booklet contains 90 questions. For Multiple Choice question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. For **Integer Types question** carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, **one** mark will be deducted.
2. Use Black Ball point Pen only for writing particulars on this page/marking responses.
3. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
4. On completion of the test, the candidate must handover the Answer Sheet to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
5. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
7. Each candidate must show on demand his/her Admission Card to the Invigilator.
8. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.
9. Use of Electronic/Manual Calculator is prohibited.
10. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
11. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.

Name of Student : _____

Topic :

PHYSICS

SEC-A : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : –1 If wrong option is selected.

1. In certain electronic transition from quantum level n to ground state in atomic hydrogen in one or more steps no line belonging to Brackett series is observed. The wave numbers which may be observed in Balmer series is :-

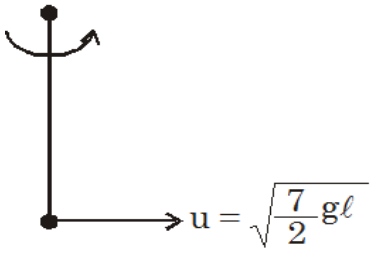
(A) $\frac{8R}{9}, \frac{5R}{36}$

(B) $\frac{3R}{16}, \frac{8R}{9}$

(C) $\frac{5R}{36}, \frac{3R}{16}$

(D) $\frac{3R}{4}, \frac{3R}{16}$

2. A small ball is given a velocity $\sqrt{\frac{7}{2}g\ell}$ at the lowest point of verticle circle. Find the maximum height reached by the ball :-



(A) $\frac{4\ell}{5}$ (B) $\frac{5\ell}{4}$

(C) $\frac{3\ell}{2}$ (D) $\frac{27\ell}{16}$

3. In Bohr's theory for hydrogen-like atoms

(A) For the higher atomic number, radius of the n^{th} orbit is higher.

(B) For the higher quantum number, velocity of electron in that orbit is greater.

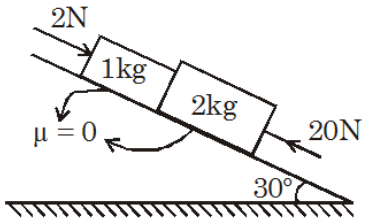
(C) In some hypothetical condition if mass of electron would have been higher then electron velocity in that orbit would have been same.

(D) For the higher quantum number, time period of an electron revolving around nucleus is smaller.

4. The K, L and M energy levels of platinum lie roughly at 78, 12 and 3 keV respectively. The ratio of wavelength of K_α line to that of K_β line in X-ray spectrum is :

(A) $\frac{22}{3}$ (B) $\frac{3}{22}$ (C) $\frac{22}{25}$ (D) $\frac{25}{22}$

5. The normal reaction force between the blocks and direction of acceleration are :-



(A) 8 N, up the incline (B) 8N, down the incline

(C) 5N, up the incline (D) 5N, down the incline

6. A normal stationary lithium atom releases an alpha particle with velocity $\left(2\hat{i} + 3\hat{j} + 7\hat{k}\right)$ km/s. What will be the velocity of the daughter element just after the release of the alpha particle?

(A) $(1/2)\left(2\hat{i} + 3\hat{j} + 7\hat{k}\right)$ km/s

(B) $(-4/3)\left(2\hat{i} + 3\hat{j} + 7\hat{k}\right)$ km/s

(C) $(-1/4)\left(2\hat{i} + 3\hat{j} + 7\hat{k}\right)$ km/s

(D) $(1/5)\left(2\hat{i} + 3\hat{j} + 7\hat{k}\right)$ km/s

7. The emitted $_{-1}\beta^0$ particle by a radioactive atom is an electron which is-

(A) Emitted from the orbit of the atom.

(B) Already present in the nucleus.

(C) Produced by the conversion of neutron into proton in the nucleus.

(D) Produced by the conversion of proton into neutron in the nucleus.

8. The radioactive sources A and B of half lives of 2hr and 4hr respectively, initially contain the same number of radioactive atoms. At the end of 2 hours, their rates of disintegration are in the ratio :-

(A) 4 : 1 (B) 2 : 1

(C) $\sqrt{2}$: 1 (D) 1 : 1

9. With the x-axis horizontal and the y-axis vertically upward as positive, the change in the horizontal component of velocity, Δv_x, and the change in the vertical component of velocity, Δv_y, of a projectile are related to the time since leaving the barrel, Δt, as

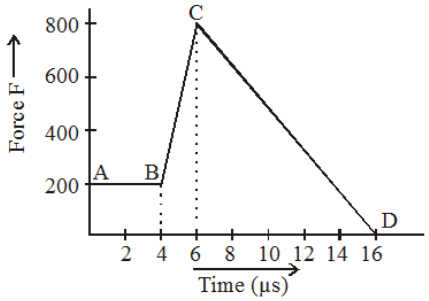
(A) $\Delta v_x = 0; \Delta v_y = 0$

(B) $\Delta v_x = g\Delta t; \Delta v_y = 0$

(C) $\Delta v_x = 0; \Delta v_y = g\Delta t$

(D) $\Delta v_x = 0; \Delta v_y = -g\Delta t$

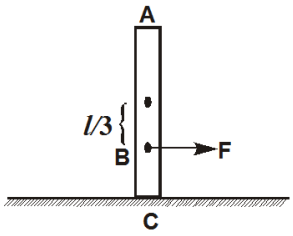
10. The net force (in newtons) acting on a body of mass 2kg (at rest) varies with time t (in microseconds) as shown in the figure. AB, BC and CD are straight line segments. Find velocity of the block at 16μs.



(A) 2.9×10^{-3} m/s (B) 2.9×10^{3} m/s

(C) 5×10^{-3} m/s (D) None of these

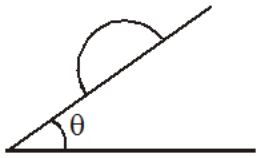
11. A uniform thin rod ABC of mass M and length ℓ is placed vertically on a rough horizontal surface. The coefficient of kinetic friction between the rod and the surface is μ. A force F (sufficient for sliding) is applied on the rod at point B at distance $\ell/3$ below centre of the rod as shown in figure. The initial acceleration of point A is



(A) $\mu g - \frac{F}{M}$ (B) $\frac{F}{M}$

(C) $4\mu g$ (D) $2\mu g - \frac{F}{M}$

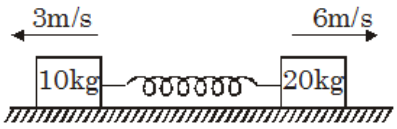
12. A uniform semi circular ring is placed on rough inclined plane as shown. If friction is large for no sliding, then the minimum angle θ at which toppling occurs is :



(A) $\tan^{-1} 2$ (B) $\tan^{-1} \frac{\pi}{2}$

(C) 45° (D) $\tan^{-1} \frac{\pi}{4}$

13. As shown in figure, two blocks are connected with a light spring. When spring was at its natural length, velocities are given to them as shown in figure. Choose the wrong alternative.



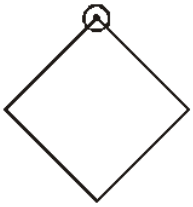
(A) Velocity of center of mass of the system is 3 m/s (towards right)

(B) When spring is maximum compressed velocity of 20 kg block is 3 m/s (towards right)

(C) When spring is maximum elongated velocity of 10 kg block is 3 m/s (towards left)

(D) At the time of maximum compression both blocks are moving in same direction.

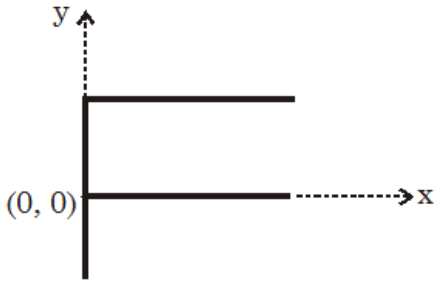
14. A square frame of mass m and side ℓ is suspended as shown. Find the time period of small oscillations in vertical plane :-



(A) $2\pi\sqrt{\frac{\ell}{g}}$ (B) $2\pi\sqrt{\frac{5\sqrt{2}}{6}\frac{\ell}{g}}$

(C) $2\pi\sqrt{\frac{\ell}{\sqrt{2}g}}$ (D) $2\pi\sqrt{\frac{5\sqrt{2}}{3}\frac{\ell}{g}}$

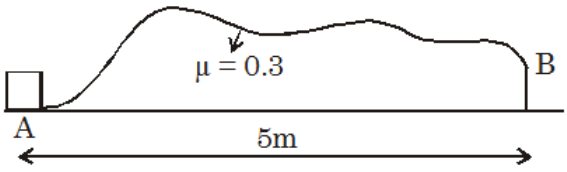
15. Letter F is formed from three identical rods of length ℓ. Find coordinates of its centre of mass.



(A) $\left(\frac{\ell}{5}, \frac{\ell}{5}\right)$ (B) $\left(\frac{\ell}{3}, \frac{\ell}{6}\right)$

(C) $\left(\frac{\ell}{6}, \frac{\ell}{3}\right)$ (D) $\left(\frac{\ell}{2}, \frac{\ell}{5}\right)$

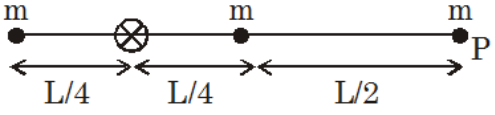
16. Find the work done by friction in slowly moving a block of mass 2kg from A to B on a small hill as shown in figure :-



(A) –30 J (B) 30 J

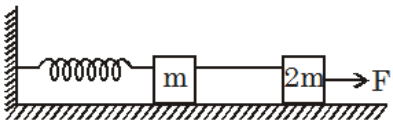
(C) –20 J (D) –15 J

17. A uniform rod of mass 5m is hinged as shown. Three particles each of mass m are kept as shown. Find acceleration of particle P at t = 0 just after release :-



(A) $\frac{18g}{17}$ (B) $\frac{g}{4}$ (C) $\frac{g}{16}$ (D) $\frac{39}{16}g$

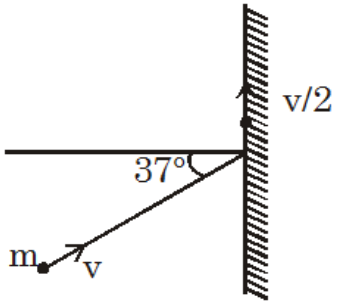
18. The system is in equilibrium with applied force F as shown. At t = 0 force F is removed. Initial acceleration of 2m block will be :-



(A) $\frac{F}{m}$ (B) $\frac{F}{3m}$

(C) $\frac{F}{2m}$ (D) $\frac{2F}{m}$

19. A ball collides with a wall and moves parallel to the wall as shown. The impulse acting on the ball during the collision is :-



(A) $mv\left(-\frac{4}{5}\hat{i} - \frac{1}{10}\hat{j}\right)$

(B) $mv\left(-\frac{4}{5}\hat{i} - \frac{2}{5}\hat{j}\right)$

(C) $mv\left(-\frac{3}{5}\hat{i} - \frac{1}{10}\hat{j}\right)$

(D) $mv\left(-\frac{3}{5}\hat{i} - \frac{2}{5}\hat{j}\right)$

20. A sample of H atoms in certain excited state emits 10 different wavelengths in de-excitation to ground state. The maximum wavelength out of these wavelengths is :-

(A) 4.05×10^{-6} m

(B) 4.05×10^{-4} m

(C) 4.5×10^{-6} m

(D) 4.5×10^{-4} m

SEC-B : (Maximum Marks: 40)

This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a Numerical Value Type questions.

For each question, enter the correct numerical value (in decimal notation, truncated/rounded off to the second decimal place; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct)

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks : 0 In all other cases.

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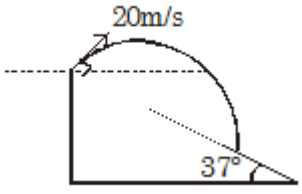
1. A silver sphere (work function 4.6 eV) is suspended in a vacuum chamber by an insulating thread. Ultraviolet light of wavelength 0.2 μ m strikes on the sphere. The maximum electric potential (in Volts) of the sphere will be (hc = 12400 eVÅ) :-

2. Rain appears to be falling at 53° with the vertical to a man standing on the ground. When he starts running at 10 km/hr, rain again appears to be falling at 53° with the vertical. Find the speed (in km/hr) of rain wrt ground :-

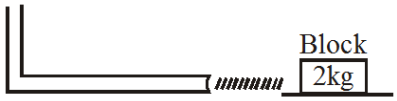
3. A projectile is thrown perpendicular to a long inclined plane as shown. The range (in m) of projectile on the incline is :-



4. The wavelength of K_α X-ray of an element having atomic number Z = 13 is λ. The wavelength of K_α X-ray of another element of atomic number Z' is 4λ. Then Z' is

5. A sample of radioactive nuclei of a certain element can decay only by γ-emission and β-emission. If the half-life for γ-emission is 24 minutes and that for β-emission is 36 minutes, the half-life (in minute) for the sample is

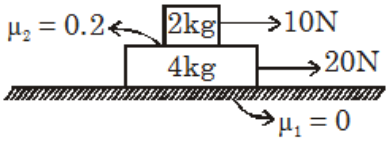
6. A block of metal weighing 2 kg is resting on a frictionless plane. It is struck by a jet releasing water at a rate of 1 kg/s and at a speed of 5 m/s. The initial acceleration (in m/s^2) of the block will be (Assume water doesn't rebound) :



7. A ball is thrown with 50 m/s at 30° with the horizontal from a building of height 500 m. The time (in sec) at which velocity vector of the ball becomes perpendicular to the initial velocity is (g = 10 m/s^2) :-

8. A particle starts from rest and performs SHM of amplitude A. Find the ratio of time taken by it from mean to $\frac{A\sqrt{3}}{2}$ to time taken by it from A to $\frac{A}{2}$:-

9. If there will be no relative motion between the two blocks, the friction force (in N) between the blocks will be :-



10. A ball is thrown with $40\sqrt{2}$ m/s at 45° with horizontal. Find the radius of curvature (in m) of its path at t = 7 sec :-

Topic :

CHEMISTRY

SEC-A : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : –1 If wrong option is selected.

1. Which of the following is INCORRECT statement ?

(A) In adiabatic expansion of an ideal gas, temperature of system always decrease

(B) In isothermal expansion of an ideal gas, temperature of a gas always remains constant

(C) In a reversible adiabatic compression of an ideal gas, change in entropy of system is zero

(D) In an irreversible adiabatic compression of an ideal gas, change in entropy of system is positive

2. Which of the following arrangement does not represent correct increasing order of the property stated against it?

(A) Sc Ti V Cr : Highest possible oxidation number

(B) Ti V Cr Mn : Melting point

(C) Cu Ni Co Fe : Paramagnetic behaviour

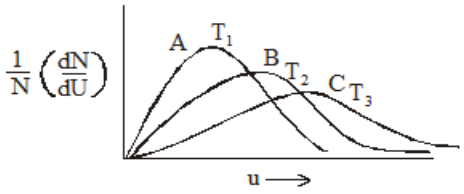
(D) Mn Fe Co : $E^\circ (M^{2+}/M)$ standard reduction potential

3. Bone deformities in children is due to deficiency of which vitamins :

(A) Ascorbic acid (B) Thiamine

(C) Riboflavin (D) Vitamin-D

4.



Which of the following statement is correct.

(i) If A & B are same gases then $T_2 > T_1$

(ii) If $T_1 = T_2$ then $A_{(g)}$ may be $SO_{2(g)}$ & $B_{(g)}$ may be $CH_{4(g)}$

(iii) If B & C are same gases then $T_3 > T_2$

(iv) If $T_1 = T_2 = T_3$ then $A_{(g)}$ may be CH_4, $B_{(g)}$ may be SO_2 & $C_{(g)}$ may be $SO_{3(g)}$

(A) i, ii & iii only

(B) i, ii, & iv only

(C) All are correct

(D) ii & iii only

5. Which of the following is electron precise molecular hydride ?

(A) B_2H_6

(B) SiH_4

(C) NH_3

(D) BeH_2

6. In which process hardness of water is removed by the formation of water soluble complex?

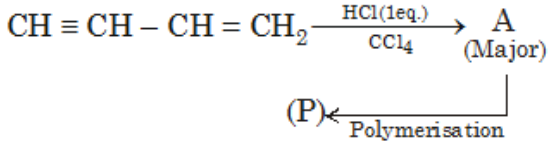
(A) Calgon's process

(B) Zeolite method

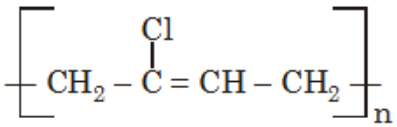
(C) Clark's method

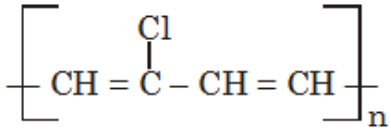
(D) Washing soda method

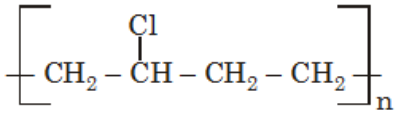
7.

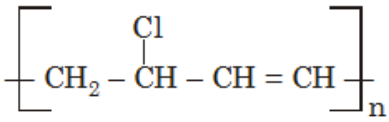


Product P is :

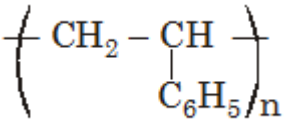
(A) 

(B) 

(C) 

(D) 

8. Identify the monomer in the given polymeric structures :



(A) Propene

(B) Styrene

(C) Vinylchloride

(D) Ethene

9. For which of the following reaction entropy, change in the system would be positive (in forward direction)

(A) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

(B) $3Mg_{(s)} + 2Fe^{3+}_{(aq)} \rightarrow 3Mg^{2+}_{(aq)} + 2Fe_{(s)}$

(C) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

(D) $C_{(graphite)} \rightarrow C_{(diamond)}$

10. Misch metal consist of :-

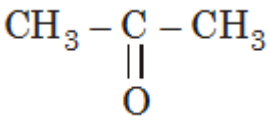
(A) ~95% Lanthanoides and ~5% Fe

(B) ~5% Lanthanoides and 95% Fe

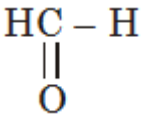
(C) ~95% Actinides and 5% Al

(D) ~95% Lanthanoides and ~5% Al

11. Which of the following aldehyde gives positive Iodoform test?

(A) 

(B) $CH_3 - CH = O$

(C) 

(D) $Me_3C - CH = O$

12. Which of the following is non reducing sugar ?

(A) Maltose (B) Sucrose

(C) Fructose (D) Lactose

13. For which of the following process $\Delta G = 0$

(A) $A_{(l)} \rightarrow A_{(g)}$ (1 atm, 90°C), B.P. of $A_{(l)}$ at 1 atm = 90°C

(B) $H_2O_{(l)} \rightarrow H_2O_{(g)}$ (1 atm, 400°C)

(C) $H_2O_{(l)} \rightarrow H_2O_{(s)}$ (1.0 atm, –10°C)

(D) $A_{(l)} \rightarrow A_{(g)}$ (2 atm, 90°C), B.P. of $A_{(l)}$ at 1 atm = 90°C

14. Select the **CORRECT** statement for heavy water.

(A) Heavy water has lower boiling point than H_2O

(B) Heavy water is more effective solvent than ordinary water

(C) Heavy water is more associated than ordinary water

(D) Ice cube of heavy water floats on H_2O(liq.)

15. Incorrect statement regarding solution obtained by dissolving alkali metals in liquid ammonia.

(A) Paramagnetic nature

(B) Show oxidising nature

(C) Deep blue due to presence of ammoniated electrons

(D) Good conductor

16. Which of the following reaction is not correctly matched with their major product?

(A) $CH_3CHCHCH_2CN \xrightarrow[(ii)\ H_2O]{(i)\ AlH(i-Bu)_2} CH_3CHCHCH_2CHO$

(B) $CH_3CH_2CN \xrightarrow[(2)\ H_3O^+]{(i)\ SnCl_2 / HCl} CH_3CH_2CHO$

(C) $CH_3CH_2COCl + (CH_3)_2Cd \rightarrow CH_3COCH_3 + CdCl_2$

(D) $C_2H_5COCH_3 \xrightarrow{NaOCl} C_2H_5COO^-Na^+ + CHCl_3$

17. Select the correct statement :-

(i) Lithium nitrate when heated gives N_2 gas

(ii) LiF and Li_2O are comparatively much less soluble in water than the corresponding compound of alkali metals

(iii) LiCl is deliquescent and crystallises as a hydrate, $LiCl.2H_2O$

(iv) In KO_2, peroxide ion is present which is diamagnetic

(A) (i), (ii)

(B) (ii),(iii)

(C) (i),(iv)

(D) (iii),(iv)

18. Select the correct statement :-

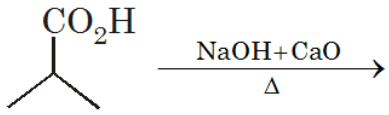
(A) MnO_2 is used in dry battery cells

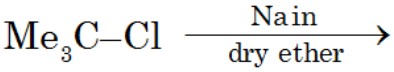
(B) Lanthanoids react with H_2O to formed $Ln(OH)_4$ and H_2

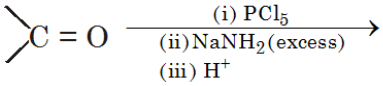
(C) Lanthanoids react with acids & do not produce H_2

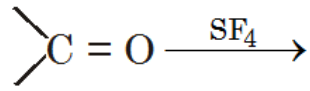
(D) In actinoids series common oxidation state is +4

19. In which reaction hydrocarbon is not formed as major product :

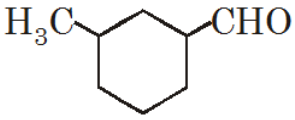
(A) 

(B) 

(C) 

(D) 

20. Correct IUPAC name of given compound is



(A) 3-methylcyclohexanecarbaldehyde

(B) 3-methylcyclohexanal

(C) 5-Methylcyclohexane carbaldehyde

(D) 3-Methylcyclohexanol

SEC-B : (Maximum Marks: 40)

This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a Numerical Value Type questions.

For each question, enter the correct numerical value (in decimal notation, truncated/rounded off to the second decimal place; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct)

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks : 0 In all other cases.

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1. For the real gases reaction

$2A_{(g)} + B_{(g)} \rightarrow 4C_{(g)}$; $\Delta H = ?$

In a 10 litre vessel at 500 K the initial pressure is 50 bar. After the complete reaction, volume of gases was found to be 15 litre at a pressure of 80 bar. Find change in enthalpy (in kJ) if change in internal energy is +50 kJ {1 bar-litre = 100 Joule}

2. In acidic medium $KMnO_4$ is decolourised by which of the following specie(s). Give the total sum of the atoms present in them :-

(a) $H_2C_2O_4$ (b) HNO_3

(c) $Na_2S_2O_3$ (d) HNO_2

3. Which of the following is essential amino acid? Give total number of hydrogen atoms present in it.

(a) Proline (b) Glutamine

(d) Serine (c) Valine

4. 50 gm $H_2O(A)$ is mixed with 70 gm of $H_2O(B)$ in a rigid adiabatic vessel. The initial temperature of A & B was 46° & 70°C. Find ΔH_A [change in enthalpy of water $H_2O(A)$] (in calories) specific heat of water = 1 cal/gm/°c

5. $HCl + BOH \rightarrow BCl + H_2O \quad \Delta H = -57$ kJ

$CH_3COOH + BOH \rightarrow CH_3COOB + H_2O \quad \Delta H = -50$ kJ

$HCl + DOH \rightarrow DCl + H_2O \quad \Delta H = -45$ kJ

then ΔH (in kJ) for $CH_3COOH + DOH \rightarrow CH_3COOD + H_2O$, is equal to :-

6. In one of the following reaction H_2O_2 shows reducing nature. Find the n-factor of the species getting reduced ?

(1) $CrO_4^{2-} + 2H_2O_2 \xrightarrow{H^+} CrO_5 + 3H_2O$

(2) $MnO_2 + H_2O_2 + H_2SO_4 \longrightarrow MnSO_4 + 2H_2O + O_2$

(3) $H_2S + H_2O_2 \longrightarrow S\downarrow + 2H_2O$

(4) $Mn^{+2} + H_2O_2 \xrightarrow{OH^-} MnO_2 + 2H_2O$

7. The molecular speed in a sample of 100 molecules are distributed as

Number of molecules

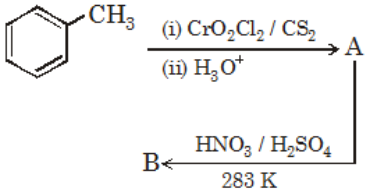
10 20 40 15 10 5

Speed m/sec.

60 80 100 120 140 160

Give the sum of V_{mp} & $V_{avg.}$ in m/sec

8.



Give the total number of atoms present in final product 'B'.

9. The critical point of CO_2 is 304 K and 73 atm. Under which condition is carbon dioxide liquid.

I) 305 K, 70 atm II) 303 K, 75 atm

III) 303 K, 73 atm IV) 305 K, 80 atm

Give the ratio

$$\frac{\text{sum of temperature (in K) of all these conditions}}{\text{sum of pressure (in atm) of all these conditions}}$$

10. At what temperature (in K) is the following reaction at equilibrium, when all substances are at standard pressure? Assuming that entropies and enthalpies of reaction do not vary with temperature.

$PCl_3 + Cl_{2(g)} \rightleftharpoons PCl_{5(g)}$

	ΔH_f^0 kJ/mole	S°J/mole/kelwing
$PCl_{3(g)}$	–290	310
$Cl_{2(g)}$	0	220
$PCl_{5(g)}$	–375	360

Topic :

MATHEMATICS

SEC-A : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : –1 If wrong option is selected.

1. The value of $\int_0^{10\pi} [\sin x + \cos x]\, dx$ is (where [.] denotes greatest integer function)

(A) -5π (B) -10π

(C) $-\frac{5\pi}{2}$ (D) $-\frac{15\pi}{2}$

2. Let $f : R \to R$ be a continuous function. If $f(x) + f(x+1) + f(x+2) + f(x+3) = 2021$, $\forall\, x \in R$ and $\int_0^4 f(x)\, dx = A$, then the value of $\int_0^{100} f(x)\, dx$ is equal to -

(A) A (B) 20A

(C) 25A (D) 50A

3. If $f(x) = 2(g(x))^3 - 3(g(x))^2 + 3g(x) - 2x + \cos x$, where g(x) is a differentiable function then which of the following is always true-

(A) $f(x)$ is increasing if g(x) is decreasing

(B) $f(x)$ is decreasing if g(x) is increasing

(C) $f(x)$ is increasing if g(x) is increasing

(D) $f(x)$ is decreasing if g(x) is decreasing

4. Angle between the tangents drawn at origin to the two curves $x^5 + 4x^3y^2 + 3x + 4y = 0$ and $x^3 - 27y^3 + 5(4x - 3y)^2 = 0$ is

(A) $\tan^{-1}1 + \tan^{-1}2 + \tan^{-1}3$

(B) $\cot^{-1}1 + \cot^{-1}2 + \cot^{-1}3$

(C) is the angle between the lines $11y = 2x$ and $x + 2y = 0$

(D) $2\cot^{-1}1 + \cot^{-1}2$

5. The point on the curve $y^3 = 4x^2 + 12y$ at which the tangent is horizontal is

(A) (2,2) (B) (–2,–2)

(C) (0,0) (D) (1,1)

6. Equation of a straight line with gradient 1 which touches curve $y = \frac{x}{1+|x|}$ is

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

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

7. If A is a symmetric matrix ($|A| = -1$) and $AA^T = I$, then identify the incorrect option-

(A) $A^T = A^{-1}$ (B) $A^T + \text{adj}A = 0$

(C) $A^2 = A^4$ (D) $A^2 = A^3$

8. The function $f(x) = \int_{-2}^{x} (e^{-t} - 1)(t^2 - 1)^5 (t+2)^9 (t-3)^7$ has a local minimum at 'x' equal to

(A) –2 (B) 0

(C) 3 (D) –1

9. If $f(x)$ is an even function such that $f(10 - x) = f(x)$ and $\int_0^5 f(x)dx = 7$. Then the value of $\int_0^{10} f(x)dx$ is

(A) 10 (B) 12 (C) 14 (D) 21

10. If $f(x) = \int (2\sin(2\ell nx) - \cos(2\ell nx))\, dx$ and $f\left(e^{\frac{\pi}{2}}\right) = 0$. Then the value of $f(e^{\pi/4})$ is

(A) $-e^{\pi/2}$

(B) $e^{\pi/4}\left(1 - 2e^{\pi/4}\right)$

(C) $e^{\pi/4}\left(2e^{\pi/4} - 1\right)$

(D) $e^{\pi/4}\left(2e^{\pi/2} - 1\right)$

11. If length of subnormal to the curve $x\left(\frac{y}{k}\right)^n = k$ is always constant then 'n' is equal to

(A) 2 (B) 1

(C) –1 (D) –2

12. Let A and B are orthogonal matrices of order 3 × 3 such that $X = AB^T$ and $Y = BA^T$, then the value of tr(XY) is equal to -

(A) 1 (B) 2

(C) 3 (D) 4

13. Number of point(s) of inflection of $f(x) = x^4 + 6x^3 + 35x^2 + 6x - 3$ is -

(A) 0 (B) 1

(C) 2 (D) 4

14. Solution of differential equation $\left(\sqrt{1 - x^2y^2} - y\right) dx = xdy$ cannot be

(A) $xy + \cos x = 0$

(B) $xy = \sin x$

(C) $xy + \sin x = 0$

(D) $xy = \tan x$

15. The curve which satisfy differential equation $(x^2y - y)dx + (xy^2 - x)dy = 0$ is-

(A) $\pi x^2y^2 = e^{x^2+y^2}$ (B) $\pi x^2y^2 = e^{x+y}$

(C) $exy = e^{x+y}$ (D) $exy = e^{x^2+y^2}$

16. A function $y = f(x)$ satisfies the differential equation $\frac{dy}{dx} + x^2y + 2x = 0$, $f(1) = 1$, then the value of $f'(1)$ is-

(A) 1 (B) –1 (C) 3 (D) –3

17. Equation of tangent drawn to the curve $f(x) = x^3\frac{(2^x - 1)}{(2^x + 1)} + \sin^2 x\cos^6 x - 1$ at its point of intersection with y-axis is-

(A) $y + 1 = 0$ (B) $x + 3y = 10$

(C) $x + y = 0$ (D) $x = -1$

18. Consider a system of equations $x - y + z = -1$, $\lambda x + 3y + 2z = 3$ and $3x + \lambda y + z = 2$, if system have a unique solution then λ **cannot** be-

(A) 3 (B) –3 (C) –4 (D) 2

19. If $A = \begin{bmatrix} 3 & 2 & 1 \\ 1 & 2 & 1 \\ 0 & 1 & 2 \end{bmatrix}$ also, $|adj\lambda A| = \lambda^a.a^\lambda$ (where $a,\lambda \in N$). Then the value of '$\alpha + \lambda$', is-

(A) 6 (B) 8 (C) 10 (D) 12

20. If $A = \begin{pmatrix} 2 & 7 \\ 1 & 3 \end{pmatrix}$, then the value of $\det(A^{2019} - 3A^{2018})$ is equal to-

(A) –7 (B) 7 (C) 5 (D) –5

SEC-B : (Maximum Marks: 40)

This section contains 10 questions Candidates have to attempt any 5 questions out of 10. If more than 5 questions are attempted, then only first 5 attempted questions will be evaluated.

The answer to each question is a Numerical Value Type questions.

For each question, enter the correct numerical value (in decimal notation, truncated/rounded off to the second decimal place; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct)

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct numerical value is entered as answer.

Zero Marks : 0 In all other cases.

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1. If $\int e^x \left(\frac{\tan x}{1+\tan x} + \frac{1}{1+\sin 2x} - \frac{1}{2}\right) dx$ $= e^x f(x) + c$, where c is integration constant.

Then $\left[5f\left(\frac{5\pi}{8}\right)\right]$ is (where [.] denotes greatest integer function)

2. If $f(x) = \begin{vmatrix} 3x^2-6x+5 & 6x^2+6x-3 & 3x^2+3x-2 \\ 2x-2 & 4x+2 & 2x+1 \\ 1 & 2 & 1 \end{vmatrix}$, then the value of $\frac{f(1)+f(3)}{f(2)}$

3. Let $f(x)$ be a thrice differentiable function such that it intersects the curve $g(x) = 2x^3 + 7x^2 - 5x + 1$ at exactly 7 distinct points, then minimum number of roots of $f'''(x) = 12$ is

4. The area bounded by $y^2 = 4x$ and $x^2 = 4y$ is

5. The area between the curve $y = 2x^4 - x^2$, the x-axis and the ordinates of two minima of the curve is of the form $\frac{a}{b}$ (where a and b are co-prime). Then the value of (b – 10a) is-

6. If $f(x) = 2000x^3 - 3000x^2 - 36000x + 2021$ has local maximum at x = p and local minimum at x = q, then the value of $\left|\frac{q}{p}\right|$ is

7. Area (in square units) bounded by the curves $f(x) = (\cos x + \sec x)^2$ and $g(x) = (\sin x + \operatorname{cosec} x)^2$ between $x = \frac{\pi}{4}$ and $x = \frac{\pi}{3}$ is of the form $\frac{19\sqrt{b}-c}{d}$, s.t. H.C.F of b,c and d is 3, then the value of $\frac{b+c}{d}$ is-

8. The area bounded by pair of straight lines $x^2 + y^2 - 2xy - 5x + 5y + 6 = 0$ and the co-ordinate axes is-

9. Minimum distance between the curves $C_1 : x^2 + y^2 = 8$ and $C_2 : xy = 9$ is-

10. If $f(x) = x^3 + 3ax^2 + (11a - 6)x - 2$ is increasing function for all $x \in R$, then number of possible integral value(s) of 'a' is/are-