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Computer Based Examination System

Exported On *	2022/06/27 11:40:24
Title *	Question Paper Answer Key
OES Exam *	GPSC09202115 / Assistant Professors in Government College in Chemistry (Physical)/ Completed / 2022-06-26

1	<p><b>Question Description</b></p> <p>The Arrhenius parameter and the activation energy for the following thermal decomposition reaction is <math>10^{13} \text{ M}^{-1} \text{ sec}^{-1}</math> and <math>104 \text{ kJ mol}^{-1}</math>. What is the <math>\Delta H^\ddagger</math> for the reaction at 400 K. Given <math>R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}</math></p> $2XY(g) \rightarrow 2X(g) + Y_2(g)$
<b>A</b>	$-9.99 \times 10^9 \text{ kJ mol}^{-1}$
<b>B</b>	$1 \times 10^{13} \text{ kJ mol}^{-1}$
<b>C</b>	$97.4 \text{ kJ mol}^{-1}$
<b>D</b>	$100.7 \text{ kJ mol}^{-1}$
<b>E</b>	None of the above
<b>Correct Answer</b>	C
<b>Marks</b>	1

2

<b>Question Description</b>	The vapour pressure exerted by 0.50 M aqueous solution of first group halide is 100 kPa at 100°C. What is the activity of water in this solution?
<b>A</b>	0.0131
<b>B</b>	0.9869
<b>C</b>	1.0000
<b>D</b>	1.0132
<b>E</b>	None of the above
<b>Correct Answer</b>	B
<b>Marks</b>	1

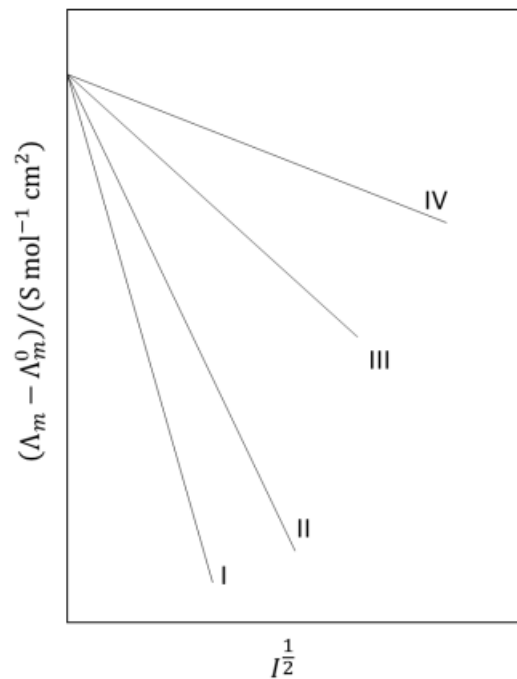
3

<b>Question Description</b>	The temperature of a system of ideal gas is raised from 300 K to 600 K. If the collision rates at 300 K is given by $R_C$ , what would be the approximate collision rate at 600 K.
<b>A</b>	$2.25R_c$
<b>B</b>	$1.73R_c$
<b>C</b>	$1.4R_c$
<b>D</b>	$0.5R_c$
<b>E</b>	None of the above
<b>Correct Answer</b>	C
<b>Marks</b>	1

4

**Question Description**

The following graph shows the theoretical variation of molar conductivities as a function of ionic strength for four different salts, viz.  $\text{AgNO}_3$ ,  $\text{CuSO}_4$ ,  $\text{FeCl}_3$ ,  $\text{SrCl}_2$ , Match the plot with the salt.



**A** I- $\text{CuSO}_4$ , II- $\text{FeCl}_3$ , III- $\text{SrCl}_2$ , IV- $\text{AgNO}_3$

**B** II- $\text{CuSO}_4$ , IV- $\text{FeCl}_3$ , III- $\text{SrCl}_2$ , II- $\text{AgNO}_3$

<b>C</b>	II-CuSO <sub>4</sub> , III-FeCl <sub>3</sub> , IV-SrCl <sub>2</sub> , I-AgNO <sub>3</sub>
<b>D</b>	IV-CuSO <sub>4</sub> , II-FeCl <sub>3</sub> , III-SrCl <sub>2</sub> , I-AgNO <sub>3</sub>
<b>E</b>	None of the above
<b>Correct Answer</b>	A
<b>Marks</b>	1

5

<b>Question Description</b>	Creatine phosphotransferase plays a role in synthesising ATP (Adenosine triphosphate) in the muscle cells. A phosphate group is transferred from creatinephosphate(CrP) to ADP (adenosine diphosphate). The experimental observations indicate that the Michaelis-Menton mechanism is prevalent. The apparent reaction rates are $1.75 \mu\text{M min}^{-1}$ and $0.8 \mu\text{M min}^{-1}$ when the concentration of CrP is 1.8 mM and 0.75 mM, respectively. What is the maximum rate that is expected for this process?
<b>A</b>	$2.46 \mu\text{M min}^{-1}$
<b>B</b>	$2.46 \text{mM min}^{-1}$
<b>C</b>	$2.46 \text{nM min}^{-1}$
<b>D</b>	$2.46 \text{M min}^{-1}$
<b>E</b>	None of the above
<b>Correct Answer</b>	A
<b>Marks</b>	1

6

<b>Question Description</b>	In case of the benzene anion radical the hyperfine splitting constant (HSC) is observed to be 3.75 gauss. The observed HSC in naphthalene anion radicals is about 4.95 gauss and 1.80 gauss respectively for the alpha and beta protons. The value of electron density (corrected to 2 places of decimal) on each alpha and beta carbon of the naphthyl anion radical are
<b>A</b>	0.22 on the alpha carbon and 0.08 on the beta carbon
<b>B</b>	0.08 on the alpha carbon and 0.22 on the beta carbon
<b>C</b>	0.76 on the alpha carbon and 0.49 on the beta carbon
<b>D</b>	0.76 on the alpha carbon and 0.24 on the beta carbon
<b>E</b>	None of the above
<b>Correct Answer</b>	A
<b>Marks</b>	1

7

**Question Description**

The number of Schottky defects in a crystal of composition MX is given by

$$n_s = N \exp\left(\frac{-\Delta H_s}{2k_B T}\right)$$

Where,  $n_s$  is the number of Schottky defects per  $m^3$  in a crystal with N cation and N anion sites per  $m^3$ ,  $\Delta H_s$  is the enthalpy required to form one defect,  $k_B$  is the Boltzmann constant, T is the temperature. Which of the following statements can be said to be true

- I. The number of defects increases as Temperature increases
- II. The proportion of defects decrease as the enthalpy of defect formation is decreased

**A**

Both statements are correct

**B**

Both statements are incorrect

**C**

Statement I is correct and Statement II is incorrect

**D**

Statement I is incorrect and statement II is correct

**E**

None of the above

**Correct Answer**

A

**Marks**

1

8

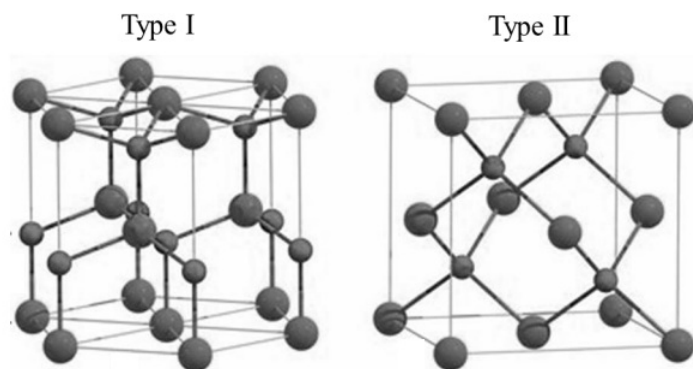
<b>Question Description</b>	The zero point energy, $E_0$ of an an harmonic oscillator whose fundamental is $\nu \text{ cm}^{-1}$ is given by
<b>A</b>	$E_0 = \frac{h\nu}{2}$
<b>B</b>	$E_0 < \frac{h\nu}{2}$
<b>C</b>	$E_0 > \frac{h\nu}{2}$
<b>D</b>	$E_0 = h\nu$
<b>E</b>	None of the above
<b>Correct Answer</b>	A
<b>Marks</b>	1



9

**Question Description**

A transition metal chalcogen arranges itself in two types as shown below. In the figure, the larger circles represent anion, while smaller ones the cation. By visual inspection identify the structures as they are popularly known as



**A** Type I- Zinc Blende, Type II- Wurzite

**B** Type I- Zinc Blende, Type II- Rock Salt

**C** Type I- Rock Salt, Type II- Wurzite

**D** Type I- Wurzite, Type II- Zinc Blende

**E** None of the above

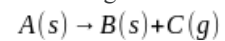
**Correct Answer** D

**Marks** 1

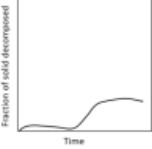
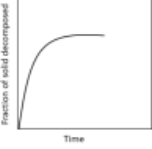
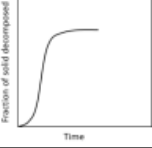
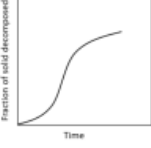
10

**Question Description**

A solid compound decomposes to give a new solid along with evolution of a gas.



Match the schematic plots of variation of fraction of solid decomposed vs time with the process involved

I	Initial slow gas evolution	a	
II	No induction period	b	
III	Short induction followed by rapid decomposition	c	
IV	Self catalysed	d	

**A** I-a, II-b, III-c, IV-d

**B** I-b, II-c, III-d, IV-a

**C** I-c, II-d, III-a, IV-b

**D** I-d, II-a, III-b, IV-c

**E** None of the above

**Correct Answer** A

**Marks**

1

11

**Question Description**

Ammonia has more than one defined moment of inertia. Following standard conventions, which of the following condition holds with regard to rotational constants, A, B and C?

**A** $A=B=C$ **B** $A=B>C$ **C** $A>B>C$ **D** $A<B=C$ **E**

None of the above

**Correct Answer**

B

**Marks**

1

12	<b>Question Description</b>	What is the total energy of pi electrons of butadienyl monoanion, if the length of the ion is estimated to be 400 pm. Given the mass of electron is $m_e = 9 \times 10^{-31}$ kg and $h = 6.6 \times 10^{-34}$ Js.
	A	$1.05 \times 10^{-17}$ J
	B	$3.78 \times 10^{-18}$ J
	C	$7.18 \times 10^{-18}$ J
	D	$3.78 \times 10^{-20}$ J
	E	None of the above
	<b>Correct Answer</b>	C
	<b>Marks</b>	1

13	<b>Question Description</b>	The mobility of Bromide ions is measured to be $8 \times 10^{-8} \text{ m}^2 \text{ s}^{-1} \text{ V}^{-1}$ . The experiment is carried out at 300 K, in a liquid whose viscosity is 0.9 cP (centipoise), what will be the solvodynamic radius (approximate) for the bromide ions in the solution. Given $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ , $F = 96500 \text{ coulomb mol}^{-1}$ , $N_a = 6.02 \times 10^{23} \text{ mol}^{-1}$
	A	14 pm
	B	118 pm
	C	3 A
	D	125 A
	E	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

14

**Question Description**

The nuclear coupling constant between four pairs of nuclei are given below

$J_{12}^{WA}$	$2\nu_0\delta_{12}$
$J_{12}^{XA}$	$\nu_0\delta_{12}$
$J_{12}^{YA}$	$0.25\nu_0\delta_{12}$
$J_{12}^{ZA}$	0

The splitting between the central lines are in the order

**A** WA>XA>YA>ZA

**B** WA<XA<YA<ZA

**C** WA<YA<XA<ZA

**D** YA<WA<XA<ZA

**E** None of the above

**Correct Answer** B

**Marks** 1

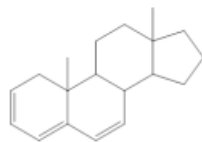
15	<b>Question Description</b>	The thermal reaction between $\text{H}_2$ and a halogen gas $\text{X}_2$ is known to take place at the rate of $11.2 \text{ mol}^2 \text{ l}^{-2} \text{ sec}^{-1}$ . The rate constant for the chain initiation step is found to be $1.12 \text{ mol l}^{-1} \text{ sec}^{-1}$ . What would be the chain length of the reaction if the reaction is started with $15 \text{ M X}_2$ .
	<b>A</b>	0.11
	<b>B</b>	0.67
	<b>C</b>	0.84
	<b>D</b>	1.50
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

16	<b>Question Description</b>	The bandgap of a material is increased by two times, according to the BCS theory what will be its effect on the coherence length of the material?
	<b>A</b>	Coherence length is unaffected by band gap
	<b>B</b>	Coherence length is reduced by 50%
	<b>C</b>	Coherence length increases by 100%
	<b>D</b>	Coherence length increases by 50%
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

17

**Question Description**

The approximate wavelength of absorbance maxima in the electronic spectra of the following molecule predicted by Woodward rules is

**A**

243 nm

**B**

264 nm

**C**

303 nm

**D**

344 nm

**E**

None of the above

**Correct Answer**

C

**Marks**

1

18

<b>Question Description</b>	The transmission coefficient for a system exhibiting a completely symmetric potential energy surface with a basin is
<b>A</b>	0
<b>B</b>	0.50
<b>C</b>	1.00
<b>D</b>	0.75
<b>E</b>	None of the above
<b>Correct Answer</b>	B
<b>Marks</b>	1



19

<b>Question Description</b>	NMR spectrum of a compound is recorded at 300 K and 270 K. In the two experiments I. At lower temperature there are larger availability of excited proton magnetic states II. The chemical shift, measured in ppm, will be different at the two temperatures
<b>A</b>	Both statements are correct
<b>B</b>	Both statements are incorrect
<b>C</b>	Statement I is correct, but Statement II is incorrect
<b>D</b>	Statement I is incorrect, but statement II is correct
<b>E</b>	None of the above
<b>Correct Answer</b>	A
<b>Marks</b>	1

20

<b>Question Description</b>	The ESR spectrum of Naphthyl radical anion is
<b>A</b>	Doublet of Quintet
<b>B</b>	Quintet of a doublet
<b>C</b>	Quintet of a quintet
<b>D</b>	Quintet of Quartet
<b>E</b>	None of the above
<b>Correct Answer</b>	C
<b>Marks</b>	1

21

**Question Description**

In a thermocouple, the phenomenological equations for the flow of heat ( $J_q$ ) and current ( $I_e$ ) can be in terms of electric field ( $E$ ) and temperature ( $T$ ) as

$$J_q = \frac{-1}{T^2} L_{qq} \frac{\partial T}{\partial x} + \frac{L_{qe} E}{T}$$

$$I_e = \frac{L_{ee} E}{T} - \frac{1}{T^2} L_{eq} \frac{\partial T}{\partial x}$$

The Peltier heat ( $P$ ) can be related to the Onsager coefficients as

**A**

$$L_{qe} = PL_{ee}$$

**B**

$$L_{qe} = L_{ee}/P$$

**C**

$$L_{eq} = -L_{ee} TP$$

**D**

$$L_{eq} = -L_{qe} T/P$$

**E**

None of the above

**Correct Answer**

A

**Marks**

1

22	<b>Question Description</b>	The total number of IR Active vibrational modes in a linear symmetric BAB molecule is
	<b>A</b>	3N-8
	<b>B</b>	3N-6
	<b>C</b>	3N-4
	<b>D</b>	3N-2
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

23	<b>Question Description</b>	A superconducting material has critical temperature of 4 K at zero magnetic field and a critical field of 0.04 Tesla at 0 K. What is the critical field at 2 K?
	<b>A</b>	0.02 Tesla
	<b>B</b>	0.03 Tesla
	<b>C</b>	0.04 Tesla
	<b>D</b>	0 Tesla
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

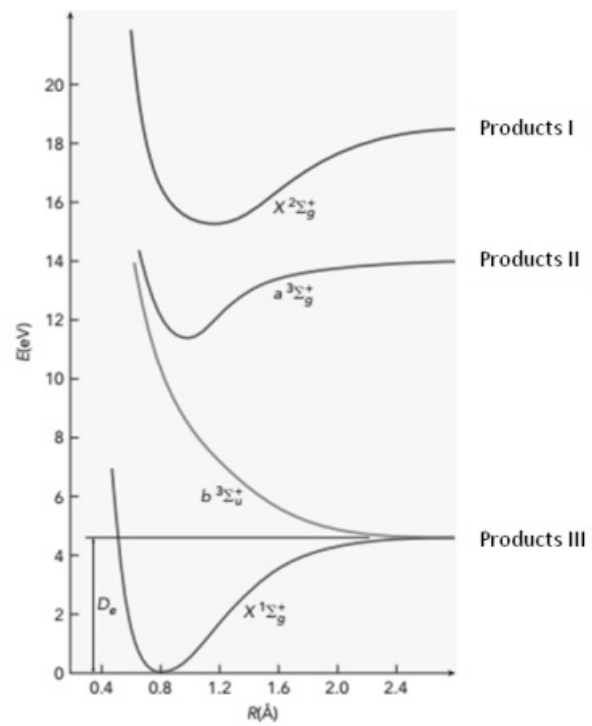
24	<b>Question Description</b>	The vibrational levels of the electronic ground state of the molecule can be obtained from
	<b>A</b>	Absorption spectrum
	<b>B</b>	Photoelectron spectrum
	<b>C</b>	Fluorescence spectrum
	<b>D</b>	X-Ray Spectrum
	<b>E</b>	None of the above
	<b>Correct Answer</b>	C
	<b>Marks</b>	1

25	<b>Question Description</b>	If $dH$ and $dS$ represent the enthalpy and total entropy change for a chemical reaction at constant temperature and pressure and $dS_s$ and $dS_i$ represent the contributions of entropy change of surrounding and chemical reaction to the total entropy, then the rate of entropy production can be given by
	<b>A</b>	$\frac{dS_i}{dt} = -\frac{1}{T} \left( \frac{dG}{dt} \right)$
	<b>B</b>	$\frac{dS_i}{dt} = \frac{1}{T} \left( \frac{dG}{dt} \right)$
	<b>C</b>	$\frac{dS_i}{dt} = -\frac{1}{P} \left( \frac{dG}{dt} \right)$
	<b>D</b>	$\frac{dS_i}{dt} = \frac{1}{P} \left( \frac{dG}{dt} \right)$
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

26	<b>Question Description</b>	An ionic salt crystallises as bcc (body centered cubic) lattice with side of the unit cell $2\sqrt{3} \text{ \AA}$ . Calculate the angle at which the second order reflection maxima may be expected from 111 plane when X-rays of wavelength 50 pm (picometer) is used.
	<b>A</b>	30 degrees
	<b>B</b>	60 degrees
	<b>C</b>	45 degrees
	<b>D</b>	75 degrees
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

27	<b>Question Description</b>	In the presence of an external electric field of strength "E" the maximum number of lines originating from 12B rotational level of a diatomic molecule is
	<b>A</b>	7
	<b>B</b>	9
	<b>C</b>	11
	<b>D</b>	12
	<b>E</b>	None of the above
	<b>Correct Answer</b>	C
	<b>Marks</b>	1

28	<b>Question Description</b>	The potential energy curves of selected states of H <sub>2</sub> are shown below. If the necessary amount of energy is supplied, then predict the dissociation products I, II, and III.
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A

Products I-H(1s)+H(1s), Products II-H(1s)+H(2s), Products III-H<sup>+</sup>+H(1s)

<b>B</b>	Products I- $H^+$ +H(1s), Products II-H(1s)+H(2s), Products III- H(1s)+H(1s)
<b>C</b>	Products I-H(1s)+H(1s), Products II- H(1s)+H(1s), Products III-H(1s)+H(1s)
<b>D</b>	Products I-H(1s)+H(2s), Products II-H(1s)+H(2s), Products III- $H^+$ +H(1s)
<b>E</b>	None of the above
<b>Correct Answer</b>	B
<b>Marks</b>	1

29

<b>Question Description</b>	<p>The standard Gibbs energy change for the following reaction is <math>1354 \text{ kJmol}^{-1}</math>.</p> $2Fe^{3+}(aq) + 3Mg(s) \rightarrow 2Fe(s) + 3Mg^{2+}(aq)$ <p>What is the difference between potentials of reduction and oxidation reactions? Given Faraday's constant is <math>96500 \text{ C mol}^{-1}</math>.</p>
<b>A</b>	14.3 V
<b>B</b>	7.0 V
<b>C</b>	4.7 V
<b>D</b>	2.3 V
<b>E</b>	None of the above
<b>Correct Answer</b>	D
<b>Marks</b>	1



30

**Question Description**

Which of the following statement is true about a first-order phase transition of a substance

- I. The derivative of chemical potential with respect to temperature is discontinuous
- II. The second derivative of chemical potential with respect to temperature is continuous
- III. during transition, the constant pressure heat capacity,  $C_p$ , of the substance is infinite
- IV. during the transition, the enthalpy changes by a finite amount for an infinitesimal change in temperature

**A** I, III and IV only

**B** II, III and IV only

**C** III and IV only

**D** I and IV only

**E** None of the above

**Correct Answer** A

**Marks** 1

31

**Question Description**

Buckminsterfullerene ( $C_{60}$ ), an isotope of Carbon, can be approximated as a hollow sphere. What will be the wavelength of transition for a transition from  $l = 4$  to  $l = 5$  state. Given the diameter of  $C_{60}$  is  $7 \text{ \AA}$  and mass of electron is  $9 \times 10^{-31} \text{ kg}$ , mass of  $C_{60}$  is  $720 \text{ g mol}^{-1}$ . Take  $h = 6 \times 10^{-34} \text{ J sec}$

**A**

110.45 nm

**B**

217.8 nm

**C**

435.6 nm

**D**

1699.3 nm

**E**

None of the above

**Correct Answer**

C

**Marks**

1

32

**Question Description**The term symbol for  $N_2^+$  molecular ion is

A	$1\Sigma_g^+$
B	$2\Sigma_g^+$
C	$2\Sigma_u^+$
D	$4\Sigma_u^-$

**A**

A

**B**

B

**C**

C

**D**

D

**E**

None of the above

**Correct Answer**

B

**Marks**

1

33	<b>Question Description</b>	The fundamental difference between Physical and Chemical deposition techniques of thin film production is
	<b>A</b>	In Chemical deposition the material is synthesised while film is produced, while in physical deposition the material is already present
	<b>B</b>	the physical deposition always produces non uniform films, while chemical deposition always yield uniform films
	<b>C</b>	Chemical deposition can never be done with vapours, while physical deposition uses vapours of the material.
	<b>D</b>	Physical deposition methods cannot be used for photovoltaic material while chemical deposition is the preferred method for preparing photovoltaic material films
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

34	<b>Question Description</b>	The Spherical harmonics, $Y_l(\theta, \phi)$ of one electron atom are eigen functions of the square of total angular momentum ( $\hat{L}^2$ ) and the z-component of angular momentum ( $\hat{L}_z$ ) and respectively returns the eigenvalues of $k_l$ and $k_m$ . What will be the value of $(\hat{L}_x^2 + \hat{L}_y^2)$
	<b>A</b>	$k_l - k_m$
	<b>B</b>	$k_l - k_m^2$
	<b>C</b>	$k_l^2 + k_m$
	<b>D</b>	$k_l + k_m^2$
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

35	<b>Question Description</b>	A pace-maker based fuelled by a nuclear fuel is built. The fuel gives energy output of 0.5kW/g. The half-life of the fuel element is 69.3 years. The pacepaker requires energy of 100 uW to function. What will be the approximate amount of fuel required to be placed in the pacemaker at the time of manufacture, if it has maintain the output power for 25 years. Assume a first order decay for the radioactive nuclei. Given $\ln=0.693$ , $e^{-0.25}=0.8$
	<b>A</b>	0.28 $\mu\text{g}$
	<b>B</b>	0.56 $\mu\text{g}$
	<b>C</b>	0.20 $\mu\text{g}$
	<b>D</b>	0.18 $\mu\text{g}$
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

36	<b>Question Description</b>	Assuming that the restoring forces for the bonds each of the molecule is same, the vibrational frequency for the following molecules will be in the order: $^{13}\text{C}^{18}\text{O}$ , $^{15}\text{N}^{14}\text{N}$ , $^{13}\text{C}^{16}\text{O}$ , $^{14}\text{N}^{14}\text{N}$
	<b>A</b>	$^{13}\text{C}^{18}\text{O} > ^{15}\text{N}^{14}\text{N} = ^{13}\text{C}^{16}\text{O} > ^{14}\text{N}^{14}\text{N}$
	<b>B</b>	$^{13}\text{C}^{18}\text{O} < ^{15}\text{N}^{14}\text{N} = ^{13}\text{C}^{16}\text{O} < ^{14}\text{N}^{14}\text{N}$
	<b>C</b>	$^{13}\text{C}^{18}\text{O} > ^{13}\text{C}^{16}\text{O} > ^{15}\text{N}^{14}\text{N} > ^{14}\text{N}^{14}\text{N}$
	<b>D</b>	$^{13}\text{C}^{18}\text{O} < ^{15}\text{N}^{14}\text{N} < ^{13}\text{C}^{16}\text{O} < ^{14}\text{N}^{14}\text{N}$
	<b>E</b>	None of the above
	<b>Correct Answer</b>	D
	<b>Marks</b>	1

37

<b>Question Description</b>	The first stokes' and anti-stokes' line are respectively shifted by $12.312 \text{ cm}^{-1}$ and $-12.312 \text{ cm}^{-1}$ from the Rayleigh line in the rotational Raman spectrum of a linear triatomic molecule. What would be the position of J=5-6 line in the spectrum?
<b>A</b>	$73.812 \text{ cm}^{-1}$
<b>B</b>	$61.560 \text{ cm}^{-1}$
<b>C</b>	$24.624 \text{ cm}^{-1}$
<b>D</b>	$12.312 \text{ cm}^{-1}$
<b>E</b>	None of the above
<b>Correct Answer</b>	C
<b>Marks</b>	1

38

**Question Description**

The Gibbs energy of mixing of two substances a and b is given by the following expression

$$\Delta_{mix} G = RT \{ x_a \ln x_a + x_b \ln x_b + \beta x_a x_b \}$$

where  $x_a$  and  $x_b$  are the mole fractions of the two substances in the mixture. For what values of  $\beta$  would the phase separation be spontaneous?

**A**

$\beta = 0$

**B**

$\beta < 2$

**C**

$\beta > 2$

**D**

$\beta = 2$

**E**

None of the above

**Correct Answer**

C

**Marks**

1

39	<b>Question Description</b>	The uncertainty in simultaneous measurement of total electronic energy and one of the components of orbital angular momentum of the electron in $\text{He}^+$ ion is
	<b>A</b>	$i\hbar$
	<b>B</b>	$\hbar$
	<b>C</b>	$2\pi$
	<b>D</b>	0
	<b>E</b>	None of the above
	<b>Correct Answer</b>	D
	<b>Marks</b>	1

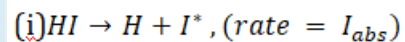
40	<b>Question Description</b>	The transport number for $\text{K}^+$ ions is 0.490. Estimate the liquid junction potential at 300 K for the cells $\text{Ag}(s) \text{AgCl}(s) \text{KCl}(0.01\text{M})  \text{KCl}(0.005\text{M}) \text{AgCl}(s) \text{Ag}(s)$ Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ , $\ln 2 = 0.693$ , $\ln 5 = 1.609$
	<b>A</b>	-0.36 mV
	<b>B</b>	-8.78 mV
	<b>C</b>	+0.36 mV
	<b>D</b>	+8.78 mV
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1



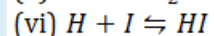
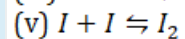
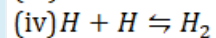
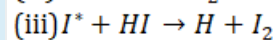
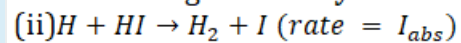
41

**Question Description**

The photochemical decomposition of HI results in the formation of ground state H atom and excited state I atom.



The following secondary reactions can possibly occur:



In the above, reactions (iv) and (vi) are highly exothermic and occurs only through three body collision. The step three is endothermic with a high activation energy.

Under the circumstances above, what will be the quantum yield for the process of decomposition of HI

**A**

1

**B**

2

**C**

3

**D**

4

**E**

None of the above

**Correct Answer**

B

**Marks**

1

42

**Question Description**

The variation of total volume of a binary mixture is given by the following relationship

$$v = 1.9005 + 0.054x - 0.00943x^2 + 0.0000586x^3$$

where  $x$  is the molefraction of solute. The plot of variation in partial molar volume of solute with the molefraction is expected to be

**A**

Straight line with positive slope

**B**

Straight line with negative slope

**C**

Parabolic

**D**

Sigmoidal

**E**

None of the above

**Correct Answer**

C

**Marks**

1

43

**Question Description**

The rate of forward and backward reactions at  $27^{\circ}\text{C}$  for the reaction  $A \rightleftharpoons B$  is  $3.5 \times 10^{-4} \text{ s}^{-1}$  and  $1.5 \times 10^{-4} \text{ s}^{-1}$ . The mixture of A and B is maintained at  $27^{\circ}\text{C}$  long enough to attain equilibrium. The temperature of the mixture is increased by  $50^{\circ}\text{C}$  using a pulsed laser within 3 ns and the elevated temperature is maintained thereafter. How long would it take for the system to relax to equilibrium. Assume that the rate of reaction doubles for every  $10^{\circ}\text{C}$  rise in temperature.

**A**  $2.0 \times 10^3$  seconds

**B**  $6.25 \times 10^1$  seconds

**C**  $2.0 \times 10^{-3}$  seconds

**D**  $6.25 \times 10^{-3}$  seconds

**E** None of the above

**Correct Answer** B

**Marks** 1

44

**Question Description**

The wavefunction of the  $n^{\text{th}}$  energy state of a particle in a 1D box of length 1 units is given by  $\sqrt{\frac{2}{l}} \sin\left(\frac{n\pi x}{l}\right)$ . If the length of the box is five units, What will be the probability of finding the particle within one unit length of the box as  $n \rightarrow \infty$  ?

**A**

1

**B**

0.5

**C**

0.2

**D**

0.1

**E**

None of the above

**Correct Answer**

C

**Marks**

1

45

**Question Description**

Considering  $O_2$  to be a rigid molecule, and given that the ground state of the molecule is  ${}^3\Sigma_g^-$ . Which electronically excited states are accessible by allowed electronic transitions?

A	${}^3\Sigma_u^-$ and ${}^3\Pi_u$ states
B	${}^3\Sigma_g^-$ and ${}^3\Pi_u$ states
C	${}^3\Sigma_u^+$ and ${}^3\Pi_u$ states
D	${}^3\Sigma_g^+$ and ${}^3\Pi_u$ states

A

A

B

B

C

C

D

D

E

None of the above

**Correct Answer**

A

**Marks**

1

46

**Question Description**

The rate of a chemical reaction that could be catalysed by acid as well as base is given by

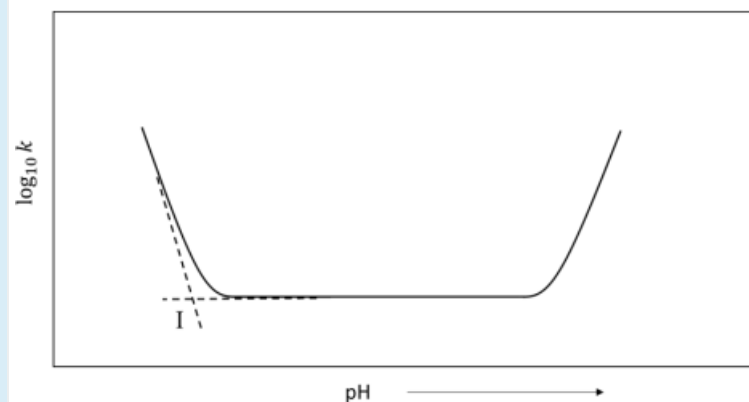
$$\text{rate} = k_0 [S] + k_{H^+} [S][H^+] + k_{OH^-} [S][OH^-]$$

Where [S] is concentration of the substrate formed during the catalysed reaction,  $k_0$  is the rate constant of uncatalysed reaction.

The first order rate constant for the reaction can be given as

$$k = \frac{\text{rate}}{[S]}$$

A schematic plot of  $\log_{10} k$  vs pH is given below.



At the point of intersection, I, the observed rate constant for the reaction would be

**A**

$k_0$

**B**

$2k_0$

**C**

$k_0/2$

**D**

$k_0 + k_{H^+}$

**E**

None of the above

**Correct Answer****B**

Marks

1

47

Question Description

The dipole moment operator is given by  $\hat{\mu} = er\cos\phi$ . The wave-function for an electron orbiting in the Bohr's orbit is given by  $\psi(\phi) = \frac{1}{\sqrt{\pi}}\sin\phi$ , where  $0 \leq \phi \leq 2\pi$ . What is the average value of dipole moment of the electron in the Bohr's orbit?

A

$\infty$

B

$\pi$

C

$2\pi$

D

0

E

None of the above

Correct Answer

D

Marks

1

**Question Description**

For a set of parallel reactions  $A \rightarrow B$  and  $A \rightarrow C$ , with respective rate constants,  $k_1$  and  $k_2$ , the following rate expression could be written

$$\frac{-dC_A}{dt} = (k_1 + k_2)C_A = k_{obs}C_A$$

Where  $C_A$  is the concentration of A. What is the activation energy for this system if the activation energies of reactions with rate constants  $k_1$  and  $k_2$  respectively are  $E_{a1}$  and  $E_{a2}$ ?

**A**

$$\frac{k_1 E_{a1} + k_2 E_{a2}}{k_1 + k_2}$$

**B**

$$\frac{k_1 E_{a2} + k_2 E_{a1}}{k_1 + k_2}$$

**C**

$$k_1 E_{a1} + k_2 E_{a2}$$

**D**

$$k_1 E_{a1} / k_2 E_{a2}$$

**E**

None of the above

**Correct Answer**

A

**Marks**

1



49	<b>Question Description</b>	Nitration at a particular carbon atom causes 2097.2 Hz frequency shift of the $^{13}\text{C}$ -NMR resonant signal. What is chemical shift expected in the magnetic field of 7.11 T. Given, gyromagnetic ratio of $^{13}\text{C}$ is $10.7 [2\pi \text{ MHz T}^{-1}]$ .
	<b>A</b>	28 ppm downfield shift
	<b>B</b>	28 ppm upfield shift
	<b>C</b>	4.5 ppm downfield shift
	<b>D</b>	4.5 ppm upfield shift
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

50	<b>Question Description</b>	N,N-dimethylformamide (DMF) shows two equally intense peaks for the two methyl protons. The two peaks coalesce around $120^\circ\text{C}$ to give a broad peak which becomes sharper as temperature approaches $170^\circ\text{C}$ . If the separation between the two peaks of methyl protons at room temperature is 12.5 Hz, what is the first order rate constant for the exchange of two methyl protons at coalescence temperature
	<b>A</b>	$27.7 \text{ s}^{-1}$
	<b>B</b>	$8.83 \text{ s}^{-1}$
	<b>C</b>	$0.11 \text{ s}^{-1}$
	<b>D</b>	$0.04 \text{ s}^{-1}$
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

<b>Comprehension</b>	<p>Read the Passage below and answer the following questions:</p> <p>We in India have our own special problems. No one can deny that some of them are of a serious nature and must be attacked with <i>vigour</i> and determination. Our national objectives have been defined clearly. We aim at providing every citizen with basic necessities and complete freedom to lead a life of his or her choice. We aim to create a democratic society, strong and free, in which every citizen, irrespective of his religious beliefs, will occupy an equal and honoured place, and be given full and equal opportunities for growth and service. We aim at ending untouchability and doing away with the present inequalities of status and wealth. We are opposed to the concentration of wealth in a few hands.</p>
<b>Question Description</b>	<p>“No one can deny that some of them are of a serious nature and must be attacked with <i>vigour</i> and determination.” Identify from the following options, the one that comes closest in meaning to the overall sense that it conveys.</p>
<b>A</b>	All can agree that some of them are not of a serious nature and must not be attacked with <i>vigour</i> and determination
<b>B</b>	Everyone cannot deny that some of them are of a serious nature and must be attacked with <i>vigour</i> and determination
<b>C</b>	No one can agree that some of them are not of a serious nature but must be attacked with <i>vigour</i> and determination
<b>D</b>	Everyone can agree that some of them are of a serious nature and must be attacked with <i>vigour</i> and determination
<b>E</b>	None of the above
<b>Correct Answer</b>	D
<b>Marks</b>	1

52

**Comprehension**

Read the Passage below and answer the following questions:

We in India have our own special problems. No one can deny that some of them are of a serious nature and must be attacked with *vigour* and determination. Our national objectives have been defined clearly. We aim at providing every citizen with basic necessities and complete freedom to lead a life of his or her choice. We aim to create a democratic society, strong and free, in which every citizen, irrespective of his religious beliefs, will occupy an equal and honoured place, and be given full and equal opportunities for growth and service. We aim at ending untouchability and doing away with the present inequalities of status and wealth. We are opposed to the concentration of wealth in a few hands.

**Question Description**

Identify from the options given, the one closest to the term “concentration” in the sense it is used in the passage

**A**

attentiveness

**B**

industry

**C**

accumulation

**D**

focusing

**E**

None of the above

**Correct Answer**

C

**Marks**

1

**Comprehension**

Read the Passage below and answer the following questions:

We in India have our own special problems. No one can deny that some of them are of a serious nature and must be attacked with *vigour* and determination. Our national objectives have been defined clearly. We aim at providing every citizen with basic necessities and complete freedom to lead a life of his or her choice. We aim to create a democratic society, strong and free, in which every citizen, irrespective of his religious beliefs, will occupy an equal and honoured place, and be given full and equal opportunities for growth and service. We aim at ending untouchability and doing away with the present inequalities of status and wealth. We are opposed to the concentration of wealth in a few hands.

**Question Description**

The passage implies that the real challenge taken up by our society is

**A**

ending untouchability and inequality

**B**

creating a democratic society

**C**

attacking problems with vigour

**D**

concentrating wealth among few people

**E**

None of the above

**Correct Answer**

A

**Marks**

1

**Comprehension**

Read the Passage below and answer the following questions:

We in India have our own special problems. No one can deny that some of them are of a serious nature and must be attacked with *vigour* and determination. Our national objectives have been defined clearly. We aim at providing every citizen with basic necessities and complete freedom to lead a life of his or her choice. We aim to create a democratic society, strong and free, in which every citizen, irrespective of his religious beliefs, will occupy an equal and honoured place, and be given full and equal opportunities for growth and service. We aim at ending untouchability and doing away with the present inequalities of status and wealth. We are opposed to the concentration of wealth in a few hands.

**Question Description**

“We are opposed to the concentration of wealth in a few hands.”

Select the closest version of re-writing the above sentence, from the options provided below:

**A** We are not committed to concentrating wealth in many hands

**B** We are supportive of not concentrating wealth in a few hands

**C** We are not opposed to diluting wealth in a few hands

**D** We are backing non-concentration of wealth in many hands.

**E** None of the above

**Correct Answer**

B

**Marks**

1

55

**Comprehension**

Read the Passage below and answer the following questions:

We in India have our own special problems. No one can deny that some of them are of a serious nature and must be attacked with *vigour* and determination. Our national objectives have been defined clearly. We aim at providing every citizen with basic necessities and complete freedom to lead a life of his or her choice. We aim to create a democratic society, strong and free, in which every citizen, irrespective of his religious beliefs, will occupy an equal and honoured place, and be given full and equal opportunities for growth and service. We aim at ending untouchability and doing away with the present inequalities of status and wealth. We are opposed to the concentration of wealth in a few hands.

**Question Description**

Identify the option from the passage which is antonymous to the term “lethargy”

**A**

status

**B**

determination

**C**

vigour

**D**

problems

**E**

None of the above

**Correct Answer**

C

**Marks**

1

56

<b>Question Description</b>	The world's first wildlife conservation bond Has been issued by the World Bank for which animal?
<b>A</b>	White elephant
<b>B</b>	Black Rhinoceros
<b>C</b>	Asiatic Lion
<b>D</b>	Bengal Tiger
<b>E</b>	None of the above
<b>Correct Answer</b>	B
<b>Marks</b>	1

57

<b>Question Description</b>	In which state, the Department of Posts delivered mail using a drone for the first time?
<b>A</b>	Kerala
<b>B</b>	Gujarat
<b>C</b>	Uttar Pradesh
<b>D</b>	Goa
<b>E</b>	None of the above
<b>Correct Answer</b>	B
<b>Marks</b>	1

58	<b>Question Description</b>	India set to launch 1st Human Space Mission Gaganyaan& 1st Human Ocean Mission in which year?
	<b>A</b>	2026
	<b>B</b>	2023
	<b>C</b>	2025
	<b>D</b>	2024
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

59	<b>Question Description</b>	The pass located at the southern end of the Nilgiri Hills in south India is called
	<b>A</b>	the Palghat gap
	<b>B</b>	the Bhorghat pass
	<b>C</b>	the Thalghat pass
	<b>D</b>	the Bolan pass
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1



60

<b>Question Description</b>	India's first 'Amrit Sarovar' has been established in Rampur of which state?
<b>A</b>	Haryana
<b>B</b>	Uttar Pradesh
<b>C</b>	Kerala
<b>D</b>	Telangana
<b>E</b>	None of the above
<b>Correct Answer</b>	B
<b>Marks</b>	1

61

<b>Question Description</b>	<b>Who among the following has recently become the first batter in international cricket history to score nine consecutive half-centuries in all three formats of cricket?</b>
<b>A</b>	Babar Azam
<b>B</b>	Joe Root
<b>C</b>	Rohit Sharma
<b>D</b>	Jos Buttler
<b>E</b>	None of the above
<b>Correct Answer</b>	A
<b>Marks</b>	1

62

<b>Question Description</b>	The books 'Loktantra ke Swar' and 'The Republican Ethic' have selected speeches of _____.
<b>A</b>	Atal Bihari Vajpayee
<b>B</b>	Manmohan Singh
<b>C</b>	Narendra Modi
<b>D</b>	Ram Nath Kovind
<b>E</b>	None of the above
<b>Correct Answer</b>	D
<b>Marks</b>	1

63

<b>Question Description</b>	Which country has built World's largest petroleum research centre?
<b>A</b>	Iran
<b>B</b>	UAE
<b>C</b>	Kuwait
<b>D</b>	Qatar
<b>E</b>	None of the above
<b>Correct Answer</b>	C
<b>Marks</b>	1

64	<b>Question Description</b>	The purpose of choke in tube light is ?
	<b>A</b>	To decrease the current
	<b>B</b>	To increase the current
	<b>C</b>	To decrease the voltage momentarily
	<b>D</b>	To increase the voltage momentarily
	<b>E</b>	None of the above
	<b>Correct Answer</b>	D
	<b>Marks</b>	1

65	<b>Question Description</b>	Federation Cup, World Cup, Allywyn International Trophy and Challenge Cup are awarded to winners of
	<b>A</b>	Tennis
	<b>B</b>	Volleyball
	<b>C</b>	Basketball
	<b>D</b>	Cricket
	<b>E</b>	None of the above
	<b>Correct Answer</b>	B
	<b>Marks</b>	1

66

**Question Description**

In a class, there are 36 very tall boys. If these constitute three-fourths of the boys and the total number of boys is two-thirds of the total number of students in the class, what is the total number of girls in the class?

**A**

36

**B**

72

**C**

24

**D**

48

**E**

None of the above

**Correct Answer**

C

**Marks**

1

67

**Question Description**

There are six Indian cricketers, namely Virat, Rohit, Dhoni, Raina, Ishant, and Rahane. Among them two are batsmen, while others are wicket keeper, fast bowler, all rounder and spinner, though not necessarily in the same order. Also, each of these cricketers belongs to a different city, namely Chandigarh, Delhi, Ranchi, Chennai, Mumbai and Jaipur.

I. Virat, a fast bowler, is neither from Chennai nor from Jaipur.

II. The one who is from Mumbai is a spinner. Neither Raina nor Rohit is from Mumbai.

III. Rohit is the all-rounder of the team and is from Jaipur.

IV. Virat is not from Ranchi while Rahane is not from Chennai.

V. Raina the wicket keeper is from Delhi. Neither Dhoni nor Rahane is a spinner.

Who among the following is from Chandigarh?

**A**

Dhoni

**B**

Virat

**C**

Ishant

**D**

Rahane

**E**

None of the above

**Correct Answer**

B

**Marks**

1

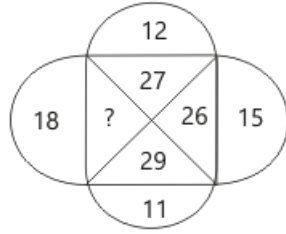
68	<b>Question Description</b>	AERIE : EAGLE::?
	<b>A</b>	bridge : architect
	<b>B</b>	unit : apartment
	<b>C</b>	kennel : veterinarian
	<b>D</b>	house : person
	<b>E</b>	None of the above
	<b>Correct Answer</b>	D
	<b>Marks</b>	1

69	<b>Question Description</b>	BLOCKED : YOLXPVW :: ? : OZFMMXS
	<b>A</b>	LAUNNCH
	<b>B</b>	RESULTS
	<b>C</b>	LABOURS
	<b>D</b>	DEBATES
	<b>E</b>	None of the above
	<b>Correct Answer</b>	A
	<b>Marks</b>	1

70

**Question Description**

Find missing number

**A**

22

**B**

35

**C**

25

**D**

30

**E**

None of the above

**Correct Answer**

D

**Marks**

1



71	<b>Question Description</b>	Pointing to a boy in a photograph, a girl said, "His father's mother is the mother-in-law of my brother's mother." How is the person in photograph related to the girl?
	<b>A</b>	Maternal Uncle
	<b>B</b>	Grandfather
	<b>C</b>	Brother
	<b>D</b>	Paternal Uncle
	<b>E</b>	None of the above
	<b>Correct Answer</b>	C
	<b>Marks</b>	1

72	<b>Question Description</b>	Select the one which is different from the other three responses.
	<b>A</b>	(96, 24)
	<b>B</b>	(39, 18)
	<b>C</b>	(81, 54)
	<b>D</b>	(82, 64)
	<b>E</b>	None of the above
	<b>Correct Answer</b>	D
	<b>Marks</b>	1

73

**Question Description**

If first, third and sixth letters of the word “LINGUIST” are changed to their immediately preceding letters as per English alphabet series and fourth and seventh letters are changed to their immediately succeeding letters as per English alphabet series, then how many letters (in English alphabet series) are there between the third and fifth letters of the newly formed word?

**A**

5

**B**

6

**C**

7

**D**

8

**E**

None of the above

**Correct Answer**

C

**Marks**

1

74

**Question Description**

Following questions are based on the five three-digit numbers given below:

284 , 312 , 437 , 585 , 696

If 2 is added to the first digit of each of the numbers how many numbers thus formed will be divisible by three?

**A**

None

**B**

One

**C**

Two

**D**

Three

**E**

None of the above

**Correct Answer**

A

**Marks**

1

75

**Question Description**

Sudesh starts driving from point A and drives 12 km towards north. He takes a right turn and drive 20 km. He now drives 8 km after taking a left turn. Finally he takes a left turn; and drives 20 km and stops at point B.

How far is point A with respect to point B?

**A**

18 km

**B**

20 km

**C**

35 km

**D**

25 km

**E**

None of the above

**Correct Answer**

B

**Marks**

1