భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad
Kandi, Sangareddy, IITH-502284; Tel: 040-23016074

Advt. No. IITH/2023/Rec/NF/15 dated 22.10.2023

Question Paper ID : **104**

Application Number of the Candidate

Name of the Post: **Junior Technician – Chemistry** Pay Level: **03**

Date & Time of the Exam: **07/12/2023 & 09:30 AM** Duration: 01 hr. 30 min

Scheme of the Exam:

Topic	Number of Question	Marks
PART -A		
Section 1: Arithmetic	05	10
Section 2: General English	05	10
PART -B		
Section 1 – Physical Chemistry	13	26
Section 2: Inorganic and Analytical Chemistry	14	28
Section 3: Organic Chemistry	13	26

Each question carries two marks.

Instructions to fill the responses in the OMR answer sheet

1. Candidate must write his/her **application number** in the designated box on the top of OMR answer sheet
2. Candidate must write the Question paper ID in the designated boxes on the top of OMR answer sheet

3. Candidate must sign in the box provided in the OMR answer sheet
4. Each answer sheet must be signed by the invigilator in the space printed in the OMR answer sheet
5. Only one response to be selected & marked. In case more than one response is marked for a single question or no response is marked for a question, no marks will be awarded for that question.
6. Partially filled circles shall not be considered as responses
7. Erasing or changing of answer is not allowed.
8. No negative marking
9. Candidate must use Blue/Black ball point pen to fill his/her responses
10. Rough work should not be done on the OMR answer sheet.
11. Candidate can use the designated page(s) of the question booklet for the purpose of rough work

PART- A

1. There are coins of Rs. 1, 50 paise, 25 paise, in the ratio of 4: 3: 8 in a box. If the value of the box is Rs. 150, then find the number of coins of Rs. 1.

    a. 20

    b. 80

    c. 60

    d. 180

2. In what ratio a solution having 30% alcohol is mixed with another solution of 50% alcohol so that the resultant solution has 42% alcohol?

    a. 1:3

    b. 2:3

    c. 1:3

    d. 3:2

3. The sum of two numbers is 20, and the product is 91. What should be the sum of their reciprocal?

    a. 13/7

b. 20/91

c. 91/20

d. 13/20

4. $66\frac{2}{3}$% of Rs. 312, is how much more than Rs. 200?

a. 96

b. 8

c. 4

d. 104

5. Find the total number of factors of 1800 is:

a. 32

b. 48

c. 36

d. 40

6. Select the correct meaning of the given phrases/idioms. “Hand in glove”

a. be in collusion

b. holding opposite views

c. be warm and secure

d. be with. Friends

7. She has_____her money and jewellery to help the poor.

a. given up

b. given away

c. given in

d. given way

8. The vehicle will_____down unless you apply the _____right away

   a. break, break
   b. brake, break
   c. break, brake
   d. brake, brake

9. Select the option that expresses the given sentence in passive voice "Someone stole his traveller's cheques when he was travelling in Europe"

   a. His traveller's cheques was stole when he was travelling in Europe
   b. His traveller's cheques were stolen when he was travelling in Europe
   c. His traveller's cheques are stole when he was travelling in Europe
   d. Someone had been stole his traveller's cheque when he was travelling in Europe.

10. A large building with an extensive floor area, typically for housing aircraft

   a. Shed
   b. Airport
   c. Barn
   d. Hangar

PART B

Physical Chemistry

11. An electron has energy 50 eV. What would be the de Broglie wavelength in angstrom units?

   a. 1.7
   b. 2
   c. 17
   d. 5

12. A particle in 3D box has energy $14h^2/8mL^{2.}$ What is the degeneracy of the state?
    a. 4
    b. 7
    c. 6
    d. 8
13. What is the bond angle in a molecule with a trigonal pyramidal shape?
    a. 90 degrees
    b. 109.5 degrees
    c. 120 degrees
    d. 107 degrees
14. Which of the following substances is likely to have London dispersion forces as the primary intermolecular force?
    a. H_2O
    b. CH_4
    c. Cl_2
    d. HF
15. Maxwell-Boltzmann statistics cannot be applied to which of the following?
    a. Molecules
    b. Atoms
    c. Photons
    d. Lattice
16. Which of the following pairs are tetragonal and cubic?
    a. $HgCl_2$ and $FeSO_4$
    b. NH_4Cl and NaCl
    c. KNO_3 and $HgCl_2$
    d. Titanium and NaCl
17. Calculate the empty space in the diamond unit cell is
    a. 33%
    b. 66%
    c. 48%
    d. 26%

18. Match the following

A) $dU = TdS - PdV$	1) $(\partial T/\partial S)_s = (\partial V/\partial S)_p$
B) $dH = TdS + VdP$	2) $(\partial S/\partial P)_T = (\partial V/\partial T)_p$
C) $dA = -PdV - SdT$	3) $(\partial T/\partial V)_s = (\partial P/\partial S)_V$
D) $dG = VdP - SdT$	4) $(\partial P/\partial T)_V = (\partial S/\partial V)_T$

	A	B	C	D
a.	3	1	4	2
b.	1	3	4	2
c.	3	2	1	4
d.	2	4	3	1

19. The two solutions of a non-electrolyte material are combined. 520 mL of the second solution (1.2 M) and 480 mL of the first solution (1.5 M). What is the final mixture's molarity?

a. 2.30 M
b. 2.50 M
c. 1.344 M
d. 2.70 M

20. The rate constant of a 1st order reaction is 1.15×10^{-3} s^{-1}. What is the time required for the reduction of 5 grams of this reactant to 3 grams?

a. 622 s
b. 534 s
c. 444 s
d. 523 s

21. The temperature of the reaction increases from 300 to 400 K. The rate constant increases by four. Calculate the activation energy in kJ mol^{-1}.

a. 20
b. 25
c. 14
d. 27

22. Which of the following statements is incorrect with respect to physisorption?

a. It is spontaneous
b. It is reversible

c. $\Delta H < 0$

d. $\Delta S > 0$

23. If T is the surface tension of the soap solution, the amount of work done in blowing bubble from diameter D to a diameter 2D is

a. $4\pi D^2T$

b. $2\pi D^2T$

c. $6\pi D^2T$

d. $10\pi D^2T$

Inorganic and Analytical Chemistry

24. Which point group contains a mirror plane as one of its symmetry elements?

a. C_3V

b. D_2h

c. C_2V

d. T_d

25. Which of the following is the correct order of acidic strength?

a. $CF_3COOH > CCl_3COOH > CH_3COOH$

b. $CF_3COOH > CH_3COOH > CCl_3COOH$

c. $CCl_3COOH > CF_3COOH > CH_3COOH$

d. $CH_3COOH > CCl_3COOH > CF_3COOH$

26. Which ligand system is present in vitamin B12?

a. Corrin

b. porphyrin

c. crown ether

d. Phthalocynine

27. Superoxide dismutase contains which of the following metals?

a. Cu^{2+} and Zn^{2+}

b. Mg^{2+} and Ni^{2+}

c. Ca^{2+} and Ni^{2+}

d. Mg^{2+} and Zn^{2+}

28. Which of the following is the inverse spinel?

a. $MgAl_2O_4$

b. Mn_3O_4

c. Co_3O_4

d. Fe_3O_4

29. At what path difference the peaks of scattered intensity is observed ?

a. λ

b. $\lambda/2$

c. $3\lambda/2$

d. No peaks are observed at any condition

30. The type of radiation emitted during the conversion of $_{11}Na^{21}$ to $_{12}Mg^{24}$ is

a. α ray

b. β ray

c. c) ϒ ray

d. d) X – ray

31. One gram sample of a radioactive element ($t_{1/2}$ = 1hr) is taken 8am. How much of the element would remain at 6pm on the same day?

a. 100 mg

b. 200 mg

c. 10 mg

d. 1 mg

32. In the Ziese's salt

a. pi bond is strengthened and hence olefin C-C is lengthened

b. pi bond is weakened and hence olefin C-C is lengthened

c. pi bond is weakened and hence olefin C-C is shortened

d. pi bond is Strengthened and hence no change in C-C bond length

33. Find the correct option

A) oxo process X) CO_2CO_8

B) Wackers process Y) $PdCl_2.CuCl_2$

C) Ziegler Natta catalyst Z) $TiCl_4.AlEt_3$

	A	B	C
a.	X	Y	Z
b.	Y	X	Z
c.	Z	Y	X
d.	Z	X	Y

34. Cd ions can be estimated by

a. Polarography

b. Potentiometry

c. Polarimetry

d. Viscometer

35. Graphite with Alk.$KMnO_4$ gives

a. Mellitic acid and Oxalic acid

b. Graphitic acid and Oxalic acid

c. Mellitic acid and Graphitic acid

d. Graphitic acid

36. The no.of lines in the ESR spectrum of $[C_6H_6]^{\circ}$ is

a. 3

b. 6

c. 9

d. 7

37. The presence of sunlight $[CO(NH_3)_5H_2O]^{3+} + Cl^{-} \rightarrow [COCl(NH_3)_5]^{2+} + H_2O$

a. Photo aquation

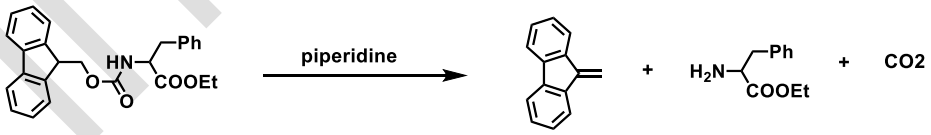
b. Photo anation

c. Photo reduction

d. Photo oxidation

Organic Chemistry

38. The Mechanism involved in the following reaction is:



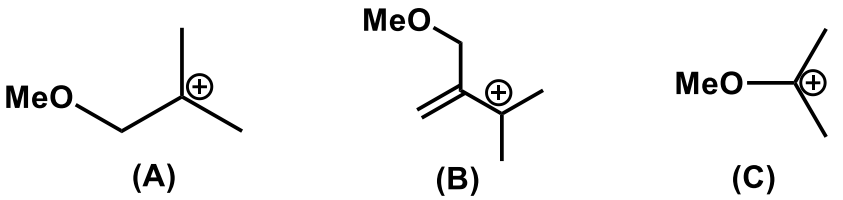
a. E2- elimination

b. E1-elimination

c. Syn-elimination

d. E1 CB-elimination

39. The correct order of stability of the following carbocation is-



a. A > C > B

b. B > C > A

c. C > A > B

d. C > B > A

40. The Correct order of the rate constants for the following series of reactions

(Z=CF_3/CH_3/OCH_3) is:

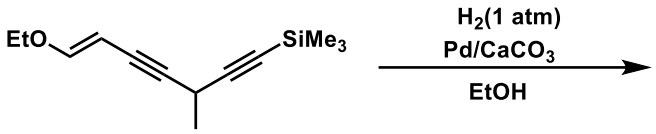
a. CF_3 >CH_3 >OCH_3

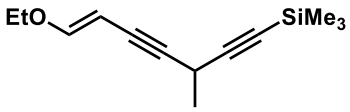
b. CF_3> OCH_3 >CH_3

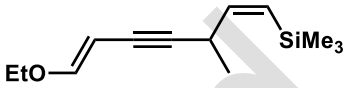
c. OCH_3> CF_3> CH_3

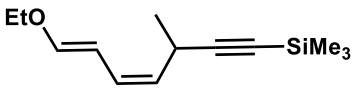
d. CH_3 >OCH_3 > CF_3

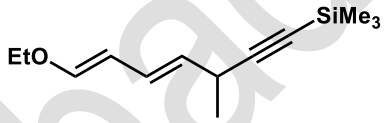
41. The major product of the following reaction is :



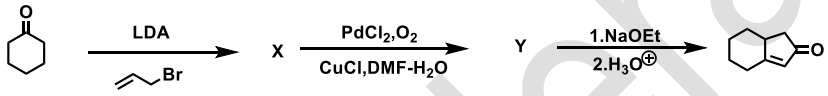
(a) 

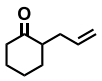
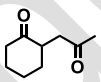
(b) 

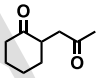
(c) 

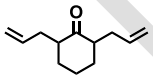
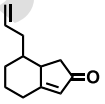
(d) 

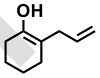
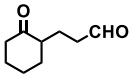
42. The products X and Y in the following reaction sequence are :



(a) X =  Y =  ;

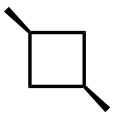
(b) X =  Y = 

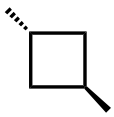
(c) X =  Y = 

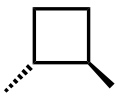
(d) X =  Y = 

43. Among the following, the optical active compound is…….

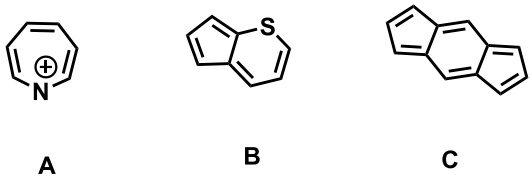

(a)


(b)


(c)


(d)

44. Which of the following species is/are aromatic?



A B C

a. Only A

b. Only B and C

c. Only A and B

d. Only B

45. Flammable materials, like alcohol (-OH), should never be dispensed or used near

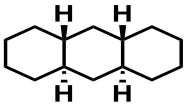
a. An open door

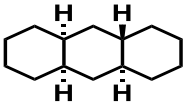
b. An open flame

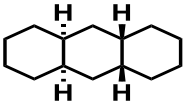
c. Another student

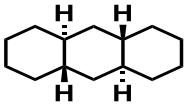
d. A sink

46. The hydrocarbon among the following having conformationally locked chair-boat-chair form is:

(a) 

(b) 

(c) 

(d) 

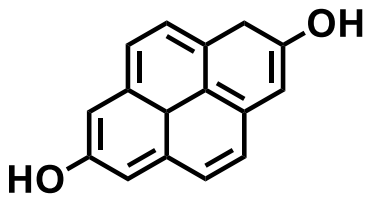
47. Among the following, the amino acid which is basic in nature is

    a. Tyrosine
    b. Asparagine
    c. Leucine
    d. Arginine

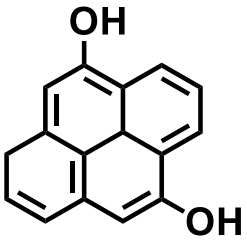
48. The biosynthetic precursor for the steroids is

    a. Secologanin
    b. Shikimic acid
    c. mevalonic acid
    d. α-ketoglutaric acid

49. In the broadband decoupled ^{13}C NMR spectrum, the number of signals appearing for the pyrene diols A and B



(A)



(B)

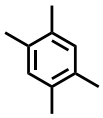
a. 8 and 8

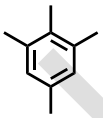
b. 8 and 16

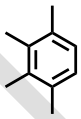
c. 5 and 10

d. 5 and 8

50. An organic Compound having the molecular formula $C_{10}H_{14}$ exhibited two siglets in the ^{1}H NMR spectrum, and three signals in the ^{13}C NMR spectrum. The compound is

(A) 

(B) 

(C) 

(D)