Chemistry 2202 Common Exam 2010

Answer Section

MULTIPLE CHOICE

1. ANS: B PTS: 1 DIF: level 1 REF: page 24
   OBJ: 115-3

2. ANS: C PTS: 1 DIF: level 1 REF: page 24
   OBJ: 115-3

3. ANS: D PTS: 1 DIF: level 2 REF: page 24
   OBJ: 115-3

4. ANS: C PTS: 1 DIF: level 2 REF: page 26
   OBJ: 323-1

5. ANS: A PTS: 1 DIF: level 2 REF: page 30, (STSE)page 115
   OBJ: 323-1, (STSE)323-12

6. ANS: D PTS: 1 DIF: level 1 REF: page 32
   OBJ: 213-5

7. ANS: D PTS: 1 DIF: level 1 REF: page 32
   OBJ: 213-5

8. ANS: B PTS: 1 DIF: level 1 REF: page 32
   OBJ: 213-5

9. ANS: B PTS: 1 DIF: level 1 REF: page 32
   OBJ: 213-5

10. ANS: B PTS: 1 DIF: level 2 REF: page 32
    OBJ: 213-5

11. ANS: B PTS: 1 DIF: level 1 REF: page 34
    OBJ: 213-5

12. ANS: A PTS: 1 DIF: level 3 REF: page 34
    OBJ: 213-5

13. ANS: C PTS: 1 DIF: level 2 REF: page 36
    OBJ: 323-10

14. ANS: A PTS: 1 DIF: level 2 REF: page 38
    OBJ: 323-10

15. ANS: A PTS: 1 DIF: level 3 REF: page 38
    OBJ: 323-11

16. ANS: A PTS: 1 DIF: level 1 REF: page 40
    OBJ: 323-11

17. ANS: C PTS: 1 DIF: level 1 REF: page 40-41
    OBJ: 323-11

18. ANS: A PTS: 1 DIF: level 2 REF: page 40
    OBJ: 323-11

19. ANS: D PTS: 1 DIF: Level 2 REF: 56
    OBJ: 321-7

20. ANS: B PTS: 1 DIF: Level 1 REF: 58
OBJ: 321-4

21. ANS: A PTS: 1 DIF: Level 2 REF: 58
OBJ: 321-4

22. ANS: B PTS: 1 DIF: Level 1 REF: 60
OBJ: 321-11

23. ANS: D PTS: 1 DIF: Level 2 REF: 60
OBJ: 321-11

24. ANS: A PTS: 1 DIF: Level 2 REF: 60
OBJ: 114-2

25. ANS: A PTS: 1 DIF: Level 1 REF: 62
OBJ: 321-5

26. ANS: C PTS: 1 DIF: Level 2 REF: 62
OBJ: 321-5

27. ANS: D PTS: 1 DIF: Level 1 REF: 64
OBJ: 321-5

28. ANS: C PTS: 1 DIF: Level 1 REF: 68
OBJ: 321-4

29. ANS: C PTS: 1 DIF: Level 1 REF: 70
OBJ: 321-4

30. ANS: A PTS: 1 DIF: Level 3 REF: 74
OBJ: 323-7

31. ANS: D PTS: 1 DIF: Level 2 REF: 72
OBJ: 214-2

32. ANS: A PTS: 1 DIF: Level 1 REF: 82
OBJ: 319-4

33. ANS: B PTS: 1 DIF: Level 1 REF: 86
OBJ: 319-7

34. ANS: C PTS: 1 DIF: Level 1 REF: 86 and 88
OBJ: 319-7

35. ANS: D PTS: 1 DIF: Level 2 REF: 90
OBJ: 319-7

36. ANS: B PTS: 1 DIF: Level 1 REF: 96
OBJ: 319-8

37. ANS: C PTS: 1 DIF: Level 1 REF: 104
OBJ: 319-7

38. ANS: A PTS: 1 DIF: Level 2 REF: 104
OBJ: 319-7

39. ANS: C PTS: 1 DIF: Level 3 REF: 106
OBJ: 319-8

40. ANS: D PTS: 1 DIF: Level 3 REF: 106
OBJ: 319-8

SHORT ANSWER

41. ANS:

(A) Novium-272: 271.853 amu x 0.7069 = 192.17 amu 1/2

Novium-276: 275.985 amu x 0.1771 = 48.88 amu 1/2

Novium-280: 279.859 amu x 0.1160 = 32.46 amu 1/2

Average Atomic Mass of Novium = (192.17 + 48.88 + 32.46) = 273.5 amu 1 1/2

(B) $M_{C2H5COOH}$ = 3 x 12.01 g/mol = 36.03 g/mol
6 x 1.01 g/mol = 6.06 g/mol
2 x 16.00 g/mol = 32.00 g/mol
74.09 g/mol 1

n = m/M = 3.45 g/ 74.09g/mol = 0.0466 moles 1

#particles = nN_a = (0.0472 moles)(6.02 x 10^{23} particles/mole) = 2.80 x 10^{22} molecules 1

(C) Assume 100 grams, thus 43.64 grams of P and 56.36 g of O

n_P = m/M = 43.64 g/ 30.97g/mol = 1.409 moles 1/2
n_O = m/M = 56.36 g/ 16.00 g/mol = 3.523 moles 1/2

1.409/1.409 : 3.523/1.409 = 1 : 2.5 (multiply by 2) 2 : 5 1/2

thus we get P_2O_5 which has a molar mass of 141.94 g/mol 1/2

M_{P2O5} = 2 x 30.97 g/mol = 61.94 g/mol
5 x 16.00 g/mol = 80.00 g/mol
141.94 g/mol

283.88 g/mol / 141.94 g/mol = 2, thus our molecular formula is twice as large 1

Answer: molecular formula is P_4O_{10} 1

(D) (i) ANS:

Mass of sample + vial	15.6 g
Mass of empty vial	10.4 g
Mass of sample	5.2 g

1

M = 39.10 + 54.94 + 4(16.00) = 158.04 g/mol 1

$$n = \frac{m}{M} = \frac{5.2\ g}{158.04\ ^{g}/_{mol}} = 0.032(9031)\ mol$$ 1

$$C = \frac{n}{v} = \frac{0.032(9)031\ mol}{1.500\ L} = 0.0219354\ ^{mol}/_{L} = 0.022\ ^{mol}/_{L}$$ 1

PTS: 4 DIF: level 3 REF:page 34 OBJ: 213-5

(ii) Use a balance and weigh boat, obtain 5.2 g of solute.
Dissolve in a large (1000. mL) beaker containing about 750 mL of water.
Stir with glass stirring rod to dissolve.
Transfer to 1.5 L volumetric flask using a funnel and stirring rod.
Rinse beaker rod and funnel thoroughly into the flask.
Stopper flask and invert several times to ensure homogeneity. 3

(E) Calculate solution concentration: $[CaCl_2] = 0.26\ M \times ½ = 0.13\ M$ 1
Find moles of $CaCl_2$: $0.13\ M \times 4.0\ L = 0.52\ mol$ 1
Mass of $CaCl_2$: $n \times M = 0.52\ mol \times 110.98\ g/mol = 58\ g$ 1

PTS: 3 DIF: level 3 REF: page 40 OBJ: 323-11

(F)

$$n_{NH_3} = \frac{m}{M} = \frac{154\,g}{17.04\,{}^{g}\!/\!_{mol}} = 9.0375587\ mol\ NH_3$$

$$n_{H_2} = n_{NH_3} \times \frac{W}{G} = 9.0375587\ mol\ NH_3 \times \frac{3\ mol\ H_2}{2\ mol\ NH_3} = 13.556338\ mol\ H_2$$

$$v = n \times V_{STP} = 13.556338\ mol\ H_2 \times 22.4\,{}^{L}\!/\!_{mol} = 303.66197\ L = 304\ L$$

1 pt / step = 3

PTS: 3 DIF: level 2 REF: page 38 OBJ: 323-11

(G)

$$2\ AgNO_{3(aq)} + CaCl_{2(aq)} \rightarrow 2\ AgCl_{(s)} + Ca(NO_3)_{2(aq)}$$

$$n_{AgNO_3} = C \times v = 0.075\ L \times 1.25\,{}^{mol}\!/\!_{L} = 0.09375\ mol$$
$$n_{CaCl_2} = C \times v = 0.075\ L \times 0.775\,{}^{mol}\!/\!_{L} = 0.058125\ mol$$

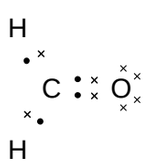
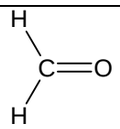
$$n_{AgNO_3} = 0.058125\ mol\ CaCl_2 \times \frac{2\ mol\ AgNO_3}{1\ mol\ CaCl_2} = 0.11625\ mol\ AgNO_3$$

$$n_{CaCl_2} = 0.09375\ mol\ AgNO_3 \times \frac{1\ mol\ CaCl_2}{2\ mol\ AgNO_3} = 0.046875\ mol\ CaCl_2$$

Since the amount of $AgNO_3$ available (0.09375) is less than the amount required (0.11625), it is limiting.

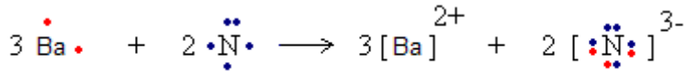
Points breakdown: ½ per mol calculation, 1 per mole ratio calculation, 1 for correct conclusion

42. (A) ANS:

(i)		Points: Award 1 for individual Lewis diagrams and 1 for correct Lewis diagram for molecule = 2
(ii)	 Trigonal Planar	1 for shape diagram 1 for name of shape

(iii) Yes. Since the electronegativities of hydrogen and oxygen are different, the bond dipoles will not cancel. Therefore, H_2CO is polar. 2

(B) ANS:



3

½ per Lewis diagram and 1 point for correct coefficients

PTS: 3 DIF: level 2 REF: page 70 OBJ: 321-4

(C) ANS:

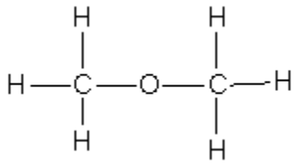
Sodium is a metal and exhibits metallic bonding (1/2). Cations are surrounded by free moving valence electrons (1/2). When struck with a hammer, the cations can shift and the electrons are free to move thus preventing any potential like-like repulsions (1/2). Sodium chloride is an ionic compound that exists as a crystal lattice (1/2). The cations and anions are arranged such that the ions of opposite charges are close to one another to maximize attraction and minimize repulsion (1/2). When stuck with a hammer, it is possible that ions of like charge will come in close contact causing repulsion. The ionic compound will break along this line of repulsion. (1/2)

PTS: 3 DIF: level 2 REF: page 70, 76 OBJ: 321-8

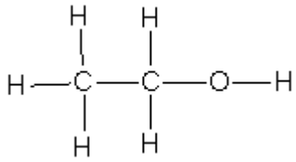
(D) ANS:

Answer

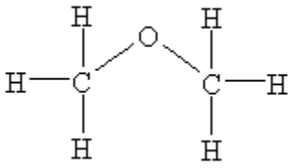
i. Either



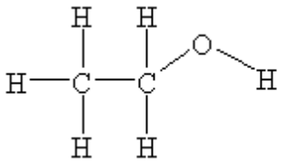
or



or, more specifically,



and



(or Lewis diagrams; 1 point per diagram)

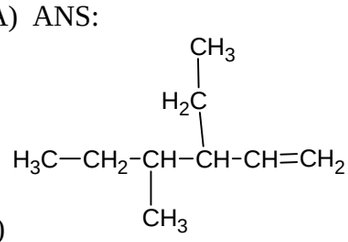
PTS: 2 DIF: level 3 REF: page 60 OBJ: 321-4

ii. In both substances, the molecules have 26e- each (isoelectronic) and are polar (1); however, C_2H_5OH molecules will experience hydrogen bonding force due to the highly polar O-H bond (1). C_2H_5OH has a higher boiling point and melting point than CH_3OCH_3. (1)

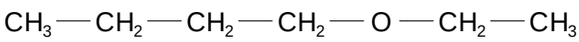
Assign marks if explanation is correct based on student diagrams even if incorrect.

PTS: 3 DIF: level 3 REF: page 66, OBJ: 321-8

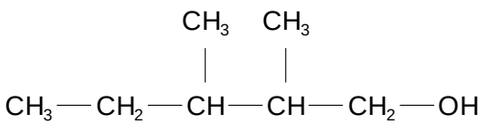
43. (A) ANS:



(i) 2



(ii) 2

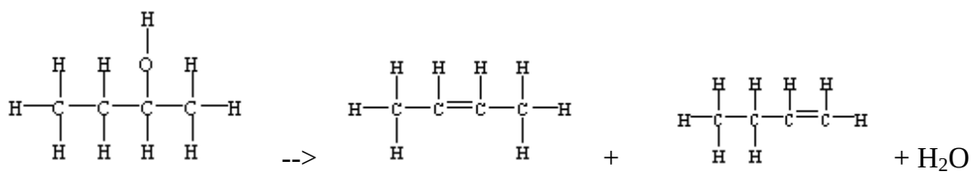


(iii) 2

PTS: 6 DIF: Level 2 REF: 92, 94 and 104
OBJ: 319-5, 319-6 and 319-7

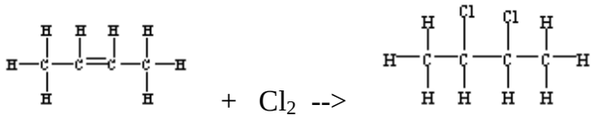
(B) ANS:

Reaction1:



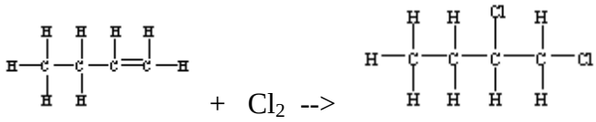
2-butanol 2-butene

Reaction 2:



2-butene 2,3-dichlorobutane

Reaction 3:



1-butene

Award 1 point per correct structural formula = total 4 points

PTS: 4 DIF: level 3 REF: page 104, 106 OBJ: 319-5,7

(C) ANS:

(i) 5-ethyl-3-methyl-2-heptene 2

(ii) 1-methyl-2,4-diethylbenzene or 2,4-diethyl-1-methylbenzene 2

(iii) 1-bromo-3-iodocyclopentane 2

PTS: 6 DIF: level 2 REF: page 92, 100 OBJ: 319-5,7