ORGANIC HL PAPER 1A

1. C
2. B
3. B
4. A
5. C

6. A
7. C
8. B
9. A
10. B

11. A
12. B
13. B
14. D
15. B

16. A
17. C
18. B
19. C
20. C

21. B
22. B
23. B
24. C
25. A

26. C
27. B
28. B
29. B
30. C

31. C
32. B
33. B
34. B
35. C

36. A
37. A
38. D

39. A
40. A

ORGANIC HL PAPER 1B

1. (a) Concentrated nitric acid (HNO_3) [1] and concentrated sulfuric acid (H_2SO_4) [1].

(b) Heat under reflux with Tin (Sn) and concentrated Hydrochloric acid (HCl) [1]. Neutralize final mixture with NaOH [1].

2. (a) The formula C_2H_6O matches ethanol (CH_3CH_2OH) or methoxymethane (CH_3OCH_3) [1]. The spectrum features a quartet and a triplet (along with a singlet), which mathematically points to a CH_2 group next to a CH_3 group (n+1 rule) [1]. Methoxymethane would only have one singlet [1]. Thus the compound is Ethanol.

(b) The breaking of the C-C bond leaves the characteristic CH_2OH^+ fragment [1], which has a mass of 31.

3. (a) The S_N1 mechanism proceeds via a completely planar carbocation intermediate [1]. The subsequent nucleophile (OH^-) can attack this planar face from either the top side or the bottom side with precisely equal probability [1], generating a 50:50 mixture of both enantiomers, leaving the net rotation of light completely zero (racemic) [1].

4. (a) Two distinct homolgous series required. Examples: But-1-yne (an alkyne) [1]. Cyclobutene (a cycloalkene) [1] or Buta-1,3-diene (a diene).

ORGANIC HL PAPER 2

1. (a) Adding water/steam ($H_2O(g)$) with concentrated H_3PO_4 catalyst gives propan-2-ol (Markovnikov). Converting propene to propan-1-ol natively requires hydroboration-oxidation (anti-Markovnikov), or theoretically converting to an intermediary like 1-bromopropane via peroxide HBr before substitution. [3] for a valid recognized pathway.

(b) Mixing the propan-1-ol with acidified Potassium Dichromate ($K_2Cr_2O_7$ / H^+) [1] and heating tightly under reflux [1].

2. (a) Utilize a polarimeter [1]. One pure enantiomer will rotate plane-polarized light to the left by X degrees, while the other will mathematically rotate it fully to the right by exactly X degrees [1].

3. (a) S stands for Substitution, N stands for Nucleophilic [1]. The 2 signifies standard bimolecular kinetics, meaning the rate law relies upon the concentrations of exactly two species (the halogenoalkane and the nucleophile) in its single rate-determining step [1].

(b) 4 marks for drawing: 1. Curly arrow from OH^- lone pair to the delta+ carbon atom [1]. 2. Proper representation of the pentacoordinate transition state with negative charge

and partial bonds [1]. 3. Curly arrow from C-Br bond to Br [1]. 4. Final product (ethanol and Br^-) drawn correctly [1].

4. (a) Very hot Ethanol (ethanol solvent / ethanolic NaOH) [1].

5. (a) 2-bromobutane is the major product [1]. The intermediate relies on a secondary carbocation on C2, which is significantly more stable (due to overlapping positive inductive effects from two alkyl groups) [1] than the volatile primary carbocation on C1 [1].

6. (a) $HNO_3 + 2H_2SO_4 \rightleftharpoons NO_2^+ + 2HSO_4^- + H_3O^+$ [2] (Accept simplified $HNO_3 + H_2SO_4 \rightleftharpoons H_2NO_3^+ + HSO_4^-$).

7. (a) m/z = 43 correlates rigorously to $[CH_3CO]^+$ [1]. m/z = 72 correlates to the entirely unfragmented $[C_4H_8O]^+$ parent molecular ion (M^+) [1]. Ketone is Butanone [1].

8. (a) Diatomic oxygen contains a physically symmetrical non-polar bond, hence stretching it generates absolutely no change in its net molecular dipole moment [1]. IR absorption strictly requires a functional asymmetric change in dipole during standard vibration [1].

9. (a) The formation of an Amide linkage (Peptide bond) [1]. -C(=O)-N(H)- [1].

10. (a) Protic solvents hydrogen-bond harshly and encapsulate the attacking nucleophile, lowering its effective reactivity [1]. Aprotic solvents lack hydrogen bonding to anions, heavily "stripping" the nucleophile to attack bare and thus massively raising the S_N2 kinetic rate [1].