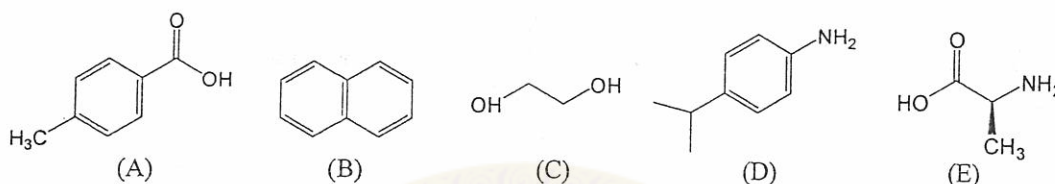


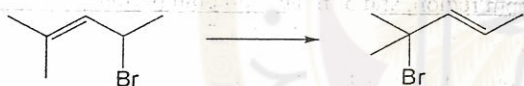
※注意：請於試卷上「非選擇題作答區」作答，並註明作答之題號。

1. Heptane has 9 constitutional isomers. (a) Draw the skeletal structure of the constitutional isomer that has the highest boiling point. (4%) (b) Draw the skeletal structure of the constitutional isomer with no secondary carbon atoms. (4%)

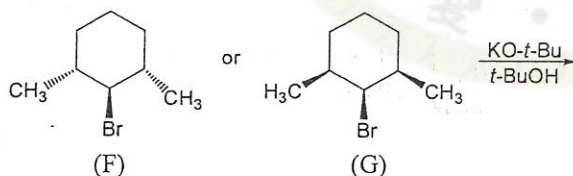
2. From the structures A-E below, identify:



- (a) The compounds that are soluble in pure water. (2%)  
 (b) The compounds that are not soluble in pure water, but are soluble in aqueous HCl. (2%)  
 (c) The compounds that are not soluble in pure water, but are soluble in aqueous NaOH. (2%)  
 (d) The compounds that are not soluble in water under any conditions. (2%)
3. Is the following reaction endothermic, exothermic or neither? Explain. (4%)



4. One of the two stereoisomers of 2-bromo-1,3-dimethylcyclohexane (F and G) shown below readily undergoes elimination upon treatment with potassium *tert*-butoxide. (a) Which stereoisomer reacts readily? Explain. (4%) (b) Write the products of the elimination reaction. (4%)



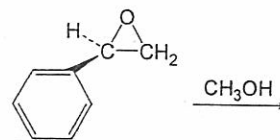
5. The chiral epoxide adds methanol to form 2-methoxy-1-phenylethanol or 2-methoxy-2-phenylethanol, depending on the conditions used.

- (a) In acidic conditions, catalytic  $H_2SO_4$  in  $CH_3OH$ , (i) which one is formed?

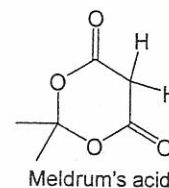
Draw the structure. (ii) Is the stereochemistry retained or inverted? (4%)

- (b) In basic conditions,  $NaOCH_3$  in  $CH_3OH$ , (i) which one is formed? Draw

the structure. (ii) Is the stereochemistry retained or inverted? (4%)

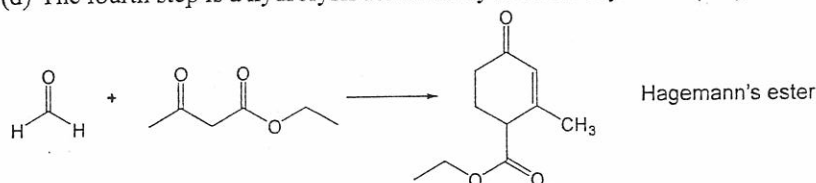


6. Meldrum's acid was discovered in 1908 and was thought to contain a carboxylic acid group. The true structure was later determined to be that shown right. Draw the three most important resonance structures of the conjugate base of Meldrum's acid. Make sure to show all charges and lone pairs of electrons. (6%)

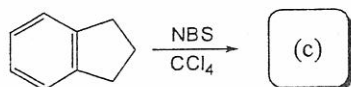
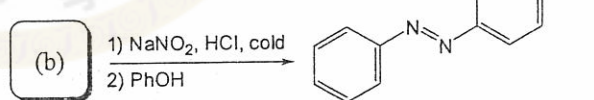
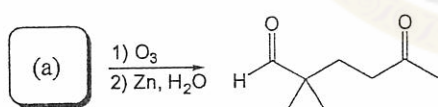


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7. A compound known as Hagemann's ester can be prepared by treating a mixture of formaldehyde and ethyl acetoacetate first with base and then with acid and heat. Write the structure for the product of each step.
- The first step is an aldol-like condensation. (4%)
  - The second step is a Michael addition. (4%)
  - The third step is an intramolecular aldol condensation. (4%)
  - The fourth step is a hydrolysis followed by a decarboxylation. (4%)



8. Compound X and Y are isomers with formula  $C_6H_8$ . Both react with  $H_2$  in the presence of Pt to give compound Z, formula  $C_6H_{12}$ . Z shows a single peak in its  $^{13}C$  NMR spectrum. X has no absorption maximum above 200 nm in its UV-vis spectrum, while Y has  $\lambda_{max} = 259$  nm. What are the structures of X, Y, and Z? Briefly explain. (6%)
9. Identify the unknown compound based on the data given below. (8%)
- Molecular formula:  $C_{10}H_{14}$ .
  - $^{13}C$  NMR shows 7 absorptions, 4 in the 110-175 ppm region, and 3 in the 0-50 ppm region.
  - IR shows C-H stretching just above and just below  $3000\text{ cm}^{-1}$ .
  - $^1H$  NMR spectrum: 1.5 ppm (3H, triplet), 2.4 ppm (6H, singlet), 2.6 ppm (2H, quartet), 7.5 ppm (1H, singlet), 7.8 ppm (2H, singlet)
10. Complete each of the following reactions by adding the missing part: either the starting compounds or the expected major product. (4% each)



NBS: N-bromosuccinimide

