Benha University
Faculty of Science
Chemistry
Department.

Chemistry of Paints and Coatings
526 Chem.
Time: 2 hrs.

26 May, 2016

الإجابة النموذجية لامتحان كيمياء و تكنولوجيا البويات

526 ك

(نصف ورقة امتحانية)

الفرقة : دبلومة البترول و البتروكيماويات

التاريخ : الخميس 2016/5/26

الممتحن : د/ محمد عبد الرحمن موسى ابو ريا

قسم : الكيمياء

كلية : العلوم

1 – a) How can you prepare each of the following resins: *(10Marks)*

i- Chlorinated rubber.

To manufacture chlorinated rubber (CR) natural or synthetic rubber such as polyethylene, polypropylene or polyisoprene is degraded to low molecular mass compounds by mastication or addition of radical formers and dissolved in carbon tetrachloride (CTC). Chlorine contents are typically 64-68 wt %. Chlorine gas is introduced into this solution and reacts with the raw material to form CR. The solution is then introduced into boiling water. The CR is precipitated, and the solvent vaporizes. The CR is separated from water, rinsed, dried and ground to form a white powder which is the saleable product. After removal of the water, chlorine, hydrochloric acid and other impurities the solvent is reused.

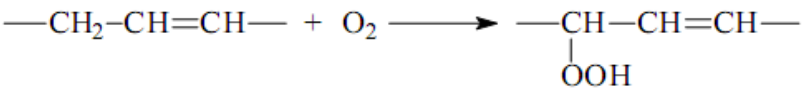
ii- Alkyd resins.

The manufacture of the alkyds proceeds in two stages. Pentaerythritol and vegetable oil are first heated with the catalyst for about two hours at 270^{o}C. The vegetable oil is an ester of glycerol and long chain unsaturated fatty acids, and the reaction is a trans-esterification, the fatty acids forming an ester with the polyhydroxy-alcohol pentaerythritol. Di- and tri- esters of PE and di- and monoglycerides are also presumably formed. After cooling the mixture to 150^{o}C, a slight excess of phthalic anhydride is added and the mixture is reheated to 240^{o}C where it is held for several hours while the polyester alkyd resin is formed

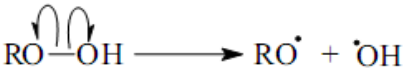
b) Illustrate the drying mechanism of Oil-Based Coatings. *(10Marks)*

The drying process is a complex one of polymerisation, probably catalyzed by peroxides. The theory is that drying progresses as follows:

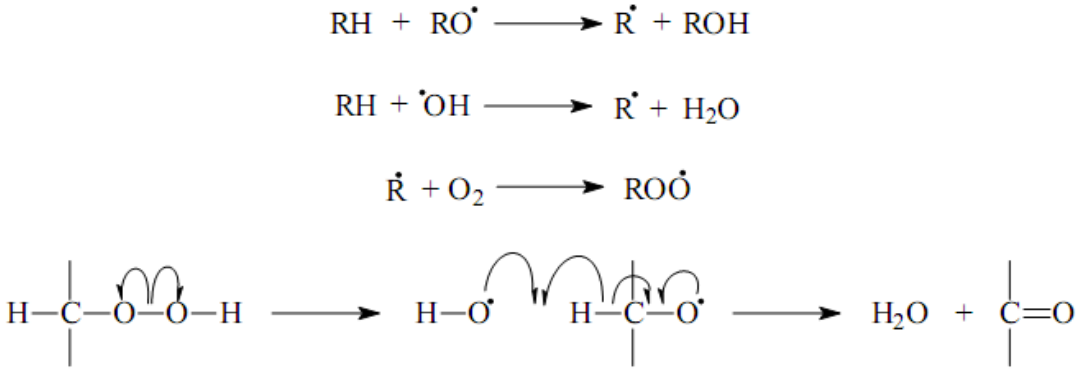
1. double bonds are oxidised by atmospheric oxygen to give hydroperoxy groups:



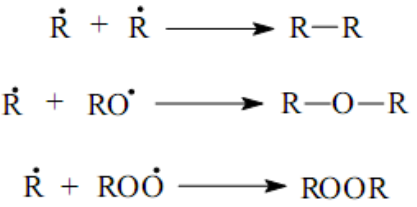
2. these peroxides then decompose to give radicals:



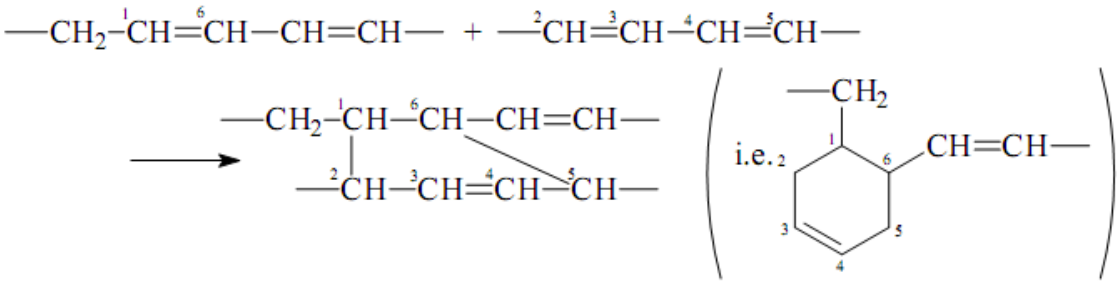
3. the radicals then initiate various polymerisation reactions:



4. before recombining:



Other reactions also occur, including the Diels-Alder reaction:



2–a) How can you convert alkyd resins into waterborne alkyd resins. (5Marks)

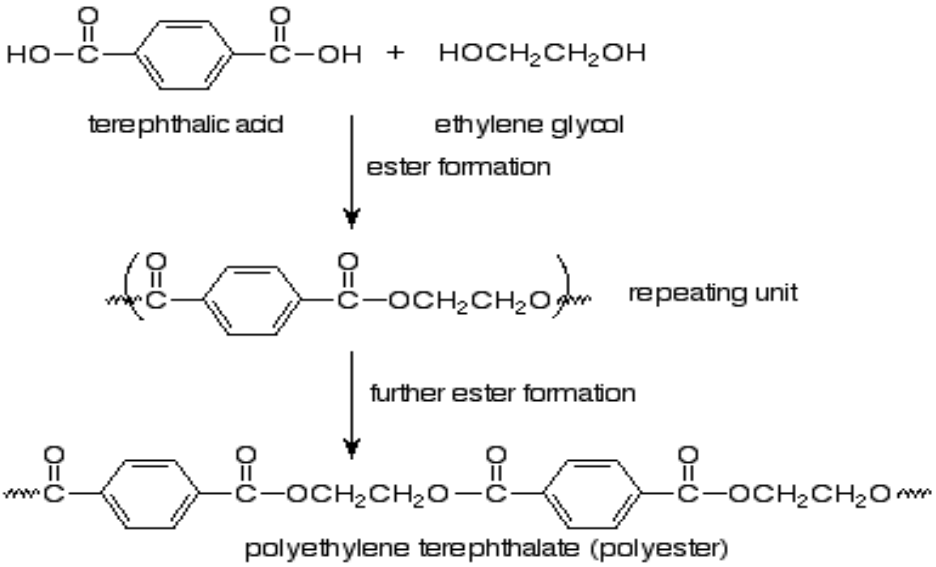
1) Alkyd Resins with High-Solids content. Alkyd resins have been developed for producing high-solids paints to reduce solvent emission.

2) Alkyd resins are emulsified in water after addition of emulsifying agents and stabilizers or after chemical modification with special monomers e.g. polyglycols

3) Alkyd resins with high acid numbers (> 50) are neutralized with amines; solubility in water is due to salt formation.

b) Illustrate by chemical equation how can you prepare a Saturated Polyester Coatings.

(5 Marks)



c) What is the importance of using pigments in paint industry, and what is the general properties it should have. *(10 Marks)*

. Pigments are used in paint formulation to carry out one or more of the following tasks:

1. Provide color
2. Hide substrates and obliterate previous colors
3. Improve the strength of the paint film
4. Improve the adhesion of the paint film
5. Reduce gloss
6. Reduce cost

Pigments not only give the paint its colour and finish, but also serve to protect the surface underneath from corrosion and weathering as well as helping to hold the paint together.

Pigments should be insoluble in the medium, in which they are used, chemically inert, free of soluble salts, and unaffected by normal temperatures.

They should be easily wetted for proper dispersion, nontoxic, noncorrosive, and have low oil-absorption characteristics. In general the following properties of pigments are important in selecting

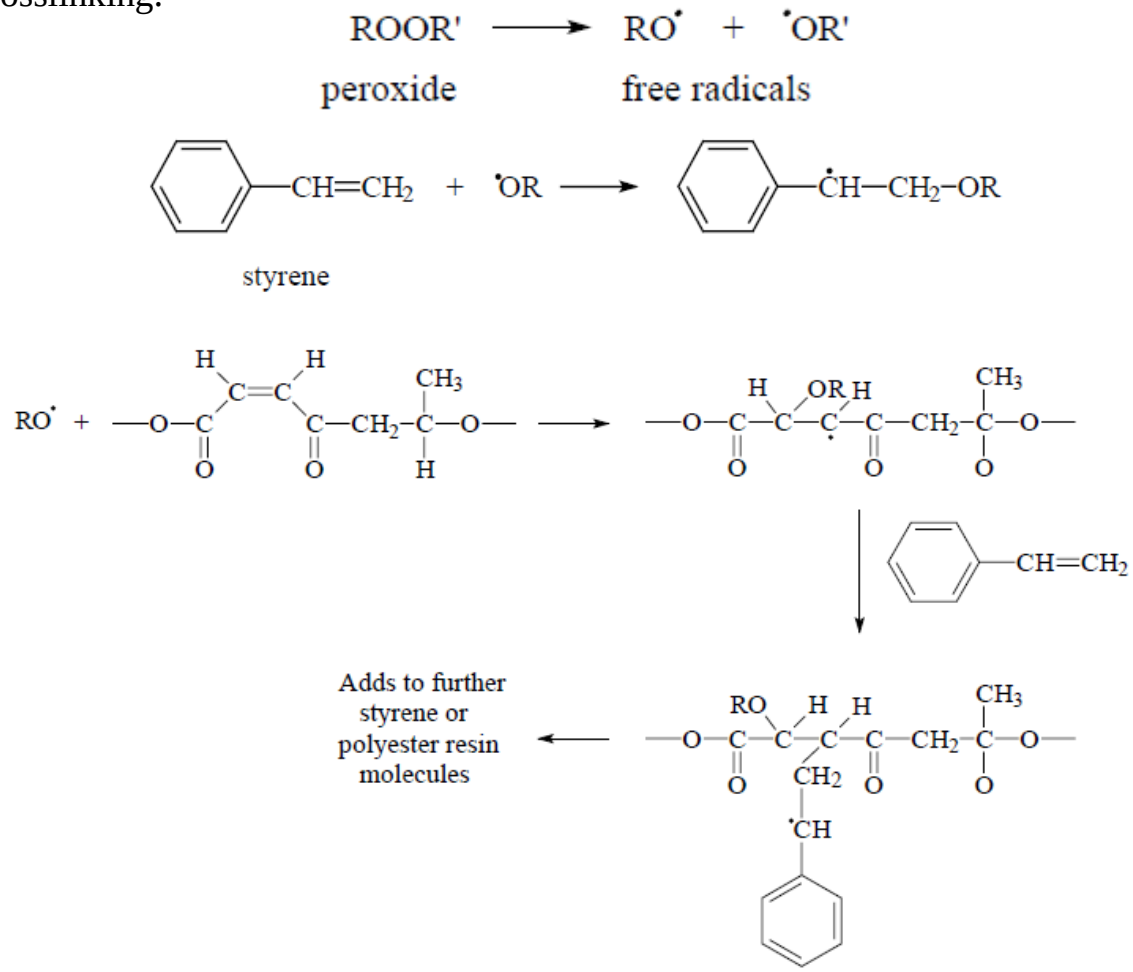
a pigment for any particular product:

1. Hiding power
2. Tinting strength
3. Refractive index
4. Light-fastness
5. Bleeding characteristics
6. Particle size and shape

3–a) Discuss the drying mechanism of unsaturated polyesters. *(10 Marks)*

In all of these applications the polyester-styrene mixture is poured into a mould and a free radical initiator such as MEKP (methyl ethyl ketone peroxide) or benzoyl peroxide added to initiate

crosslinking.



Thus polyester chains are linked together by polystyrene bridges. Polyesters can be easily moulded (by simply pouring the solution into a mould) and the resulting end product is resistant to attack and long-lasting.