

Question 38**(18 marks)**

Polymethyl methacrylate and polycarbonate are two polymers that are used as alternatives to glass. Polymethyl methacrylate is more commonly known as Perspex or plexiglass and is an addition polymer, while polycarbonate is a type of condensation polymer.

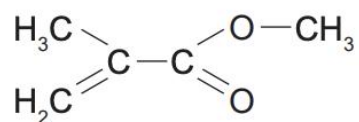
Both polymers are transparent to visible light and have other properties as listed below.

Polymethyl methacrylate	Polycarbonate
lightweight	moderate chemical resistance
moderate UV resistance	high heat resistance
low impact strength	high impact strength
low chemical resistance	low scratch resistance
low heat resistance	low UV resistance

- (a) For the following uses as an alternative to glass, identify which polymer would be the more appropriate. Justify your choice of polymer by comparing the effect of **two** relevant properties as listed for both polymers. (4 marks)

Use	Choice of polymer	Justification
Skylight		
Safety glasses		

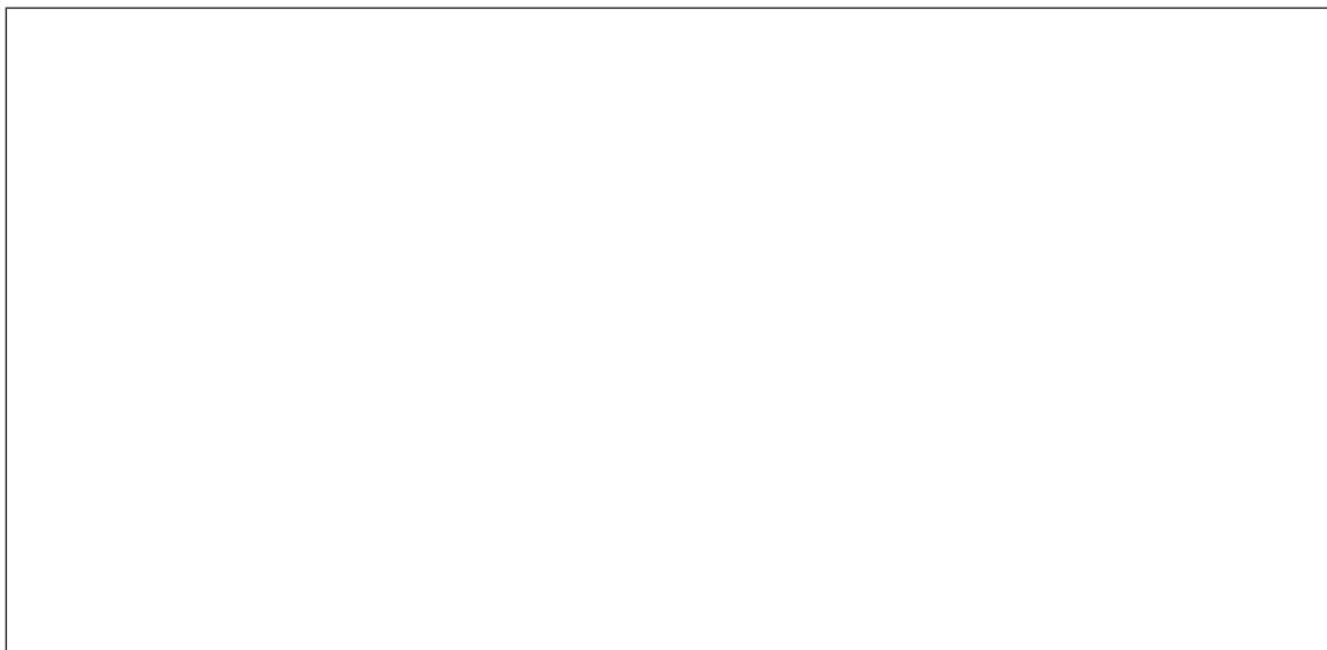
The monomer, methyl methacrylate, can be formed from the esterification of methanol and methacrylic acid (2-methylprop-2-enoic acid). The structural formula of methyl methacrylate is shown below.



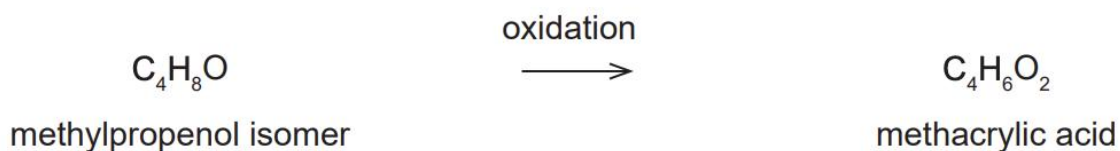
- (b) Write a balanced equation for the esterification of methanol and methacrylic acid. Show the full structural formula of each species in the equation. (4 marks)

Methyl methacrylate can undergo addition polymerisation to form polymethyl methacrylate.

- (c) Draw a section of a polymethyl methacrylate showing **all** atoms and at least **three** repeating units of the monomer. (3 marks)



One method for the production of methacrylic acid is by the following oxidation.



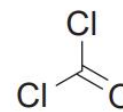
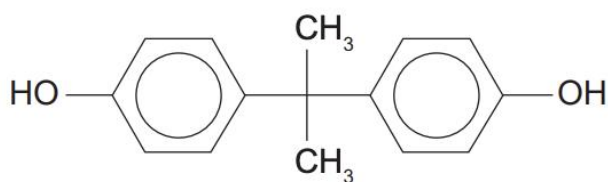
- (d) Suggest an assumption that **must** be made regarding the mole ratios of product to reactant for this reaction and then determine the mass of the methylpropenol isomer required to produce 1.50 tonne of methacrylic acid if the efficiency of this oxidation is 65%. (Note: 1 tonne = 1000 kg.) (5 marks)

Assumption: _____

Calculation: _____

Polycarbonates are condensation-type polymers for which the by-product is hydrogen chloride instead of water.

The two monomers for polycarbonate are shown below.



- (e) Why is polymethyl methacrylate classified as an addition polymer, while polycarbonate is classified as a condensation polymer? (2 marks)
