

- 6 Some cars in Brazil use ethanol,  $\text{C}_2\text{H}_5\text{OH}$ , as a fuel instead of petrol.

The ethanol is made by the fermentation of glucose which is obtained from sugar cane.

The sugar is extracted from the sugar cane and then dissolved in water to make a sugar solution.

- (a) (i) Name the substance that is added to the sugar solution that causes glucose to ferment. (1)

- (ii) Which temperature is the most suitable for fermentation? (1)

- ☐ A  $0^\circ\text{C}$   
☐ B  $10^\circ\text{C}$   
☐ C  $30^\circ\text{C}$   
☐ D  $80^\circ\text{C}$

- (iii) Explain why fermentation is done in the absence of air. (2)

- (b) (i) State what is meant by the term **fuel**. (1)

- (ii) Write a chemical equation for the complete combustion of ethanol in air. (2)

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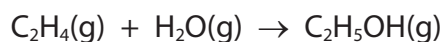
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(c) Ethanol is also manufactured by reacting steam with ethene, C<sub>2</sub>H<sub>4</sub>

The equation for this reaction is



State the conditions of temperature and pressure used in this process.

(2)

temperature .....

pressure .....

(d) When ethanol is heated with acidified potassium dichromate(VI), it is oxidised to ethanoic acid.

(i) State the colour change that occurs in the potassium dichromate(VI) during this reaction.

(1)

from ..... to .....

(ii) The structural formula of ethanoic acid is CH<sub>3</sub>COOH

Draw the displayed formula of ethanoic acid.

(2)

(iii) Complete the equation for the reaction of ethanoic acid with sodium.

(2)



(Total for Question 6 = 14 marks)

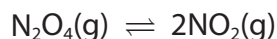


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7 Dinitrogen tetraoxide,  $\text{N}_2\text{O}_4$ , is a colourless gas.

Nitrogen dioxide,  $\text{NO}_2$ , is a brown gas.

The two gases can exist together in dynamic equilibrium according to the equation



(a) Explain what is meant by the term **dynamic equilibrium**.

(2)

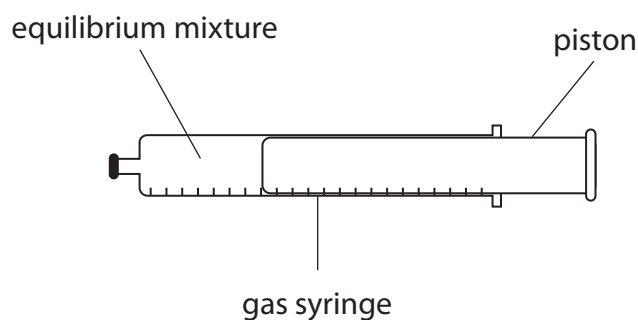
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(b) Some  $\text{N}_2\text{O}_4$  and some  $\text{NO}_2$  are put into a sealed gas syringe and allowed to form an equilibrium mixture.



This equilibrium mixture is brown.

(i) The pressure of the gas in the syringe is increased by pushing in the piston. The mixture is then allowed to reach a new equilibrium at the same temperature as before.

Explain why the new equilibrium mixture contains less  $\text{NO}_2$  than the original equilibrium mixture.

(2)

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- (ii) A student suggests that the new equilibrium mixture would be lighter in colour than the original equilibrium mixture, as there is now less  $\text{NO}_2$  present.

Suggest why the new equilibrium mixture is actually darker than the original.

(1)

- (c) Carbon monoxide,  $\text{CO}$ , and oxides of nitrogen are produced in a car engine when petrol is burned.

These oxides can be partly removed by using a catalytic converter fitted to the car's exhaust system.

- (i) State how oxides of nitrogen are produced in the car engine.

(1)

- (ii) Give a disadvantage of allowing oxides of nitrogen to escape into the atmosphere.

(1)

- (iii) Write a chemical equation for the reaction between nitrogen monoxide,  $\text{NO}$ , and carbon monoxide to form carbon dioxide and nitrogen.

(1)

**(Total for Question 7 = 8 marks)**



P 5 8 5 6 3 A 0 1 7 2 0