2.3.2 RATES AND EQUILIBRIUM TEST MS

1. (a) $MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + CO_2(g) + H_2O(l)$

balancing ✓
state symbols ✓ 2

(b) (as the reaction proceeds) the concentration decreases ✓
(rate) of collision decreases ✓
reaction stops when all of one reagent is used up ✓ 3

[5]

2. (i) curve displaced to the right **(1)**
maximum is lower **(1)** 2

(ii) area under curve exceeding E_a = number of molecules that can react **(1)**
at higher temperature, area under curve > E_a is greater so more can react **(1)** 2

[4]

3. catalyst alters rate of reaction/ lowers Ea (1)

remains unchanged **after** the reaction/ is not changed at the **end** of the reaction
BUT negated by does not take part in reaction (1)

[2]

4. (adding a catalyst):

- speeds up a reaction
- provides an alternative route *or* forms an intermediate of some sort
- of lower E_{act} (can be read into a label on a Boltzmann distribution)
- so more molecules have $E > E_{act}$ *or* more collisions are successful
- weakens bonds in the reactants

[any 4 points.] ✓✓✓✓

[5]

5. Any two of the following bullet points ✓✓

- forward rate = reverse rate [NOT just "forward reaction = reverse reaction"]
- can be approached from either direction
  [*"forward rate of reaction = reverse rate of reaction"* is worth both the above bullet points]
- no change in overall macroscopic properties or a specific one (e.g. colour)
- takes place in a closed system
  [N.B. every wrong point negates a correct one]

[2]

6. (a) when the conditions on a system in equilibrium are changed **(1)**
the equilibrium moves to minimise the effects of the change/
counteract/ resist/ oppose the change **(1)** 2

(b) (i) equilibrium moves towards LHS/ towards NO_2 **(1)**
forward reaction is exothermic/ reverse reaction is endothermic **(1)** 2

(ii) equilibrium moves towards RHS/ towards N_2O_4 **(1)**
fewer moles on RHS **(1)** 2

(iii) no change in equilibrium position **(1)**
catalyst speeds up forward ad reverse reactions by same amount **(1)** 2

[8]

7. (i) no effect because it only increases rate of reaction (1) 1

(ii) moves to LHS/ more N_2 and H_2/ less NH_3 (1)

forward reaction is exothermic (1) 2

(iii) moves to LHS / more N_2 and H_2/ less NH_3 (1)

fewer moles on RHS (1) 2

[5]

8. (i) more CO and H_2/ less CH_3OH/ moves to LHS ✓
reaction is exothermic/ ora ✓ 4
(moves in endothermic direction scores 1)

less CO and H_2/ more CH_3OH/ moves to RHS ✓
more mole/molecules/particles on LHS/ ora ✓

(ii) more particles per unit volume/
increased concentration/ particles closer together ✓
more collisions **and** increases rate✓ 2

(iii) none ✓

affects forward and reverse reaction the **same** ✓ 2

[8]

9. (a) pressure 50 – 1000 atm ✓
temperature 200 – 600°C ✓ 2

(b) **rate** 9
(increased) pressure increases rate because molecules are closer together/ more concentrated ✓
(increased) temperature increases rate because molecules are moving faster/ have more energy ✓

equilibrium
increased pressure pushes equilibrium to RHS ✓ because fewer (gas) moles/ molecules on RHS ✓

increased temperature pushes equilibrium to LHS ✓
because (forward) reaction is exothermic ✓

compromise
if temperature is **too** high, low yield ✓
if temperature is **too** low, slow rate ✓

if pressure is too high, increased costs/ safety issues ✓

[11]