Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

(a) mol R = $2x$

1

(b) $3.6 = \frac{(2x)^2}{(1-x)^2}$

M1 can be awarded for the insertion of their answer from (a) correctly

1

$\sqrt{3.6} = \frac{2x}{1-x}$ (only positive root to be used)

M2 can be awarded if their expression is expanded

1

$\sqrt{3.6} - \sqrt{3.6}\,x = 2x$
$1.9 = 3.9x$
$X = 0.49$
[R] = 0.97 mol dm^{-3} (allow range 0.97–.098)

M3 solve for x from their expression in M1 and use it to calculate [R]

1

[4]

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Q2.

(a) This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.

Level 3 (5 – 6 marks)
All stages are covered and the explanation of each stage is generally correct and virtually complete. To access Level 3, statement 3a must be considered.
Answer is communicated coherently and shows a logical progression from stage 1 (including 1b) to stage 2 and stage 3

Level 2 (3 – 4 marks)
All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete.
Answer is mainly coherent and shows progression from stage 1 to stage 2 and/or stage 3.

Level 1 (1 – 2 marks)
Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete.
Answer includes isolated statements but these are presented in a logical order, with sensible reasoning.

Level 0 (0 marks)
Insufficient correct chemistry to gain a mark.

Indicative chemistry content

Stage 1 – Deductions from graph
1a Yield increases as temperature increases (or converse)
1b After a certain temperature yield no longer increases
1c Yield decreases as pressure increases (or converse)

Stage 2 – Optimum temperature and explanation
2a High temperature results in high energy costs/expensive
2b (After a certain temperature) yield no longer increases therefore there is no gain in using a higher temperature
2c Optimum temperature is between 780-880oC

Stage 3 – Optimum pressure and explanation
3a Low pressure may be too slow
3b So compromise pressure required
3c Optimum pressure is 1000-2000kPa or moderate pressure used

6

(b) Moles of carbon monoxide 17.9

Allow 17.94

1

Moles of hydrogen 19.9

Allow 19.88

1

(c) $$K_p = \frac{pp(CH_3OH)}{pp(CO) \times pp(H_2)2}$$

ignore brackets

If K_p expression incorrect can only score M2 & M3 & M4

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1

Total moles of gas = (2.76 + 4.51 + 0.36) = 7.63

If CE in M2 allow ecf for M3, M4 and M6

If no total moles calculated then can only score M1 and M6

1

$pp(CO) = \frac{2.76}{7.63} \times 630$ (kPa) (= 228 (kPa))

$pp(H_2) = \frac{4.51}{7.63} \times 630$ (kPa) (= 372 (kPa))

$pp(CH_3OH) = \frac{0.36}{7.63} \times 630$ (kPa) (= 29.7 (kPa))

All 3 pp of CO, H_2 and CH_3OH = 2 marks

2 pp correct = 1 mark

2

$Kp = \frac{29.7}{228 \times (372)2} = 9.4(1) \times 10^{-7}$ or $9.4(1) \times 10^{-13}$ if *pp* in Pa

can also score M1 from this expression

Allow 9.39 to 9.50 × 10^{-7} (kPa^{-2})

1

kPa^{-2} or **Pa^{-2}** (if converted to 630 000)

*If no marks awarded allow M6 only for **kPa^{-2}** or **Pa^{-2}***

1

[14]

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