

Quantitative Rate Work (e.g., Rate from Graphs)

Q1. (2018) – 9a (ii)

Question Number	Answer	Additional guidance	Mark
9(a)(ii)	final answer in range 0.44 – 0.52 inclusive with or without working (2) If answer not in range: $\text{difference in volume} = \frac{(43 - 15)}{(60 - 0)}$ (1) $= 0.47 \text{ / } 0.467$ (1)	allow ecf throughout where values are less than 1 (1 max) use of inverted gradient expression giving 2.27 – 1.92 scores 1 mark (evidence of working required)	(2) AO 2 1

Q2. (2024) – 2b (ii)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	answer in range 6.197 – 6.5 with or without working scores 3 Δy (gas volume) = 70 – (any no. in range 24-26) = 44-46 (1) Δx (time) = 7.1 – 0 = 7.1 (1) $\frac{\Delta y}{\Delta x} = 6.197 - 6.479$ (1)	allow 7-7.2 with or without working allow in these ranges: 6.197-6.5 scores 3 6.10-6.196 or 6.51-6.60 scores 2 6.0-6.099 or 6.61-6.70 scores 1 12.50 – 13.20 scores 2 13.21-13.75 scores 1 if answer is rounded, mark pre-rounded answer and ignore rounding if final answer not given or outside 6.0-6.70, or 12.50-13.75, then max 2 for MP1 and/ or MP2	(3) AO3 2

Energy-change

Q1. (2018)

Question Number	Answer	Additional guidance	Mark
10(a)	award full marks for correct numerical answer without working energy needed to break bonds $= (2 \times 435) + (1 \times 500)$ $= 1370 \text{ (kJ mol}^{-1}\text{)} \text{ (1)}$ energy released when bonds are formed $= 4 \times 460$ $= 1840 \text{ (1)}$ energy change $= 1370 - 1840$ $= (-) 470 \text{ (kJ mol}^{-1}\text{)} \text{ (1)}$ negative sign or 'energy released' (1)	allow $1840 - 1370 = 470 \text{ (1)}$ ignore sign allow exothermic (reaction) final answer 450 award 2 marks -450 award 2 marks final answer +450 award 3 marks	(4) AO 2 1

Q2. (2020) – 9b

Question number	Answer	Additional guidance	Mark
9(b)	-730 as final answer with or without working scores 4 +730 as final answer with or without working scores 3 bonds broken $= (4 \times 435) + (2 \times 496) = 2732 \text{ (1)}$ bonds made $= (2 \times 805) + (4 \times 463) = 3462 \text{ (1)}$ energy change = broken – made (1) [2732 – 3462] $= -730 \text{ (kJ mol}^{-1}\text{)} \text{ (1)}$	allow ECF	(4)

Q3. (2021) – 9c

Question number	Answer	Additional guidance	Mark
9(c)	bonds broken $= \text{C}=\text{C} + \text{O}-\text{H}$ $= 612 + 464 \text{ (1)}$ $(= 1076 \text{ (kJ mol}^{-1}\text{)})$ bonds formed $= \text{C}-\text{C} + \text{C}-\text{O} + \text{C}-\text{H}$ $= 347 + 358 + 413 \text{ (1)}$ $(= 1118 \text{ (kJ mol}^{-1}\text{)})$ energy change of reaction $= 1076 - 1118 \text{ (1)}$ $= - (1) \text{ (42 (kJ mol}^{-1}\text{))}$	answer of - 42 (kJ mol⁻¹) scores 4 marks answer of (+) 42 (kJ mol⁻¹) scores 3 marks bonds broken $= \text{C}=\text{C} + \text{C}-\text{C} + 6 \text{ C}-\text{H} + 2 \text{ O}-\text{H}$ $= 612 + 347 + 6 \times 413 + 2 \times 464 \text{ (1)}$ $(= 4365 \text{ (kJ mol}^{-1}\text{)})$ bonds formed $= 2 \text{ C}-\text{C} + 7 \text{ C}-\text{H} + \text{C}-\text{O} + \text{O}-\text{H}$ $= 2 \times 347 + 7 \times 413 + 358 + 464 \text{ (1)}$ $(= 4407 \text{ (kJ mol}^{-1}\text{)})$ Energy change $= 4365 - 4407 \text{ (1)} = - (1) \text{ (42 (kJ mol}^{-1}\text{))}$	(4) AO2

Q4. (2022) – 9a (ii)

Question number	Answer	Additional guidance	Mark
9(a)(ii)	- energy change in reactants $= 436 + 158 (= 594) \text{ (1)}$ - energy change in products $= 2 \times 562 (= 1124) \text{ (1)}$ - overall energy change $= 594 - 1124 \text{ (1)}$ $= -530 \text{ (1) (kJ mol}^{-1}\text{)}$	allow ECF throughout ignore sign/unit in MP1 ignore sign/unit in MP2 MP3 for the difference between MP1 and MP2 ignore sign / unit in MP3 MP4 for correct sign or stating exothermic / endothermic based on MP3 (+)530 scores 3 marks (loses MP4) (+)64 scores 3 marks (MP1 doubled) -64 scores 2 marks (MP1 doubled and loses MP4) (+)32 scores 3 marks (MP2 not doubled) -32 scores 2 marks (MP2 not doubled and loses MP4)	(4) AO2 1

Q5. (2023) – 8b (iii)

Question number	Answer	Additional guidance	Mark
8 (b)(iii)	-76 with or without working scores 4 BROKEN $944 + (3 \times 436) = 2252$ (1) MADE $2 \times (3 \times 388) = 2328$ (1) DIFFERENCE (broken) 2252 – (made) 2328 (1) ANSWER = - 76 (1)	allow ecf ignore sign ignore sign MP3 for difference between their 2 values MP4 for correct evaluation, including correct sign, of <u>bonds broken – bonds made</u> using their values (+)76 scores 3 (+)1088 scores 3 (+)604 scores 3 (+)1476 scores 3 -1088 scores 2 -604 scores 2	(4) AO2-1

Q6. (2024) – 7d

Question number	Answer		Mark
7(d)	-55 with or without working scores 4 BROKEN: $612 + 4(412) + 431 = 2691$ (1) MADE: $412 + 348 + 338 + 4(412) = 2746$ (1) DIFFERENCE: $2691 - 2746$ (1) ANSWER: = - 55 (1)	allow positive or negative allow positive or negative allow ecf for +broken -made allow ecf for addition or subtraction of 2 <u>calculated</u> values (working required) using bond energies	(4) AO2 1
	OR BROKEN: $612 + 431 = 1043$ (1) MADE: $412 + 348 + 338 = 1098$ (1) DIFFERENCE: $1043 - 1098$ (1) ANSWER: = - 55 (1)	allow positive or negative allow positive or negative allow ecf for +broken -made allow ecf for addition or subtraction of 2 <u>calculated</u> values (working must be seen) using bond energies with or without working, final answers of: -55 scores 4 (+) 55 scores 3 (+)293 scores 3 (+)705 scores 3 -486 scores 3 (+)486 scores 2	