CHEM105L Name ____KEY______________

Uncertainty Analysis Practice - answers

Show work in this column	Calculated value	Absolute uncertainty	Relative uncertainty (show as %)
$q_{tot} = -(q_{cal} + q_{surr})$ $= -(4.345 + 3.45) = -7.795$ kJ but we're adding and 3.45 only has precision to 100ths place, so we round to 100ths place q_{cal} = 4.345 ± 0.003 kJ q_{surr} = 3.45 ± 0.05 kJ For a sum, AU = ΣAUs = 0.003 + 0.05 = 0.053 kJ but we round to 1 sf, so AU = 0.05 kJ. For a sum, we have to calculate RU from the calculated AU (before we rounded), so RU = AU/|q_{tot}| = (0.053 kJ)/(7.795 kJ) = 0.0068, so, rounded to 1 sf, RU = 0.7%	q_{tot} = -7.80 kJ q_{tot} and AU have the same precision, so we don't need to worry about rounding to make them agree.	0.05 kJ	0.7%
E = mad = (1.0)(170.0)(10.00)J = 1700.00J but we're multiplying and m only has 2 sig figs, so we round to 2 sig figs m = 1.0 ± 0.5 kg a = 170.0 ± 0.1 m/s^2 d = 10.00 ± 0.01 m For a product, RU = ΣRUs = (.5)/(1.0) + (.1)/(170) + (.01)/(10) = 0.502 but we round all uncertainties to 1 sf, so RU = 0.5 = 50%. Note that this is basically coming entirely from m, which has 50% uncertainty. For a product, we have to calculate AU from the calculated RU (before we rounded), so AU = RUx|E| = (0.502)(1700J) = 853, so, rounded to 1 sf, AU = 9 x 10^2 J	E = 1.7x10^2 J Again, E and AU have the same precision, so we don't need to worry about rounding to make them agree.	9 x 10^2 J	50%
C = f^2 = 5^2 = 25 but we're multiplying and f only has 1 sig fig, so we round to 1 sig fig. C = 2x10 (an exact 5 rounds to the nearest even number) f = 5 ± 1 For a product, RU = ΣRUs = 1/5 + 1/5 = 2/5 = 0.4 to 1 sf, so RU = 40%. Notice that f^2 has twice the uncertainty of f. For a product, we have to calculate AU from the calculated RU (use un-rounded numbers), so AU = RUx|f| = (0.4)(25) = 10 1 sf, AU = 1 x 10	C =2x10 Again, E and AU have the same precision, so we don't need to worry about rounding to make them agree.	1x10	40%
X = H + I - J= 14.5 + 76.5 – 4.0 = 87.0 and since we're adding and subtracting, and all numbers are precise to the tenths place, we round to the tenths place H = 14.5 ± 0.6 I = 76.5 ± 0.4 J = 4.0 ± 0.3 For adding or subtracting, AU = ΣAUs = 0.6 + 0.4 + 0.3 = 1.3 but we round to 1 sf, so AU = 1. For addition/subtraction, we have to calculate RU from the calculated AU (un-rounded), so RU = AU/|X| = (1.3)/(87.0) = 0.0149, so, rounded to 1 sf, RU = 0.01 = 1%. Don't round too early! If you had rounded 0.0149 to 0.015, you would have then rounded to 0.02.	X =87 In this case, the precision of X and AU differed, so we had to round both to match the least precise, which was AU, which was precise to the 1s place.	1	1%

CHEM105L Name ____KEY______________