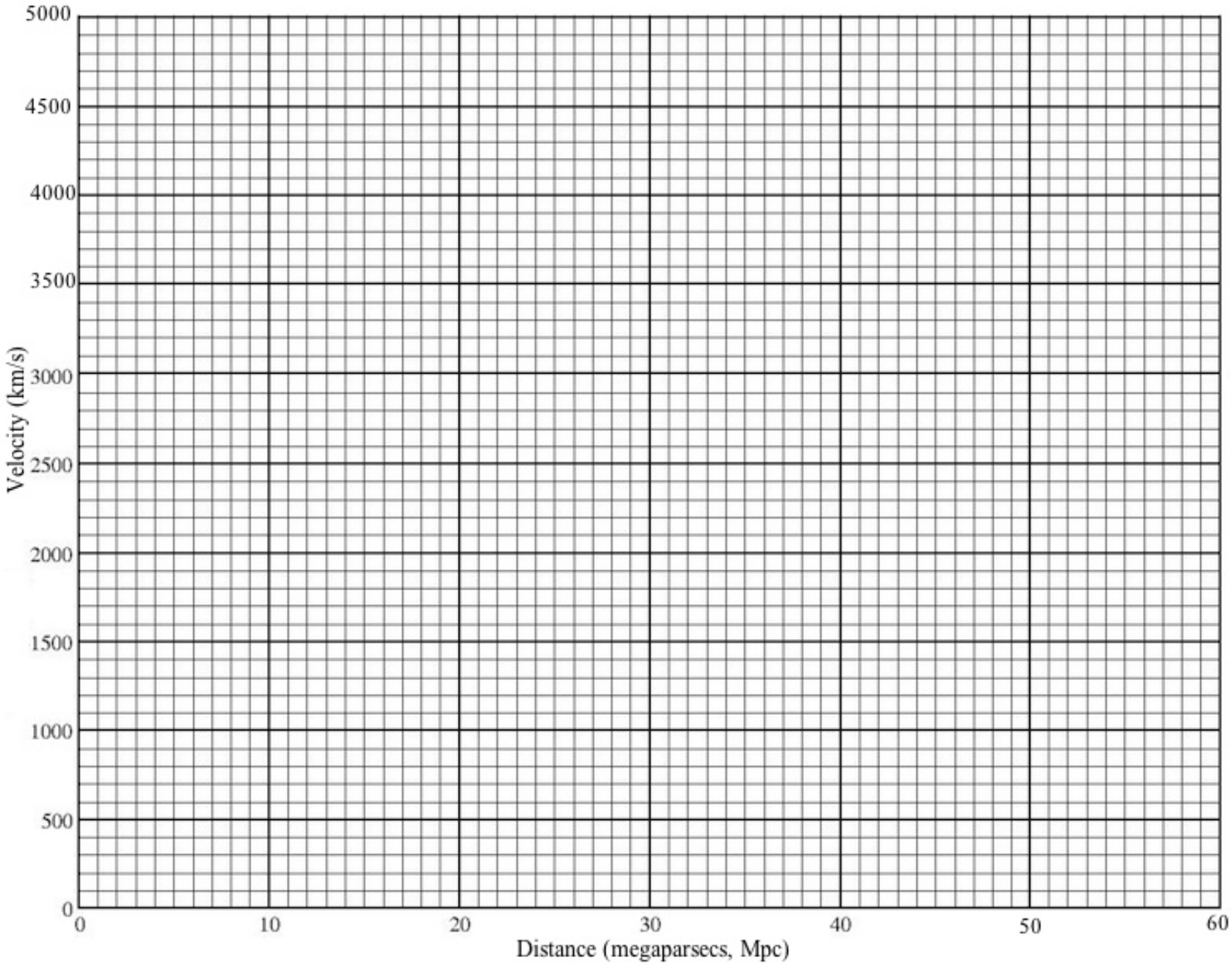
Astronomy 101 A

Hubble's Law: Work sheet for recording values and calculations if a spreadsheet is not used.

Galaxy ID (NGC number)	**Angular Size (milli-radians)**	Distance (Mpc)	**Redshifted Wavelength values**							
			Calcium (CaII) K (rest λ=3933.7 Å)		**Calcium (CaII) H (rest λ=3968.5 Å)**		**Hydrogen (Hα) (rest λ=6562.8 Å)**		**Average redshift**	**Velocity (km/sec)**
		(22 kpc true size)	Measured	Redshift (z)	Measured	Redshift (z)	Measured	Redshift (z)		
	Distance = true size / angular size		$z = \frac{(\lambda\text{measured} - \lambda\text{true})}{\lambda\text{true}}$		$z = \frac{(\lambda\text{measured} - \lambda\text{true})}{\lambda\text{true}}$		$z = \frac{(\lambda\text{measured} - \lambda\text{true})}{\lambda\text{true}}$		v = average $z \times c$	
Sample:	1.44	15	3946.7	0.0033	3982.3	0.0035	6585	0.0034	0.0034	1016
1357										
1832										
2276										
2775										
2903										
3034										
3147										
3227										
3245										
3310										

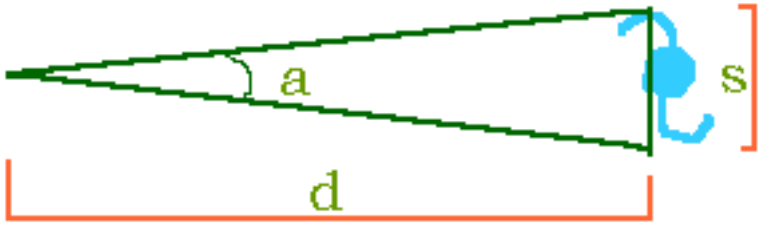
3368										
3471										
3516										
3623										
3627										
3941										
4472										
4631										
4775										
5248										
5548										
5866										
6181										
6217										
6643										
6764										
7469										


5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Velocity (km/s)
0
10
20
30
40
50
60
Distance (megaparsecs, Mpc)

Relevant formulae:

$$\text{redshift} = \left(\frac{\lambda_{measured} - \lambda_{true}}{\lambda_{true}} \right) = \frac{v}{c} = z$$

Small angle formula approximation: a = s/d or d = s/a
distance = actual size of the object ÷ angular size in radians
(watch units – distance will come out in the same units as the actual size)



Finding the steepest slope (rise over run) and shallowest slope (rise over run) allowed by your data in order to determine the uncertainty in your value of the Hubble constant:

$$\frac{\left(H_{steepest} - H\right) + \left(H - H_{shallowest}\right)}{2} = \text{uncertainty in } H$$