Exercise – plot a wind profile (Project Prairie Grass run 57)

Project Prairie Grass was a tracer dispersion experiment performed over ideal uniform terrain; gas was released continuously from a point 0.46 m above ground, and the resulting 10-min average concentration field was measured on arcs at radii *R* = (50, 100, 200, 400, 800) m downwind. The table gives the wind profile measured during run 57, for which the Obukhov length was effectively infinite (i.e. the surface layer was neutrally stratified**). Plot this wind profile on log-linear graph paper, and determine the friction velocity graphically from the slope (rise-over-run) of a fit to the data.

z [m]	U [m s^{-1}]
16	9.89
8	8.79
4	8.24
2	7.20
1	6.42
0.5	5.56
0.25	4.69

** in a neutral surface layer, the wind profile is $$\frac{U}{u_*} = \frac{1}{k_v} \ln \frac{z}{z_0}$$ (where k_v=0.4) , and

this implies that $$\frac{\Delta U}{\Delta \ln z} = \frac{u_*}{k_v}$$

eas372_plot windprfl.odp,
JDW, EAS U. Alberta,
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Exercise – calculations relating to the neutral wind profile

Suppose a neutrally stratified ABL is blowing over an open plain whose surface aerodynamic roughness length is z_0=0.05 m. The surface pressure and temperature are 980 hPa and 17°C. If measurements within the surface layer** give the values in the table then:

z [m]	U [m s^{-1}]
15	4.28
3	3.07

(1) what was the friction velocity u_* ?

(2) what was the drag τ on ground?

(3) what was the wind speed at standard reporting height (10 m)?

(4) what would be a plausible value for the standard deviation σ_w of vertical velocity?

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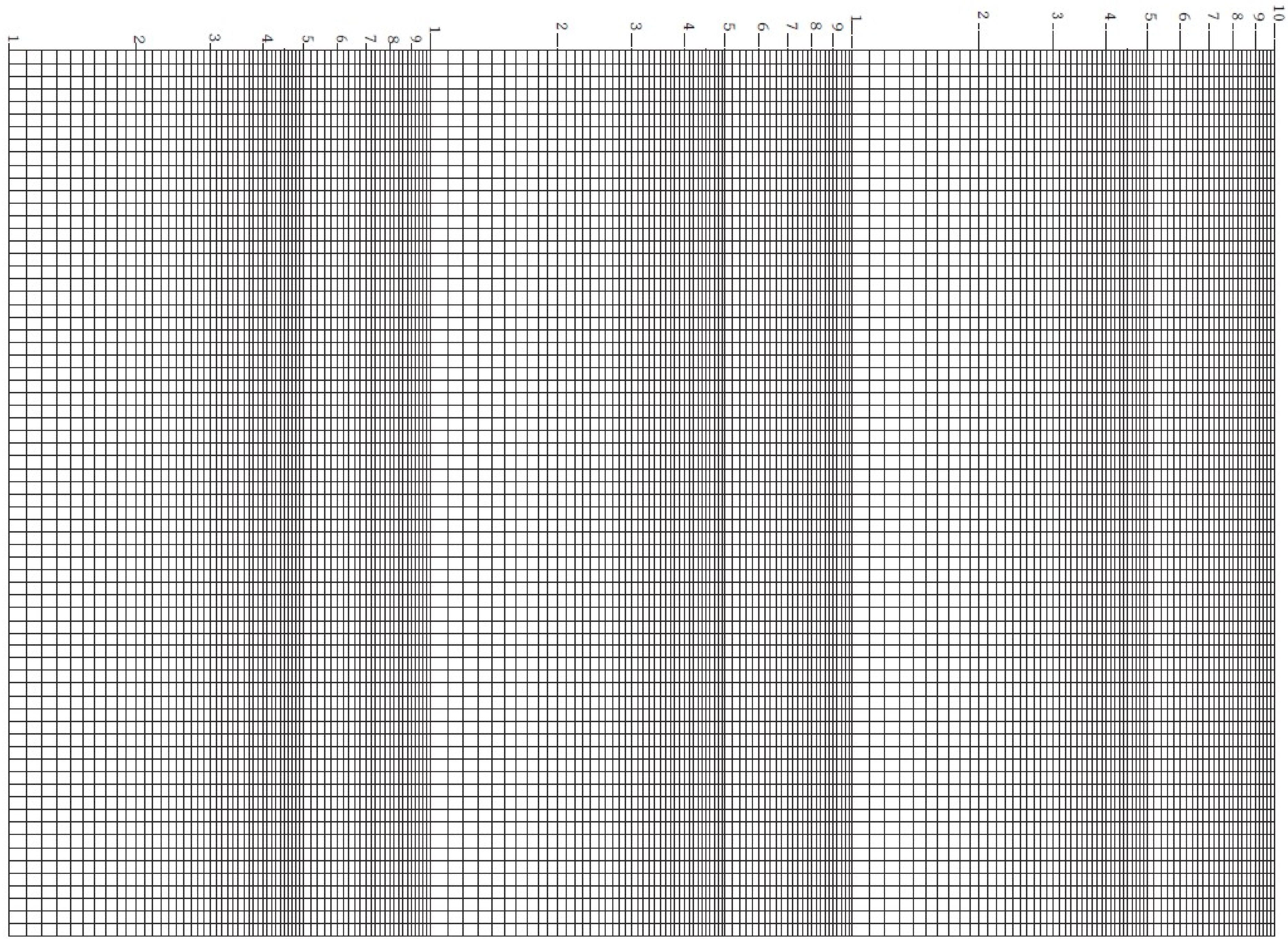
(Again, to determine u_* you *might* use log-linear graph paper; but it can also be done without plotting the data)


1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 10

0.01 or 0.1 or
1 or 10 or...

0.03 or 0.3 or
3 or 30 or...

0.1 or 1 or 10
or 100 or...

0.3 or 3 or 30
or 300 or...