HW2 001021120 Zehua Wang

$C = (S + N_A + N_p)A$

1. a) $Var(C) = A^2[Var(S) + Var(N_A) + Var(N_p)]$

$\because Var(S) = 0$
$Var(N_A) = 1$
$Var(N_p) = S$

$\therefore Var(C) = A^2 + A^2 S$

b) $mean(C) = AS$

$$S_{2n} = \frac{mean(C)}{\sigma_C} = \frac{AS}{A\sqrt{1+S}} = \frac{S\sqrt{1+S}}{1+S}$$

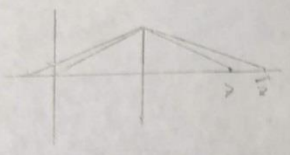
c) $S_{2n} \geq 100$

$$\frac{S}{\sqrt{1+S}} \geq 100$$

$S^2 - 10000S - 10000 \geq 0 \Rightarrow S \geq 10000.9999 \approx 10001$
or $S \leq -0.9999 \approx -1$ (ignore)

So $S_{min} = 10001$

2.



a) $z' = 6\,cm$ $f = 4\,cm$

$$\frac{1}{z'} + \frac{1}{-z} = \frac{1}{f}$$

$$\frac{1}{6} + \frac{1}{-z} = \frac{1}{4}$$

$z = -12\,cm$ "$-$" means direction $\therefore$ distance $= 12\,cm$

b)

$$\frac{z}{500} = 0.004 = \frac{b}{z}$$

$$\frac{\frac{b}{z}}{\frac{d}{z}} = \frac{0.004}{1} = \left|\frac{\bar{z}' - 6}{\bar{z}'}\right| \Rightarrow \bar{z}' = 6.024$$

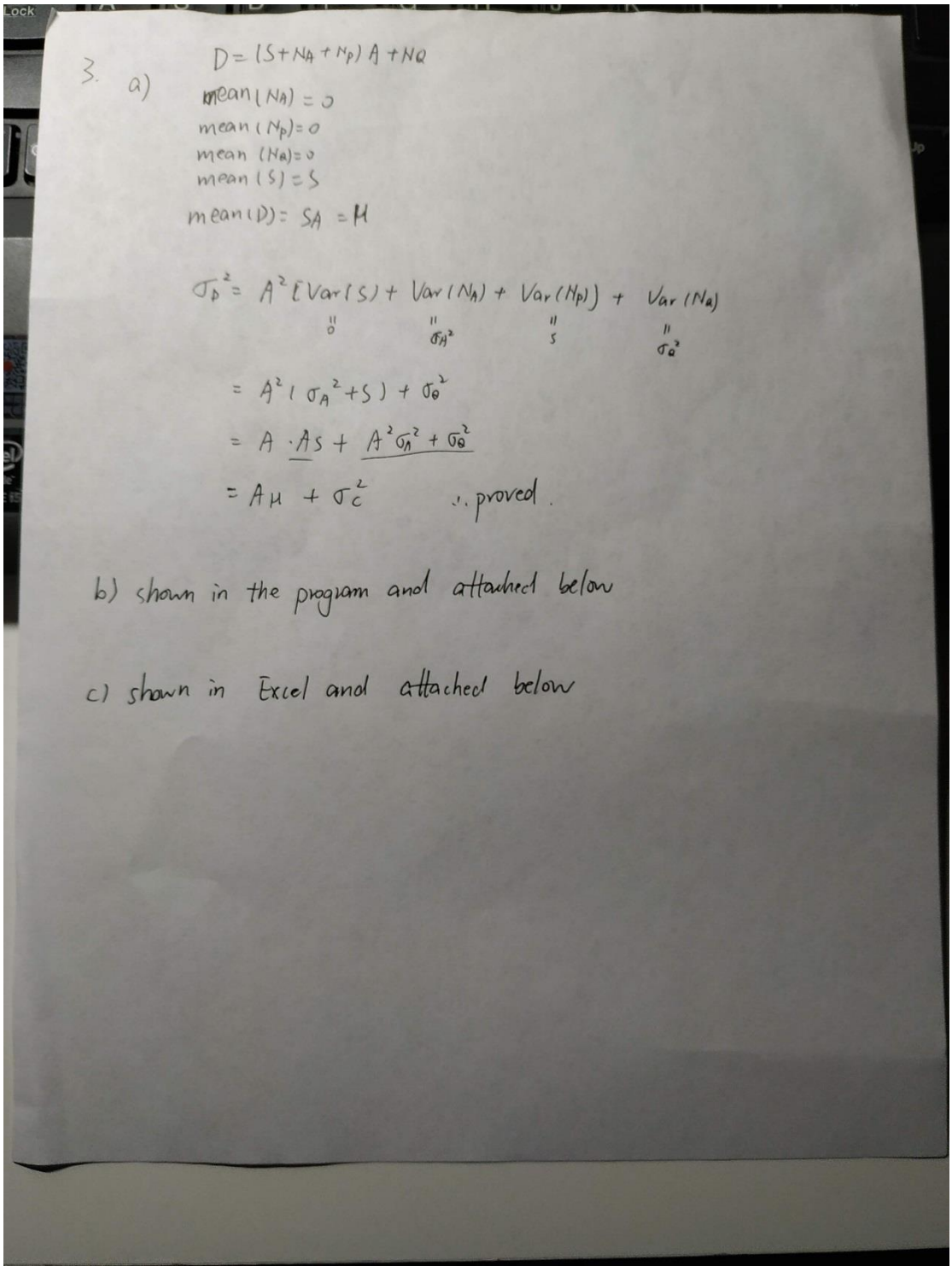
or $= 5.9$ (ignore because in focus towards lens)

$$\frac{1}{\bar{z}'} + \frac{1}{-\bar{z}} = \frac{1}{f}$$

$$\frac{1}{6.024} + \frac{1}{-\bar{z}} = \frac{1}{4}$$

$\bar{z} = -11.91\,cm$

$|\bar{z} - z| = 0.09\,cm$ $\therefore$ so can move $0.09\,cm$.


3. a)
$D = (S + N_A + N_P) A + N_Q$
mean $(N_A) = 0$
mean $(N_P) = 0$
mean $(N_Q) = 0$
mean $(S) = S$
mean $(D) = SA = M$
$\sigma_D^2 = A^2 [Var(S) + Var(N_A) + Var(N_P) + Var(N_Q)$
$= A^2 (\sigma_A^2 + S) + \sigma_Q^2$
$= A \cdot AS + A^2\sigma_A^2 + \sigma_Q^2$
$= AM + \sigma_C^2$ ∴ proved.
b) shown in the program and attached below
c) shown in Excel and attached below

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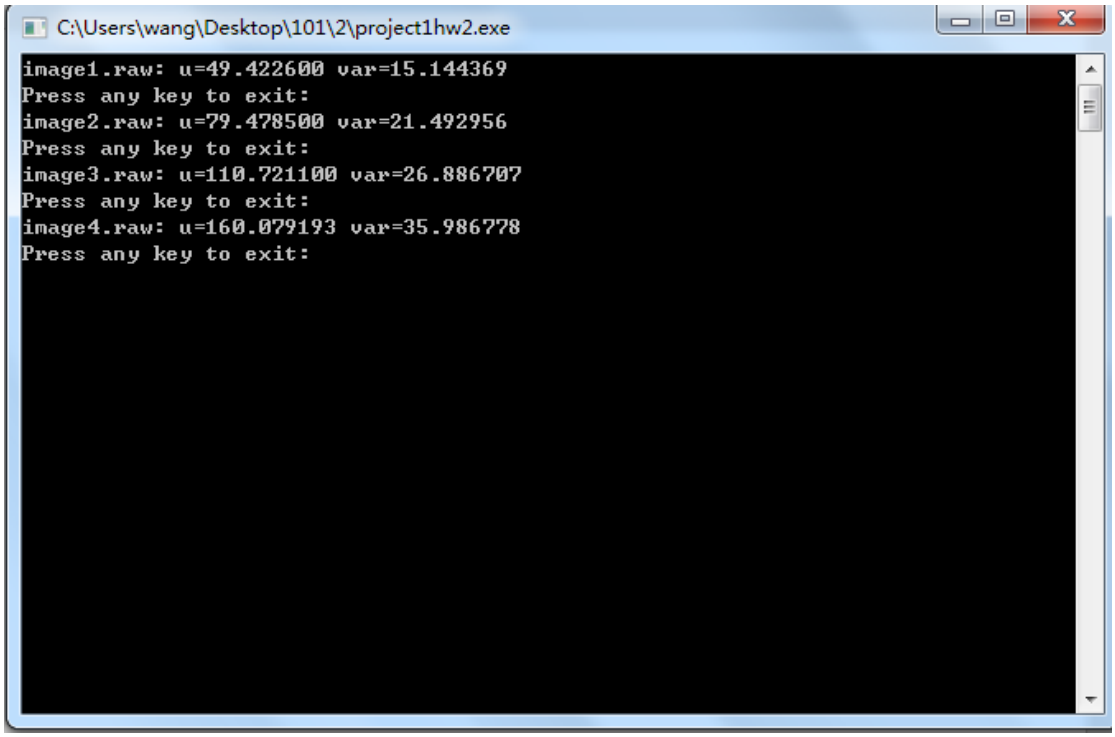
b) .



c)

	A	B	C	D	E	F	G	H	I	J	K	L
1	file	var	u		Y'	b=	6.234441					
2	1	15.14437	49.4226		15.45531	k=	0.186572					
3	2	21.49296	79.4785		21.0629	R^2=	0.999369					
4	3	26.88671	110.7211		26.8919							
5	4	35.98678	160.0792		36.10074							
6												
7	SEE FROM CHART											
8	A	0.1866										
9	var(C)	6.2344										
10												
11												
12												
13												
14												
15												
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