Josh Whitehead
Nucl 3100

HW 5

1) $P(x) = \frac{n!}{(n-x)!\,x!} p^x (1-p)^{n-x}$

where $n = 12$, $p = \frac{1}{2}$, $x = 8$

$\therefore P(8) = \frac{12!}{(12-8)!\,8!}(0.5)^8 \left(1-\frac{1}{2}\right)^4$

$\boxed{= 12.1\%}$

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2) $n = 15$
$p = 0.75$

mean $\boxed{\bar{x} = pn = 11.25}$

$\boxed{\sigma^2 = \text{variance} = \bar{x} = 11.25}$

std dev : $\sqrt{\sigma^2} = \sqrt{11.25}$ $\boxed{= 3.35}$

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3) $P(x) = \frac{n!}{(n-x)!\,x!} p^x (1-p)^{n-x}$

where $n = 10$, $p = \frac{1}{6}$, $x = 0$

$\boxed{P(0) = 16.2\%}$

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4) $\boxed{a, b, e, d}$

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5) $n = 871 - 624 = 247$

$\sigma = \sqrt{871 + 624} = 38.7$

$\therefore\ n = \boxed{247 \pm 38.7}$

6.) for 10 min source + background: $\frac{753 \cdot 10}{15} = 502$ counts

$\therefore\ n = 502 - 58 = 444$

$\sigma = \sqrt{502 + 58} = 23.7$

$\therefore\ n = \frac{444 \pm 23.7}{10} = \boxed{44.4 \pm 2.37 \ \frac{\text{counts}}{\text{min}}}$

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7) $L_c = 2.326\,\sigma_{NB} = 2.326\sqrt{95 \cdot 45} = 152.082$

$\boxed{= 152.1 \ \frac{\text{counts}}{30\text{ min}}}$

$N_D = 4.653\,\sigma_{NB} = 4.653\sqrt{95 \cdot 45}$

$= \underline{304.2}$

$MDA = \frac{N_D}{\epsilon T f} = \frac{304.2}{0.15\,(45 \cdot 60)\,0.85}$

$\boxed{= 0.884 \text{ Bq}}$

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8) Pulse - Separate electrical pulse is generated for each interaction

Current - measures interaction rate X charge generated

MSV - Blocks steady state component and squares the varying component which is proportional to q^2

	Pulse	Current	MSV
Pro	Preserve info. on energy and timing of each event - good energy resolution	- useful for high event rates	- Detect ~~different types of radiation~~ mixed radiation
Con	Not useful for high radiation levels	- Slow response to rapid changes in radiation	- not good for small amplitude events

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9) $490 - 435 = 55$

$\therefore R_{435} = \frac{55}{435} = 0.1264$

$R_{490} = \frac{55}{490} = 0.1122$

$11.22 < 12.64 \rightarrow \boxed{11.2\%}$

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10)

$\ln(m_0) = \ln(n_0) - n_0 \tau$

$\ln(m_1) = -n_0 \tau e^{-\lambda t} + \ln(n_0) - \lambda t$

$\rightarrow \ln(n_0) = \frac{\lambda t e^{\lambda t} - \ln(m_0) + e^{\lambda t} \ln(m_1)}{-1 + e^{\lambda t}}$

$\rightarrow \ln(n_0) = \frac{e^{\lambda t}(\lambda t + \ln(m_1)) + \ln(m_0)}{e^{\lambda t} - 1}$

$\lambda = \frac{\ln(2)}{54.3}$ $\quad t = 40$

$m_1 = 93384$

$m_0 = 137340$

$\rightarrow n_0 = 200{,}691 \frac{\text{count}}{\text{min}}$

$\boxed{= 2.01 \times 10^5 \frac{1}{\text{min}}}$

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11) $n = \frac{m}{1-m\tau} \rightarrow 1-m\tau = \frac{m}{n}$

$m\tau = 1 - \frac{m}{n} \rightarrow \tau = \frac{1-\frac{m}{n}}{m}$

$\rightarrow \tau = \frac{1-\frac{19000}{20000}}{19000} \boxed{= 2.63 \times 10^{-6} \text{ sec}}$

12.) $n = \frac{1}{\tau}$ max when $\frac{\partial(ne^{-nt})}{\partial n} = 0$

$m = ne^{-n\tau}$

$\therefore 50000 = \frac{1}{\tau}e^{-1} \rightarrow \tau = \frac{1}{50000}e^{-1}$

$\boxed{= 7.36 \times 10^{-6} \text{ sec}}$