Complex Part 2 Questions - Radiation Interactions

Question 3 of 5

Calculate the energy of an emitted Auger electron following a photoelectric type interaction involving an x-ray of 90 keV and a lead nucleus if the photon hits a k level electron and ejects it with an L1 level electron filling the vacancy. The emitted x-ray then ejects an Auger electron after interacting with an L2 level electron.

Level	Binding Energy (eV)
K	88005
L1	15861
L2	15200
L3	3851
M1	3554

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- 56.9 keV
- 72.1 keV
- 15.2 keV
- 72.8 keV

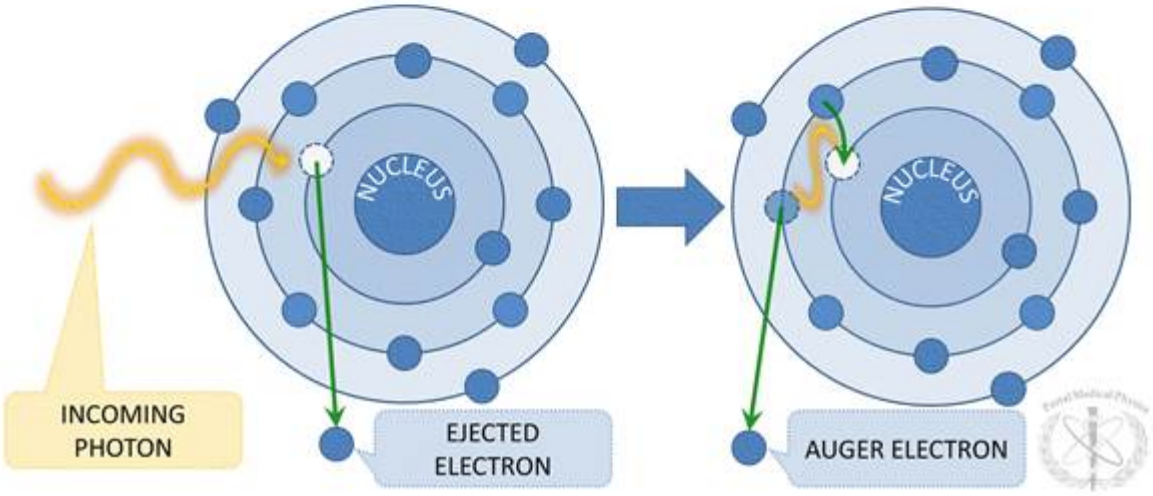
We know that the energy of the ejected Auger electron will be equal to the difference in the binding energies of the shells for various transitions.

$$KE_{Auger} = E_K - E_{L1} - E_{L2}$$

In this case we are given E_K is 88 keV, E_{L1} is 15.9 keV, E_{L2} is 15.2 keV. Substituting back into the equation we find:

$$KE_{Auger} = 88 - 15.9 - 15.2 = 56.9\ keV$$

Please note that this is technically an approximation as binding energies change slightly as an atom is ionized, but this is a common shortcut for determining rough Auger electron energies. Interestingly, there is a whole field of study revolving around Auger electron spectroscopy wherein the energy spectrum of emitted electrons can be used to determine the composition of materials.



Complex Part 2 Questions - Radiation Generating Equipment

Question 1

A proton has a rest mass of 938 MeV. If it has kinetic energy of 200 MeV then what is its speed?

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Answer choices	Correct	Your choice	Users statistics

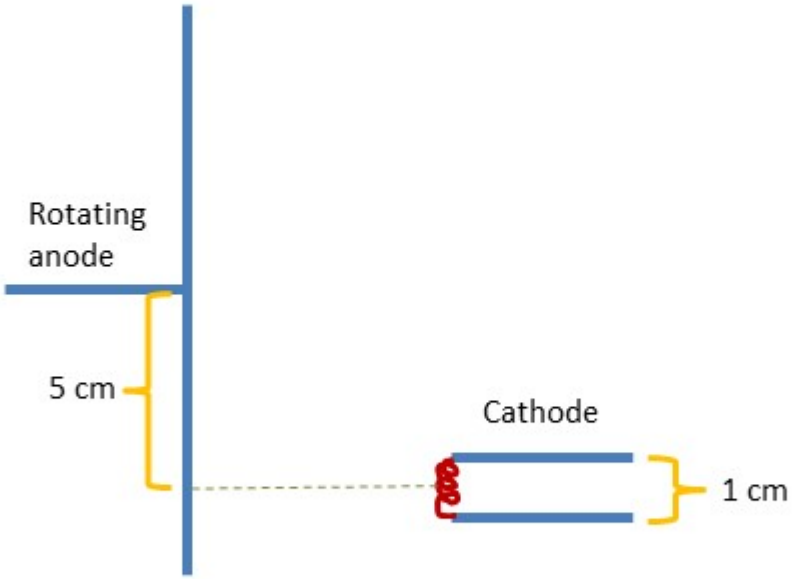
56.3% the speed of light	✔	✔	63%
76.4% the speed of light			11%
89.7% the speed of light			20%
99.5%			6%

Your score: 1

Question 2

Ignoring all cooling effects calculate the temperature rise of a tungsten anode following a 1 second exposure at 120 kvP and 200 mA. The electrons penetrate the anode to a depth of 1 mm. The density of tungsten is 19.3 g/cm^3 and the specific heat is 0.134 J/g-K.

Hint: Remember that; $Watts = Volts * Amps$



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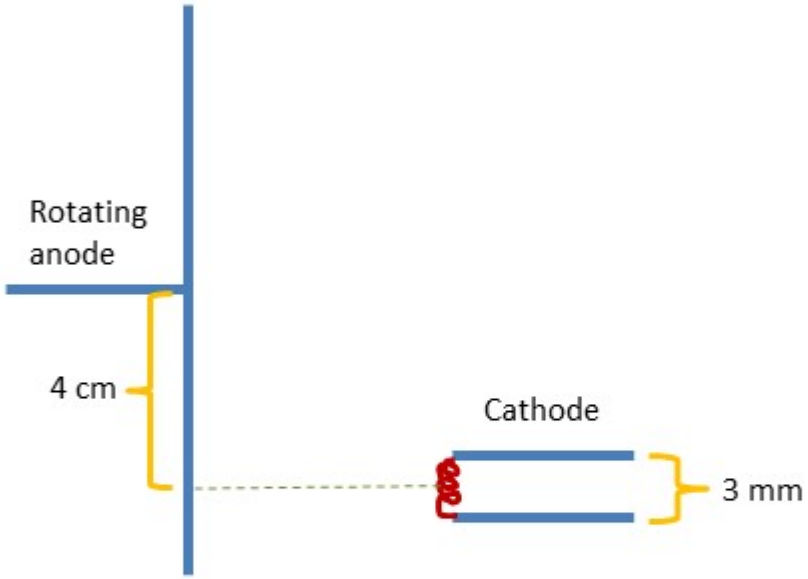
Answer choices	Correct	Your choice	Users statistics
2683 °C	✔		54%
2981 °C			16%
3098 °C		✔	13%

3150 °C 17%

Your score: 0

Question 3

For an x-ray tube, calculate the increase in surface area that a rotating anode supplies as compared to a stationary anode given the following design. The effective width of the focal spot at the anode is 1 mm.



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Answer choices	Correct	Your choice	Users statistics
251.3 times larger	✔	✔	71%
374.5 times larger			8%
215.4 times larger			11%

325.2 times larger 10%

Your score: 1

Question 4

Co-60 Teletherapy machines turn the x-ray beam on and off by mechanically moving the Co-60 source out of or into its shielded position. This creates a delay in the effective time the machine is on. This effect has been termed the shutter effect. Given the following table of information calculate the shutter effect for the machine.

Timer Reading (s)	Chamber Readings (R)
5	9.25, 9.39, 9.28
15	29.43, 29.52, 29.56
45	90.91, 90.85, 91.32

627193

Answer choices	Correct	Your choice	Users statistics
0.5 seconds	✔	✔	74%
0.25 seconds			13%
0.75 seconds			7%

1 second 7%

Your score: 1

Question 5

A proton is traveling through a perpendicular magnetic field with a strength of 1 T. If it travels in a circular path at 50% the speed of light what is the radius of its path?

Remember the following classical relationships:

The mass of a proton is $1.67*10^{-27}$ kg

The force exerted on a charged particle in a magnetic field:

$$F_m = qv \times B$$

The centripetal force:

$$F_c = \frac{mv^2}{r}$$

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Answer choices	Correct	Your choice	Users statistics
1.8 m	✔	✔	71%
0.9 m			8%
0.4 m			14%

0.2 m 6%

Your score: 1