Question 16: **C** (Probability of a male with XLA = 0.25. Probability of a female with XLA = 0. Probability of having a child who is a carrier = 1/8) ✓

XLA is a recessive X-linked disease which means males with one copy of the disease gene express the disease phenotype, while females with two copies express the disease phenotype. Because person 4 is unaffected and person 3 is affected, and person 9 (their child) is affected, we know that person 4 must be a carrier. We can notate this as X^1X^0, where X^1 is the chromosome containing the disease gene and X^0 is a normal copy of the chromosome.

Person 8 is a genetic mix of person 3 (X^0Y) and person 4 (X^1X^0), meaning they are either X^0X^0 or X^1X^0, as they are female and inherit one X chromosome from their maternal side and one from their paternal side. Given that the partner of person 8 is unaffected, we can note this as X^0Y. A punnet square will help us to interpret the options from here.

	$\mathbf{X^0}$	$\mathbf{X^0}$
$\mathbf{X^0}$	X^0X^0	X^0X^0
Y	X^0Y	X^0Y

	$\mathbf{X^1}$	$\mathbf{X^0}$
$\mathbf{X^0}$	X^1X^0	X^0X^0
Y	X^1Y	X^0Y

Of the four female offspring, none will have XLA. Of the four male offspring, one will have XLA. Of all the children, only one will be a carrier.

Question 17: **F** (An alpha-source outside of your body can be dangerous because the radiation is very penetrating and can affect cells deep inside.) ✓

The statement F is incorrect: an alpha-source outside of your body is safe because the particles cannot penetrate your skin to reach your internal organs. However, an alpha source inside your body is incredibly dangerous because it causes a lot of ionisation.

Question 18: **D** (240 cm^3) ✓

Aqueous H_3PO_4 is triprotic, meaning that it can donate three protons per molecule of H_3PO_4. Cobalt (II) hydroxide can also be written as $Co(OH)_2$, meaning that it is able to accept two protons per molecule of $Co(OH)_2$. This 3:2 ratio is important. As we know there is 30 cm^3 of $Co(OH)_2$ solution, this means 20 cm^3 of the same concentration H_3PO_4 will be required to provide enough protons to fully neutralise it, due to the 3:2 ratio. However, the concentration of the H_3PO_4 is 12 times less than that of the $Co(OH)_2$ and therefore we multiply the 20 cm^3 by 12 to get 240 cm^3 in total.

