Higher Physics
Particles and Waves
Check Test 3: Solutions

1. B
2. D
3. A
4. D
5. D
6. C
7. D
8. D
9. E
10. B

11 (a). $A = Z + N$

$241 = 95 + N$

$N = 146$ (1)

(b). (i). $r = 93$ (1)

$s = 237$ (1)

(ii). $T = Neptunium/Np$ (1)

12 (a). Induced because an incident neutron triggers the reaction. (1)

(b). $E = mc^2$ (1)

$1.53 \times 10^{-13} = m \times (3 \times 10^8)^2$ (1)

$m = 0.0017 \times 10^{-27}\ kg$

13 (a). (i). Number of protons (atomic number). (1)

(ii). Number of protons and neutrons (mass number). (1)

(b). The two neutrons released in the reaction can go on to hit two other Uranium nuclei and therefore cause two further fission reactions. (1)

(c). $Mass\ before = (390.173 \times 10^{-27}) + (1.675 \times 10^{-27}) = 3.91848 \times 10^{-25}\ kg$

$Mass\ after = (232.242 \times 10^{-27}) + (155.884 \times 10^{-27}) + 2 \times (1.675 \times 10^{-27})$

$= 3.91476 \times 10^{-25}\ kg$

$Lost\ mass = (3.91848 \times 10^{-25}) - (3.91476 \times 10^{-25}) = 0.00372 \times 10^{-25}\ kg$ (1)

$E = mc^2$ (1)

$= (0.00372 \times 10^{-25}) \times (3 \times 10^8)^2$ (1)

$= 3.35 \times 10^{-11}\ J$ (1)

14 (a). The process in which two smaller/lighter nuclei join together/fuse/combine to form a nucleus, with energy being released. (1)

(b). (i). Some mass is lost and converted to energy. (1)

(ii). $Mass\ before = (5.008 \times 10^{-27}) + (3.344 \times 10^{-27}) = 8.352 \times 10^{-27}\ kg$

$Mass\ after = (6.646 \times 10^{-27}) + (1.673 \times 10^{-27}) = 8.319 \times 10^{-27}\ kg$

$Lost\ mass = (8.352 \times 10^{-27}) - (8.319 \times 10^{-27}) = 0.033 \times 10^{-27}\ kg$ (1)

$E = mc^2$ (1)

$= (0.033 \times 10^{-27}) \times (3 \times 10^{8})^2$ (1)

$= 2.97 \times 10^{-12}\ J$ (1)