Question			Marking details	Marks Available
3	*(a)*		$^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + {}^{1}_{0}\text{n}$ (1) (1)	2
	(b)		$P = \frac{E}{t}$ **or** watt = J s^{-1} (1)	
			confinement time = $\frac{E}{P}$: $\therefore$ $\frac{\text{J}}{\text{J s}^{-1}}$ = s (1)	2
	(c)		High temperature → need fast particles to overcome repulsion (1) High density → more ions / particles means more reactions / collisions [$\therefore$ more energy out] (1) Long time → more time means more reactions / collisions [$\therefore$ more energy out] (1)	3
	(d)		Along magnetic field lines → no force [or constant v] (1) $\perp^{r}$ to **B**, experience a force [**or F = Bqv**] (1), at right angles (to **v** and **B**) giving circular motion [accept: gives centripetal force](1). Constant velocity (along **B** field) combined with circular motion gives a spiral [or helix] (1)	4
	(e)		Any 3 × (1) from 5: abundance – plenty for at least 1000 years [or similar](✓) safety – cannot get out of control because there is only a small amount of fuel (1) environment – no CO_2 / greenhouse emissions (✓) radioactive for only ~ 50 years [accept: no radioactive waste](✓) output – large amount of energy from small amount of fuel (✓)	3
	(f)	(i)	$0 = 4(m)v + (m)w$ (1) [**or** $5mu = 4mv + mw$] neutron speed = 4 × helium speed (1) [implies 1st mark] KE = $\frac{1}{2}mv^2$ (1) [or by impl] $\frac{1}{2} \times 4mw^2 = 2mw^2$ **and** $\frac{1}{2} \times m(4w^2) = 8mw^2$ (1) [Accept: showing that momentum is conserved with the data supplied for full marks]	4
		(ii)	• pass through walls ✓ • take away KE ✓ • unaffected by **B**-field ✓ • provide heating outside torus ✓ • produce β-emitters [accept r/a particles]✓ } any 2 × (1)	2 **[20]**