Question	Answer	Marks
8(a)	a region where a magnet / magnetic material / moving charge / current carrying conductor experiences a force	**B1**
8(b)	$B = F / Il$ e.g. = $9 \times 10^{-3} / (5.0 \times 0.045)$	**C1**
	= **0.040** T	**A1**
8(c)(i)	force is (always) perpendicular to the velocity / direction of motion	**B1**
	magnetic force provides the centripetal force *or* force perpendicular to motion causes circular motion	**B1**
	magnitude of force (due to the magnetic field) is constant *or* no work done by force *or* the force does not change the speed	**B1**
8(c)(ii)	Applying the list rule, any 2 from: accelerating p.d. radius of path / radius of semicircle magnetic flux density	**B2**

Question	Answer	Marks
9(a)(i)	9.0 / √2 = **6.4** V	**A1**
9(a)(ii)	$\omega = 20$ $\omega = 2\pi / T$ $T = 2\pi / 20$	**C1**
	T = **0.31** s	**A1**
9(b)	the r.m.s. voltages are different, so no	**B1**
9(c)(i)	$P = V_{\text{r.m.s.}} \times I_{\text{r.m.s.}}$	**C1**
	= 120 × 0.64 = 76.8 W	**C1**
	efficiency = (76.8 / 80) × 100 = **0.96** or **96** %	**A1**
9(c)(ii)	Any one from: • heat losses due to resistance of windings / coils • heat losses in magnetising and demagnetising core / hysteresis losses in core • heat losses due to eddy currents in (iron) core • loss of flux linkage	**B1**

Question	Answer	Marks
10(a)	energy of a photon required to remove an electron	**B1**
	either: energy to remove electron from a surface *or*: minimum energy to remove electron *or*: energy to remove electron with zero kinetic energy	**B1**
10(b)(i)	Correct read off from graph of f as 5.45×10^{14} Hz when $E_{MAX} = 0$ $5.45 \times 10^{14} \times 6.63 \times 10^{-34}$	**C1**
	= $\mathbf{3.6 \times 10^{-19}}$ J	**A1**
10(b)(ii)	$3.6 \times 10^{-19} / 1.6 \times 10^{-19} = 2.3$ eV so potassium	**A1**
10(c)(i)	each photon has same energy so no change	**B1**
10(c)(ii)	more photons (per unit time) so (rate of emission) increases	**B1**

Question	Answer	Marks
11(a)	$eV = hf$ $f = 1.60 \times 10^{-19} \times 100\,000 / 6.63 \times 10^{-34}$	**C1**
	$= \mathbf{2.41 \times 10^{19}}$ Hz	**A1**
11(b)	(aluminium filter) absorbs (most) low energy X-rays	**B1**
	Any 2 from • X-ray beam contains many wavelengths • so low energy X-rays are not absorbed in the body • low energy X-rays can can cause harm but do not contribute to the image	**B2**
11(c)(i)	$I / I_o = e^{-\mu x}$ $e^{-0.23 \times 0.80} = 0.83$	**C1**
	17% absorbed	**A1**
11(c)(ii)	bone is seen as lighter / muscle is seen as darker	**B1**
	either bone has a higher μ value so absorbs more *or* muscle has a lower μ value so transmits more	**B1**

Question	Answer	Marks
12(a)	(minimum) energy required to separate the nucleons	**M1**
	to infinity	**A1**
12(b)(i)	**37** **2**	**B1**
12(b)(ii)	fission	**B1**
12(b)(iii)	binding energy per nucleon smaller for U than for Cs	**B1**
12(c)	Current ratio 2 Y to 1 Zr, so initially 3 Y $2 = 3\ e^{-\lambda t}$ $\lambda = 0.693 / 2.7$	**C1**
	$\ln(2 / 3) = -(\ln 2 / 2.7)t$	**C1**
	t = **1.6** days	**A1**
	or	
	$(½)^n = 2 / 3$	**(C1)**
	n = 0.585	**(C1)**
	time = 0.585×2.7 = **1.6** days	**(A1)**