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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(a)	there must be a current (in the wire)	<b>B1</b>
	(wire) must be at a non-zero angle to the magnetic field	<b>B1</b>
6(b)(i)	arrow from X pointing horizontally to the left	<b>B1</b>
	arrow from Y pointing diagonally upwards and to the left at about 45°	<b>B1</b>
	arrow from Z pointing horizontally to the right	<b>B1</b>
6(b)(ii)	(flux densities at W and X are approximately) equal	<b>B1</b>
	(flux density at) Y greater than (flux density at) Z	<b>B1</b>
6(c)	current in wire creates magnetic field around wire	<b>B1</b>
	(each) wire sits in the magnetic field created by the other	<b>B1</b>
	(for each wire,) current / wire is perpendicular to magnetic field (due to other wire), (so) experiences a (magnetic) force	<b>B1</b>

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Question	Answer	Marks
7(a)	induced e.m.f. is (directly) proportional to rate	<b>M1</b>
	of change of (magnetic) flux (linkage)	<b>A1</b>
7(b)	$V_2$ stepped, all at non-zero values, between $t = 0$ and $t = 0.40$ s	<b>B1</b>
	$V_2$ shown with same non-zero magnitude up to $t = 0.15$ s and after $t = 0.25$ s but with a different magnitude between these times	<b>B1</b>
	$V_2$ shown with a magnitude between $t = 0.15$ s and $t = 0.25$ s that is three times the magnitude before $t = 0.15$ s and after $t = 0.25$ s	<b>B1</b>
	$V_2$ shown with same sign up to $t = 0.15$ s and after $t = 0.25$ s, and opposite sign in between	<b>B1</b>
7(c)(i)	changing current in coil causes changing (magnetic) field <b>or</b> changing (magnetic) flux causes induced e.m.f. in ring	<b>B1</b>
	induced e.m.f. in ring causes current in ring	<b>B1</b>
	(magnetic) field due to (induced) current in ring interacts with (coil's) field to cause upwards force (on ring) <b>or</b> (induced) current in ring perpendicular to (coil's magnetic) field causes upwards force (on ring)	<b>B1</b>
7(c)(ii)	both magnetic fields reverse direction so ring still jumps up <b>or</b> current (in ring) and (coil's) field both reverse so ring still jumps up	<b>B1</b>



Question	Answer	Marks
8(a)(i)	photoelectric effect	<b>B1</b>
8(a)(ii)	electron diffraction	<b>B1</b>
8(b)(i)	$\lambda = h / p$	<b>C1</b>
	$p = 4 \times 1.66 \times 10^{-27} \times 6.2 \times 10^7$ ( = $4.1 \times 10^{-19}$ N s)	<b>C1</b>
	$\lambda = 6.63 \times 10^{-34} / 4.1 \times 10^{-19}$ = $1.6 \times 10^{-15}$ m	<b>A1</b>
8(b)(ii)	line with negative gradient throughout	<b>B1</b>
	curve asymptotic to both axes with non-zero $\lambda$ at $v = 6.2 \times 10^7$ m s <sup>-1</sup>	<b>B1</b>
8(c)	(de Broglie) wavelength negligible compared with width of doorway	<b>B1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(a)(i)	speed is (directly) proportional to distance	<b>M1</b>
	where speed is speed of recession of galaxy (from observer) and distance is distance of galaxy away from observer	<b>A1</b>
9(a)(ii)	wavelengths (of spectral lines) are greater (than their known values)	<b>B1</b>
	redshift shows stars (in distant galaxies) moving away from Earth	<b>B1</b>
9(b)	(all) parts of Universe moving away from each other	<b>B1</b>
	more distant objects are moving away faster	<b>B1</b>
	matter must have been close together / very dense in the past	<b>B1</b>



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Question	Answer	Marks
10(a)	spontaneous emission of (ionising) radiation	<b>B1</b>
	emission from unstable nucleus	<b>B1</b>
10(b)(i)	curve with decreasing negative gradient passing through $(0, N_0)$	<b>B1</b>
	curve passing through $(T, 0.5N_0)$	<b>B1</b>
	curve passing through $(2T, 0.25N_0)$ <b>and</b> $(3T, 0.125N_0)$	<b>B1</b>
10(b)(ii)	line through origin with positive gradient	<b>B1</b>
	straight line passing through $(N_0, A_0)$	<b>B1</b>
10(c)(i)	activity	<b>B1</b>
10(c)(ii)	decay constant	<b>B1</b>
10(d)	$N = N_0 \exp(-\ln 2 \times 1.70T / T)$	<b>C1</b>
	$N / N_0 = 0.31$	<b>A1</b>

