Particle Physics Mark Scheme 1

Level	Inter	national A Level	
Subject	Phys	cs	
Exam Board	CIE		
Торіс	Parti	cle & Nuclear Physics	
Sub Topic	Parti	cle Physics	
Paper Type	Theo	ry	
Booklet	Mark	Scheme 1	

Time Allowed:	75 minutes
Score:	/62
Percentage:	/100

CHEMISTRYONLINE

A*	A	В	С	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 (a 92 protons and 143 neutrons

(b)					
		value			
	а	1			
	b	0	(a and b both required)	B1	[3]
	С	141		B1 B1	
	d	55			
(c)	kinetic ene	rgy (of products	s) or gamma/ γ (radiation or photon)	B1	[1]
(d)	(total) mas side/produ	s on left-hand s cts	ide/reactants is <u>greater</u> than (total) mass on right-hand		
	difference	in mass is (conv	verted to) energy	A1	[2]

(a (i)	(rate of decay) not affected by any external factors or changes in temperature and pressure etc.	B1	[1]
(ii)	two protons and two neutrons	B1	[1]
(b) (i)	(total) mass before decay/on left-hand side is greater than (total) mass on right-hand side/after the decay	M1	
	the difference in mass is released as kinetic energy of the products	A1	[2]
	(may also be some γ radiation) (to conserve mass-energy)		
(ii)	$(6.2 \times 10^{6} \times 1.6 \times 10^{-19}$ =) $9.9(2) \times 10^{-13}$ J	A1	[1]
	(a (i) (ii) (b) (i) (ii)	 (a (i) (rate of decay) not affected by any external factors or changes in temperature and pressure etc. (ii) two protons and two neutrons (b) (i) (total) mass before decay/on left-hand side is greater than (total) mass on right-hand side/after the decay the difference in mass is released as kinetic energy of the products (may also be some γ radiation) (to conserve mass-energy) (ii) (6.2 × 10⁶ × 1.6 × 10⁻¹⁹ =) 9.9(2) × 10⁻¹³ J 	(a (i) (rate of decay) not affected by any external factors or changes in temperature and pressure etc.B1(ii) two protons and two neutronsB1(b) (i) (total) mass before decay/on left-hand side is greater than (total) massM1(b) (i) (total) mass before decay/on left-hand side is greater than (total) massM1(ii) the difference in mass is released as kinetic energy of the productsA1(may also be some γ radiation) (to conserve mass-energy)A1

3	(a	(i)	A: 206, nucleon(s) or neutron(s) <u>and</u> proton(s) B: 82, proton(s)	} } all correct	A1	[1]
		(ii)	kinetic/ <i>E</i> _K /KE		B1	[1]
	(b)	ene	ergy = $5.3 \times 1.6 \times 10^{-13}$ (J) [= 8.48×10^{-3} (J)]		C1	
		pov	ver = $(7.1 \times 10^{18} \times 5.3 \times 1.6 \times 10^{-13}) / (3600 \times 24)$			
			= 70 (69.7) W		A1	[2]
4	(a	α: I	nelium nucleus			
		β: ϵ	electron			
		γ: <u>e</u>	electromagnetic radiation/wave/ray or photon			
		thre	ee correct 2/2, two correct 1/2		В	[2]
	(b)	(i)	atomic number/proton number/Z-2, nucleon/r	nass number/A –4	B1	[1]
		(ii)	atomic number/proton number/Z +1 nucleon/mass number/A no change		B1	[1]
		(iii)	no change in proton or mass number <i>or</i> "no change"		B1	[1]
5	(a	the or v	e majority/most went straight through were deviated by small angles		B1	
		a v sm	ery small proportion/a few were deviated by large all angles described as < 10° <u>and</u> large angles de	angles escribed as >90°	B1 B1	[3]
	(b)	mo ma cor	est of the atom is empty space/nucleus very small lss <u>and</u> charge concentrated in (very small) nucle rect links made with statements in (a)	compared with atom us	B1 B1 B1	[3]

6	(a	(i)	W = 206 and X = 82 Y = 4 and Z = 2	A1 A1	[2]
		(ii)	mass-energy is conserved mass on rhs is less because energy is released	B1 B1	[2]
	(b)	not or tw	affected by external conditions/factors/environment vo examples temperature and pressure	B1	[1]
7	(a)) (i)	nucleus contains 92 protons nucleus contains 143 neutrons (missing 'nucleus' 1/2) outside / around nucleus 92 electrons most of atom is empty space / mass concentrated in nucleus total charge is zero diameter of atom ~ 10^{-10} m or size of nucleus ~ 10^{-15} m any two of (B1) marks	B1 (B1) (B1) (B1) (B1) (B1)	[4]
		(ii)	nucleus has same number / 92 protons nuclei have 143 and 146 neutrons (missing 'nucleus' 1/2)	B1 B1	[2]
	(b)) (i)	Y = 35 Z = 85	A1 A1	[2]
		(ii)	mass-energy is conserved in the reaction	B1	
			mass on rhs of reaction is less so energy is released explained in terms of $E = mc^2$	B1	[2]

8	(a	ا 92 143	protons in the nucleus and 92 electrons around nucleus neutrons (in the nucleus)	B1 B1	[2]
	(b)	(i)	α -particle travels short distance in air	B1	[1]
		(ii)	very small proportion in backwards direction / large angles majority pass through with no /small deflections either most of mass is in very small volume (nucleus) and is charged or most of empty space	B1 B1 f atom B1	is [3]
	(c)	I = n/t n/t	Q / t = $(1.5 \times 10^{-12}) / (2 \times 1.6 \times 10^{-19})$ = $4.7 \times 10^{6} s^{-1}$	C1 C A1	[3]
9	(a	(i)	electron		[1]
		(ii) (iii)	any two: can be deflected by electric and magnetic fields or negatively charged / absorbed by few (1 – 4)mm of aluminum / 0.5 to 2 m or metres for range in air speed up to 0.99c / range of speeds / energies decay occurs and cannot be affected by external / environmental factors or two stated factors such as chemical / pressure / temperature / humidity	/ B2 B1	[
	(b)	3 a 2 a	nd 0 for superscript numbers nd –1 for subscript numbers	B1 B1	[2]
	(c)	ene	ergy = $5.7 \times 10^3 \times 1.6 \times 10^{-19}$ (= 9.12×10^{-16} J)	C1	
		<i>v</i> ² :	$=\frac{2\times9.12\times10^{-16}}{9.11\times10^{-31}}$	C1	
		<i>v</i> =	= 4.5 × 10 ⁷ m s ⁻¹	A1	[3]
	(d)	bot 1 n (sp diff	h have 1 proton and 1 electron eutron in hydrogen-2 and 2 neutrons in hydrogen-3 ecial case: for one mark 'same number of protons / atomic number erent number of neutrons')	B1 B1	[2]