GCE

Physics A

Advanced GCE **2826/01**

Unifying Concepts in Physics

Mark Scheme for June 2010

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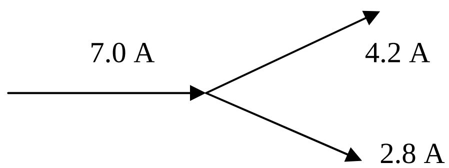
Candidates are expected to answer **all** the questions

1	**(a)**	arrows correct	(1)		
		(contact) force from seat and/or chain (tension allowed)		(1)	
		(gravitational) force from Earth / weight	(1)		[3]
	(b)	**(i)** 220 N / 9.81 = 22.4 kg	(1)	{1}	
		(ii) 2π x 3 / 4.7 = 4.01 m s^{-1}	(1)	{1}	
		(iii) $½mv^2$	(1)		
		= ½ x 22.4 x 4.01^2 = 180 J	(1)	{2}	
	(iv)	$F = mv^2/ r$	(1)		
		= 22.4 x 4.01^2 / 3 = 120 N	(1)		
		horizontally towards the centre of the child's rotation	(1)	{3}	
		(v) vertical component 220 N; horizontal component 120 N	(1)		
		$\theta = \tan^{-1}$ (120 / 220) = 28.6°	(1)	{2}	[9]
	(c)	a triangle of force is for equilibrium	(1)		
		the child is accelerating (so is not in equilibrium)	(1)		
		the tension and the weight alone are the forces acting OR the centrifugal force does not exist OR there is an inward resultant force	(1)		[3]
		[Total: 15]			
2	**(a)**	gravitational field	(1)		
		strength of gravitational field is force per unit mass	(1)		
		electric field	(1)		
		electric field strength is force acting per unit positive charge	(1)		
		magnetic field	(1)		
		magnetic field strength is force acting per unit current on a wire of unit length (at right angles to the field)	(1)		[6]
	(b)	in a gravitational field force always acts towards mass	(1)		
		in an electric field the force acts (on a positive charge) in a direction towards a negative charge	(1)		
		but away from a positive charge	(1)		
		in a magnetic field the force direction is at right angles to the field	(1)		
		and in a direction given by Fleming's left hand rule	(1)		[5]
	(c)	**2 of** cannot be a gravitational force because it is far too small	(1)		
		cannot be an electrical force because that would be repulsion	(1)		
		cannot be magnetic because there is no current	(1)		[2]
		[Total: 13]			
3.	**(a)(i)**	at any junction the algebraic	(1)		
		sum of the currents is zero	(1)	{2}	
	(ii)	sketch e.g.	(1)	{1}	



	(iii)	charge	(1)	{1}	[4]

	(b)(i)	energy	(1)	{1}	
	(ii) 1	10 Ω and 40 Ω in parallel have total resistance 8 Ω			
		total resistance = 10 Ω	(1)		
		current from supply = 0.30 A	(1)		
		p.d. across 2 Ω resistor = 0.60 V	(1)		
		p.d. across 10 and 40 Ω resistors = 2.4 V	(1)	{4}	
	2	a closed loop consists of the cell, the 2.0 W internal resistor and ONE of the other two resistors	(1)		
		e.g. so 3 V e.m.f. = $V_{10} + V_2$ = 0.6 V + 2.4 V	(1)	{2}	[7]
		[Total: 11]			
4	**(a)**	38 is the number of protons (in the nucleus)	(1)		
		90 is the number of protons + neutrons	(1)	{2}	[2]
	(b)	the proton and the neutron do not have mass exactly equal to 1 u	(1)		
		binding energy alters the total mass	(1)		
		the mass of all the protons and neutrons is larger than the nuclear mass	(1)		
		the difference between them is given by E = Δmc^2	(1)	MAX	[3]
	(c)(i)	$^{2}_{1}H + ^{2}_{1}H \Rightarrow ^{4}_{2}He$	(1)	{1}	
	(ii)	mass of left hand side = 2 x 2.01410 = 4.02820 u			
		mass of right hand side = 4.00260 u			
		Δm = 0.02560 u	(1)		
		E = 0.02560 x 1.66 x 10^{-27} x (3 .0 x 10^8)^2	(1)		
	=	3.82 x 10^{-12} J = 3.82 x 10^{-12} / 1.6 x 10^{-13} (= 23.9 MeV)	(1)	{3}	[4]
	(d)(i)	$^{1}_{0}n + ^{235}_{92}U \Rightarrow ^{142}_{54}Xe + ^{90}_{38}Sr + 4\,^{1}_{0}n$			
		initial neutron	(1)		
		correct nuclides	(1)		
		numbers all balancing	(1)	{3}	
	(ii)	left hand side 1.00867 + 235.0439 = 236.05257			
		right hand side 141.9070 + 89.9073 + 4.03468 = 235.8490	(1)		
		Δm = 0.20259 u allow e.c.f. from (i)	(1)		
		equivalent to 3.363 x 10^{-28} kg			
		E = 3.027 x 10^{-11} J	(1)		
		= 189 MeV	(1)	{4}	[7]
		[Total: 16]			
5		sensible choice of answer	(1)		
		relation between physics and use	(3) MAX		
		reasons given	(3) MAX		
		OVERALL MAXIMUM			[5]
		[Total: 5]			

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