OCR

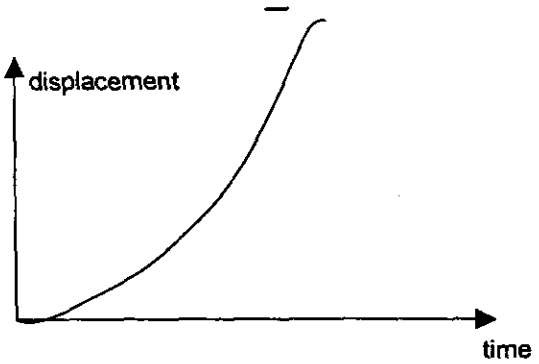
RECOGNISING ACHIEVEMENT

UNIFYING CONCEPTS IN PHYSICS

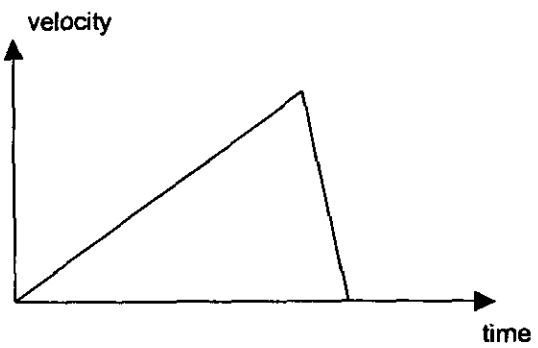
Mark Scheme 2826/01
January 2002

Abbreviations, annotations and conventions used in the Mark Scheme	/	= alternative and acceptable answers for the same marking point
	;	= separates marking points
	NOT	= answers which are not worthy of credit
	()	= words which are not essential to gain credit
	____	= (underlining) key words which must be used to gain credit
	ecf	= error carried forward
	AW	= alternative wording
	ora	= or reverse argument

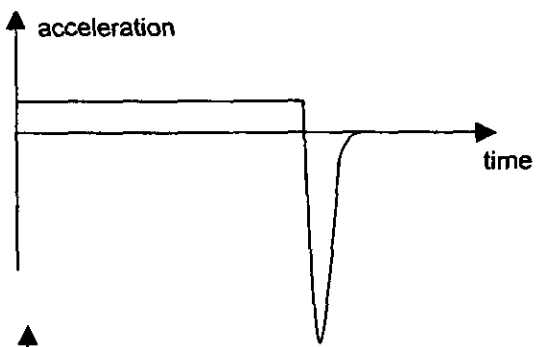
1 (a) Points which can be credited



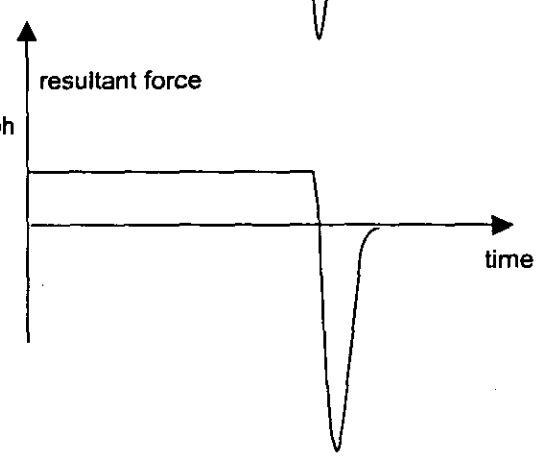
(i) upward curve 1
zero gradient at the start 1
short time to stop 1 3



(ii) straight line 1
sudden stop 1
which is not instantaneous 1 3



(iii) constant zero slope 1
does not start at origin 1
high negative peak 1
final acceleration zero 1 4



(iv) identical shape to acceleration graph 1
final force zero 1 2 **9**

12 marks available
9 required for maximum mark

(b)(i)	object starts with gravitational p.e.	1		
	converted into k.e. (as it falls)	1		
	maximum k.e. as it hits ground	1		
	on stopping converted into elastic p.e. (for an instant)	1		
	becomes internal energy / heat of fragments (and floor)	1		
	and sound	1	4	
	6 marking points; only 4 required			
(ii)	momentum of falling object (increases as it falls)	1		
	total momentum starts at zero	1		
	momentum finishes at zero	1		
	Earth gains momentum up as body falls	1		
	Earth's velocity is very small (due to its large mass)	1	4	**8**
	5 marking points; only 4 required			
(c)	ball is elastic but cup is brittle	1		
	distortion of cup is small	1		
	so acceleration of cup is very large	1		
	requiring a large force	1		
	distance of distortion for ball is much greater	1	4	**4**
	OR in terms of $F\delta t$ or $F\delta x$			
	5 marking points; only 4 required			

2(a)	a transformer	1	1	
(b)	the turns ratio	1		
	9/230 OR 0.039 OR 1:25 OR 1:26	1	2	
	If a factor of 1.41 appears, 1:36 allow full credit			
(c)	marking points allowed - 3 required for full marks	3	3	
	diode in connection from secondary to battery			
	diode connected the correct way round			
	light bulb connected in possible circuit			
	light bulb connected across transformer secondary – (it will then go out when the transformer is not in use)			
(d)	secondary coil is removed from (alternating) field of primary	1		
	so no induced e.m.f. (diode prevents bulb lighting from the battery)	1	2	**8**

3(a)	Q charge on capacitor (at time t)	Q_0 initial charge (on capacitor)	1		
	C capacitance	R resistance	1		
	N number of undecayed atoms (at time t)	N_0 initial number of undecayed atoms	1		
	λ decay constant	t time	1	4	
(b)(i)	unit of C = coulomb per volt = ampere second per volt OR as A s V^{-1}		1		
	unit of R = volt per ampere OR as V A^{-1}		1		
	deduction required		1		
	e.g. unit of CR = A s V^{-1} x V A^{-1} = s therefore since t has the unit s				
	t/CR has no unit				
(ii)	s^{-1}		1	4	
(c)(i)	$\frac{Q}{Q_0} = e^{-\frac{5CR}{CR}}$		1		
	$= e^{-5} = 0.0067$ (4)		1		
(ii)	$\frac{½Q}{Q_0} = e^{-\frac{t}{100\times10^{-6}\times200\times10^{3}}}$		1		
	$\frac{1}{2} = e^{-\frac{t}{20}}$		1		
	$\ln 0.5 = -\frac{t}{20} = -0.693$				
	$t = 13.86 = 13.9$s		1	5	
(d)(i)	time constant = $1/\lambda$		1		
(ii)	$\lambda t_{½} = 0.693$		1		
	time constant = $1/\lambda$ = 850/0.693 = 1230 s		1		
(iii)	same as for capacitors, namely 0.0067(4)		1	4	**17**

4(a)	Gravitational field	1		
	as force acting on unit mass	1		
	Electric field	1		
	Strong nuclear force	1		
	as force acting on unit (positive) charge	1		
	Magnetic field	1		
	as force acting on unit current in a wire of unit length	1		
	Allow as force acting on unit charge travelling with unit velocity	1	6	
	Notes: deduct 1/3 if done in terms of units			
	deduct 2/3 if done with equations for which the symbols are not explained			
(b)	Gravitational field - only one kind of mass so force is always in the direction of the field	1		
	Electrical field - two kinds of charge	1		
	Strong nuclear force	1		
	so force is either in the direction of the field (with positive charge) or in the opposite direction to the field (with negative charge)	1		
	Magnetic field – direction of wire controls direction of force	1		
	maximum force when wire is at right angles to field	1		
	direction of force given by (Fleming's) left hand rule	1		
	Distance over which forces act / inverse square law	1		
	force given by $BIl \sin\theta$ where θ is angle between field and current	1	5	
	Maximum 5 awarded for 5 of these 8 points			
(c)	protons in the nucleus have a positive charge	1		
	they are very close (10^{-15} m) so repel each other strongly			
	(because of their charge)	1		
	since the nucleus does not explode there must be an (even larger) force holding it together	1		
	magnetic and/or gravitational forces are (far) too small	1		
	so there must be another force, provided by some other (nuclear) field	1	3	**14**
	Maximum 3 awarded for 3 of these 5 points			