OCR

RECOGNISING ACHIEVEMENT

UNIFYING CONCEPTS IN PHYSICS

Mark Scheme 2826/01

January 2003

1	(a)(i)	49 minutes (allow 48 minutes 58 or 59 seconds)	1		
		47 minutes (allow 47 minutes 1 or 2 seconds)	1		
	(ii)	minimum 98 km h^{-1}	1		
		maximum 102 km h^{-1}	1		
	(iii)	100 ± 2 km h^{-1}	1		
	(iv)	2%	1	6	
	(b)	e.g. use a different clock	1		
		which will measure time to the nearest second	1		
		e.g. use the car odometer	1		
		which will be more accurate than a distance from a map	1	4	
		OR e.g. use the marker posts on the motorway (1)			
		Which will enable an accurate distance to be found (1)			
		For each improvement allow one mark for a bald statement and the second Mark for sensible elaboration.			10
2	(a)	The sum of the kinetic (and potential) energies of all the atoms (in the gas)	1		
		inclusion of the word 'random' when applied to kinetic energies	1	2	
	(b)	(i) total mass / mass of one atom	1		
		= 0.020 (kg) /6.6 x 10^{-26} (kg)	1		
		= 3.03 x 10^{23} atoms	0	2	
		(ii) kinetic energy = ½ x 6.6 x 10^{-26} x $(440)^2$	1		
		= 6.39 x 10^{-21} J	1	2	
		(iii) 1 eV = 1.6 x 10^{-19} J	1		
		4.3 MeV = 6.88 x 10^{-13} J	1		
		ratio required = 6.88 x 10^{-13} / 6.39 x 10^{-21} = 1.08 x 10^{8}	1	3	
	(c)	(i) 19.5 % of 3.0 x 10^{23} (= 5.85 x 10^{22})	1	1	
		(ii) 1% + 2½ % = 3½ %, 3½ % of 3.0 x 10^{23} (= 1.05 x 10^{22})	1	1	
		(iii) total is 98.5 %	1		
		1.5 % of 3.0 x 10^{23} = 4.5 x 10^{21}	1	2	
		(iv) twice average speed = 880 m s^{-1}	1		
		percentage less than 900 m s^{-1} = 97 %	1		
		percentage between 880 m s^{-1} and 900 m s^{-1} about 0.8 %			
		giving 3.8 % = approx. 4 %	1	3	
	(d)	sketch shows more atoms at higher speed	1		
		and fewer atoms at lower speed	1	2	
	(e)	1 for fact 1 for brief explanation (Allow 1 for just 'change of state)		2	20
		e.g. a liquid cools when it evaporates because	1		
		faster atoms escape more readily (than slow ones)	1		
		OR e.g. a liquid evaporates more quickly at high temperature because			
		more rapid evaporation from the surface of a liquid			
		OR e.g. fast atoms in upper atmosphere may reach escape velocity			

3 (a) velocity (allow speed) 1 1

(b) (i) 3.4 (± 0.2) s 1 1

(ii) e.g. gradient = (114 – 8)/(5 – 2) = 1

= 35 (± 4) $m\ s^{-1}$ 1 2

(c) (i) Straight line through origin 1

additional detail given e.g. one of gradient approx 10, slight curve at end, 1 2

(ii) upward curve to zero at 4.9 (± 0.2) s 1

positive half loop to zero at 7.9 (± 0.2) s 1 2

(d)

distance of fall/ m	gravitational p.e. /J	elastic p.e. /J	kinetic energy /J
0	54 000	0	0
20	42 000	0	**12 000**
40	30 000	0	24 000
50 (unstretched length)	24 000	**0**	**30 000**
59 (equilibrium position)	**18 600**	**2700**	**32700**
90 (bottom)	0	**54 000**	**0**

[1] mark for each entry

PLUS an extra mark correct method for 2700 J = ½ x 67.5 x 9^2 9 9

(e) resultant force equal to zero 1

OR upward force (due to rope) = downward force (weight)

TWO further ideas required

e.g. increase air resistance 1

by spread-eagle position, or by wearing clothes with more drag 1

e.g. using different elastic in the rope 1

with greater hysteresis 1 5 22

e.g. less mass

difficult for a particular person

e.g. increase the damping (allow one mark only unless a reason is given)

4 (a) As a region in which a (remote) force acts on something 1

e.g. on a mass or a charge or a current in a wire (two only required) 1 2

(b) Example given 1

diagram appropriate 1

explanation of use 1

x 2 for second example 3 6 8

e.g. gravitational field. If this is measured (accurately) over a *region, a* reduced value of *g* can indicate a low density region –perhaps where oil exists

e.g. electrical field. If this is found experimentally near an irregularly shaped object the field is *strong near points*, (lightning conductor) Made use of in field ion microscope to 'see' atoms – as frequently illustrated in false colour