Physical Quantities & Units

Mark Scheme 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Physical Quantities & Units
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 3

Time Allowed: **84 minutes**

Score: **/70**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1	**(a**	**(i)** $Q = It$ (*allow any subject for the equation*)	B	[1]
		(ii) I	B1	
		t	B1	[2]
		(*allow 1 mark only if all three quoted*)		
	(b)	**(i)** base unit of I is A		
		base unit of n is m^{-3} (*not* $/m^{-3}$)		
		base unit of S is m^2		
		base unit of q is A s (*not C*)		
		base unit of v is $m\ s^{-1}$		
		(*–1 for each error or omission*)	B3	[3]
		(ii) $A = m^{-3}\ m^2\ A\ s\ (m\ s^{-1})^k$	M1	
		e.g. for m: $0 = -3 + 2 + k$		
		$k = 1$	A1	[2]

2	**(a**	allow anything in range 20 Hz → 20 kHz	B1	[1]
	(b)	allow anything in range 10 nm → 400 nm	B1	[1]
	(c)	allow anything in range 10 g → 100 g	B1	[1]
	(d)	allow anything in range 0.1 kg m^{-3} → 10 kg m^{-3}	B1	[1]

CHEMISTRY ONLINE
— TUITION —

3	**(a**	kg m s^{-2}	B1	**[1]**
	(b)	kg m^{-1} s^{-1}	B1	**[1]**
	(c) (i)	$v^2 = 2gs$		
		$= 2 \times 9.8 \times 4.5$	C1	
		$v = 9.4$ m s^{-1}	A1	**[2]**
	(ii)	*either*		
		F (= $3.2 \times 10^{-4} \times 1.2 \times 10^{-2} \times 9.4$) = 3.6×10^{-5} N	M1	
		weight of sphere (= mg = $15 \times 10^{-3} \times 9.8$) = 0.15 N	M1	
		3.6×10^{-5} << 0.15, so justified	A1	**[3]**
		or		
		$mg = crv_T$ (M1)		
		terminal speed = 3.8×10^4 m s^{-1} (M1)		
		9.4 << 3.8×10^4, so justified (A1)		

4	**(a)**	allow 100 m s^{-1} → 900 m s^{-1}	B1	**[1]**
	(b)	allow 0.5 kg m^{-3} → 1.5 kg m^{-3}	B1	**[1]**
	(c)	allow 5 g → 50 g	B1	**[1]**
	(d)	allow 2×10^3 cm^3 → 9×10^3 cm^3	B1	**[1]**

CHEMISTRY ONLINE
— TUITION —

5	**(a)**	scalar: magnitude only	B1	
		vector: magnitude and direction *(allow scalar with direction)*	B1	**[2]**
		(allow 1 mark for scalar has no direction, vector has direction)		
	(b)	diagram has correct shape	M1	
		with arrows in correct directions	A1	
		resultant = 13.2 ± 0.2 N *(allow 2 sig. fig)*	A2	**[4]**
		(for 12.8 → 13.0 and 13.4 → 13.6, allow 1 mark)		
		(calculated answer with a correct sketch, allow max 4 marks)		
		(calculated answer with no sketch – no marks)		
		Total		**[6]**

6	kg m^{-3}	B1	
	frequency or count rate or activity or decay constant	B1	
	NC^{-1} or V m^{-1} or kg m s^{-2} C^{-1} etc.	B1	
	momentum or impulse.....	B1	[4]
	(Allow solidus notation and non SI units)		

7	**(a)** (i)	mass/ volume ...(ratio must be clear).....	B1	
	(ii)	kg m^{-3} OR kg / m^3	B1	[2]
	(b)	v has unit of m s^{-1}	B1	
		$p\,Ip$ has unit of kg m^{-1} s^{-2} / kg m^{-3} (no e.c.f. from (a))	M1	
		$\sqrt{(p\,Ip)}$ has unit of m s^{-1}	A1	
		LHS = RHS so y has no unit	AO	[3]

8	**(a**	speed = distance / time and velocity = displacement / time		
		speed is a scalar as distance has no direction **and** velocity is a vector as displacement has direction	B1	[2]
	(b)	**(i)** <u>constant</u> acceleration or linear/uniform increase in velocity until 1.1 s	B1	
		rebounds or bounces or changes direction	B1	
		decelerates to zero velocity at the same acceleration as initial value	B1	[3]
		(ii) $a = (v - u)/t$ or use of gradient implied	C1	
		= (8.8 + 8.8) / 1.8 or appropriate values from line or = (8.6 + 8.6) / 1.8		
		= 9.8 (9.78) m s^{-2} or = 9.6 m s^{-2}	A1	[3]
		(iii) **1.** distance = first area above graph + second area below graph	C1	
		= (1.1 × 10.8) / 2 + (0.9 × 8.8) / 2 (= 5.94 + 3.96)	C1	
		= 9.9 m	A1	[3]
		2. displacement = first area above graph – second area below graph	C1	
		= (1.1 × 10.8) / 2 – (0.9 × 8.8) / 2		
		= 2.0 (1.98) m	A	[2]
		(iv) correct shape with straight lines and all lines above the time axis or all below	M1	
		correct times for zero speeds (0.0, 1.15 s, 2.1 s) and peak speeds (10.8 m s^{-1} at 1.1 s and 8.8 m s^{-1} at 1.2 s and 3.0 s)		[2]
9	**(a**	the wire returns to its original length (*not 'shape'*)	M	
		when the load is removed	A1	[2]
	(b)	energy: N m / kg m^2 s^{-2} and volume m^3	C1	
		energy / volume: kg m^2 s^{-2} / m^3	M1	
		energy / volume: kg m^{-1} s^{-2}	A0	[2]
	(c)	ε has no units	B1	
		E: kg m s^{-2} m^{-2}	M1	
		units of RHS: kg m^{-1} s^{-2} = LHS units / satisfactory conclusion to show *C* has no units	A1	[3

10	(a) (i)	(change in) potential energy= *mgh*	C1	
		= 0.056 × 9.8 × 16		
		= 8.78 J *(allow 8.8)*	A1	[2]
	(ii)	(initial) kinetic energy= *½mv2*	C1	
		= ½ × 0.056 × 18^2		
		= 9.07 J *(allow 9.1)*	C1	
		total kinetic energy= 8.78 + 9.07 = 17.9 J	A1	[3]
	(b)	kinetic energy= *½mv2*		
		17.9 = ½ x 0.056 x *v2* and *v* = 25(.3) m s^{-1}	81	[1]
	(c)	horizontal velocity= 18 m s^{-1}	81	[1]
	(d) (i)	correct shape of diagram		
		(two sides of right-angled triangle with correct orientation)	81	
	(ii)	angle = 41 ° – 48° (allow trig. solution based on diagram)	A2	[3]
		(for angle 38°-,, 41° or 48°-,, 51°, allow 1 mark)		

CHEMISTRY ONLINE
— TUITION —