Ideal Gases

Mark Scheme 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Ideal Gases
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 1

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

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

1	(a	pressure = force / area (normal to force)	A1	[1]
	(b)	molecules/atoms/particles in (constant) random/haphazard motion	B1	
		molecules have a change in momentum when they collide with the walls	M1	
		(force exerted on molecules) therefore force on the walls	A1	
		reference to average force from many molecules/many collisions	A1	[4]
	(c)	elastic collision when kinetic energy conserved	B1	
		temperature constant for gas	B1	[2]

2	(a	apparatus: cell with particles e.g. smoke (container must be closed)	B1	
		diagram showing suitable arrangement with light illumination and microscope	B1	[2]
	(b)	specks / flashes of light	M1	
		in random motion	A1	[2]
	(c)	cannot see what is causing smoke to move hence molecules smaller than smoke particles	(B1)	
		continuous motion of smoke particles implies continuous motion of molecules	(B1)	
		random motion of particles implies random motion of molecules	(B1)	
			max. 2	[2]

3	(a	any two of: large number of molecules / atoms / particles molecules in random motion no intermolecular forces elastic collisions time of collisions much less than time between collisions volume of molecules much less than volume of containing vessel	B1 + B1	[2]
	(b)	molecules collide with the walls change in momentum of molecules implies force (on molecules) molecules exert equal and opposite force on wall pressure is averaging effect of many collisions (*any three statements, 1 each*)	B	[3]

4	**(a**	density in solids and liquids similar	M1	
		spacing in solids and liquids about the same	A1	
		density in gases <u>much</u> less as spacing in gases much greater	B1	[3]
	(b)	density = mass / volume	C1	
		mass = 1.67×10^{-27} kg and volume = $4/3\ \pi\ r^3$	C1	
		density = $(1.67 \times 10^{-27}) / 4/3 \times \pi \times (1.0 \times 10^{-15})^3$		
		= 3.99×10^{17} kg m^{-3}	A1	[3]
	(c)	atoms / molecules composed of large amount of empty space / nucleus has very small volume compared to volume of atom / space between atoms in a gas is very large	B1	[1]

5	**(a** **(i)**	solid has fixed volume and fixed shape/incompressible	B1	[1]
	(ii)	gas fills any space into which it is put	B1	[1]
	(b)	atoms/molecules have (elastic) collisions with the walls (of the vessel)	B1	
		momentum of atom/molecule changes	B1	
		<u>so</u> impulse (on wall)/force on wall	B1	
		random motion/many collisions (per unit time) gives rise to (constant) force/pressure	B1	[4]
	(c)	spacing (much) greater in gases than in liquids/about ten times	C1	
		either spacing depends on $1/\sqrt[3]{\rho}$		
		or ratio of spacings is about 8.8	A1	[2]

6	**(a**	haphazard / random / erratic / zig-zag movement	M1	
		of (smoke) particles (*do not allow molecules / atoms*)	A	[2]
	(b)	motion is due to unequal / unbalanced collision rate**<u>s</u>** (on different faces)	B1	
		(unequal collision rate due to) random motion of (gas) molecules / atoms	B1	[2]
	(c)	*either* collisions with air molecules average out	M1	
		this prevents haphazard motion	A1	[2]
		or particle is more massive / heavier / has large inertia (M1)		
		collision**<u>s</u>** cause only small movements / accelerations (A1)		

7	**(a)**	speck of light	B1	
		that moves haphazardly/randomly/jerkily/etc.	B1	**[2]**
	(b)	randomness of collisions would be 'averaged out'	B1	
		so less (haphazard) movement	B1	**[2]**
		(do not allow 'more massive so less movement')		

8	**(a**	mean speed = $1.44 \times 10^3\,\mathrm{m\,s^{-1}}$	A1	[1]
	(b)	evidence of summing of individual squared speeds	C1	
		mean square speed = $2.09 \times 10^6\,\mathrm{m^2\,s^{-2}}$	A1	[2]
	(c)	root-mean-square speed = $1.45 \times 10^3\,\mathrm{m\,s^{-1}}$	A1	[1]
		*(allow ECF from **(b)** but only if arithmetic error)*		