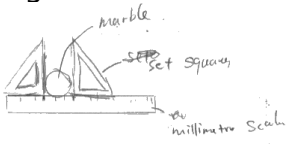
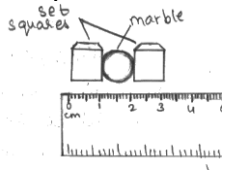
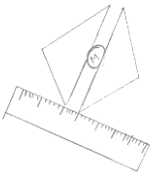
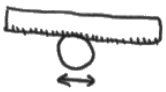
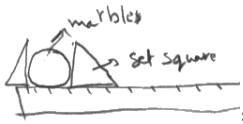
Question number	Answer	Notes	Marks
2 (a)	MP1. set squares used correctly to mark diameter of marble; MP2. Set squares measured against ruler; MP3. EITHER repeat and find average (mean); OR measure 2 or more marbles (in a line);	allow labelled diagram  =mp1 +2  =mp1 +2  =mp2  =0  = mp1 +2	3
(b)	Any 5 from MP1. mass measured; MP2. suitable device for measuring mass; MP3. suitable container named e.g. measuring cylinder, displacement can; MP4. displacement method described (can be shown on diagram); MP5. volume determined e.g.=volume after-volume before or volume displaced;	Allow labelled/annotated diagram uses diameter to calculate the volume states V= 4/3 π r^3	5

	MP6. repeats and averages OR more than 2 marbles used; MP7. uses density= mass/volume;	 allow recognisable symbols	

Total 8 marks

Question number			Answer	Notes	Marks
4	(a)		(however expressed) driving force> resistive force;	there is a resultant force forces are not balanced	1
	(b)	i	a= **change** in velocity time;	in words or accepted symbols	1
	b	ii	substitution; evaluation;		2
			e.g. a= 24-15 6 a= 9/6 = 1.5 (m/s^2)		
	(c)		any two from: MP1. braking force increases; MP2. the driving / forward force becomes zero/decreases; MP3. air resistance decreases (as speed decreases); MP4. resultant force is now in opposite direction;	the overall resistive force /backwards force increases allow resultant force increases for 1 mark	2

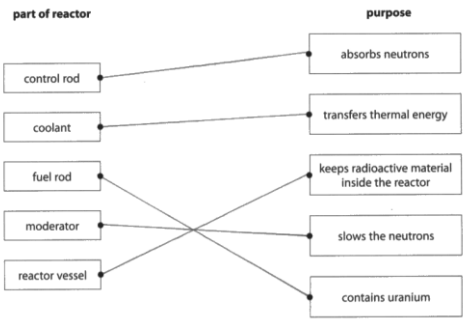
Total 6 marks

Question number	Answer	Notes	Marks
6 (a)	a microphone; a loudspeaker;		2
b i	v= f x λ;	in words or accepted symbols any rearranged form	1
ii	changing kHz into Hz; substitution; evaluation; e.g. 12 000 = 12 000 000 v = 25 x 12 000 000 300 000 000 (m/s)	seen anywhere 3.0×10^8 (m/s) POT error loses the conversion mark	3

Total 6 marks

Question number	Answer	Notes	Marks
9 (a)	gravitational potential (energy);	GPE	1
b	any three of: MP1. turbine spins; MP2. (causes) coils of wire spin; MP3. between the poles of (large) magnets; MP4. current or voltage is **induced;** MP5. in or across the coils of wire;	allow turbines rotates magnets spin inside coils of wire	3
c	any one of: MP1. to keep voltage or current (value) constant; MP2. voltage (or current) produced depends on the speed of rotation (of coil);	allow frequency of voltage depends on the speed of rotation	1
d i	efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$		1
ii	substitution; rearrangement; evaluation of useful energy; subtraction from input energy; e.g. $\frac{36}{100} = \frac{\text{output energy}}{1050}$ gains 1 OP energy = $\frac{36 \times 1050}{100}$ gains 2 =378 (kJ) gains 3 wasted energy = 1050-378 = 672 (kJ) gains 4	allow alternative method by calc 64% of 1050 kJ POT error (often as 36 not seen as % or fraction) loses 1st mark	4
iii	any two suitable energy forms: e.g. thermal energy (of the water); frictional heating (along the pipe/in bearings); noise/sound;	 condone 'heat' not just 'friction'	2

Total 12 marks

Question number	Answer	Notes	Marks
12 (a)	5 correct lines score 4 marks;;;; 4 or 3 correct lines score 3 marks;;; 2 correct lines score 2 marks;; 1 correct line scores 1 mark;  		4
b	C neutrons;		1
c	any four from: MP1. neutron absorbed by; MP2. uranium(-235) **nucleus**; MP3. causing it to split; MP4. into 2 daughter **products /nuclei / isotopes**; MP5. releasing further neutrons /energy;	only accept precise terminology allow hits/collides/eq allow named products	4
d	any three comparisons from (however expressed): MP1. decay is random but fission is not; MP2. fission induced by input particle but decay occurs without an input particle; MP3. fission produces 2 daughter nuclei but decay produces only 1; MP4. α or β are emitted from decay but not from fission;		3

	MP5. decay rate can't be altered but rate of fission can; MP6. Number of fissionable isotopes much less than radioactive isotopes;		

Total 12 marks