EDEXCEL GCSE ADDITIONAL SCIENCE (360SCIENCE)

SCIENCE



EXAM QUESTION PACK

UNIT P2 HIGHER TIER 5020H PAPERS

STEMUP

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Centre No.						Paper Reference (complete below)							Surname	Initial(s)
Candidate No.										H	/	1 H	Signature	

Paper Reference(s)

5020H/1H 5048H/1H

Edexcel GCSE

Additional Science (5020H)

Physics (5048H)

P2 – Topics 9 to 12

Higher Tier

Tuesday 7 June 2011 – Afternoon

Time: 30 minutes

Materials required for examination
Calculator

Items included with question papers
Nil

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature, and complete the paper reference.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use blue or black ink.
Show all stages in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 5 questions in this question paper. The total mark for this paper is 30.
There are 12 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.

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FORMULAE

You may find the following formulae useful.

$\text{average velocity} = \dfrac{\text{displacement}}{\text{time}}$	$v = \dfrac{s}{t}$
$\text{acceleration} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{(v-u)}{t}$
force = mass × acceleration	$F = m \times a$
momentum = mass × velocity	$p = m \times v$
change in potential energy = mass × gravitational field strength × change in height	$PE = m \times g \times h$
kinetic energy = ½ × mass × (velocity)^2	$KE = ½ \times m \times v^2$
electrical energy = voltage × current × time	$E = V \times I \times t$
$\text{power} = \dfrac{\text{work done}}{\text{time taken}}$	$P = \dfrac{W}{t}$
work done = force × distance moved in the direction of the force	$W = F \times s$

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1. Alex flies a Boeing 777 over a city at night.
The plane's anti-collision lights flash once every second.
The photograph shows several seconds of his flight from left to right.



The photograph shows the plane as it accelerates from left to right.
State **two** pieces of evidence in the photograph which suggest that the plane is accelerating.

1 .....

.....

2 .....

.....

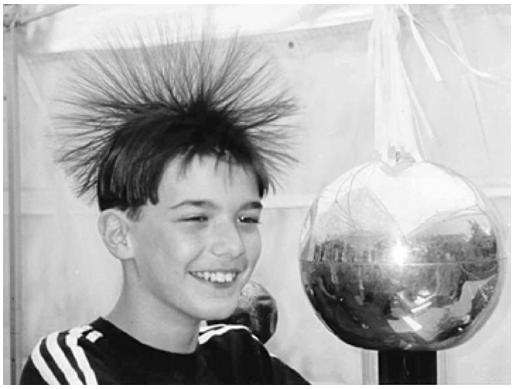
Q1

(Total 2 marks)

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2. (a) Darren has been charged up using a Van de Graaff generator.
His teacher tells him he is negatively charged.



State why his hair stands on end.

.....

.....

(1)

(b) Bev combs her hair with a plastic comb.
Bev's hair also gains a negative charge and her hair stands on end.

Explain how Bev's hair gains a negative charge.

.....

.....

.....

.....

.....

.....

(3)

Q2

(Total 4 marks)

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Leave blank

3. Safety engineers investigate car crashes.

(a) First the safety engineers accelerate a car.
The car contains a test dummy which has a mass of 80 kg.
The average acceleration of the test dummy is 7.5 m/s^2.

Calculate the average accelerating force acting on the test dummy.
State the unit.

force = ... unit = ...

(3)

(b) Next the safety engineers crash the car into a wall.



The car hits the wall at 25 m/s.
The car takes 0.12 s to stop.
Calculate the average acceleration of the car.

acceleration = ... m/s^2

(2)

Q3

(Total 5 marks)

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4. (a) (i) The table shows some properties of alpha and beta particles.
Complete the table.

particle	nature	charge	range in air	ionising ability
alpha	2 protons and 2 neutrons	+2	5 cm	.....
beta	.....	.....	over 50 cm	medium

(2)

(ii) Why do alpha particles travel a shorter distance in air than beta particles?

.....

.....

.....

(1)

(b) Radon-222 and radon-226 are both unstable isotopes of radon.

(i) Explain the word **isotopes**.

.....

.....

.....

(1)

(ii) The activity of a sample of radon-222 is 160 Bq.
Calculate its activity two half-lives later.
Show your working.

activity two half-lives later = ... Bq

(2)

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Leave blank

(iii) Radon-222 occurs naturally as a gas and decays by emitting alpha particles. Explain why radon-222 is more dangerous as a gas than it would be as a solid.

.....

.....

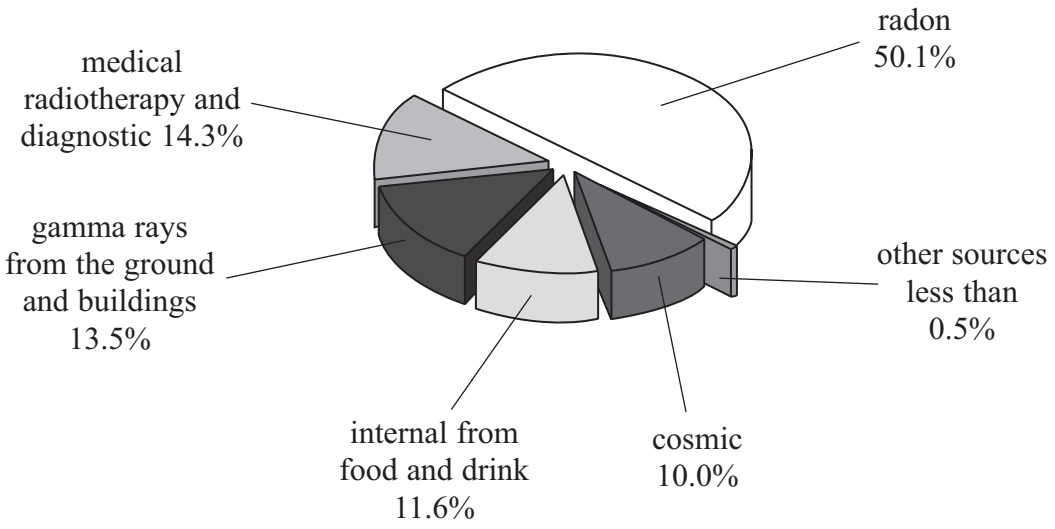
.....

.....

.....

(2)

(iv) The diagram shows the composition of the average background radiation in the U.K.



The background radiation is different from place to place within the U.K.

Explain how radon-222 gas contributes to these regional variations in the background radiation.

.....

.....

.....

.....

.....

(2)

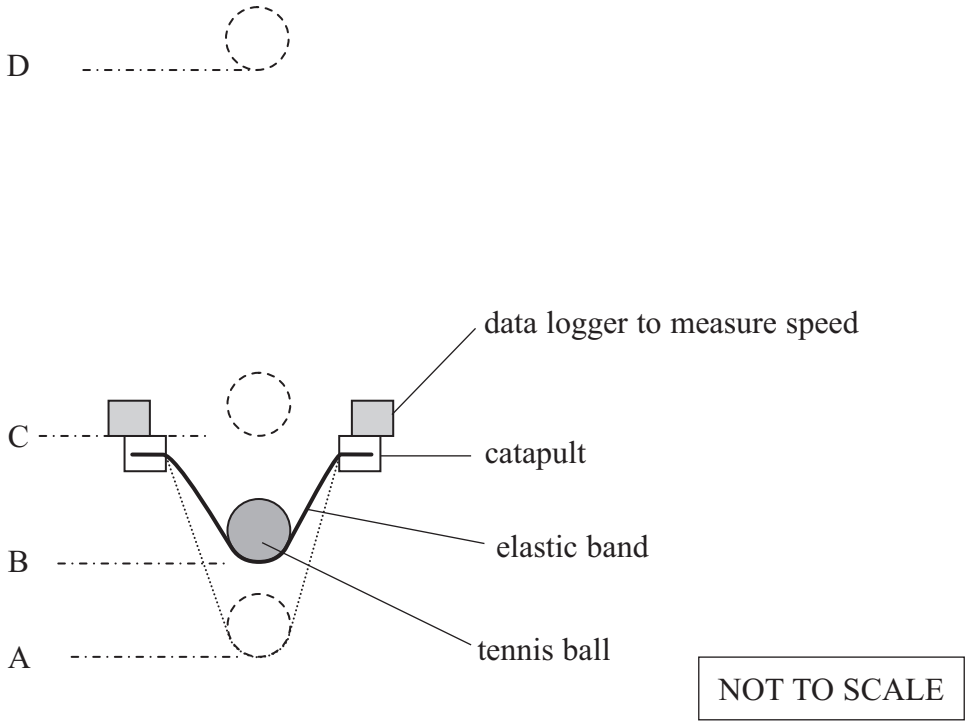
Q4

(Total 10 marks)

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5. Andrew investigates gravitational potential energy and kinetic energy.
He uses a modified catapult to fire a tennis ball vertically upwards as shown.
He pulls the elastic band to position B and then lets it go.
The data logger measures the speed of the tennis ball at position C, just above the level of the catapult.



(a) The mass of the tennis ball is 0.057 kg.
The speed of the tennis ball at C is 5.6 m/s.

(i) Show that the kinetic energy of the tennis ball at C is about 0.9 J.

(2)

(ii) Calculate the theoretical maximum height that the tennis ball can rise above C.
Gravitational field strength is 10 N/kg.

maximum height above C = ... m

(3)

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Leave blank

(iii) In practice, the tennis ball does not reach this theoretical maximum height. Explain why.

.....

.....

(1)

(b) Andrew repeats his investigation.
This time he stretches the elastic band further, to A.
Compare the speed at C now with that when it was released from B.
Explain your answer in terms of energy.

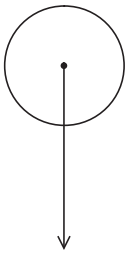
speed at C is .....

reason.....

.....

(1)

(c) The diagram shows the resultant vertical force acting on the tennis ball when it passes C on the way up.



Explain why the ball continues to move upwards even though the resultant force is downwards.

.....

.....

.....

.....

.....

.....

(2)

Q5

(Total 9 marks)

TOTAL FOR PAPER: 30 MARKS

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Mark Scheme (Results)

June 2011

360Science

GCSE Additional Science
Structured Paper P2 (5020H/1H)

GCSE Physics
Structured Paper P2 (5048H/1H)

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5020H & 5048H Mark Scheme
June 2011

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
1	**Marks may be in any order**. 1. (flashes of)light get further apart ; 2. idea that plane changes direction;	allow dots for lights path is curved /bent	getting dimmer		**(2)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
2(a)	like charges repel ;	• (negative) hairs repel (each other) • hair repelled by head • (because of) static (electricity) • electrons repel	• repeat of stem • idea of transfer of electrons to positive hair		**(1)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
2(b)	Any **three** from: 1. comb / plastic is an insulator; 2. idea of charging by friction or rubbing; 3. electrons; 4. (negative charges) <u>transfer</u>; 5. from comb (to hair) ;	friction causes static	repeat of stem e.g. 'combs' 'puts a negative charge'	for MP3,4 and 5 idea of protons or positive charges moving positive electrons	**(3)**

Question Number	Answer		Acceptable answers	Ignore	Reject	Mark
3(a)	**substitution** **evaluation** **unit**	= 80 x 7.5; = 600; N;	 bald correct ans = 2 marks unit independent acceptable units are • kg m/s^2 • newton		 for unit mark • Ns • kg/m/s^2	 **(3)**

Question Number	Answer		Acceptable answers	Ignore	Reject	Mark
3(b)	**substitution** **evaluation**	(a =) $\frac{0 - 25}{0.12}$ (-)210	a = $\frac{25 - 0}{0.12}$ 208 bald correct ans = 2 marks	signs		 **(2)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
4(a)(i)	<table><tr><th>particle</th><th>nature</th><th>charge</th><th>range in air</th><th>ionising ability</th></tr><tr><td>alpha</td><td>2 protons and 2 neutrons</td><td>+ 2</td><td>5 cm</td><td>high / strong / good/ best</td></tr><tr><td>beta</td><td>either • electron or • positron</td><td>- / minus + / positive 1</td><td>over 50 cm</td><td>medium</td></tr></table>			reject contradiction within a box for that box ;; 4 correct = 2 marks 2 or 3 correct = 1 mark 1 correct = 0	**(2)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
4(a)(ii)	Any **one** of the following ideas which compare alpha and beta: 1. (alpha has) high(er) ionising ability; 2. (alpha) more likely to make collision ; 3. bigger charge ; 4. travels slower ;	‘more’ or ‘greater’ for ‘higher’ makes many collisions more mass	ideas of penetration or absorption		**(1)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
4(b)(i)	same number protons AND different number of neutrons;	same {element / atomic number} different {mass / nucleon} number e.g. same element different number of neutrons	same atom electrons		**(1)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
4(b)(ii)	1. idea that two half-lives mean divide by 4 / eq ; 2. 40 (Bq) ;	 correct answer full marks allow $\frac{160}{2}$ or 80 (Bq) for 1 mark			**(2)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
4(b)(iii)	Any **two** from: 1. breathe in gas ; 2. short range of alpha (in air); 3. damage /ionise tissue ; 4. radon gas can {disperse/spread} ORA;	 solid can't enter the body as easily does not penetrate skin damage to { lungs / cells /mouth } can cause cancer radon gas is harder to contain can build up (in houses) harder to filter from the air solid cannot {disperse/spread}	 harder to see solid harder to escape the solid does not penetrate paper damage to body /person		**(2)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
4(b)(iv)	for 1 mark any **one** from: 1. radon from rocks / ground 2. some parts of the country have high levels of radon-bearing rocks 3. radon major contributor to background ; AND for 1 mark idea that higher levels of gas give a higher background;	 from granite / soil different levels of {radon / gas} in different parts of the country biggest % / (over) ½ / 50% less radon gas reduces the background			**(2)**

Question Number	Answer		Acceptable answers	Ignore	Reject	Mark
5(a)(i)	**substitution ;** **evaluation ;**	(KE =) ½ x0.057x 5.6^2 =0.89 (J) (which rounds to 0.9)	allow alternative methods e.g. start with KE = 0.9.....	unit		**(2)**

Question Number	Answer		Acceptable answers	Ignore	Reject	Mark
5(a)(ii)	**substitution** **transp**. **evaluation**	0.89=0.057x10xh h= $\frac{0.89}{10 \times 0.057}$ 1.6 (m)	sub and transpose in either order ecf from (a) allow use of 0.9 for energy value h= $\frac{0.9}{10x.057}$ 1.56 (m) to 1.58 bald correct ans = 3 marks			**(3)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
5(a)(iii)	air resistance (increases the force acting on the ball);	{air friction} / drag (slows the ball down quicker) energy is lost as {heat / thermal}	changes in g wind sound comments about density		**(1)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
5(b)	Idea of increase in speed **AND** more initial energy ;	faster (at C) more KE (at C/ gained) more PE at A more energy from elastic band			**(1)**

Question Number	Answer	Acceptable answers	Ignore	Reject	Mark
5(c)	Any **two** from: 1. acceleration is downwards ; 2. {momentum /velocity} is upwards ; 3. (resultant) force reduces the {velocity / momentum} (to zero) ;	 acceleration is in opposite direction to {velocity/speed} ball is slowing down ball is decelerating still has momentum (resultant/downward) force causes {slowing down/deceleration}	KE PE	upward {force/acceleration} for MP1 and MP2	**(2)**

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Mark Scheme Summer 2009

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GCSE 360Science

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Additional Science (2103)
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Additional Science 5020H/1H
Physics 5048H/1H
P2 Mark Scheme

Question Number	Answer	Accept	Ignore	Reject	Mark
1(a)	any 2 from: causal mechanism what moves which direction;;	e.g. (due to) friction/rubbing negative charge moves OR electrons onto hose OR from fuel	repeat of stem	Reject incorrect physics reject for the last two marking points ions or positive electrons	**(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
1(b)	consequence AND *some* explanation; OR explanation AND *some* consequence	both needed for the mark e.g. chance of explosion as fuel is flammable chance of explosion/ignition if spark static build-up/it could ignite fuel static build-up/it could cause explosion spark/it could ignite fuel	Do not award repeat of stem…'it is dangerous' (electric /static) shock	unqualified explosion	**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
1(c)	movement of charge (in wire); effect of this movement;	electrons/charges move (along the wire / from hose to plane) this discharges it/the static build-up this neutralises it this earths it / to earth this grounds it / to ground gives plane and hose the same potential/ same charge Prevents build-up of charge for **both** marks	 floor	ions or positive electrons for the first mark UNLESS mark has been deducted in 5a	 **(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
2(a)	any sensible *suggestion*;	• lack of perception of risk • to check for fit (with movement of feet) • children had scientific interest • to keep them happy/amused			 **(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
2(b)	any sensible concept **and** consequence based on physics; OR they can cause DNA mutation	**both** needed Any sensible suggestion e.g. X-rays are dangerous…. <u>and</u> • need trained operator • need to limit dose of X-rays • in high doses • with long exposure • shielding is needed look for reversed answers such as ionising radiation and therefore dangerous they can cause cancer / cell mutation / cell damage	Confusion with gamma too expensive unqualified ‘dangerous’ unqualified health-risk		**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
2(c)(i)	any sensible *suggestion*;	• doctors are trained • doctors understand the risks /know what they are doing • (they) closely monitor /control the dose • (they)/doctors take suitable precautions during use • idea of lesser of 2 risks--X-ray or illness • will do more good than harm • this use is sensible / eq / ORA	• Can/ helps to diagnose illness unless qualified, e.g. barium x-ray • Dose is less nowadays • Used to treat illness		**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
2(c)(ii)	can 'see' what is happening in real time/eq	• ORA • X-ray gives you one photo—fluoroscope gives continuous monitoring • See it as it is done • Moving/video images possible	'better (image)' is not enough portability cost smaller area can be in same room or converse clear(er) image		**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
3(a)(i)	he/she should raise it ; bring it forwards; *either order*	• for either mark but only credit this once: move it so that it is in the good/ correct region • make the height equal to Y (Y in range +4cm to -6 cm) / reduce height difference / eq • make the backset equal to X (X in range 0-8cm) /reduce the backset /eq •	move it vertically increase the height difference change the backset		**(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
3(a)(ii)	reduction of chance of injury;	• reduction of named relevant injury e.g. whiplash • to ensure (correct) support of head • (correct) protection of neck / head • to make sure its in the good region on the graph *if not given in 3ai*	bald 'its safer'		**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
3(b)	any sensible suggestion;	perception of improved safety e.g. he thinks he's safer with ABS brakes reduction in risk avoidance			**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
3(c)	decreases rate of change of momentum for **both** marks OR any **two** from longer time of impact momentum **is reducing to zero** force is reduced;;	reduces momentum more slowly for 2 marks Slower impact **If no argument in terms of momentum/time/force** then allow a maximum mark of 1 for an energy argument, e.g. absorbs some of the energy of the car	references to stopping distance of car bald 'reduces momentum' 'absorbs momentum'		**(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
4(a)(i)	(atom/nucleus with) same no of protons different numbers of neutrons;	allow same element /atomic no different number of neutrons /atomic mass /mass number	Bald different mass	Same no of n different no of p	**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
4(a)(ii)	alpha is 4 nucleons, tritium has (only) 3) /eq;	tritium has only 1p, 2p are in alpha tritium has not got enough mass tritium has not got enough nucleons tritium has not got enough p tritium has not got enough p+n	tritium is too small tritium has not got enough neutrons		**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
4(b)	any **one** from energy explanation absorption explanation penetration explanation;	e.g. • beta particles have given up all their KE on impact • beta particles have hit phosphor therefore none can escape • beta can not penetrate thick glass	beta particles have low ionisation /OWTTE no gas can escape gas /beta can not leak		**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
4(c)(i)	**time** for half of the **atoms** to **decay** OR **time** for the (radio)**activity** to drop to half (of original value);	accept isotope / element / nuclei / radioactive substance/radioactive material / tritium for atoms must be clear and correct as to what has halved	mass particles matter	**do not accept** ion(s)/atom/reactivity **do not accept** decompose/die/lose for decay	**(1)**

Question Number	Answer	Accept	Ignore	Reject	Mark
4(c)(ii)	method shown as maths or on graph; 13.5 years; +/- 0.5 years	Bald correct answer (in range) with unit, 2 marks, without unit 1 mark check values from graph allow y or yrs for years			**(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
4(d)	**both** must be seen • correct statement re time (at which the count is 400 or count at 20 years) • correct judgement re claim	description of fading/OWTTE *with* time comparison of 440 to 400	random nature of decay mention of half-life		**(1)**

Question Number	Answer	Accept	Comments	Reject	Mark
5(a)(i)	subst.; ans; unit;	38 × 1.2 45.6 kg m/s	unit is independent mark, allow Ns		**(3)**

Question Number	Answer	Accept	Accept	Reject	Mark
5(a)(ii)	subst.; ans;	35 × 6 210(J)	ignore missing unit	incorrect units for one mark	**(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
5(b)(i)	Frank continues in straight line; no force acting on him to cause him to change direction;	• He carries on straight • He slides to outside of sledge • He falls off outside of sledge Any of above mark points can be gained either in words or by unambiguous additions to diagram (eg arrow / clear sequence of blobs) . • there is no force / friction to keep him going in a circle / hold him on the sledge • no change in direction of momentum • he has inertia	References to trajectory of sledge		**(2)**

Question Number	Answer	Accept	Ignore	Reject	Mark
5(b)(ii)	he will hit the <u>far</u> side of the box;	• hits outer edge of box • breaks through the side of the box • box tips over / Simon falls out (to the outside of the arc)	Unqualified "Simon stays inside the box"	Box tips over /Simon falls out to **inside** of arc / backwards	**(1)**

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Q1a,b,c		Correct Answer		Acceptable Answers	Ignore	Reject	Mark
	1a	0.135(m)				13.5 cm	**1**
	1b	subst.; ans; units;	250 000 × 0.135 33 750 J / joules / Nm	ecf from incorrect ans in (a) bald correct answer (allowing for ecf from (a) if appropriate) gains 2 marks (if (a) is omitted a bald 3 375 000 =1 mark) **independent mark**		 nm / NM /Js	3
	1c	33 750 (J);		**allow ecf from 1b** Can give credit for correct unit mark if *missing* in (b) but correctly written in response to (c)			**1**

Q1d/e		Correct Answer		Acceptable Answers	Ignore	Reject	Mark
	1d	subst.; ans;	230 × 21 × 12 57960(J)	bald correct answer gains 2 marks	 units (note: units were tested in Qib)		2
	1e	idea of transferred into heat / thermal /sound or named E type AND named place or 'dissipated to the surroundings'		changed/dissipated / OWTTE e.g. the motor/bearings heat(s) up (overcome) friction in named place	 wasted to the surroundings	KE PE chemical	**1**
Q2a		Correct Answer		Acceptable Answers	ignore	Reject	Mark
	2a	subst; ans;	18/2.4 7.5 (m/s)	 7 ½ 7.50 bald correct answer gains both marks		incorrect units in the answer	**2**

Q2b		Correct Answer	Acceptable Answers	Ignore	Reject	Mark
	2b	either **idea** that ball does not travel at constant speed; or **idea** that path of ball is not straight;	• speed decreases • velocity changes/varies/ alters spin/swerve of ball	• references to possible experimental error • differences in bowlers • need to repeat the experiment etc. • references to the bowling action	• increase in speed • speed **fluctuates** (implies goes up as well as down)	**1**

Q2c		Correct Answer		Acceptable Answers	Ignore	Reject	Mark
	2c	subst or rearrangement; ans;	90=1.5 X a OR a=F/m OR a=90/1.5; a=60	bald correct answer gains both marks		incorrect units in the answer	**2**

<table>
<tr><td>Q3a</td><td>3</td><td colspan="2">Correct Answer</td><td colspan="2">Further Instruction</td><td>Mark</td></tr>
<tr><td></td><td>3a</td><td colspan="2"><table><tr><th>particle</th><th>charge sign</th><th>charge size</th></tr><tr><td>alpha</td><td>positive /+</td><td>2</td></tr><tr><td>beta</td><td>- given</td><td>1given</td></tr></table></td><td colspan="2">both needed for mark</td><td>1</td></tr>
<tr><td>Q3bi</td><td></td><td>Correct Answer</td><td>Acceptable Answers</td><td>Ignore</td><td>Reject</td><td>Mark</td></tr>
<tr><td></td><td>3bi</td><td>(neutral source) becomes positive;</td><td>allow symbols e.g. +ve</td><td>size of the charge if mentioned</td><td>Source goes negative to positive</td><td>1</td></tr>
<tr><td>Q3bii</td><td></td><td>Correct Answer</td><td>Acceptable Answers</td><td>Ignore</td><td>Reject</td><td>Mark</td></tr>
<tr><td></td><td>3bii</td><td>any TWO from
• action at a distance i.e. attraction between strip and source;
• copper strip becomes negative;
• (source and strip) oppositely charged;</td><td>one is positive the other is negative</td><td></td><td>arguments based on non-electric forces such as magnetic or gravitational for both marks
for 3rd marking point copper positive</td><td>2</td></tr>
</table>

Q3b iii 1,2		Correct Answer	Acceptable Answers	Ignore	Reject	Mark
	3biii 1	lifespan is dependant on the **activity** of the source **or** *solely* dependant on half life of source;	• (no of) particles emitted (per sec) is not affected by gap size • half life has not changed so battery life has not changed • allow other references to the half life of the source *if* suitably qualified and in sufficient detail			**1**
	3biii2	idea of time-being reduced or shorter; alpha has/transfers twice as much charge or +2 or more charge ;	time is less time is halved/reduced to ¼	• reference to ionising effect of alpha • sign of charge • stronger		**2**

Q3b iv 1,2,3		Correct Answer	Acceptable Answers	Ignore	Reject	Mark
	3biv 1	hydrogen 3 PLUS energy emitted is lowest;	**comparative is needed** allow suitably correct ORA 'less' for lowest' 0.02 (MeV) is (very) small only 0.02(MeV)		**do not allow the term 'radiation' as a alternative to 'energy'**	**1**
	3b iv 2	half life too short OR consequences of short half life; high level of energy emitted (per beta particle) OR consequences of high level energy emitted;	**only** 50 days decays quickly/runs out quickly needs replacing does not last long enough E is quite high/ too much need for shielding causes/risk of harm to humans	powerful	**do not allow the term 'radiation' as a alternative to 'energy'**	**2**
	3biv 3	nickel PLUS TWO from • long half life • low energy emitted • consequence of long half life	½ life is 100years 'will last for his life (time)'		**do not allow the term 'radiation' as a alternative to 'energy'**	**1**

		• consequence of low E;	'does not require shielding'			
Q4ai		Correct Answer	Acceptable Answers	Ignore	Reject	Mark
	4ai	good description of fusion to include 2 or more named/small/light element PLUS one from • join together/combine • forms heavier 'atom'/He; good description of fission to include any TWO from • neutron collides with • 'heavy'/high mass/named atom • splits up/ breaks apart • forms 2 or more smaller/lighter/daughter atoms; minimum of TWO conditions for fusion from • high pressure • very high temperature • high particle density;	nucleus/nuclei/ion/atom for element nucleus/nuclei for atom in fission LOOK FOR CONDITIONS FOR FUSION IN DESCRIPTION OF FUSION	particles references to energy released • references to energy released • chain reactions • extra neutrons released • particles	molecules collide (without sticking together) molecules	**3**

Q4aii		Correct Answer	Acceptable Answers	Ignore	Reject	Mark
	4a ii	description of difficulty in maintaining any specified condition or (currently) more E in than E out;	• credit explanations of current progress / status e.g. magnetic bottles contain plasma for up to 6 mins • can't contain plasma • can't *maintain* the (high) temperatures • needs high temperature AND high pressure/particle density	• Can't reach the temps required is not enough • creation of energy • economic arguments	• answers for fission • 'dangerous'	**1**
Q4bi/ ii		Correct Answer	Acceptable Answers	Ignore	Reject	Mark
	4b i	any sensible e.g. • possible supply of more environmentally friendly energy • potentially large amounts of energy with minimal equipment • could get fusion to work at low temps/conditions easier to achieve • excitement over/curious about new ideas/contradictory theories • no-one had ever done it before	renewable if qualified cheap if qualified normally needs high temps	vague statements such as "solve our energy problems" references to energy in *v* energy out safety arguments	more energy out than put in	**1**
	4b ii	any sensible e.g. • seems to contradict existing theories • no existing theory of cold fusion • not yet consistently reproducible • lack of proper peer review	not enough evidence	not yet proven		**1**

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