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Mark Schemes Summer 2009

IGCSE

IGCSE Physics (4420)

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Contents

Physics 4420-1F Mark Scheme

Abbreviations used in mark schemes:
OWTTE - or words to that effect
dop - depending on previous
ecf - error carried forward
ora - or reverse argument
sfs - start from scratch
UP - unit penalty

Question Number	Acceptable Answers	Extra Information	Mark
1 (a)	250 (metres)		1

Question Number	Acceptable Answers	Extra Information	Mark
1 (b)	6 (minutes) Six		1

Question Number	Acceptable Answers	Extra Information	Mark
1 (c)	C B A	correct order essential	1

Question Number	Acceptable Answers	Extra Information	Mark
1 (d)	5 (minutes) five (minutes)		1

Question Number	Acceptable Answers	Extra Information	Mark
1 (e)	17 (minutes)		1

Question Number	Acceptable Answers	Extra Information	Mark
2 (a)	flat		1

Question Number	Acceptable Answers	Extra Information	Mark
2 (b)(i)	reflection	accept minor misspellings but not anything which could be refraction	1
2 (b)(ii)	$a = g$	accept $g = a$	1
2 (b)(iii)	normal	do not credit 'horizontal' or 'perpendicular'	1

Question Number	Acceptable Answers	Extra Information	Mark
2 (c)(i)	virtual (image)		1
2 (c)(ii)	rays/light (only) seem/appear to c from behind the mirror **dop**	**or** real rays/light do(es) not come from behind the mirror **or** cannot be seen on a screen **or** cannot touch the person behind mirror	1

Question Number	Acceptable Answers	Extra Information	Mark
3 (a)(i)	only the blade		1

Question Number	Acceptable Answers	Extra Information	Mark
3 (a)(ii)	(danger of) electric shock	accept 'electrocution' '(severe) burn'	1
3 (b)(i)	kettle/soldering iron/(electric) fire etc. accept any of a large variety of answers in which the heat is the useful output but not, for example '(electric) drill'	 do not credit television do not credit lamp unless specified as an incandescent lamp (bulb)	1
3 (c)(i)	through the wire ignore reference to cap	do not credit any suggestion that the glass is part of the path	1
3 (c)(ii)	electrical heat/thermal / internal	correct order essential	1 1

Question Number	Acceptable Answers	Extra Information	Mark
3 (c)(iii)	increase		1

Question Number	Acceptable Answers	Extra Information	Mark
3 (c)(iv)	any two • if the current is too big • fuse wire will melt/circuit breaks • (so) appliance/wiring protected from overheating • fire risk reduced/removed	 or if the circuit/wires/cable is overloaded do not credit prevents electric shock do not credit just 'safer'/ 'less dangerous'	2

Question Number	Acceptable Answers	Extra Information	Mark
4 (a)(i)	wavelength		1
4 (a)(ii)	yellow ... blue	either order	1

Question Number	Acceptable Answers	Extra Information	Mark
4 (b)(i)	frequency wavelength	allow for (1) if both correct but order reversed	1 1

Question Number	Acceptable Answers	Extra Information	Mark
4 (b)(ii)	infra-red /i.r. .... ultraviolet /u.v.	either order	1
4 (b)(iii)	speed velocity		1

Question Number	Acceptable Answers	Extra Information	Mark
4 (b)(iv)	food/medical equipment germs/bacteria/microrganisms	accept any appropriate example e.g. prawns/forceps accept any appropriate example e.g. streptococcus	1 1

Question Number	Acceptable Answers	Extra Information	Mark
5 (a)	(A) = B + C + D	accept lower case and any order	1

Question Number	Acceptable Answers	Extra Information	Mark
5 (b)	electrical		1
5 (c)	heat/thermal/internal		1

Question Number	Acceptable Answers	Extra Information	Mark
5 (d)	(efficiency =) $\frac{B}{A}$ (× 100 %) or any correct definition of efficiency	or (efficiency =) B ÷ A (× 100 %) or (efficiency =) $\frac{B}{B + C + D}$ (× 100 %) or (efficiency =) useful output (× 100%) ÷ (total) input or (efficiency =) useful energy (× 100%) ÷ kinetic energy	1

Question Number	Acceptable Answers	Extra Information	Mark
6 (a)(i)	(in) parallel		1
6 (a)(ii)	otherwise they could not be switched (on and off) independently dop	or otherwise they would either all be off or all on do not credit unless part (a)(i) correct	1

Question Number	Acceptable Answers	Extra Information	Mark
6 (b)	mA	credit any unambiguous method used to identify the correct response	1

Question Number	Acceptable Answers	Extra Information	Mark
6 (c)(i)	current		1

Question Number	Acceptable Answers	Extra Information	Mark
6 (c)(ii)	cell battery rectified mains		1
6 (d)	alternating current	accept minor misspellings but do not credit 'alternative current'	1

Question Number	Acceptable Answers	Extra Information	Mark
7 (a)(i)	electron(s)		1
7 (a)(ii)	neutron(s)		1
7 (a)(iii)	electron(s)		1
7 (a)(iv)	neutron(s) proton(s)	either order but both required	1

Question Number	Acceptable Answers	Extra Information	Mark
7 (b)(i)	(the) nucleus	accept 'the centre'	1

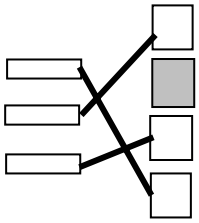
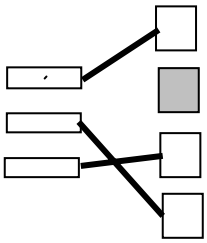
Question Number	Acceptable Answers	Extra Information	Mark
7 (b)(ii)	Geiger-Muller counter photographic film	deduct (1) each, up to (2) marks, for additional boxes ticked	1 1

Question Number	Acceptable Answers	Extra Information	Mark
8 (a)(i)	N S		1
8 (a)(ii)	attraction between unlike poles dop		1

Question Number	Acceptable Answers	Extra Information	Mark
8 (b)(i)	steel		1
8 (b)(ii)	magnetically hard materials do not easily lose their magnetism ora so effects will last longer		1 1

Question Number	Acceptable Answers	Extra Information	Mark
9 (a)	moment moment equilibrium		1 1 1

Question Number	Acceptable Answers	Extra Information	Mark
9 (b)	to the left to the left	towards end X / away from the pivot/the girl/(end) Y towards end X/ the pivot/the boy / away from (end) Y	1 1

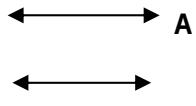
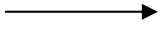
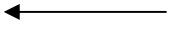
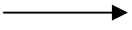
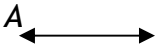
Question Number	Acceptable Answers	Reject	Mark
10 (a)	 or 	two lines going from one object or two lines going to one graph.	**3**

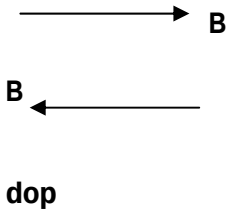
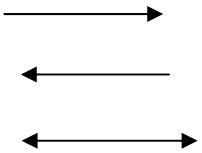
Question Number	Acceptable Answers	**ct**	Mark
10 (b)(i)	force extension weight *x* load strain mass *F* stress *either order* <u>directly</u> **dop**	distance elasticity length stretch	**1** **1**

Question Number	Acceptable Answers	reject	Mark
10 (b)(ii)	(graph) D just the straight line	spring metal wire	**1**

Question Number	Acceptable Answers	Extra Information	Ignore	Mark
11 (a)(i)	move hand further up and down or Increase (size of) vibration or increase **A**	**owtte**		**1**
11 (a)(ii)	change or reduce frequency **(1)** increase frequency/ decrease period hand (up and down) faster/more often	scores both mark	moves the chair closer uses rope of different length	**2**

Question Number	Acceptable Answers	Extra Information	Mark
11 (b)	Use of $v = f \times \lambda$ 1.5 x 0.8 = 1.2 (m/s)	 **nwn**	**1** **1** **1**

Question Number	Acceptable Answers	Reject	Mark
11 (c)(i)	 **A** **A** seen anywhere along spring **A**  and  with at least one labelled	 *A* 	**1**

11 (c)(ii)	 **dop**	unlabelled 	**1**

Question Number	Acceptable Answers	Extra Information	Mark
12 (a)	expands less reduces **no ecf** convection conduction **ecf** radiation **ecf**	 either order	**1** **1** **1** **1** **1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
12 (b)	Use of $W = m \times g$ and/or 3 500 x 10 = 35 000 (N)	 **nwn** allow use of 9.8 or 9.81 (34 300 or 34335)	**1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
13 (a)(i)	**Be**cqu**erel**(s) **Be**qu**erel**(s) **Be**cu**erel**(s) **Be**cq**erel**(s) **Be**ck**erel**(s)		**1**

Question Number	Acceptable Answers	Extra Information	Mark
13 (a)(ii)	2 half lives / 2 divisions by 2 2 500 (Bq)	**nwn** 2 500 scores both marks	**2**

Question Number	Acceptable Answers	Ignore	Mark
13 (b)(i)	**same** number of protons atomic number element **different** number of neutrons nucleons mass number nucleon number **dop**	electrons particle molecule atom	**2**

Question Number	Acceptable Answers	Extra Information	Mark
13 (b)(ii)	background (radiation) background (activity) background (radioactivity)		**1**

Question Number	Acceptable Answers	Reject	Mark
13 (c)	tracer/leak detector dating smoke detector/fire alarm thickness or quality control/gauging crack detection sterilising/destroy bacteria **ANY TWO**	nuclear energy nuclear weapons	**2**

Question Number	Acceptable Answers	Extra Information	Mark
14 (a)	6/20 = 24/N N = 80	or any transposed form **nwn**	**1** **1**

Question Number	Acceptable Answers	Reject	Ignore	Mark
14 (b)	reverse input and output OWTTE		reverse current	**1**
14 (c)	output too high/ output dangerous/240 V	high current		**1**
14 (d)	reduce current/reduce power loss/reduce energy loss/reduce heat loss		reduces resistance more efficient	**1**

Question Number	Acceptable Answers	Extra Information	Mark
15 (a)(i)	opposite/unlike charges (attract)	+ and – (attract)	**1**

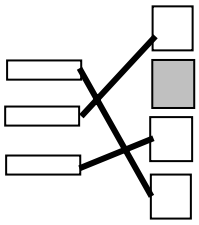
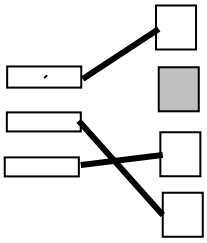
Question Number	Acceptable Answers	Extra Information	Mark
15 (a)(ii)	now positively charged/ like charges repel	ignore 'neutral'	**1**

Question Number	Acceptable Answers	Extra Information	Mark
15 (b)	charges on metal can move all over/ whole frame is charged/ back is negative		**1**
15 (c)	give them a positive charge/ cover them up		**1**
15 (d)	photocopier/fingerprinting (inkjet) printer removing pollution from chimneys sticking balloons to walls/any classroom demonstration safe use of sparks	Reject : prevent explosions on aircraft	**2**

Question Number	Acceptable Answers	Ignore	Mark
16 (a)(i)	vibrate **owtte**		**1**
16 (a)(ii)	randomly slide over each other move around move freely		**1**
16 (b)	not close-packed widely spaced not touching	reference to movement or density	**1**

Question Number	Acceptable Answers	Extra Information	Mark
16 (c)	evaporation boiling		**1**

PAPER TOTAL 100 MARKS

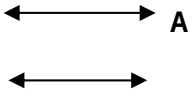
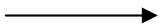
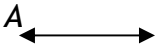
Question Number	Acceptable Answers	Reject	Mark
1 (a)	 or 	two lines going from one object or two lines going to one graph.	**3**

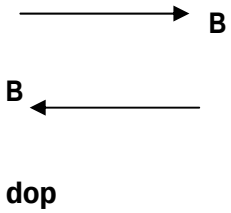
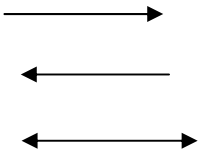
Question Number	Acceptable Answers		**ct**	Mark
1 (b)(i)	force weight load mass *F* stress	extension *x* strain	distance elasticity length stretch	**1**
	either order <u>directly</u> **dop**			**1**

Question Number	Acceptable Answers	reject	Mark
1 (b)(ii)	(graph) D just the straight line	spring metal wire	**1**

Question Number	Acceptable Answers	Extra Information	Ignore	Mark
2 (a)(i)	move hand further up and down or Increase (size of) vibration or increase **A**	**owtte**		**1**
2 (a)(ii)	change or reduce frequency **(1)** increase frequency/ decrease period hand (up and down) faster/more often	scores both mark	moves the chair closer uses rope of different length	**2**

Question Number	Acceptable Answers	Extra Information	Mark
2 (b)	Use of $v = f \times \lambda$ 1.5 x 0.8 = 1.2 (m/s)	 **nwn**	**1** **1** **1**

Question Number	Acceptable Answers	Reject	Mark
2 (c)(i)	 **A** **A** seen anywhere along spring **A**  and  with at least one labelled	 *A* 	**1**

2 (c)(ii)		unlabelled 	**1**

Question Number	Acceptable Answers	Extra Information	Mark
3 (a)	expands less <u>reduces</u> **no ecf** convection conduction **ecf** radiation **ecf**	 either order	**1** **1** **1** **1** **1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
3 (b)	Use of $W = m \times g$ and/or 3 500 x 10 = 35 000 (N)	 **nwn** allow use of 9.8 or 9.81 (34 300 or 34335)	**1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
4 (a)(i)	**Be**cqu**erel**(s) **Be**qu**erel**(s) **Be**cu**erel**(s) **Be**cq**erel**(s) **Be**ck**erel**(s)		**1**

Question Number	Acceptable Answers	Extra Information	Mark
4 (a)(ii)	2 half lives / 2 divisions by 2 2 500 (Bq)	**nwn** 2 500 scores both marks	**2**

Question Number	Acceptable Answers	Ignore	Mark
4 (b)(i)	**same** number of protons atomic number element **different** number of neutrons nucleons mass number nucleon number **dop**	electrons particle molecule atom	**2**

Question Number	Acceptable Answers	Extra Information	Mark
4 (b)(ii)	background (radiation) background (activity) background (radioactivity)		**1**

Question Number	Acceptable Answers	Reject	Mark
4 (c)	tracer/leak detector dating smoke detector/fire alarm thickness or quality control/gauging crack detection sterilising/destroy bacteria **ANY TWO**	nuclear energy nuclear weapons	**2**

Question Number	Acceptable Answers	Extra Information	Mark
5 (a)	6/20 = 24/N N = 80	or any transposed form **nwn**	**1** **1**

Question Number	Acceptable Answers	Reject	Ignore	Mark
5 (b)	reverse input and output OWTTE		reverse current	**1**
5 (c)	output too high/ output dangerous/240 V	high current		**1**
5 (d)	reduce current/reduce power loss/reduce energy loss/reduce heat loss		reduces resistance more efficient	**1**

Question Number	Acceptable Answers	Extra Information	Mark
6 (a)(i)	opposite/unlike charges (attract)	+ and – (attract)	**1**

Question Number	Acceptable Answers	Extra Information	Mark
6 (a)(ii)	now positively charged/ like charges repel	ignore 'neutral'	**1**

Question Number	Acceptable Answers	Extra Information	Mark
6 (b)	charges on metal can move all over/ whole frame is charged/ back is negative		**1**
6 (c)	give them a positive charge/ cover them up		**1**
6 (d)	photocopier/fingerprinting (inkjet) printer removing pollution from chimneys sticking balloons to walls/any classroom demonstration safe use of sparks	Reject : prevent explosions on aircraft	**2**

Question Number	Acceptable Answers	Ignore	Mark
7 (a)(i)	vibrate **owtte**		**1**
7 (a)(ii)	randomly slide over each other move around move freely		**1**
7 (b)	not close-packed widely spaced not touching	reference to movement or density	**1**

Question Number	Acceptable Answers	Extra Information	Mark
7 (c)	evaporation boiling		**1**

Question Number	Acceptable Answers	Extra Information	Reject	Mark
8 (a)	has size/magnitude/(quantitative) value/ quantity /amount **and** direction	either order	unit	**1**

Question Number	Acceptable Answers	Extra Information	Mark
8 (b)	(unbalanced force =) X-Y or in words e.g. forward force – backward force forward force - drag		**1**

Question Number	Acceptable Answers	Extra Information	Mark
8 (c)	acceleration is a vector or acceleration is not a scalar	<u>acceleration</u> and any **one** other from the list are vectors/not scalars scores 1	**2**

Question Number	Acceptable Answers	Reject	Mark
9 (a)	uniform constant uniformed regular	continuous linear strong equal even balanced attractive the same polar	**1**

Question Number	Acceptable Answers	Extra Information	Mark
9 (b)	north/N ..... south/S	correct order essential	**1**

Question Number	Acceptable Answers	**Reject**	Mark
9 (c)	charged positive or negative parallel/along owtte	positive negative towards	**1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
10 (a)(i)	pressure (difference) = density × *g* × height (g may be referred to as 'gravity' but not 'acceleration') *p* = *hρg*	or any correctly transposed version accept *d* for density	**1**
10 (a)(ii)	1025 × 10 × any height 1025 x 10 x (135-15) = <u>1 230 000</u> pascal(s)/Pa or <u>1230</u> kilopascal(s)/kPa	1025 x 10 x 135 = 1 383 750 or 1025 x 10 x 15 = 153 750 or 1025 x 10 x 150 = 1 537 500 **nwn** 1 205 400 or 1 206 630 allow N/m^2	**1** **1** **1**

Question Number	Acceptable Answers	Reject	Mark
10 (a)(iii)	in all directions all around	downwards	**1**

Question Number	Acceptable Answers	Extra Information	Mark
10 (b)	air/atmosphere /gas(es)/named gas either weight of ..... **or** ..... above us **dop**	ignore ideas of collisions	**1** **1**

Question Number	Acceptable Answers	Reject	Mark
11 (a)	variable resistance variable resistor rheostat	resistance resistor thermistor	**1**
11 (b)	rate ..... charge or any named charged particle		**1**
11 (c)	coulomb(s) amp(ere)(s) sec(ond)(s)	C A s **ignore** quantity e.g charge	**1** **1** **1**
11 (d)(i)	electrons		**1**
11(d)(ii)	negatively charged **or** attracted to positive **or** repelled from negative		**1**

Question Number	Acceptable Answers	Extra Information		Mark
12 (a)(i)	acceleration = <u>change in velocity</u> time (taken) $a = (v - u) / t$	or any correctly transposed version allow 'speed' instead of 'velocity'		1
12 (a)(ii)	correct pair of readings from the graph e.g. 45 m/s and 30 minutes 45/1800 = 0.025 **nwn** m/s^2	 45/30 = 1.5 **nwn** m/s/min	 45/0.5 = 90 **nwn** m/s/h	**1** **1** **1**

Question Number	Acceptable Answers	Ignore	Mark
12 (b)	50 <u>m/s</u> scores 2 marks or constant velocity steady speed uniform motion or not accelerating scores only 1 mark	terminal velocity	**2** **1**
12 (c)	km or kilometre		**1**

Question Number	Acceptable Answers	Ignore	Mark
13 (a)(i)	weight/gravity is greater than friction/drag **ora** or downward force greater than upward force **ora**	upthrust	**1**
13 (a)(ii)	air resistance air friction drag	upthrust wind	**1**
13 (a)(iii)	increases (gets) bigger (gets) larger builds up		**1**

Question Number	Acceptable Answers	Reject	Mark
13 (a)(iv)	terminal velocity terminal speed		1

Question Number	Acceptable Answers	Extra Information	Mark
13 (b)(i)	(kinetic energy) = ½ mass × speed ^{2}	or (KE) = ½ m v^2 or any correctly transposed version	1
13 (b)(ii)	32.4 = ½ × 0.80 × v^2 v = 9 **nwn** m/s or metres/second	v^2 = 81 or v = √81 scores 1st mark	1 1 1

Question Number	Acceptable Answers	Extra Information	Mark
14 (a)	Use of $p_1V_1 = p_2V_2$ $\frac{250 \times 450}{200}$ = 560 (kPa)	 562.5 scores 2	**1** **1** **1**
14 (b)	no change in temperature mass stays constant	or the gas does not get any hotter/cooler or no gas escapes (from the gas-holder) *answers in either order*	**1** **1**

Question Number	Acceptable Answers	Reject	Mark
14 (c)	kilopascal(s) 1000 pascals *any recognisable spelling*	kN/m^2 pascal **ignore** pressure	**1**

Question Number	Acceptable Answers	Extra Information	Mark
15 (a)(i)	(GPE =) mass × acceleration due to gravity × height mass × gravitational field strength × height mass × gravity × height weight x height gravitational force (on mass) x height *mgh*	 or any correctly transposed version	**1**
15 (a)(ii)	400 × 10 × 8 = <u>32 000</u> (J) **nwn**	 scores both marks	**1** **1**
15 (a)(iii)	32 000 (J)	**or** candidate's answer for (a)(ii)	**1**

Question Number	Acceptable Answers	Extra Information	Mark
15 (b)(i)	*either (1)* short stopping time large deceleration **or** large negative acceleration force = mass x deceleration/acceleration **or** $F = m \times a$ **or** <u>*F*</u> is proportional to *a*	*or(2)* short stopping distance large amount of energy transferred work done = force x distance $W = F \times d$ *no mix and match (1) and (2)*	 **1** **1** **1**
15(b)(ii)	up(wards)		**1**

Question Number	Acceptable Answers	Extra Information	Mark
16 (a)	-273 0/zero	do not credit 273	**1**

Question Number	Acceptable Answers	Extra Information	Mark
16 (b)(i)	increases faster speeds up		**1**
16 (b)(ii)	increases		**1**

Question Number	Acceptable Answers	Ignore	Mark
16 (c)	(average) (kinetic energy)doubles	pressure doubles	**1**

Question Number	Acceptable Answers	Reject	Mark
17 (a)	magnetic field electromagnetic field	field electric field magnetic force	**1**

Question Number	Acceptable Answers	Extra Information	Mark
17 (b)	(Fleming's) left hand (rule) thumb - motion/movement/force first finger - (magnetic) field second finger – current field from north/N to south/S or left to right *and* current from positive/+ to negative/- or downwards	**Reject 'left hand grip rule'** may be given either in writing or on a diagram but do not credit if there is a contradiction may be given either in writing or on a diagram but do not credit if there is a contradiction	**1** **1** **1**

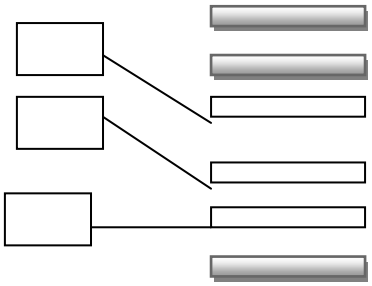
Question Number	Acceptable Answers	Extra Information	Mark
17 (c)	any one • increase the current or voltage • use a stronger/more powerful magnet • move magnets closer together • longer length of wire in the field • reduce the resistance/use a thicker wire	not : bigger magnet	**1**

Question Number	Acceptable Answers	Extra Information	Mark
17 (d)	(loud)speaker headphones		**1**

Question Number	Acceptable Answers	Extra Information	Mark
18 (a)	path continues along the surface as a horizontal line to the right	arrow not essential but a contradictory arrow cancels the mark	**1**
18 (b)	*either* for refraction to take place the angle of incidence must be smaller than or equal to the critical angle **or** angle of incidence for which angle of refraction is 90 degrees.	*or* if the angle of incidence is greater than the critical angle (total internal) reflection will occur	**1**
18 (c)	sine of = $\frac{1}{\text{refractive index}}$ critical angle	or sin *c* = $\frac{1}{n}$ or any correctly transposed version	**1**

Question Number	Acceptable Answers	Extra Information	Mark
18 (d)(i)	it will be (totally internally)reflected (towards the sea- bed)	allow minor misspellings but do not credit any word which could just as well be refracted	**1**
18 (d)(ii)	total internal reflection	all three words essential allow minor misspellings but do not credit any word which could just as well be refraction	**1**

Question Number	Acceptable Answers	Extra Information	Mark
18 (e)	continued in a straight line and reflected at the inside face of the optical fibre two, three or four reflections seen in total	angle of incidence = angle of reflection as judged by eye further arrows not essential but a contradictory arrow loses a mark	**1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
19 (a)		if more than one arrow links a feature or an observation box do not credit either arrow	**1** **1** **1**

Question Number	Acceptable Answers	Extra Information	Mark
19 (b)	$^{4}_{2}He$	must be correct in every detail	**1**

Question Number	Acceptable Answers	Extra Information	Mark
19 (c)(i)	$^{14}_{7}N + ^{0}_{-1}e$	must be correct in every detail	**1**
19 (c)(ii)	beta/ß (radiation) electrons are emitted *independent marks*		**1** **1**

PAPER TOTAL 120 MARKS

Physics 4420-03 Mark Scheme

Question Number	Acceptable Answers	Extra Information	Mark
1 (a)(i)	1.12 (seconds) 1.12 1.12 s		1

Question Number	Acceptable Answers	Extra Information	Mark
1 (a)(ii)	1. getting less with time reaction time gets quicker each time getting less left to right They are all the same within the range 0.22 to 0.15 Reject they are all the same 2. starting and stopping at will not having to react as he is the one starting the process It is not a reaction to something happening only tests how quickly he can move his finger Reject watch has a time lag	 1 1	 2

Question Number	Acceptable Answers	Extra Information	Mark
1 (b)	12.5 30 –12.5 = 17.5 Correct final answer with no working gets three marks	 Correct subtraction from 30	1 1 1

Question Number	Acceptable Answers	Extra Information	Mark
1 (c)(i)	7/seven		1

Question Number	Acceptable Answers	Extra Information	Mark
1 (c)(ii)	7 x 0.02 = 0.14 (s) 8 x 0.02 scores 0/2 7 x 0.2 scores 0/2		1 1

Question Number	Acceptable Answers	Extra Information	Mark
1 (c)(iii)	dots getting further apart gaps getting bigger(and bigger) dots at start closer than dots at end		1

Question Number	Acceptable Answers	Extra Information	Mark
1 (c)(iv)	0.19 s ecf Allow tolerance of ± 0.005 s Allow correct time (0.19) if distance not written down. No credit for wrong time if distance not written down		1

Question Number	Acceptable Answers	Extra Information	Mark
2 (a)(i)	87 87 g 87 grams/grammes 0087	reject 86.73	1

Question Number	Acceptable Answers	Extra Information	Mark
2 (a)(ii)	• wrong units/ balance shows mass (not force) • difficult to exert same force each time • balance needs constant not momentary force/force changes as key is pressed	ANY TWO	2

Question Number	Acceptable Answers	Extra Information	Mark
2 (b)(i)	1.6 (May be on diagram) 1.6 x 1.6 = 2.56/ 2.6		1 1

Question Number	Acceptable Answers	Extra Information	Mark
2 (b)(ii)	0.73 /2.56 **ecf** for area = 0.28/0.281/0.285/0.29 2 or 3 s.f.		1 1 1

Question Number	Acceptable Answers	Extra Information	Mark
2 (b)(iii)	Link to sf in raw data Ignore answer in terms of dp ignore description of rounding 0.29 is 3sf does not score Allow same number of figures as force (because 0.73 is the least accurate item of data) Have same margin of accuracy as data		1

Question Number	Acceptable Answers	Extra Information	Mark
3 (a)	3.6		1

Question Number	Acceptable Answers	Extra Information	Mark
3 (b)(i)	27	Working not required for mark	1

Question Number	Acceptable Answers	Extra Information	Mark
3 (b)(ii)	one reading/There is an anomalous result/ 52 taken for 2 minutes/ more than a minute **DOP**	Ignore distance changed Ignore another source was present	1 1

Question Number	Acceptable Answers	Extra Information	Mark
3 (c)(i)	6 / 0 to 6 (cm)		1

Question Number	Acceptable Answers	Extra Information	Mark
3 (c)(ii)	1. Find background count 2. Place detector close to/touching source 3. Record counts (in one minute) / measure count rate/ measure counts per minute 4. Repeat for other distances 5. Note distance when/until count rate is about background count/ 27 6. Deduct background count from readings 7. Reference to valid safety aspect Failure to refer to background will score points 2, 3, 4 and 7 only	ANY FIVE Reject if candidate claims real count can become zero	5

Question Number	Acceptable Answers	Extra Information	Mark
3 (d)(i)	Using tweezers to handle the radioactive source		1

Question Number	Acceptable Answers	Extra Information	Mark

3 (d)(ii)	• In darkroom could not locate source/light makes no difference (to decay rate) • Fans make no difference • Alpha particles only travel short distance in air. No need for lead screen. Reject answer about tweezers	Any two points	2

Question Number	Acceptable Answers	Extra Information	Mark
4 (a)	ammeter/cell/rheostat (any missing 0/2) working series circuit	Allow any symbol that could represent a power source Allow switch Any resistor or lamp or LED loses second mark	1 1

Question Number	Acceptable Answers	Extra Information	Mark
4 (b)(i)	rule ruler metre rule metre ruler metre stick measuring tape		1

Question Number	Acceptable Answers	Extra Information	Mark
4 (b)(ii)	Measure or set *L* and measure I move slider and note *L* and *I* further repeats Note that to gain three marks the values for both length and current must be recorded more than twice Examples Measure length and Increase L by 1 cm each time and record I for each distance (3 marks) Move slider several times noting L and I (3 marks) Measure L and I, record I for different lengths (2 marks) Take reading of I at 0 cm move 1cm at a time reading I each time (3 marks)		1 1 1

Question Number	Acceptable Answers	Extra Information	Mark
4 (c)	.15 0.15 0.150		1

Question Number	Acceptable Answers	Extra Information	Mark
4 (d)(i)	column headings units readings in order First Mark Amps/I/A/Current and Distance/ length/ L second mark both units seen once somewhere Third mark readings ascending or descending but loses mark if one or more wrong		1 1 1

Question Number	Acceptable Answers	Extra Information	Mark
4 (d)(ii)	plots within ±1 mm no blobs >1mm label both axes with units	2 marks –1 each wrong 1	 3

Question Number	Acceptable Answers	Extra Information	Mark
4 (d)(iii)	circle (the candidates) 6, 0.14		1

Question Number	Acceptable Answers	Extra Information	Mark
4 (d)(iv)	curve Dot to dot with or without benefit of ruler 0/1 Curve taking in 6, 0.14 0/1		1

Question Number	Acceptable Answers	Extra Information	Mark
4 (d)(v)	measured L from wrong end	Reference to inaccurate measurements do not score	1

Question Number	Acceptable Answers	Extra Information	Mark
4 (e)	high current/overheat/higher percentage uncertainty examples Current too high for this ammeter Ammeter scale too small Reading would be more than 0.5A Result too large to plot on the graph		1

PAPER TOTAL 50 MARKS

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