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Mark Schemes Summer 2008

IGCSE

IGCSE Physics (4420)

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Contents

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

Physics 4420-1F Mark Scheme

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)(i)	P	p		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)(ii)	Q	q		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)(iii)	Q and R	q and r either order		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(i)	sloping straight independent marks but sloping and horizontal scores (0)		sloping and horizontal	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(ii)	horizontal ignore 'straight'			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (c)	less distance (travelled in section R than in section P)			**(1)**

(Total 7 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(i)	long	allow answers to (i) and (ii) in either order		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(ii)	frayed			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)	stray wire(s)			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(i)	plastic (casing)			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(ii)	small/low current			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (d)	* circuit breaker * double insulation	either one		**(1)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (a)	energy information	in either order		**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (b)	D C		wrong order	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (c)(i)	cycles/waves second/unit time		wrong order	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (c)(ii)	speed	velocity (time) period time to travel a wavelength		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (d)(i)	longitudinal			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (d)(ii)	20 Hz – 20 000 Hz			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (d)(iii)	less than			**(1)**

(Total 10 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)(i)	microphone			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)(ii)	kettle/iron/heater/ (electric) fire/ toaster/hairdryer/ soldering iron	there are many other examples credit if the useful energy transfer is from electricity to heat		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (b)	any falling body		do not credit examples where both falling and rising occur e.g. child's swing or bungee jump unless falling is specified	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (c)	heat	sound		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (d)	total energy input total energy output	in either order scores 2 or 0		**(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (e)	kinetic kinetic			**1** **1** **(2)**

(Total 8 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (a)(i)	100 000			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (a)(ii)	500 000	100 000 × 5 for (1) mark		**2** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (b)(i)	330	400 – 70 for (1) mark		**2** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (b)(ii)	background (count/radiation) random/variable/not constant			**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (c)	cosmic rays/rocks/medical etc	any two (1) each		**(2)**

(Total 9 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
6 (a)	yellow green	1 mark if colours reversed		**1** **1** **(2)**

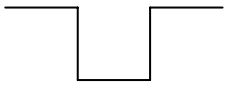
Question Number	Correct Answer	Acceptable Answers	Reject	Mark
6 (b)(i)	A infra-red B ultra violet		answers reversed	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
6 (b)(ii)	B / ultra violet			**(1)**

(Total 5 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
7 (a)(i)	continuously	continually		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
7 (a)(ii)	1 0	both either way round accept 'on' and 'off' accept 'high' and 'low'		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
7 (b)	first horizontal line in high position  next horizontal line in low position next horizontal line in high position	ignore any missing vertical lines		**1** **1** **1** **(3)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
7 (c)	easier to build/design/regenerate/amplify /clean up/ less noise /carry more information.			**(1)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
8 (a)	boiling	evaporation		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
8 (b)	four particles shown smaller spacing than gas shown free movement shown			**1** **1** **1** **(3)**

(Total 4 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
9 (a)(i)	0.8 (seconds)	4/5 second 8/10 second	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
9 (a)(ii)	3.2 (seconds)	3 1/5 allow **ecf** from (i) 4.0 – previous answer	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
9 (a)(iii)	*one line* horizontal line beyond 0.8 less steep slope down (to the *x* axis) **dop**	 *two separate lines or one of these lines* labelled 1 mark for each correct	 **1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
9 (b)(i)	air (resistance) mass of car speed (of the car) brakes tyre pressure area of tyre streamlining	drag weight (force of) gravity size shape velocity (of car)	wind (resistance) temperature	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
9 (b)(ii)	intentionally straight vertical arrow pointing downwards from, above, below or through point X	arrow from middle of car	**1** **(1)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (a)(i)	infra red *allow* phonetic spelling	i.r. IR	microwaves ultraviolet	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (a)(ii)	gamma (rays/radiation)	γ gama	X-rays	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (b)(i)	same speed (in a vacuum) same velocity (in a vacuum) *or* (travel at) speed of light (travel at)velocity of light	travel through a vacuum or empty space	transverse	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (b)(ii)	water (waves)/waves on water/tidal waves/sea waves/ocean waves	waves on (slinky) spring shaken/moved up and down or side to side waves on a rope moved up and down or side to side S waves *ignore* 'seismic' mexican wave	P waves analogue wave waves on a CRO	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (b)(iii)	90˚ energy *independent marks*	normal/ perpendicul right angles information or data wavefront/front	 crest/vibration/direction/ pattern	**1** **1** **(2)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable answers	Reject	Mark
11 (a)(i)	voltage = current × resistance *or* current = voltage/resistance *or* resistance = voltage/current	V = IR I=V/R R=V/I	V = C x R	**1** **(1)**
11 (a)(ii)	4.5 **nwn** volts or V or J/C or JC^{-1} or AΩ			**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
11 (b)	decrease increase	 Increase decrease scores 1 decrease decrease scores 1 increase increase scores 1	**1** **1** **(2)**

(Total 5 marks)

Question Number	Correct Answer	Reject	Mark
12 (a)(i)	(semiconductor)diode	LED light emitting diode	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
12 (a)(ii)	50 50	both required		**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
12 (a)(iii)	one cell is connected the wrong way	two cells cancel one another/not all facing the same way	battery	**1**
	some of the voltage is across/used up by diode/component Y/ ammeter(s)/(connecting) wire /switch	reference to resistance of these components /cells / whole circuit	voltage used up by/voltage across *voltmeter/lamp* voltmeter does not have infinite resistance *ignore* reference to current and energy	**1** **(2)**

Question Number	**Correct Answer**	Acceptable Answers	Mark
12 (b)	*any <u>three</u> points* current increases increases temperature increases resistance line or slope becomes less steep	 voltage increases increases heat **/** molecular movement non-ohmic / *I* not proportional to *V*/ decrease rate of increase /current levels off	 **1** **1** **1** **(3)**

(Total 7 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
13 (a)(i)	not moving (or vibrating) none zero	no <u>kinetic</u> energy no momentum	a response which suggests any kind of movement	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
13 (a)(ii)	-273 (˚C)	minus 273 -273.15	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
13 (a)(iii)	373 (K)	373.15(K)	373˚C	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
13 (b)	particles knock /jostle /collide smaller/invisible /air/water particles cause a change of direction **dop** only as 3rd mark	diffusion	**1** **1** **1** **(3)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
14 (a)(i)	electrons electrons	both required	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
14 (a)(ii)	*points in either order* polythene is an (electrical) insulator (so) slow to discharge /retains charge	 poor / bad (electrical) conductor 'charge (or electrons)leak away /move slowly (to earth)'	 poor conductor of heat	 **1** **1** **(2)**
14 (a)(iii)	copper is an (electrical) conductor (so charge is earthed)		copper is a good conductor of heat	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
14 (b)	spark/sparking	flame	**1** **(1)**

(Total 5 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
15 (a)	clear indication on the graph that a suitable interval has been chosen 1 ½ (hours) 90 (minutes)	 i.e. an interval between a value and half that value 87 93 or 96 **ecf** conversion of previous answer to minutes	**1** **1** **1** **(3)**

Question Number	Correct Answer	Reject	Mark
15 (b)	*any <u>two</u> points* (isotope) ingested / swallowed/eaten /taken in /injected (gamma) radiation emitted trace / track / detect (radiation) / follow progress	 X-rays alpha beta 	 **1** **1** **1** **(2)**

(Total 5 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
16 (a)	induced magnetic field responses only in this order	 flux (linkage)	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
16 (b)	(number of) primary turns _____ (number of) secondary turns	primary coils _____ secondary coils = I_S / I_P	**1** **(1)**

Question Number	Correct Answer	Mark
16(c)(i)	Just before the transmission line	**1** **(1)**

Question Number	Correct Answer	Mark
16c)(ii)	Just after the transmission line	**1** **(1)**

(Total 5 marks)

PAPER TOTAL 100 MARKS

Question Number	Correct Answer	Acceptable Answers	Mark
1 (a)(i)	0.8 (seconds)	4/5 second 8/10 second	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
1 (a)(ii)	3.2 (seconds)	3 1/5 allow **ecf** from (i) 4.0 – previous answer	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
1 (a)(iii)	*one line* horizontal line beyond 0.8 less steep slope down (to the *x* axis) **dop**	 *two separate lines or one of these lines* labelled 1 mark for each correct	 **1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(i)	air (resistance) mass of car speed (of the car) brakes tyre pressure area of tyre streamlining	drag weight (force of) gravity size shape velocity (of car)	wind (resistance) temperature	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
1 (b)(ii)	intentionally straight vertical arrow pointing downwards from, above, below or through point X	arrow from middle of car	**1** **(1)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(i)	infra red *allow* phonetic spelling	i.r. IR	microwaves ultraviolet	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(ii)	gamma (rays/radiation)	γ gama	X-rays	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(i)	same speed (in a vacuum) same velocity (in a vacuum) *or* (travel at) speed of light (travel at)velocity of light	travel through a vacuum or empty space	transverse	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(ii)	water (waves)/waves on water/tidal waves/sea waves/ocean waves	waves on (slinky) spring shaken/moved up and down or side to side waves on a rope moved up and down or side to side S waves *ignore* 'seismic' mexican wave	P waves analogue wave waves on a CRO	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)(iii)	90° energy *independent marks*	normal/ perpendicu right angles information or data wavefront/front	 crest/vibration/direction/ pattern	**1** **1** **(2)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable answers	Reject	Mark
3 (a)(i)	voltage = current × resistance *or* current = voltage/resistance *or* resistance = voltage/current	V = IR I=V/R R=V/I	V = C x R	**1** **(1)**
3 (a)(ii)	4.5 **nwn** volts or V or J/C or JC^{-1} or AΩ			**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
3 (b)	decrease increase	 Increase decrease scores 1 decrease decrease scores 1 increase increase scores 1	**1** **1** **(2)**

(Total 5 marks)

Question Number	Correct Answer	Reject	Mark
4 (a)(i)	(semiconductor)diode	LED light emitting diode	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)(ii)	50 50	both required		**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)(iii)	one cell is connected the wrong way	two cells cancel one another/not all facing the same way	battery	**1**
	some of the voltage is across/used up by diode/component Y/ ammeter(s)/(connecting) wire /switch	reference to resistance of these components /cells / whole circuit	voltage used up by/voltage across *voltmeter/lamp* voltmeter does not have infinite resistance *ignore* reference to current and energy	**1** **(2)**

Question Number	**Correct Answer**	Acceptable Answers	Mark
4 (b)	*any <u>three</u> points*		
	current increases	voltage increases	**1**
	increases temperature	increases heat **/** molecular movement	**1**
	increases resistance		**1**
	line or slope becomes less steep	non-ohmic / *I* not proportional to *V*/ decrease rate of increase /current levels off	**(3)**

(Total 7 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (a)(i)	not moving (or vibrating) none zero	no <u>kinetic</u> energy no momentum	a response which suggests any kind of movement	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
5 (a)(ii)	-273 (˚C)	minus 273 -273.15	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
5 (a)(iii)	373 (K)	373.15(K)	373˚C	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
5 (b)	particles knock /jostle /collide smaller/invisible /air/water particles cause a change of direction **dop** only as 3rd mark	diffusion	**1** **1** **1** **(3)**

(Total 6 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
6 (a)(i)	electrons electrons	both required	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
6 (a)(ii)	*points in either order* polythene is an (electrical) insulator (so) slow to discharge /retains charge	 poor / bad (electrical) conductor 'charge (or electrons)leak away /move slowly (to earth)'	 poor conductor of heat	 **1** **1** **(2)**
6 (a)(iii)	copper is an (electrical) conductor (so charge is earthed)		copper is a good conductor of heat	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
6 (b)	spark/sparking	flame	**1** **(1)**

(Total 5 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
7 (a)	clear indication on the graph that a suitable interval has been chosen 1 ½ (hours) 90 (minutes)	 i.e. an interval between a value and half that value 87 93 or 96 **ecf** conversion of previous answer to minutes	**1** **1** **1** **(3)**

Question Number	Correct Answer	Reject	Mark
7 (b)	*any <u>two</u> points* (isotope) ingested / swallowed/eaten /taken in /injected (gamma) radiation emitted trace / track / detect (radiation) / follow progress	 X-rays alpha beta	 **1** **1** **1** **(2)**

(Total 5 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
8 (a)	induced magnetic field responses only in this order	 flux (linkage)	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
8 (b)	(number of) primary turns _____ (number of) secondary turns	primary coils _____ secondary coils = I_S / I_P	**1** **(1)**

Question Number	Correct Answer	Mark
8 (c)(i)	Just before the transmission line	**1** **(1)**

Question Number	Correct Answer	Mark
8 (c)(ii)	Just after the transmission line	**1** **(1)**

(Total 5 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
9 (a)(i)	gradient	slope	area	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
9 (a)(ii)	6.0 ÷ 0.25 = 24 m/s^2 or m/s/s or ms^{-2} *ignore minus signs*	 **Nwn** N/kg or Nkg^{-1}		**1** **1** **1** **(3)**
9 (a)(iii)	$F = m \times a$ = 70 × 24 = 1680 (N)	 **ecf** from (a)(ii) **nwn**	 70 x 10 700 x 24 score 0/3	**1** **1** **1** **(3)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
9 (b)	*any <u>three</u> points* same change in velocity (in) more time less acceleration or deceleration **ora** less force **ora**	 comes to a stop over a longer distance 24 ms^{-2} is too high *allow* 'slower deceleration'	 damage to joints effect of area of contact and pressure impact reduced	 **1** **1** **1** **1** **(3)**

(Total 10 marks)

Question Number	Correct Answer	Acceptable Answers	Mark
10 (a)	recall n = sin i ÷ sin r sin i = 1.5 × sin 40° i = 74.6(°) or 75(°)	 $\sin^{-1}$(1.5 sin 40°) 73.7(°) or 74(°) **nwn** (rounding sin 40° to 0.64) i= 40˚ r = 25.3˚ scores 1st mark only	**1** **1** **1** **(3)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (b)(i)	intentional straight line from point of incidence above existing refracted ray		bending away from normal	**1** **(1)**
10 (b)(ii)	n less r is more	less dense/slows down less/less bent turns less to normal refracts less *Calculation of r = 47.9˚scores both marks*	bends away from normal greater refracted 'ray'	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (c)	external normal correctly drawn i correctly marked between incident ray and drawn normal *independent marks*	 **ecf**	arrow(s) on normal	**1** **1** **(2)**

(Total 8 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
11 (a)	fracture energy = initial gpe - final gpe i.e. E = I – F <u>in words</u>	 I = E + F F = I – E <u>in words</u>	division or product of phrases	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
11 (b)(i)	60 × 10 × 0.5 = 300 (J) nwn	60 x 9.81 x 0.5 = 294.3(j) 60 x 9.8 x 0.5 = 294(j)	**1** **1** **(2)**
11 (b)(ii)	300 / same as (i)	**ecf**	**1** **(1)**
11 (b)(iii)	½mv^2 = answer from (i) or (ii) = 3.16 (m/s)	**ecf**	**1** **1** **(2)**
11 (b)(iv)	friction / air resistance /drag not all gpe changed to ke	energy lost to a stated form e.g heat and/or sound	**1** **(1)**
11 (b)(v)	300 – 70 = 230 (J) or 0.230 kJ	allow ecf from b(i) no ecf from (a)	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
11 (c)(i)	metal any metal *ignore* 'spring'	metal spring metal wire	**1** **(1)**

Question Number	Correct Answer	Reject	Mark
11 (c)(ii)	linear region correctly marked		**1** **(1)**
11 (c)(iii)	**<u>dop</u>** <u>proportionality</u> between force(or mass or load or weight) and extension **OWTTE**	elastic behaviour	**1** **(1)**

(Total 12 marks)

Question Number	Correct Answer	Reject	Mark
12 (a)	(Fleming's) left hand (rule)	(Fleming's)right hand left hand grip rule left hand corkscrew rule	**(1)**

Question Number	Correct Answer	Mark
12 (b)(i)	**I** out of page correct direction anywhere in circuit	**1** **(1)**

Question Number	Correct Answer	Mark
12 (b)(ii)	**M** downwards allow B as a label	**1** **(1)**

Question Number	Correct Answer	Mark
12 (b)(iii)	**F** to the right **must ecf from b(i)&(ii)**	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
12 (c)	stronger magnet more current	magnets closer larger voltage/ more batteries	bigger magnets electromagnet bigger battery	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
12 (d)(i)	current/voltage varies about axis pattern repeated **dop** *maximum of 2 marks if no diagram*	diagram with at least 1½ cycles about axis scores 3 'current changes direction' scores 1 single cycle sine wave seen anywhere e.g. on a.c. supply scores 1	**1** **1** **1** **(3)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
12 (d)(ii)	(moves)backwards and forwards (quickly) vibrate (not up and down) at (a frequency of) 50 Hz *independent marks*	(moves)right and left side to side (quickly) at high frequency appears stationary	changes direction	**1** **1** **(2)**

(Total 11 marks)

Question Number	Correct Answer	Mark
13 (a)(i)	n 1 0	**1** **1** **(2)**

Question Number	Correct Answer	Mark
13 (a)(ii)	Be 9 4	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
13 (b)(i)	He	Helium 2 protons & 2 neutrons	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
13 (b)(ii)	electron ignore ß+	symbol **e-** or **β-**	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Mark
13 (c)(i)	same no of protons *ignore* 'electrons' different no of neutrons or N **dop** *exception* : 'same element with different number of neutrons' scores 1	same atomic number or Z different mass number or A different nucleon number	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
13 (c)(ii)	U-238 → Th-234 Th-234 → Pa-234 Pa -234 → U-234 bald answer (2)	 final product has atomic number 92 score 1 if no other mark scored	**1** **1** **1** **(3)**

(Total 11 marks)

Question Number	Correct Answer	Reject	Mark
14 (a)	daughter two/ three/more/ a few/several / some chain speed/velocity/kinetic energy/momentum	 fast / ≥ 4 / **1**	**1** **1** **1** **1** **(4)**

Question Number	Correct Answer	Acceptable Answers	Mark
14 (b)(i)	slow down neutrons/particles (not nuclei) enable fission to occur	absorbs (kinetic) energy of neutrons/particles reaction is more efficient **OWTTE** increase rate of collision	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
14 (b)(ii)	absorb neutrons stop / reduce / control the rate of fission or reaction	stop neutrons		**1** **1** **(2)**

(Total 8 marks)

Question Number	Correct Answer	Mark
15 (a)(i)	p = 100 × 450 / 300 = 150(kPa) nwn *any unit must be correct*	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Mark
15 (a)(ii)	same mass same volume	same amount of gas no gas lost same size (container) 'same density' scores 1 mark if no other mark scored	**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
15 (b)(i)	increased average speed **dop**	faster average (kinetic) energy average velocity speed of most of the molecules sum of speeds total of speeds	'decreased' scores 0/2	**1** **1** **(2)**

Question Number	Correct Answer	Mark
15 (b)(ii)	**(** Kelvin **)** temperature is proportional to the (average or total) kinetic energy of its molecules.	**1** **(1)**

(Total 7 marks)

Question Number	Correct Answer	Reject	Mark
16 (a)	energy charge	Joules coulomb	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
16 (b)(i)	$Q = I \times t$ / 0.60 × 2 = 1.2 (C) **nwn**			**1** **1** **(2)**
16 (b)(ii)	1.5 × 1.2 = 1.8 (J) **nwn**	allow **ecf**		**1** **1** **(2)**
16 (b)(iii)	no heat/energy lost in wires or internal resistance or cell	cell has no internal resistance/ all cell's voltage across resistor/wires have no resistance	no heat loss 100% efficient	**1** **(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
16 (c)	double cell voltage	3V add another cell		**1**
	quarter resistance value	0.625 Ω 4 × resistance wire area 2 x diameter or radius ¼ × resistance wire length		**1** **(2)**

(Total 8 marks)

PAPER TOTAL 120 MARKS

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)	55 (g)		any other answer	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(i)	measuring cylinder	graduated cylinder	just 'cylinder'	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(ii)	68 (cm^3)		64	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (b)(iii)	18 (cm^3)	allow candidate's answer to (b)(ii) – 50 example (64 – 50 =) 64 (cm^3)		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (c)(i)	3.1	or correct to 2 sig. fig. from candidate's answer to (b)(iii) and mass shown as any value other than 68 or correct calculation = 3.06 or from candidate's answer to (b)(iii) and mass shown as any value other than 68		**2** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (c)(ii)	readings (of mass / volume) (only) to 2 sig. fig. (so) the calculation/density cannot be more accurate (than this)			**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (d)(i)	density is the same the stones are the same type/rock /material /substance	or 'mass is (directly) proportional to volume'(2) marks or 'volume is (directly) proportional to mass' (2) marks		**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (d)(ii)	no because results not particularly precise e.g. she read the volume to the nearest 5 g e.g the mass of stone P is really between 29.5 and 30.5 e.g. the density of stone P could be 30.5 ÷ 10.5 (= 2.9 g/cm^3 to 2 sig. fig.)	or words to that effect accept any reasonably qualified comment or any other similar example	do not credit 'yes' or just 'no'	**1** **1** **(2)**

(Total 12 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(i)	torch <u>with slit</u> /ray box/ laser/light box /ray projector		just 'torch' just 'lamp'	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(ii)	mark two points (with a pencil) (and connect with a ruler)		just 'use a ruler'	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (a)(iii)	22 (degrees)		any other response	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (b)	17 (degrees)		any other response	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(i)	appropriate headings all in order unit given as degrees/	description of x e.g. angle between start and new position of mirror description of y e.g. angle between incident ray and reflected ray seen anywhere at least once and v no contradiction example *x* measured in ° *y* measured in 6 39 11 49 17 57 19 65 23 73 25 77		**1** **1** **1** **(3)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(ii)	both axes labelled *x* on the X axis **and** *y* on the Y a all points plotted correctly i.e. to within 1 mm 17,57 identified as anomalous/ unexpected straight line for the other points	 incorrect (-1) each dow to (0) for points a 'blob' (more than half a small square across is incorrect do not give consequential credit for mistakes		**1** **1** **3** **1** **1** **(7)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(iii)	67 (degrees)	correct reading from candidate's gr to within 1 mm (half a small square		**(1)**

(Total 15 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (a)	to reduce heat loss (from the (small) beaker)	allow 'to stop/prevent heat loss' or to insulate the beaker	do not credit any suggestion of electrical insulation or prevention of breakage	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (b)	(gently) stir (the water before taking the temperature)			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (c)(i)	5.4 6.8	5.40… 6.80…		**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (c)(ii)	ammeter	ameter ametre	ampmeter a meter current meter	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (c)(iii)	voltmeter	volt meter	Voltameter voltage meter	**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (c)(iv)	23 (˚C) and 31 (˚C) 8 (˚C)	or correct difference between candidate's readings. e.g. 37 and 49 to give 12		**1** **1** **(2)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
3 (d)	Any two (2) each appropriate point (1) amplification or linked point (1)	**examples** heat loss (1) by evaporation / from the surface of the water (1) readings would not be constant / would change(1) because of increase / change in resistance(1) some heating taking place while the variable resistor being adjusted(2) (very) difficult to ensure identical mass of water (1) because some drops remain in measuring cylinder(1) (very) difficult to ensure identical starting temperature (1) because room temperature not constant (1) temperature will not exceed 100 °C (1) when water boils (1)	do **not** accept responses such as 'the thermometer/ timer may not be accurate'	**2** **2** **(4)**

(Total 12 marks)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)	straight line drawn **and** instructions followed **and** point D marked			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (b)	instruction followed			**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (c)	instructions followed	must be labelled 'normal' and must point to 'l a' in the words 'oil and' or must be at 90^{o} to the surface		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (d) (i)	60 (degrees)	in the range 59 ↔ 61		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (d) (ii)	35 (degrees)	in the range 34 ↔ 36		**(1)**

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (e)	any two (3) each relevant problem identified (1) appropriate solution indicated (1) explanation/expansion (of either) (1) scope for a wide variety of responses the examples show the principles of the mark scheme	**examples** difficult to see the path of the light (1) through some kinds of oil (1) so use a (very) transparent oil (1) difficult to mark the path of the light (1) so use a transparent container of oil (1) lift up so you can see where the light arrives on (the inside of) the bottom of the container (1) difficult to measure the angles (1) use a 360˚ protractor (1) held so that the 0˚ - 180˚ line is along the surface of the oil (1)		**3** **3** **(6)**

(Total 11 marks)

PAPER TOTAL 50 MARKS

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