Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2017

Marking Scheme

Science

Higher Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

TABLE FOR ASSIGNING GRADES	
GRADE	RANGE
A	510 - 600
B	420 - 509
C	330 - 419
D	240 - 329
E	150 - 239
F	60 - 149
NG	0 - 59

GUIDELINES TO EXAMINERS

General Points regarding the Marking Scheme for Junior Certificate Science

1. In many cases only key phrases are given in the marking scheme. These points contain the information and ideas that must appear in the candidate's answer in order to merit the assigned marks.

2. The descriptions, methods and definitions given in a marking scheme are not exhaustive and alternative valid answers are acceptable.

3. The detail required in any answer is determined by the context and the manner in which the question is asked and by the number of marks assigned to the answer in the examination paper. This may vary from year to year.

4. The word(s) / phrase(s) used in the scheme indicate the essential points required in the candidate's answer. A double solidus (//) separates points for which separate marks are allocated in a part of the question. Words, expressions or statements separated by a solidus (/) are alternatives which are equally acceptable for a particular point. A word or phrase given in brackets is an acceptable alternative to the preceding word or phrase. Note, however, that words, expressions or phrases must be correctly used in context and not contradicted. Where there is evidence of incorrect use or contradiction, the marks may not be awarded.

5. In general, names and formulas of elements and compounds are equally acceptable except in cases where either the name or the formula is specifically asked for in the question. However, in some cases where the name is asked for, the formula may be accepted as an alternative. This is clarified within the scheme.

6. There is a deduction of one mark for each arithmetical slip made by a candidate in a calculation. If the incorrect calculated value is used in a subsequent calculation 'correctly' allow the marks for the subsequent calculation.

7. **Cancelled & / or Repeated Answers**

    a. In the case of short-answer questions, if an answer is cancelled and a second answer given, the cancellation is accepted and marks are awarded for the uncancelled answer.

    b. If more than the required number of (uncancelled) answers are given, surplus incorrect answers cancel the marks awarded for correct answers.

    c. If the only answer offered is cancelled, the cancelling is ignored and the answer marked as normal. However, in MCQ-type questions cancelling of an incorrect and correct answer applies.

For answers to "describe an investigation / an experiment", multiple attempts will be dealt with as follows:
If a candidate answers a question or part of a question once only and then cancels, the cancelling is ignored and the answer marked as normal. If a candidate answers a question or part of a question more than once and then cancels one attempt, the cancelling will be ignored and all the answers,

whether cancelled or not, marked as normal. However, only the marks gained in respect to the highest scoring attempt will be counted. Points cannot be "mixed and matched from two attempts". The disallowed marks should be enclosed in square brackets.

8. **Recording a mark of zero**
A zero should only be recorded in the question grid when the candidate has attempted the question but does not merit marks.

*Do not enter zero for examination components that were not presented.

If a candidate does not attempt a question (or part of) record a dash –.

9. **Deduction of marks for omitted labelled diagrams**
Assign marks in the usual way. Then use square brackets '[ ]' to deduct the marks.

10. **Application of the marking scheme**
Apply the marking scheme as agreed.

Examiners should enter marks in 'Examiner use only' Column 1.

Advising Examiners should also use Column 1.

Column 2 to be used by Appeal Examiners.

Disallowed marks should be placed in square brackets i.e. '[ ]'.

11. **Transfer of marks**

All marks should be transferred to the grid on the cover page of the examination paper. Marks should be totalled, the bonus for answering through Irish applied where relevant.

12. **Bonus for Irish**
Bonus marks at the rate of 10% of the marks obtained in the written paper will be given to a candidate who answers the written paper entirely through Irish and who obtains less than 75% of the total mark available in the written paper (i.e. less than 75% of 390). In calculating the bonus to be applied decimals are always rounded down, not up e.g., 4.5 becomes 4; 4.9 becomes 4, etc. No bonus applies to the coursework. The table below should be used where a candidate is awarded more than 75% of the total mark in the written paper.

390@10%

Marcanna Breise as ucht freagairt trí Ghaeilge

Léiríonn an tábla thíos an méid marcanna breise ba chóir a bhronnadh ar iarrthóirí a ghnóthaíonn níos mó ná 75% d'iomlán na marcanna.

N.B. Ba chóir marcanna de réir an ghnáthráta a bhronnadh ar iarrthóirí nach ngnóthaíonn níos mó ná 75% d'iomlán na marcanna don scrúdú. Ba chóir freisin an marc bónais sin **a shlánú síos**.

Tábla 390 @ 10%
Bain úsáid as an tábla seo i gcás na n-ábhar a bhfuil 390 marc san iomlán ag gabháil leo agus inarb é 10% gnáthráta an bhónais.

Bain úsáid as an ngnáthráta i gcás 292 marc agus faoina bhun sin. Os cionn an mharc sin, féach an tábla thíos.

Bunmharc	Marc Bónais	Bunmharc	Marc Bónais
293	29	341 - 343	14
294 - 296	28	344 - 346	13
297 - 300	27	347 - 350	12
301 - 303	26	351 - 353	11
304 - 306	25	354 - 356	10
307 - 310	24	357 - 360	9
311 - 313	23	361 - 363	8
314 - 316	22	364 - 366	7
317 - 320	21	367 - 370	6
321 - 323	20	371 - 373	5
324 - 326	19	374 - 376	4
327 - 330	18	377 - 380	3
331 - 333	17	381 - 383	2
334 - 336	16	384 - 386	1
337 - 340	15	387 - 390	0

SCIENCE

Higher Level Paper

WRITTEN EXAMINATION PAPER

Three Sections: Biology, Chemistry and Physics, *all* questions to be answered by candidates.

Biology   Question 1 (52 marks); Question 2 (39 marks); Question 3 (39 marks)
Chemistry Question 4 (52 marks); Question 5 (39 marks); Question 6 (39 marks)
Physics   Question 7 (52 marks); Question 8 (39 marks); Question 9 (39 marks)

COURSEWORK A

Count the number of ticked (✓) mandatory biology investigations/experiments claimed on page 5. Note this number in the box on page 6 of the Coursework booklet and enter it in the Coursework A grid on the cover page.

Count the number of ticked (✓) mandatory chemistry investigations/experiments claimed on page 6. Note this number in the box on page 7 of the Coursework booklet and enter it in the Coursework A grid on the cover page.

Count the number of ticked mandatory (✓) physics investigations/experiments claimed on page 7. Note this number in the box on page 8 of the Coursework booklet and enter it in the Coursework A grid on the cover page.

Total the number of investigations / experiments claimed and award 2 marks per investigation/experiment to an amount not exceeding maximum 60 marks.

COURSEWORK B

Mark the SEC nominated investigations according to the agreed criteria. Enter the marks for each section in the Coursework B grid on the cover page of the coursework booklet.

or

Mark the candidate nominated investigation according to the agreed criteria. Enter the marks for each section in the Coursework B grid on the cover page of the coursework booklet.

COURSEWORK A & B

Transfer total marks awarded for Coursework A and Coursework B to grid on the cover page of the examination answer-booklet.

BIOLOGY

Question 1 $(7 \times 6 + 1 \times 10)$

Question 2   (*a*)   (15)
                    (*b*)   (15)
                    (*c*)   (9)

Question 3   (*a*)   (9)
                    (*b*)   (12)
                    (*c*)   (18)

CHEMISTRY

Question 4 $(7 \times 6 + 1 \times 10)$

Question 5   (*a*)   (9)
                    (*b*)   (12)
                    (*c*)   (18)

Question 6   (*a*)   (18)
                    (*b*)   (6)
                    (*c*)   (15)

PHYSICS

Question 7 $(7 \times 6 + 1 \times 10)$

Question 8   (*a*)   (15)
                    (*b*)   (6)
                    (*c*)   (18)

Question 9   (*a*)   (21)
                    (*b*)   (9)
                    (c)   (9)

Biology (130 MARKS)

Question 1 (52)

(*a*)(*i*) respiration (3)

  (*ii*) reproduction (3)

(*b*)(*i*) limewater / calcium hydroxide / Ca(OH)$_2$ (3)

  (*ii*) water (3)

(*c*)(*i*) tearing (ripping / gripping) (3)

  (*ii*) biting (cutting / chopping) (3)

(*d*) Red blood cells: carry oxygen (O$_2$ / O) (3)

  Plasma: carries blood cells (minerals / nutrients / hormones / enzymes / antibodies / carbon dioxide (CO$_2$)/ heat / any valid substance) / regulates body temperature / maintains blood pressure (3)

(*e*)(*i*) bacteria / fungi / virus (3)

  (*ii*) to supply food (nutrition) / growth medium / supply conditions for growth / helps them to grow (3)

(*f*) Digestion: break down of food (3)

  Excretion: removal of waste / removal of valid named waste (3)

(*g*) carbon dioxide (3)

  oxygen (3)

(*h*)(*i*) X = testis / testes / testicle (3)

  Y = sperm duct / vas deferens (3)

  (*ii*) sperm **(2)**

  (*iii*) urethra **(2)**

Question 2 (39)

(*a*)(*i*) axes correctly labelled

correct scale

correct plot of 8 points (3 × 3)

[slip -1 for each incorrect point, max of 3]

(*ii*) lack of sunlight (water / nutrients) / trampling (3)

(*iii*) quadrat / belt transect (3)

(*b*)(*i*) most suitable temperature / body temperature (3)

(*ii*) iodine (3)

(*iii*) X = yellow brown / red brown (3)
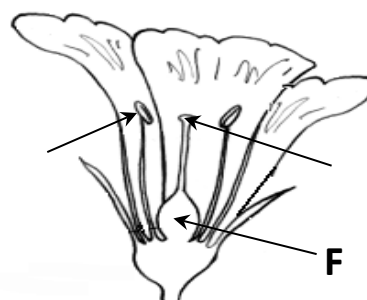
Y = blue black (3)

(*iv*) maltose (3)

(*c*)(*i*) stamen / anther / pollen grain (3)

(*ii*) **F** on / near arrow of ovary (3)

(*iii*) seed (fruit) development (formation / production) / seed dispersal (3)

Question 3 (39)

(*a*) **State or show** (3 × 3)

[Marks awarded in the context of a valid experiment.]

Container of water with thermometer / temperature sensor

Burn food

<u>Result</u>: water heats up

Relevant labelled diagram
[Diagram must have at least one label – no labelled diagram – deduct [3] marks]

(*b*)(*i*) heart / lungs (3)
  (*ii*) muscles (named muscle(s)) // pull on bones / contracts (2 × 3)

  (*iii*) calcium / magnesium (3)

(*c*) (*i*) **X** in the lens / arrow indicating location of **X** (3)

  (*ii*) iris (3)

  (*iii*) tick under left eye (3)

  (*iv*) brain and spinal cord (3)

  (*v*) **Sensory**: carries message to CNS (brain /spinal cord) /
  carries message from sense organ (3)

  Motor: carries message from CNS (brain / spinal cord) /
  carries message to muscle (gland) (3)

Chemistry (130 MARKS)

Question 4 (52)

(*a*)   water // iron sulfide   (2 × 3)

(*b*)(*i*) liquid   (3)

    (*ii*) changing of liquid to gas (vapour)   (3)

(*c*)(*i*) Nitrogen (N_2 / N)   (3)

    (*ii*) copper sulfate ($CuSO_4$) / cobalt chloride ($CoCl_2$)   (3)

(*d*)(*i*) strong / won't burn (melt)   (3)

    (*ii*) galvanising / painting   (3)

(*e*)   In any order:

    sodium hydroxide   (3)

    hydrogen   (3)

(*f*)(*i*) good conductor / ductile   (3)

    (*ii*) unreactive / malleable / lustrous / ductile   (3)

(*g*)(*i*) coal /oil / peat / named oil product [do not accept wood]   (3)

    (*ii*) carbon dioxide / water   (3)

(*h*)(*i*) proton   (3)

    (*ii*) electron   (3)

    (*iii*) nucleus   **(2)**

    (*iv*) nitrogen / N   **(2)**

Question 5 (39)

(*a*)(*i*) **State *or* show** (3 × 3)

[Marks awarded in the context of a valid experiment.]

Container with solvent

Ink spot on paper above solvent

<u>Result</u>: ink spot rises and colours separate

[Diagram is optional]

(*b*)(*i*) distillation (3)

[accept "evaporation + condensation"]

(*ii*) condenser (3)

(*iii*) condensation / gas (steam) to liquid (water) (3)

(*iv*) A (3)

(*c*)(*i*) indicator / named indicator (3)

[do not accept universal indicator]

(*ii*) shows when neutralisation occurs (when enough acid has been added) (3)

(*iii*) burette (3)

(*iv*) 19.4 cm^3 (3)

[accept "19.2 + 19.3 ÷ 2 = 19.25 cm^3 " *or* "19.25 cm^3 "]

(*v*) repeat without indicator (3)

evaporate off the water (3)

Question 6 (39)

(*a*)(*i*) 2 atoms indicated, showing a 2, 6 arrangement of electrons (3)

overlap of outer energy levels with four electrons shared, two from each atom (3)

(*ii*) force of attraction   // magnesium (Mg) loses 2 electrons (3)

two oppositely charged ions   // oxygen (O) gains 2 electrons (3)

(*iii*) dip the electrodes into the solution (3)

the bulb would light (3)

(*b*)(*i*) relights a glowing splint (3)

(*ii*) to help current (electricity) to flow / acts as a catalyst (3)

(*c*)(*i*) 2 HCl + CaCO$_3$ ⟶ (3)

CaCl$_2$ + H$_2$O + CO$_2$ (3)

(*ii*)

Tested with:	Moist blue litmus	Moist red litmus
Final colour:	**RED**	**RED**

(2 × 3)

acidic (3)

Physics (130 MARKS)

Question 7 (52)

(*a*)(*i*) water rises up the tube / water is sucked up (3)

(*ii*) gas contracts / partial vacuum created (3)

(*b*)(*i*) no (3)

(*ii*) travelling in a different direction / velocity is speed in a given direction (3)

(*c*)(*i*) blue (3)

(*ii*) breaks (melts / blows) when current (electricity / voltage) is too high / limits size of current flowing / safety (3)

(*d*)(*i*) liquid (water) to gas (steam) / evaporation (3)

(*ii*) latent (3)

(*e*)(*i*) Earth has a magnetic field / pole(s) of magnet attracted to the pole(s) of Earth (3)

(*ii*) they repel each other (3)

(*f*)(*i*) 4 cm (3)

(*ii*) extension is proportional to weight added (3)

(*g*)(*i*) better tyre grip / road holding / slows car / needed for braking (3)

(*ii*) wears (damages) the tyres / tyres get hot (3)

(*h*)(*i*) 2400 × 10 = 24000 (3)

[accept calculation done using 9.8 m s^{-2} as acceleration due to gravity]

(*ii*) Newton / N (3)

(*iii*) F ÷ A / 24000 ÷ 0.8 **(2)**

30000 N m^{-2} / Pa **(2)**

Question 8   (39)

(*a*)(*i*)   ability to do work   (3)

(ii)   provides energy for plants to make food (photosynthesis) / provides heat *or* light   (3)

(*iii*)   radiation / rays   (3)

(*iv*)   reflects light from the sun   (3)

(*v*)   risk of explosion (harmful radiation / radioactive waste) / difficult to control / can be
expensive / non-renewable   (3)

(*b*)(*i*)   B   (3)

(*ii*)   the apple (object) blocks the light   (3)

(*c*)(*i*)   sound of the bell becomes faint / can't hear the bell   (3)

(*ii*)   sound needs a medium to travel / sound will not travel through a vacuum   (3)

(*iii*)   light   (3)

see lightning before hearing thunder / see flash from a starter pistol before
hearing sound etc.   (3)

(*iv*)   Distance ÷ Time / 300 ÷ 0.2 / 150 ÷ 0.1   (3)

1500 m s^{-1} (3)

[150 ÷ 0.2 = 750 is awarded 3, 0]

Question 9

(39)

(*a*)(*i*)   five points correctly plotted   **(5 × 1)**

straight line through points   **(4)**

(*ii*)   proportional   (3)

(*iii*)   V ÷ I / voltage from graph or table ÷ current from graph or table   (3)

<u>Range</u>: 0.5 to 0.6 Ω / correct answer from student graph   (3)

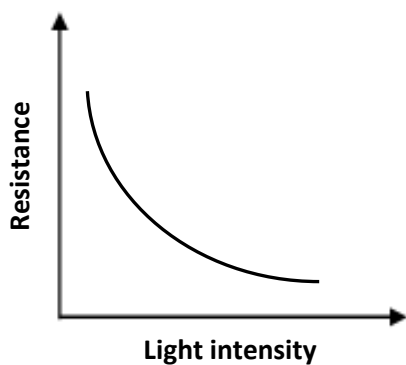(*iv*)   it gets hot / resistance rises / current decreases   (3)

(*b*) (*i*)   move the lamp / reduce the brightness / change the bulb   (3)

(*ii*)   (3)

(*iii*)   light (security) sensor / turning on (off) street lighting   (3)

(*c*) (*i*)   A   (3)

(*ii*)   forward biased / current flows   (3)

(*iii*)   uses less current (energy) / cheaper / more efficient   (3)

Marking Criteria for Coursework B (HL) - BIOLOGY

	Guide to mark assignment	
Total Marks	Investigate quantitatively, to determine the impact of each additive, the effects on samples of a garden soil of adding 20% by mass of (a) sand, (b) potting compost, and (c) clay* on (i) the soil's ability to retain water, (ii) the rate of drainage of water through the soil. ***Some readily available cat litter is composed of dry clay.***	**Mark Assignment**
5	**Introduction to the investigation** **1 (i) Statement/identification of problem/topic to be investigated** **1 (ii) Background research** *Any <u>one</u> reference to book or internet or person consulted or evidence of research*	(2) (3)
20	**Preparation and planning** **2 (i) Identify any relevant variables and necessary controls** *Identify <u>four</u> variables (at least two compulsory) and/or indicate how some of these need to be controlled or held fixed* *Compulsory variables* • volume or mass of water retained • rate of drainage *or* time for known volume to drain *or* volume drained in known time • soil additives *or* soil composition *or* soil mixture *Other variables* • soil source • moisture content (of soil *or* of additives) • quantity of soil used • quantity of additive used • particle size • volume/mass of water added • volume/mass/height of water above level of soil • temperature • funnel dimensions **2 (ii) List of the equipment needed for the investigation** *Identify any <u>five</u> pieces of equipment pertinent to procedure* **2 (iii) List of tasks to be carried out during the investigation** *Identify any <u>four</u> tasks carried out in investigation* • procure soil • add/mix in additives *or* find weight/mass of additives • add water to soil • measure volume/mass of water retained • measure volume/mass of water drained • repeat for different soil and additive mixtures • record *or* graph data	(3 + 3) *any others* (2 + 2) (5 × 1) (1 + 1 +1 + 2)

20	**Procedure, Apparatus, Safety, Data Collection / Observations**	
	3 (i) Safety precautions *Identify any <u>two</u> specific safety precautions followed*	(2 + 3)
	3 (ii) & (iii) Procedure followed in the investigation *(state or show)* *Identify any <u>seven</u> steps taken in conducting investigation* • sieve soil • measure/note mass of soil • measure/note mass of additive • mix in additive • measure/note mass/volume of water to be added • place soil in funnel/container • add water to soil • measure/note mass of wet soil • keep level of water above soil constant • measure/note mass/volume of water drained • measure/note time taken • repeat for different soil and additive mixtures • repeat to verify data • record *or* graph data	(1+ 1 + 1 + 1) + (2 + 2 + 2)
	3 (iv) Recorded Data / Observations *Identify <u>two</u> data sets - with value(s) for each of the three additives for both sets* • effect of soil additives on water retention by soil • effect of soil additives on rate of water drainage through soil	(2 + 3)
20	<u>**Analysis**</u>	
	4 (i) Calculations / Data analysis *Relevant analysis of data or calculations or graph(s)* • **Excellent** manipulation of two data sets with a data point for each additive in each set using accurate graphs / correct calculations / clear statements of analysis of data • **Good** manipulation of two data sets with a data point for each additive in each set using graphs / calculations / statements of analysis of data • **Limited** manipulation of one data set of with a data point for each additive using graphs / calculations / statement of analysis of data	(10) (7) (4)
	4 (ii) Conclusion(s) and Evaluation of Result(s) *Relevant conclusion(s) drawn and evaluation of result(s)* • **Excellent** treatment (clear, supported statements about both sets of data) • **Good** treatment (statements about both sets of data, not fully clear *or* not fully supported) • **Limited** treatment (clear, supported statements about one set of data only)	*Only if 3(iv) and/or 4(i) attempted* (10) (7) (4)
10	<u>**Comments**</u> *Any <u>two</u> comments on refinement or improvement or extension or possible application or source of error, etc.* • **Excellent** comprehension • **Good** comprehension	(5) ⎫ ⎬ × 2 (3) ⎭

Marking Criteria for Coursework B (HL) - CHEMISTRY

	Guide to mark assignment	
Total Marks	Investigate quantitatively, at room temperature, the effect of dilution on the pH of (i) vinegar, (ii) a solution containing 5 g washing soda per litre of water, (iii) a solution containing 5 g sucrose per litre of water.	**Mark Assignment**
5	**Introduction to the investigation** **1 (i) Statement/identification of problem/topic to be investigated** **1 (ii) Background research** *Any one reference to book or internet or person consulted or evidence of research*	(2) (3)

20	**Preparation and planning**
	
	2 (i) Identify any relevant variables and necessary controls
	Identify four variables (at least two compulsory) and/or indicate how some of these need to be controlled or held fixed
	
	Compulsory variables
	  • pH of solution
	  • concentration / dilution
	  • substance *or* solution tested
	
	Other variables
	  • liquid used for dilution
	  • volume of solution
	  • volume of solvent
	  • mass of substance
	  • temperature of solutions
	  • temperature of surroundings
	
	2 (ii) List of the equipment needed for the investigation
	Identify any five pieces of equipment pertinent to procedure
	
	2 (iii) List of tasks to be carried out during the investigation
	Identify any four tasks carried out in investigation
	  • procure pH meter *or* procure colour chart for universal indicator
	  • procure solutions
	  • change concentration of solutions
	  • read pH
	  • repeat for different concentrations
	  • repeat for different solutions
	  • record *or* graph data
		(3 + 3)
		
		any others
		(2 + 2)
		
		(5 × 1)
		
		(1 + 1 + 1 + 2)

20	**Procedure, Apparatus, Safety, Data Collection/Observations**	
	3 (i) Safety precautions *Identify any <u>two</u> specific safety precautions followed*	(2 + 3)
	3 (ii) & (iii) Procedure followed in the investigation *(state or show)* *Identify any <u>seven</u> steps taken in conducting investigation* • calibrate pH meter • measure/note pH of water (buffer) • measure/note mass of substance • measure/note volume of liquid • make up *or* measure out stock solution • add solvent to solution to dilute • stir *or* mix • place pH meter *or* universal indicator into solution • measure/note pH • rinse/wash pH meter *or* return pH meter to water • repeat for different concentrations • repeat for other stock solutions • repeat to verify data • record *or* graph data	(1 + 1 + 1 + 1) + (2 + 2 + 2)
	3 (iv) Recorded Data / Observations *Identify <u>three</u> data sets* • effect of dilution on pH of vinegar • effect of dilution on pH of washing soda solution • effect of dilution on pH of sucrose solution	(1 + 2 + 2)
20	**Analysis** **4 (i) Calculations / Data analysis** *Relevant analysis of data or calculations or graph(s)* • **Excellent** manipulation of three data sets with at least 3 data points in each set using accurate graphs / correct calculations / clear statements of analysis of data • **Good** manipulation of three data sets with at least 3 data points in each set using graphs / calculations / statements of analysis of data • **Limited** manipulation of two data set of with at least 3 data points using graphs / calculations / statement of analysis of data **4 (ii) Conclusion(s) and Evaluation of Result(s)** *Relevant conclusion(s) drawn and evaluation of result(s)* • **Excellent** treatment (clear, supported statements about all sets of data) • **Good** treatment (statements about all sets of data, not fully clear or not fully supported) • **Limited** treatment (clear, supported statements about two sets of data only)	(10) (7) (4) *Only if 3(iv) and/or 4(i) attempted* (10) (7) (4)
10	**Comments** *Any <u>two</u> comments on refinement or improvement or extension or possible application or source of error, etc.* • **Excellent** comprehension • **Good** comprehension	(5) ⎫ × 2 (3) ⎭

Marking Criteria for Coursework B (HL) - PHYSICS

	Guide to mark assignment	
Total Marks	Using conductors made of children's play (modelling) dough, investigate quantitatively the effect on resistance, calculated from measurements of voltage across and current through the conductors, of changing the conductor length *and* obtain data to establish whether dough colour has an effect on its resistance.	**Mark Assignment**
5	**Introduction to the investigation**	
	1 (i) Statement/identification of problem/topic to be investigated	(2)
	1 (ii) Background research	
	Any one reference to book or internet or person consulted or evidence of research	(3)
20	**Preparation and planning**	
	2 (i) Identify any relevant variables and necessary controls	
	Identify four variables (at least two compulsory) and/or indicate how some of these need to be controlled or held fixed	
	Compulsory variables	
	• length of modelling dough	
	• colour of modelling dough	(3 + 3)
	• resistance of modelling dough	
	Other variables	
	• temperature	*any others*
	• current *or* voltage	(2 + 2)
	• diameter *or* cross sectional area of modelling dough	
	• moisture content of modelling dough	
	• amount of kneading of modelling dough	
	• brand/source of modelling dough	
	• method of making electrical connections	
	2 (ii) List of the equipment needed for the investigation	
	Identify any five pieces of equipment pertinent to procedure	(5 ×1)
	2 (iii) List of tasks to be carried out during the investigation	
	Identify any four tasks carried out in investigation	(1 + 1 + 1 + 2)
	• procure modelling dough	
	• shape modelling dough to have fixed diameter *or* cross sectional area	
	• cut/measure lengths of modelling dough	
	• measure current and voltage	
	• calculate resistance from current and voltage	
	• repeat for different lengths of modelling dough	
	• repeat for different colours of modelling dough	
	• record *or* graph data	

20	**Procedure, Apparatus, Safety, Data Collection/Observations**	
	3 (i) Safety precautions *Identify any <u>two</u> specific safety precautions followed*	(2 + 3)
	3 (ii) & (iii) Procedure followed in the investigation *(state or show)* *Identify any <u>seven</u> steps taken in conducting investigation* • knead modelling dough • shape modelling dough to have fixed diameter *or* cross sectional area • cut/measure/note length of modelling dough • attach leads to modelling dough • set up circuit with power supply (*or* battery), ammeter and modelling dough in series • connect voltmeter across modelling dough • switch on circuit • measure/note current • measure/note voltage • calculate resistance • repeat for different lengths of modelling dough • repeat for different colours of modelling dough • repeat to verify data • record *or* graph data	(1+ 1 + 1 + 1) + (2 + 2 + 2)
	3 (iv) Recorded Data / Observations *Identify <u>two</u> data sets* • effect on resistance of changing length of conductor • effect on resistance of changing colour of conductor	(2 + 3)
20	**Analysis** **4 (i) Calculations / Data analysis** Relevant analysis of data or calculations or graph(s) • **Excellent** manipulation of two data sets with at least 3 data points in each set using accurate graphs / correct calculations / clear statements of analysis of data • **Good** manipulation of two data sets with at least 3 data points in each set using graphs / calculations / statements of analysis of data • **Limited** manipulation of one data set of with at least 3 data points using graphs / calculations / statement of analysis of data	(10) (7) (4)
	4 (ii) Conclusion(s) and Evaluation of Result(s) Relevant conclusion(s) drawn and evaluation of result(s) • **Excellent** treatment (clear, supported statements about both sets of data) • **Good** treatment (statements about both sets of data, not fully clear *or* not fully supported) • **Limited** treatment (clear, supported statements about one set of data only)	*Only if 3(iv) and/or 4(i) attempted* (10) (7) (4)
10	**Comments** Any two comments on refinement (or improvement) or extension or possible application or source of error, etc. • **Excellent** comprehension • **Good** comprehension	(5) ⎫ × 2 (3) ⎭

Marking Criteria for Coursework B (HL) – OWN INVESTIGATION

10	**Introduction to the investigation** **1 (i) Statement/identification of problem/topic to be investigated** • **Excellent** treatment • **Good** treatment • **Limited** treatment **1 (ii) Background research** *Any two references to book or internet or person consulted or evidence of research*	(6) (4) (2) (2 + 2)
40	**Preparation and planning** **2 (i) Identify any relevant variables and necessary controls** *Identify eight variables (two compulsory variables – which refer to the investigation title – and any six other variables) and/or indicate how some of these need to be controlled or held fixed* [If variables/controls are not relevant to the type of investigation undertaken, allow 6 marks for stating so, then re-adjust equipment to (8 × 2) and tasks to (6 × 3)] **2 (ii) List of the equipment needed for the investigation** *Identify any eight pieces of equipment pertinent to procedure* **2 (iii) List of tasks to be carried out during the investigation** *Identify any six tasks carried out in investigation*	(2 × 4) + (6 × 2) (8 × 1) (6 × 2)
40	**Procedure, Apparatus, Safety, Data Collection/Observations** **3 (i) Safety precautions** *Identify any four specific safety precautions followed* **3 (ii) & (iii) Procedure followed in the investigation** *(state or show)* *Identify any twelve steps taken in conducting investigation* **3 (iv) Recorded Data / Observations** *Identify eight data points*	(4 × 2) (4 × 1) + (4 × 2) + (4 × 3) (8 × 1)
40	**Analysis** **4 (i) Calculations / Data analysis** *Two relevant analyses of data or calculations or graph(s)* • **Excellent** manipulation of data • **Good** manipulation of data • **Limited** manipulation of data **4 (ii) Conclusion(s) and Evaluation of Result(s)** *Two relevant conclusions drawn and evaluation of results* • **Excellent** treatment • **Good** treatment • **Limited** treatment	(10) (7) } × 2 (4) *Only if 3(iv) and/or 4(i) attempted* (10) (7) } × 2 (4)
20	**Comments** *Any four comments on refinement or improvement or extension or possible application or source of error, etc.* • **Excellent** comprehension • **Good** comprehension	(5) } × 4 (3)