Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2016

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.

Coimisiún na Scrúduithe Stáit

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
293	29
294 - 296	28
297 - 300	27
301 - 303	26
304 - 306	25
307 - 310	24
311 - 313	23
314 - 316	22
317 - 320	21
321 - 323	20
324 - 326	19
327 - 330	18
331 - 333	17
334 - 336	16
337 - 340	15

Bunmharc	Marc Bónais
341 - 343	14
344 - 346	13
347 - 350	12
351 - 353	11
354 - 356	10
357 - 360	9
361 - 363	8
364 - 366	7
367 - 370	6
371 - 373	5
374 - 376	4
377 - 380	3
381 - 383	2
384 - 386	1
387 - 390	0

Junior Certificate Examination

SCIENCE

Higher Level

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 5 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 6 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 7 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.

SCIENCE HIGHER LEVEL 2016

Summary of Marking Scheme

BIOLOGY

Question 1 (7 × 6 + 1 × 10)

Question 2
(*a*) (12)
(*b*) (12)
(*c*) (15)

Question 3
(*a*) (12)
(*b*) (6)
(*c*) (21)

CHEMISTRY

Question 4 (7 × 6 + 1 × 10)

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

Question 6
(*a*) (6)
(*b*) (9)
(*c*) (24)

PHYSICS

Question 7 (7 × 6 + 1 × 10)

Question 8
(*a*) (9)
(*b*) (9)
(*c*) (21)

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

Biology (130 MARKS)

Question 1 (52)

(*a*)(*i*) muscle / connective / blood / bone / tendon / ligament / epithelial / nervous, etc (3)

[do not accept named organ *or* organ tissue e.g. brain tissue]

(*ii*) group of tissues working together (tissues with a common function) (3)

(*b*)(*i*) a living thing (organism) that cannot be seen by the naked eye (is visible with a microscope) (3)

(*ii*) production of cheese (yogurt / alcohol / insulin) / bread making, etc (3)

[allow genetically modified foods]

(*c*) **A**: pulmonary artery (3)

B: aorta (3)

(*d*)(*i*) renal artery (3)

(*ii*) ureter(s) (3)

(*e*)(*i*) carbon dioxide // water (3)

(*ii*) limewater / lime / calcium oxide / calcium hydroxide // anhydrous cobalt chloride / anhydrous copper sulfate

[*answers must match*] [allow: cobalt chloride / copper sulfate] (3)

(*f*) (*i*) phototropism (3)

(*ii*) <u>more</u> light for photosynthesis (making food) (3)

(*g*) (*i*) iodine (3)

(*ii*) prevent sample drying out / prevent sample curling up (keeps sample flat) / prevents damage to lens / protects sample, etc. (3)

(*h*)(*i*) Benedict's / Fehling's

(*ii*) heat [do not accept boil]

(*iii*) blue to red / orange

(*iv*) test water *or* a solution which doesn't contain a reducing sugar
no colour change observed

(4 + 2 + 2 + 2)

Question 2

(39)

(*a*)(*i*) stomach (3)

(*ii*) produces bile / detox centre / breaks down proteins / regulates body temperature / stores glycogen / breaks down red blood cells, etc (3)

(*iii*) reabsorption (absorption) of water (minerals, salts, vitamins) / carry (form, store) faeces (waste) / accommodates useful bacteria (micro-organisms), etc (3)

[reabsorption of nutrients is insufficient on its own]

(*iv*) mouth / stomach / small intestine (3)

(*b*)(*i*) humerus (3)

(*ii*) knee / fingers / toes / jaw (3)

(*iii*) connects muscle to bone (3)

(*iv*) arm straightens / forearm (radius and ulna) lowers / **X** relaxes (3)

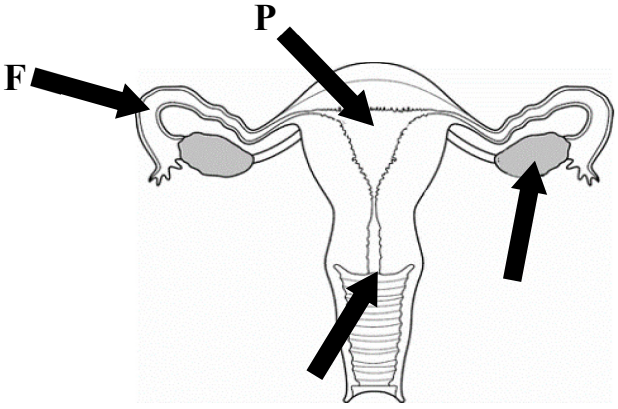
(*c*)(*i*) menstruation (breakdown / shedding of uterus lining) / period / bleeding (3)

(*ii*) when pregnancy (conception / fertilisation) can occur / ovulation occurs (3)

(*iii*) fuses (joins) with sperm [allow forms a zygote] (3)

(*iv*) **F** on fallopian tube arrow (3)

P on the uterus arrow (3)



Question 3 (39)

(*a*)(*i*) **Producer**: grass (3)

Decomposer: beetle / woodlouse (3)

(*ii*) Habitat named **(1)**

Organism from named habitat **(1)**

Name or description of adaptation //
How adaptation helps organism survive in habitat **(2 × 2)**

[adaptation must match organism]

(*b*)(*i*) xylem (3)

(*ii*) food storage / food manufacture (photosynthesis) / gas exchange / asexual reproduction (3)

(*c*) (*i*) **A**: testa (3)

B: food supply (store / source) [allow endosperm] / cotyledon (seed leaves) (3)

(*ii*) root (3)

(*iii*) **B** (3)

to remove oxygen (3)

(*iv*) **Sycamore**: wind (3)

Strawberry: animal (3)

Chemistry (130 MARKS)

Question 4 (52)

(*a*)(*i*) mixture of metals / mixture of a metal and another element (3)

(*ii*) bronze / brass / solder, etc (3)

(*b*)(*i*) coal / oil / gas (methane) / peat (turf) (3)

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

(*c*) **Au**: gold **(2)**

Cu: copper **(2)**

Fe: iron **(2)**

(*d*)(*i*) electrolysis (3)

(*ii*) O_2 (3)

(*e*) In any order:

rusting of iron (3)

burning of paper (3)

(*f*) (*i*) pH meter // universal indicator (pH paper) **(2)**

read pH // compare with colour chart **(2)**

(*ii*) sodium hydroxide / bread soda / base (alkali) **(2)**

[do not accept bleach / window cleaner]

(*g*)(*i*) zinc / aluminium / calcium / named valid metal [accept symbols] (3)

(*ii*) hydrogen (3)

(*h*)(*i*) any two of:

sodium / potassium / lithium / rubidium / caesium / francium

(*ii*) soft / easy to cut / less dense than water / shiny when cut (dull when exposed) / low melting point

(*iii*) very reactive / one electron in outer shell / reacts vigorously (quickly) with oxygen (water) / loses one electron in chemical reactions (forms positive ion) / tarnishes quickly when exposed

(4 + 2 + 2 + 2)

Question 5 (39)

(*a*)(*i*) **B** (3)

(*ii*) same volume of water / same time (vigour, shaking) / same size of soap flakes / any valid answer (3)

(*iii*) calcium (Ca) / magnesium (Mg) (3)

(*iv*) **State *or* show**

method of boiling (evaporating) water +
method of cooling (condensing) water +
method of collecting pure water

[No labelled diagram - deduct 3 marks] **(9)**

(*b*)(*i*) solvent (3)

(*ii*) saturated (3)

(*iii*) heat the solution / add more water (solvent) [boil not acceptable] (3)

(*c*)(*i*) hydrogen peroxide (3)

(*ii*) colourless (3)

(*iii*) catalyst (3)

(*iv*) neutral (pH 7) / neither acidic nor basic (3)

Question 6 (39)

(*a*)(*i*) durable / brightly coloured / easily washed / low density / not heavy / less risk of injury from breakages / don't break easily / easily worked (moulded) / flexible (easy to bend) / non-toxic, etc (3)

(*ii*) crude oil (3)

(*b*) **A** = gas (3)

B = liquid (3)

C = solid (3)

(*c*)(*i*) periodic table / formula and tables booklet (log tables) / textbook / internet (named website) / teacher / any valid source **(2)**

(*ii*)

Particle	Number	Location
Proton	**9**	**Nucleus**
Neutron	**10**	**Nucleus**
Electron	**9**	Electron cloud

(2 + 2 + 2 + 2 + 2)

(*iii*) chlorine / bromine / iodine / astatine / ununseptium (tennessine) (3)

(*iv*) attraction between oppositely charged ions / transfer of electrons between atoms **(6)**

(*v*) carbon dioxide / methane / water / any valid example (3)

Physics (130 MARKS)

Question 7 (52)

(*a*)(*i*) 2000 N m (J) **(6)**
(250 × 8) N m (J) (slip – 1)

(*b*)(*i*) latent heat / change of state (3)
(*ii*) 42 º C (3)

(*c*)(*i*) North and South poles (3)

(*ii*) direction (3)

(*d*)(*i*) LED lights up (3)

(*ii*) LED wouldn't light (3)

(*e*)(i) chemical (3)
(*ii*) potential to kinetic (3)

(*f*) more dense / A is less dense (3)
less dense / B is more dense (3)

(*g*) light travels faster (3)
than sound (3)

(*h*)(*i*) 979

(*ii*) same / equal

(*iii*) centre of **X** anywhere below the front (in the H region)

(*iv*) barometer

(4 + 2 + 2 + 2)

Question 8 (39)

(*a*)(*i*) wax / petroleum jelly (vaseline), etc. (3)

(ii) **copper**: best conductor / worst insulator / transfers heat fastest (3)

glass: worst conductor / best insulator / transfers heat slowest (3)

(*b*)(*i*) heat the ball (3)

(*ii*) try fit ball through the ring and it won't fit (3)

(*iii*) cool the ball (3)

(*c*)(*i*) **State *or* show** [do not penalise if no diagram given]
Hang the piece of cardboard to rotate freely about a point and hang a weight from this point and mark the line (3)
Rotate the cardboard and repeat (3)
Where the lines intersect is centre of gravity **stated *or* clearly labelled in diagram** (3)

or

State *or* show [do not penalise if no diagram given]
Slide the piece of cardboard until it is about to fall off the edge of a table and mark line along cardboard corresponding to edge of table (3)
Rotate the cardboard and repeat (3)
Where the lines intersect is centre of gravity **stated *or* clearly labelled in diagram** (3)

or

[The following method carries a maximum of 6 marks]
State *or* show [Do not penalise if no diagram given]
Place the piece of cardboard on a pointed (thin) object (finger) and move the cardboard to find the point of balance (3)
The point of balance is the centre of gravity **stated *or* clearly labelled in diagram** (3)

(*ii*) low (lower) centre of gravity / broader base relative to height (3)

(*iii*) **B** (3)

left hand (anti-clockwise) moment equals (is greater than) right hand (clockwise) moment /

product of force by distance on left equals (is greater than) product of force by distance on right /

moments on left and right (moments at A and at C) are in balance (equal) **(6)**

Question 9 (39)

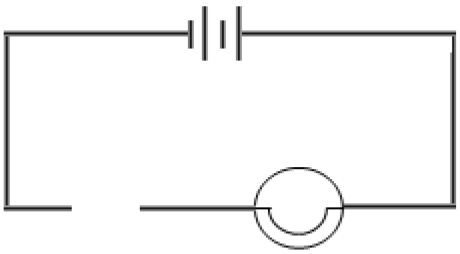
(*a*)(*i*) refraction (3)

(*ii*) dispersion (3)

(*iii*) spectrum (3)

(*iv*) red (3)

(*b*) (*i*)



battery

bulb / LED / buzzer / ammeter } in a circuit

gap / sample

correct working circuit using correct symbols *or* a correct working drawing of the set up with at least one component labelled correctly **(6)**

[no partial marks available]

(*ii*) the bulb (LED / buzzer / ammeter) will light (sound / show a reading) when a conductor is placed in the gap in the circuit (3)

(*c*) (*i*) all six points correctly plotted (3)

smooth curved line through all points (3)

[award zero marks for straight lines joining some *or* all dots.]

(*ii*) 19 ± 0.5 / answer consistent with graph ± 0.5 (3)

(*iii*) 14 m/s (m s^{-1}) (3)

56 ÷ 4 m/s (m s^{-1}) (slip –1)

(*iv*) velocity has direction / velocity is a vector / velocity is speed in a given direction / velocity has magnitude and direction / speed has no direction / speed is a scalar / speed has magnitude only / velocity is displacement over time but speed is distance over time **(6)**

[allow speed 'has any direction' for 6 marks]

Marking Criteria for Coursework B (HL) - BIOLOGY

	Guide to mark assignment	
Total Marks	Investigate and compare the quantitative effects of changing (a) the duration of light physical exercise, and (b) the time elapsed since the exercise stopped, on the pulse rate of a person.	**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 five variables (three compulsory variables & any two other variables) and/or indicate how some of these need to be controlled or held fixed* *Compulsory variables* • duration of the light physical exercise • time elapsed since the exercise stopped • pulse rate [allow heart rate] *Other variables (any two)* • type of exercise • rate (intensity) of exercise • method / duration of resting after exercise / initial (rest) pulse rate • individual being tested • temperature of surroundings *or* time of day *or* clothing worn • location of pulse (radial, finger, etc) *or* method of measuring pulse rate • frequency of reading of pulse rate **2 (ii) List of the equipment needed for the investigation** *Identify any three 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* • select method to measure pulse *or* prepare for measuring pulse • measure (note) resting pulse rate • exercise • measure pulse rate (after exercise) • repeat for different durations of exercise • measure pulse rate at suitable time intervals after stopping the exercise • record *or* graph data	 (2 + 2 + 2) (2 + 2) (2 + 2 + 1) (1 + 1 + 1 + 2)
20	**Procedure, Apparatus, Safety, Data Collection / Observations** **3 (i) Safety precautions** *Identify any two 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* • reference to method of measuring pulse rate • measure (note) resting pulse rate of individual *or* self • repeat and calculate average resting pulse rate • light exercise carried out • record (note) duration of exercise • pulse rate recorded at end of exercise period • allow pulse rate to return to rest rate • repeat exercise for different time durations • starting with a pulse rate elevated by exercise, read pulse rate at intervals after exercise has stopped • record (note) time(s) elapsed since exercise stopped • repeat to verify data • record *or* graph data **3 (iv) Recorded Data / Observations** *Identify <u>two</u> data sets* • effect of duration of exercise on pulse rate • effect of time elapsed after exercise on pulse rate	(1+ 1 + 1 + 1) + (2 + 2 + 2) (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 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* incomplete 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 **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)	(10) (7) (4) **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 • Limited comprehension	(5) (3) (1) } × 2

Marking Criteria for Coursework B (HL) - CHEMISTRY

	Guide to mark assignment	
Total Marks	Investigate and compare the quantitative effects of changing (a) the rhubarb surface area, and (b) the temperature of solution, on the rate of reaction (measured by noting time for decolourisation of solution) between the oxalic acid in rhubarb and dilute potassium permanganate solution (acidified with sulfuric acid).	**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 five variables (three compulsory variables & any two other variables) and/or indicate how some of these need to be controlled or held fixed* *Compulsory variables* • rhubarb surface area • temperature of solution • rate of reaction *or* time for decolourisation of reaction mixture *Other variables (any two)* • amount (mass, volume, length of pieces) of rhubarb used • concentration of potassium permanganate solution • volume of potassium permanganate solution • acidity of potassium permanganate solution • method of stirring *or* amount of stirring • source of rhubarb *or* method of storing rhubarb before use • temperature of surroundings (laboratory) *or* air currents *or* room temperature **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 first task and any three other tasks carried out in investigation* • use rhubarb* • procure potassium permanganate solution • mix rhubarb and potassium permanganate solution *or* vice versa • note time for decolourisation • repeat with different surface areas of rhubarb • repeat at different temperatures • record *or* graph data	 (2 + 2 + 2) (2 + 2) (1 + 1 + 1 + 1 + 1) (2) (1 + 1 + 1)
20	**Procedure, Apparatus, Safety, Data Collection/Observations** **3 (i) Safety precautions** *Identify any two 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* • measure out portions of rhubarb of known mass (volume, length) • expose certain surface area by cutting or chopping or peeling • prepare acidified potassium permanganate *or* measure known volume of acidified potassium permanganate solution • add potassium permanganate to rhubarb *or vice versa* • start timer • stir or mix • measure (note) time for decolourisation of potassium permanganate solution • repeat with different surface areas of rhubarb • using water baths or otherwise to obtain different temperatures of solution • repeat at different temperatures • repeat to verify data • record *or* graph data **3 (iv) Recorded Data / Observations** *Identify <u>two</u> data sets* • effect of changing rhubarb surface area on rate of reaction • effect of changing temperature of reaction mixture on rate of reaction	(1+ 1 + 1 + 1) + (2 + 2 + 2) (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 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* incomplete 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 **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)	(10) (7) (4) **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 • Limited comprehension	(5) (3) (1) } × 2

Marking Criteria for Coursework B (HL) - PHYSICS

	Guide to mark assignment	
Total Marks	Investigate and compare the quantitative effects of changing (a) the pendulum length, and (b) the mass of the pendulum bob, on the period (time of oscillation) of a simple pendulum oscillating through a small angle.	**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 five variables (three compulsory variables & any two other variables) and/or indicate how some of these need to be controlled or held fixed* *Compulsory variables* • length of pendulum [allow length of string] • mass of bob [allow weight][allow mass/weight of pendulum] • period *or* time of oscillation(s) *Other variables (any two)* • number of oscillations counted • string used • bob *or* shape of bob *or* volume of bob • angle of oscillation • method of attaching string to bob *or* method of attaching string to point of suspension of bob • method of release of bob • temperature *or* air currents *or* room conditions *or* gravity **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 pendulum • suspend string *or* pendulum from fixed point • set pendulum in oscillation • measure time for oscillation(s) • repeat for different lengths of pendulum • repeat for different masses of bob • record *or* graph data	 (2 + 2 +2) (2 + 2) (1 + 1 + 1 + 1 + 1) (1 + 1 + 1 + 2)
20	**Procedure, Apparatus, Safety, Data Collection/Observations** **3 (i) Safety precautions** *Identify any two 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* • attach string to bob • suspend pendulum from a fixed point • measure (note) length of pendulum • measure (note) mass of bob • measure (note) angle of release *or* keep angle of release small • set pendulum in oscillation • take time for known number of oscillations using stopwatch (timer) *or* take time(s) for one oscillation using electronic light gates or similar • note (calculate) average time for one oscillation • repeat with different pendulum lengths • repeat with bobs of different masses • repeat to verify data • record *or* graph data **3 (iv) Recorded Data / Observations** *Identify <u>two</u> data sets* • effect of changing length of pendulum on period (time of oscillation) • effect of changing mass of bob on period (time for oscillation)	(1 + 1 + 1 + 1) + (2 + 2 + 2) (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 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* incomplete 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 **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)	(10) (7) (4) **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 • Limited comprehension	(5) (3) (1) } × 2

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 not relevant to the type of investigation undertaken allow 6 marks for stating so, then readjust 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*	 (4 + 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) (4) } × 2 **Only if 3(iv) and/or 4(i) attempted** (10) (7) (4) } × 2
20	**Comments** *Any four comments on refinement (or improvement) or extension (or possible application) or source of error, etc.* • Excellent comprehension • Good comprehension • Limited comprehension	 (5) (3) (1) } × 4