

2020 HSC Investigating Science Marking Guidelines

Section I

Multiple-choice Answer Key

Question	Answer
1	C
2	B
3	D
4	A
5	C
6	D
7	B
8	C
9	C
10	A
11	B
12	B
13	D
14	D
15	B
16	A
17	A
18	C
19	D
20	C

Section II

Question 21

Criteria	Marks
<ul style="list-style-type: none"> Demonstrates a basic knowledge of any TWO of Priestley's experiments Refers to relevant data collected 	3
<ul style="list-style-type: none"> Outlines TWO of Priestley's experiments OR <ul style="list-style-type: none"> Outlines an experiment of Priestley's and refers to a piece of data collected 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

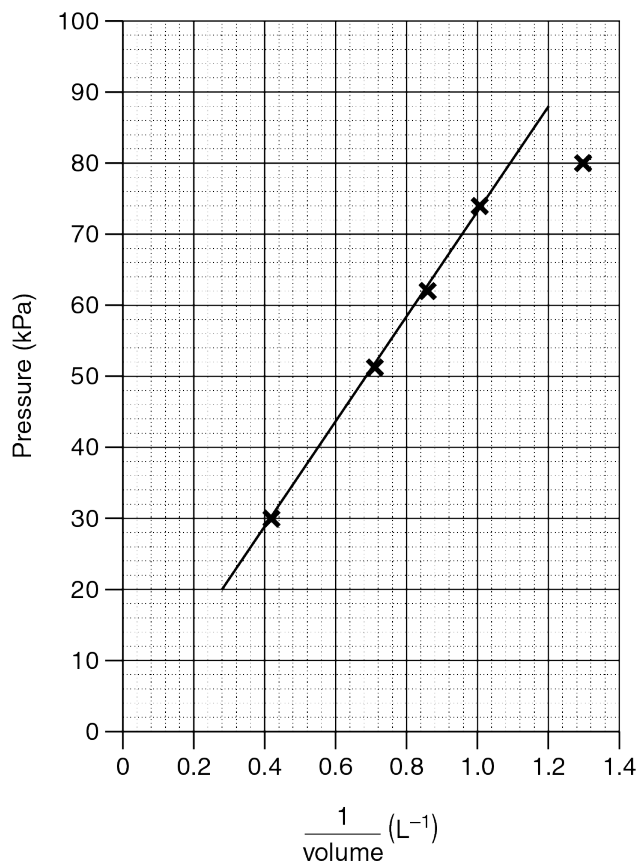
Sample answer:

Priestley placed a mouse in a sealed glass jar. The data he collected would have been how long it took for the mouse to die. Priestley repeated the experiment but included a green plant in the jar. Priestley would have collected the same data but this time, the mouse survived for a longer period of time.

Question 22 (a)

Criteria	Marks
<ul style="list-style-type: none"> Plots points correctly Provides an appropriate line of best fit 	2
<ul style="list-style-type: none"> Plots majority of points correctly 	1

Sample answer:



Question 22 (b)

Criteria	Marks
• Provides a supported judgement demonstrating a thorough understanding of the student's method	3
• Provides a judgement demonstrating some understanding of the validity of the student's method	2
• Provides some relevant information	1

Sample answer:

The method may not be valid. Extrapolating a long way beyond the data points can lead to inaccurate predictions. There is no way of knowing from the data given that a straight line relationship continues.

Question 22 (c)

Criteria	Marks
• Provides correct answer with relevant working including data from the graph	2
• Provides a correct step	1

Sample answer:

$$\frac{1}{1.1 \text{ L}} = 0.91 \text{ L}^{-1}$$

From the graph, when $\frac{1}{\text{volume}} = 0.91 \text{ L}^{-1}$, pressure = 66 kPa.

Answers could include:

Those derived from poorly drawn graphs.

Question 23 (a)

Criteria	Marks
• Provides a description of how the fraudulent research can be uncovered using an example	3
• Outlines how fraudulent research can be uncovered	2
• Identifies an example of fraudulent research OR • Identifies a process to expose fraudulent research	1

Sample answer:

McBride claimed that Debendox, an anti-nausea medication, caused birth defects. Vardy and French, who worked with McBride, raised concerns with the reliability, level of drug doses, lack of controls and falsification of data after checking the original paper. An ABC report brought the fraud to the attention of the Medical Tribunal.

Question 23 (b)

Criteria	Marks
• Explains TWO consequences related to 'publish or perish' attitudes	3
• Identifies issue(s) and/or consequence(s) of 'publish or perish'	2
• Identifies one issue OR consequence	1

Sample answer:

Funding for academic and research scientists is often dependent on the number of articles the scientist has published. Therefore, scientists may rush investigations which can lead to careless and unethical science and a decrease in trustworthiness of publications.

Question 24 (a)

Criteria	Marks
• Provides a valid conclusion consistent with the information in the graph	1

Sample answer:

In 1970, there was more spending on welfare than on space research.

Question 24 (b)

Criteria	Marks
<ul style="list-style-type: none"> Explains how the presentation of the data is misleading Links these features to the public perception 	4
<ul style="list-style-type: none"> Identifies features of the presentation of the data Links a feature of the presentation of the data to the public perception 	3
<ul style="list-style-type: none"> Identifies features of the presentation of the data OR <ul style="list-style-type: none"> Links a feature of the data to the public perception 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

The data is presented in a misleading way showing taller columns for space research. This could lead people to believe that there was too much money being spent on space research compared to welfare. In reality, the units on the axes reveal that spending on welfare was greater than on space research throughout the time period and continued to increase.

Question 25 (a)

Criteria	Marks
<ul style="list-style-type: none"> Identifies an aspect of the experiment that could impact the reliability of this investigation Relates the identified aspect to the reliability of this investigation 	2
<ul style="list-style-type: none"> Identifies an aspect of the investigation that could impact reliability 	1

Sample answer:

The sample size is only one, therefore results cannot be compared for consistency.

Question 25 (b)

Criteria	Marks
<ul style="list-style-type: none"> Outlines appropriate recommendations Appropriately justifies each recommendation 	4
<ul style="list-style-type: none"> Outlines appropriate recommendation(s) AND/OR <ul style="list-style-type: none"> Provides justification(s) 	2–3
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

An ethics committee is likely to suggest that the investigation first be undertaken on small mammals such as lab rats before being tested on humans, to decrease the risk of human fatalities or permanent disabilities resulting from contracting the condition from the bacterium.

In light of this, the committee would also likely suggest considerations be put in place to ensure the welfare of the animal test subjects is maintained at a high standard to meet legislation.

Question 26 (a)

Criteria	Marks
<ul style="list-style-type: none"> Identifies an appropriate technology Describes how the technology impacted the development of atomic theory 	3
<ul style="list-style-type: none"> Outlines a relevant technology 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

Photographic plates were a technology that had a significant impact on the development of atomic theory. Exposure of photographic plates by uranium ores led to the discovery of radioactivity which showed that atoms could be made up of smaller particles. This was a significant development in atomic theory.

Question 26 (b)

Criteria	Marks
<ul style="list-style-type: none"> Identifies specific features of radioactivity Links these features to the development of radiotherapy 	4
<ul style="list-style-type: none"> Identifies features of radioactivity Links a feature to radiotherapy 	3
<ul style="list-style-type: none"> Identifies features of radioactivity OR <ul style="list-style-type: none"> Links a feature to radiotherapy 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

Radioactive decay produces highly penetrating gamma rays. In radiotherapy treatment for cancer, a beam of gamma rays is directed at cancer cells, which kills them. However, gamma rays are also harmful to healthy cells.

Question 27 (a)

Criteria	Marks
<ul style="list-style-type: none"> Links the use of scientific terminology in pseudo-scientific claims to public opinion 	2
<ul style="list-style-type: none"> Identifies an effect on public opinion OR <ul style="list-style-type: none"> Identifies a consequence of using scientific terminology 	1

Sample answer:

The use of terms such as 'retrograde' gives the impression that astrology has a basis in science. Hence, the pseudo-scientific claims made by astrology may be given legitimacy in terms of public opinion.

Question 27 (b)

Criteria	Marks
• Provides an investigation that could be used to test the claim	4
• Provides the main steps of a suitable investigation	3
• Provides some relevant steps	2
• Provides some relevant information	1

Sample answer:

View historic records of the number of plane delays at Sydney airport over a 10-year period.

Cross reference the dates of Mercury's retrograde motion throughout the same period and average the number of delays within and outside the periods of retrograde.

Determine if there is a statistically significant difference in the number of delays between the two periods.

If a statistically significant relationship can be seen, then a correlation can be determined.

Question 28 (a)

Criteria	Marks
• Relates the use of X-ray diffraction to the structure of DNA	2
• Provides some relevant information	1

Sample answer:

Passing X-rays through DNA produced a distinctive diffraction pattern. Analysis of this pattern provided evidence for the correct positioning of the bases.

Question 28 (b)

Criteria	Marks
<ul style="list-style-type: none"> Describes TWO technologies Relates the development of these technologies to DNA structure 	4
<ul style="list-style-type: none"> Outlines a technology or technologies AND/OR <ul style="list-style-type: none"> Links technology or technologies to DNA structure 	2–3
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

In transgenic technology, knowledge that DNA contains genes (a specific sequence of bases) has allowed technology to be developed that can be used to cut a gene out of one organism and insert it into the genome of another species eg Bt cotton.

In forensic technology, knowledge that DNA contains a unique base sequence has allowed technology to be developed that can be used to take samples of DNA from a crime scene and match it against the DNA of suspects.

Answers could include:

- Human genome project
- Cloning
- CRISPR
- GMO.

Question 29 (a)

Criteria	Marks
<ul style="list-style-type: none"> Provides a relevant, testable statement 	1

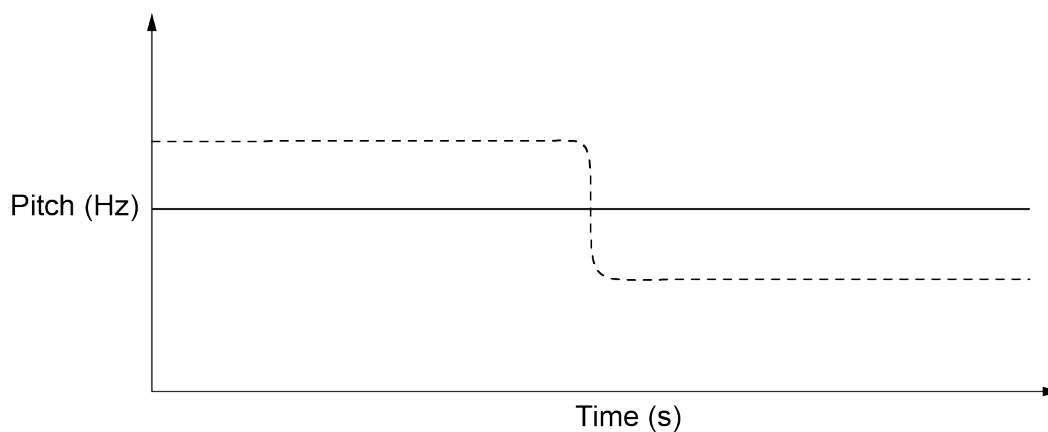
Sample answer:

A different pitch will be heard by the observer from the trumpeters on the ground compared to the pitch heard from the trumpeters on the train.

Question 29 (b)

Criteria	Marks
<ul style="list-style-type: none"> Provides labels and units on correct axes Provides sketches of how the pitch changes with time 	3
<ul style="list-style-type: none"> Provides a substantially correct sketch 	2
<ul style="list-style-type: none"> Provides some correct features of the sketch 	1

Sample answer:

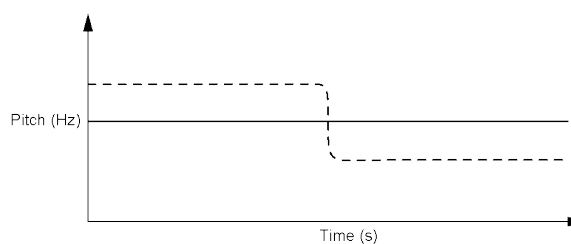
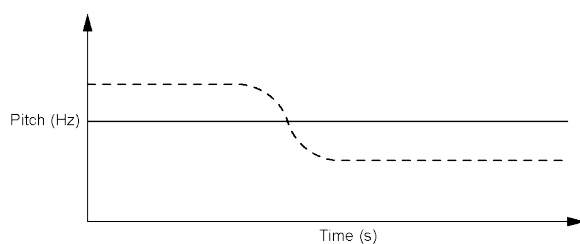


KEY

—— Sound from trumpeters on ground

----- Sound from trumpeters on train

Answers could include:



KEY

—— Sound from trumpeters on ground

----- Sound from trumpeters on train

Question 29 (c)

Criteria	Marks
• Relates all the experimental results to a relevant scientific phenomenon	4
• Relates the experimental result(s) to a relevant scientific phenomenon	2–3
• Provides some relevant information	1

Sample answer:

The experiment is a demonstration of the Doppler effect. The stationary observer would have heard a higher pitch of the note produced by the trumpeters on the train compared to the pitch from the stationary trumpeters as the train approached. This is because, relative to the observer, the sound waves from the moving trumpeters would seem to be compressed. As the train passed the observer, the pitch would seem to be lower from the moving trumpeters as the sound waves appeared to become more spread out, compared to the sound from the stationary trumpeters. Since there is no relative motion between the observer and the stationary trumpeters, the sound waves are unaffected, so the pitch observed from them remains constant.

Question 30

Criteria	Marks
<ul style="list-style-type: none"> Includes a judgement Links judgement to relevant scientific research Demonstrates a thorough knowledge of water treatment methods Communicates this understanding in a coherent, logical manner and uses scientific terminology 	7
<ul style="list-style-type: none"> Includes a judgement Demonstrates knowledge of relevant scientific research Demonstrates a sound knowledge of water treatment methods Communicates using some scientific terminology 	5–6
<ul style="list-style-type: none"> Demonstrates some knowledge of water treatment method(s) and/or the effects of scientific research into water quality 	3–4
<ul style="list-style-type: none"> Identifies effect(s) of scientific research into water quality AND/OR <ul style="list-style-type: none"> Identifies feature(s) of water treatment method(s) 	1–2

Sample answer:

Providing safe, potable water is essential in maintaining human health and wellbeing.

Water, if it is available, becomes polluted due to agricultural run-off increasing the concentration of elements and minerals and by not having adequate separation and treatment of sewage.

Scientific research has developed processes to provide and treat water.

- Desalination passes seawater through reverse osmosis membranes producing potable water.
- Coagulation, flocculation and sedimentation mix water with substances which clump chemicals present in soil and dust, so they can be removed.
- Filtration and micro-filtration will remove some microbes and small pathogens.
- Disinfection through treatment with chlorine, ozone or UV light inactivate even smaller microbes.

Scientific research continues to develop purification methods such as safe drinking straws and purification tablets usable in those areas that are unable to build the infrastructure required to provide safe drinking water. Thus developments gained through scientific research have had a significant effect on improving the health and wellbeing of people around the world.

Question 31 (a)

Criteria	Marks
• Provides detailed reasons for the differences	3
• Provides reasons for the differences	2
• Provides a reason for a difference	1

Sample answer:

The health agency is an impartial body focused on the health and wellbeing of the world population. It includes medical experts who provide evidence-based, unbiased information.

The asbestos agency is an industry funded information centre. According to the information given, Asian countries import 75% of the asbestos, hence the information centre may be biased, since it is receiving money from the asbestos industry.

Question 31 (b)

Criteria	Marks
• Identifies issues associated with the decision • Provides points for and against	4
• Identifies issues associated with the decision • Provides point(s) for and/or point(s) against	3
• Identifies issues associated with the decision OR • Outlines an issue associated with the decision	2
• Provides some relevant information	1

Sample answer:

The decision to mine asbestos disregards the long-term health of workers in the mining industry, those involved in the processing of asbestos products and in the building industry and wider community.

However, it is understandable why these countries have made this decision, since it provides employment and produces economic advantages to the government through international trade and provides cheap building materials.

Question 32 (a)

Criteria	Marks
<ul style="list-style-type: none"> Provides a correct interpretation based on data from the graph 	2
<ul style="list-style-type: none"> Provides a correct interpretation OR <ul style="list-style-type: none"> Refers to data from the graph 	1

Sample answer:

There is a close correlation between the two sets of data across the whole time period. This is particularly evident in the peak around 2010, where both sets of data show significant increases.

Question 32 (b)

Criteria	Marks
<ul style="list-style-type: none"> Makes a correct judgement about the reliability of the information in summary 1 Demonstrates a thorough understanding of reliability relating to secondary sources 	3
<ul style="list-style-type: none"> Demonstrates a sound understanding of reliability relating to secondary sources OR <ul style="list-style-type: none"> Makes a correct judgement Demonstrates a basic understanding of reliability relating to secondary sources 	2
<ul style="list-style-type: none"> Provides some relevant information 	1

Sample answer:

This information may not be reliable. It was published in a newspaper and is a student's summary and so the interpretation may not be correct. Since the summary is only of one article, there is nothing to compare it to, and so it cannot be considered consistent.

Question 32 (c)

Criteria	Marks
<ul style="list-style-type: none"> • Demonstrates an extensive understanding of the effects of conflicts of interest on the collection and interpretation of climate change data • Refers to information from each of the THREE sources • Provides a logical and coherent response using scientific language 	7
<ul style="list-style-type: none"> • Demonstrates a thorough understanding of the effects of conflicts of interest on the collection and/or interpretation of climate change data • Refers to information from the sources 	5–6
<ul style="list-style-type: none"> • Identifies a possible conflict of interest that arises in collection and/or interpretation of climate change data AND/OR <ul style="list-style-type: none"> • Identifies an impact of a conflict of interest AND/OR <ul style="list-style-type: none"> • Refers to information from the sources 	3–4
<ul style="list-style-type: none"> • Shows a basic knowledge of issues around climate change AND/OR <ul style="list-style-type: none"> • Identifies a possible conflict of interest that arises in collection and/or interpretation of data AND/OR <ul style="list-style-type: none"> • Identifies an impact of a conflict of interest AND/OR <ul style="list-style-type: none"> • Refers to information from the sources 	1–2

Answers could include:

If funds are available, quality data can be collected and analysed. If funds are not easily available, or only available from particular sources, this may lead to bias in the data collected or in the interpretation of the analysis of the data. Conflicts of interest arise if funding for climate change issues comes from those who will lose most profits by any climate change actions. This relates to both the collecting and interpreting of data.

Collection of Data

Societal influences eg politicians influence the collection of data by allocating more or less funding to projects in the climate change area.

Scientists are usually paid by governments or industry. This may influence the amount of money they can spend on equipment for collecting data or the travel funds they can use to go to locations required to gather the data, or to buy equipment for analysing/interpreting the data.

Large industries may pay scientists to investigate favourable data sets. This may be similar to Summary 1, where the astrophysicist was being paid by oil companies.

Interpretation of Data

The media can influence by constantly repeating/reinforcing particular beliefs, or displaying data and information either clearly or in a way that may be misleading from a scientific perspective. Politicians can also act, just like celebrities do, to sway the public mindset towards believing the interpretation of scientific data or disbelieving it. In Summary 2, the media attempts to impact society's interpretation of data about climate change, by refuting the astrophysicist's claim and identifying inaccuracies. It suggests the interpretation of the data displayed in the article leads to it having very low scientific credibility.

There is a conflict of interest between oil companies and their reporting of climate change issues and their profits. The result is a bias against economic investment in actions towards slowing/stopping climate change.

In Summary 3, the quotation attempts to sway the public mindset towards the interpretation that climate change data is correct, and thus action needs to be taken based on this data. It suggests that the economic influence of the fossil fuel industry affects the interpretation and actions related to climate change.

2020 HSC Investigating Science Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	Mod 5 Practical Investigations to Obtain Primary Data	12-12
2	1	Mod 7 Evidence-based Analysis	12-14
3	1	Mod 5 Practical Investigations to Obtain Primary Data	12-12
4	1	Mod 8 Incidents, Events and Science	12-5, 12-15
5	1	Mod 6 A Continuous Cycle Mod 8 Regulation of Scientific Research	12-13 12-15
6	1	Mod 7 Impacts on Investigations	12-14
7	1	Mod 8 Influence of Economic, Social and Political Forces on Scientific Research	12-15
8	1	Mod 8 Regulation of Scientific Research	12-15
9	1	Mod 5 Reliability and Validity	12-12
10	1	Mod 7 Testing Claims	12-14
11	1	Mod 5 Reliability and Validity	12-5, 12-12
12	1	Mod 8 Influence of Economic, Social and Political Forces on Scientific Research	12-4, 12-15
13	1	Mod 6 Scientific Investigation and Technology	12-5, 12-13
14	1	Mod 6 Scientific Investigation and Technology	12-5, 12-13
15	1	Mod 6 Scientific Investigation and Technology	12-4, 12-5, 12-13
16	1	Mod 8 Influence of Economic, Social and Political Forces on Scientific Research	12-4, 12-5, 12-6, 12-15
17	1	Mod 6 Scientific Investigation and Technology	12-2, 12-13
18	1	Mod 6 Scientific Investigation and Technology	12-5, 12-13
19	1	Mod 5 Reliability and Validity	12-5, 12-12
20	1	Mod 5 Practical Investigations to Obtain Primary Data	12-5, 12-6, 12-12

Section II

Question	Marks	Content	Syllabus outcomes
21	3	Mod 5 Different Types of Scientific Investigations	12-3, 12-12
22 (a)	2	Mod 6 Scientific Investigation and Technology	12-4, 12-13
22 (b)	3	Mod 6 Scientific Investigation and Technology	12-2, 12-4, 12-13
22 (c)	2	Mod 6 Scientific Investigation and Technology	12-4, 12-13
23 (a)	3	Mod 7 Science as Self-Correcting – the Issues	12-14
23 (b)	3	Mod 7 Science as Self-Correcting – the Issues	12-7, 12-14
24 (a)	1	Mod 8 Influence of Economic, Social and Political Forces on Scientific Research	12-6, 12-15
24 (b)	4	Mod 8 Influence of Economic, Social and Political Forces on Scientific Research	12-5, 12-15
25 (a)	2	Mod 5 Practical Investigations to Obtain Primary Data	12-2, 12-12
25 (b)	4	Mod 5 Reliability and Validity	12-2, 12-12

Question	Marks	Content	Syllabus outcomes
26 (a)	3	Mod 6 A Continuous Cycle	12-4, 12-13
26 (b)	4	Mod 6 A Continuous Cycle	12-4, 12-13
27 (a)	2	Mod 7 Reading Between the Lines	12-7, 12-14
27 (b)	4	Mod 5 Student Investigation	12-2, 12-12
28 (a)	2	Mod 6 A Continuous Cycle	12-4, 12-13
28 (b)	4	Mod 6 A Continuous Cycle	12-1, 12-4, 12-13
29 (a)	1	Mod 5 Different Types of Scientific Investigations	12-1, 12-12
29 (b)	3	Mod 5 Different Types of Scientific Investigations	12-4, 12-12
29 (c)	4	Mod 5 Different Types of Scientific Investigations	12-3, 12-12
30	7	Mod 8 Influences of Economic, Social and Political Forces on Scientific Research	12-6, 12-7, 12-15
31 (a)	3	Mod 7 Reading Between the Lines	12-5, 12-6, 12-14
31 (b)	4	Mod 7 Reading Between the Lines	12-6, 12-7, 12-14
32 (a)	2	Mod 7 Reading Between the Lines	12-4, 12-5, 12-14
32 (b)	3	Mod 7 Reading Between the Lines	12-5, 12-7, 12-14
32 (c)	7	Mod 7 Reading Between the Lines	12-7, 12-14, 12-15