



## Mark Scheme (Results)

January 2019

BTEC Level 3 National in Applied  
Science

Unit 7: Contemporary Issues in Science  
(31629H)



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# Unit 7: Contemporary Issues in Science – sample marking grid

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## General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

## Specific marking guidance

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The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

**Question 1:** *Discuss the implications of the scientific issues identified in the articles. (12 marks)*

Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
<b>Understanding the impact in terms of ethical/ social/ economical/ environmental</b>	<b>0</b>	<b>1-3</b>	<b>4-6</b>	<b>7-9</b>	<b>10-12</b>
	Level of response not worthy of credit	<ul style="list-style-type: none"> <li>• Demonstrates limited knowledge and understanding of the scientific issues with generalised comments made.</li> <li>• No or limited attempt to draw links to ethical/social/ economic/ environmental implications.</li> <li>• The discussion will be unstructured and limited to basic points made.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates adequate knowledge and understanding of the scientific issues by identifying and selecting relevant implications from all three articles.</li> <li>• Attempts to draw links to ethical/social/ economic/ environmental implications.</li> <li>• The discussion shows some structure and coherence.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates good knowledge and understanding of the scientific issues by identifying and selecting relevant implications from all three articles.</li> <li>• Draws some links to and between ethical/social/ economic/ environmental implications.</li> <li>• The discussion shows a structure that is mostly clear, coherent and logical.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates comprehensive knowledge and understanding of the scientific issues by identifying and selecting relevant implications from all three articles.</li> <li>• Draws a wide range of links to and between ethical/social/ economic/ environmental implications</li> <li>• The discussion shows a well-developed structure that is clear, coherent and logical.</li> </ul>

**Possible indicative content for Question 1**

**Learners may:**

- **include other valid suggestions, not listed below, which should be credited**
- **cover a number of examples from the list below**
- **would not be expected to cover all points to get full marks.**

Other valid points that they make due to own research/knowledge should also be credited.

Issue	Implications
<p><b>Using nanotechnology in generally useful ways:</b></p> <p>Sensor development (article 1)</p> <p>Monitoring systems (article 1)</p> <p>Satellite size reduction(article1)</p> <p>Solar Cell development (article1)</p> <p>Medical Applications (article 1)</p> <p>Transport Applications (Space Elevator) (article 2 and 3)</p>	<p>Developing emerging technologies that have a spin- off in other areas, such as solar cell nanotechnology, medical applications and material applications (economic)</p> <p>Monitoring the developments and the expertise of new technologies and the sharing of information between institutions (economic)</p> <p>Environmental control becomes easier. Managing Earths resources (environmental)</p> <p>Building a space elevator anchor base at sea causing an impact on marine wildlife (environmental)</p> <p>Changing employee skill sets for construction of facilities and use of equipment (social)</p>
<p><b>Exploiting resources in the local Solar System</b></p> <p>Surveying other planets (article 1)</p> <p>Terraforming possibilities (alluded to in article 1)</p> <p>Exploring nearby planets (article 1)</p> <p>Mining resources on planets and Asteroids (article 2)</p> <p>The economics consequences of using nanotechnology in various ways (B JNNNONNarticle 2 and 3)</p>	<p>Stripping resources from space (ethical)</p> <p>Polluting space and nearby worlds(ethical)</p> <p>Opportunities to spread away from Earth and to colonise the near solar system (social)</p> <p>For countries and organisations, who is it that has the right to be able to claim the resources? (ethical)</p> <p>Widening access to space for countries that would not be able to afford a space programme (social)</p> <p>Giving opportunity to obtain resources from other close by planets (economic)</p> <p>Creating opportunities for collaboration with many countries as the project would be an enormous endeavour (social)</p> <p>Possibilities of working in new ways with other countries to run and manage such a vast project (social)</p> <p>Dealing with social conflicts between countries of the project in terms of how it is run (social)</p> <p>Deciding who pays for the construction and how conflicting economic interests of countries are dealt with (economic)</p> <p>Cutting the cost of space exploration (economic)</p> <p>Clearing away space debris around the Earth</p> <p>Making exploration of the solar system cheaper in terms of research and development of payload systems (economic)</p>

<p><b>The effect on people's lives (across all three articles)</b></p> <p>International Collaboration (articles 2 and 3)</p> <p>Security in building a transport system (article 2)</p> <p>Using Space exploration to improve our lives (article 1 and 2)</p> <p>Health dangers due to radiation (article 3)</p>	<p>Possible pollution issue with billions of nanobots intruding into our lives (environmental, social and ethical)</p> <p>Issues of Artificial Intelligence (AI) (ethical)</p> <p>Changes in employment (social)</p> <p>Security of installations (social)</p> <p>Exposing people to dangerous doses of radiation (ethical)</p>
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**Question 2:** *Identify the different organisations/individuals mentioned in the articles and suggest how they may have an influence on the scientific issues. (6 marks)*

Assessment focus	Band 0	Band 1	Band 2	Band 3
<p><b>Understanding the influence of different organisations / individuals</b></p>	<p><b>0</b></p> <p>Level of response not worthy of credit</p>	<p><b>1-2</b></p> <ul style="list-style-type: none"> <li>• Demonstrates adequate knowledge and understanding of how key organisations/individuals can influence the scientific issue by identifying different types of organisation/individual.</li> <li>• A basic explanation of how the organisation/individual may have an influence is given but with general statements made and limited linkages to the articles.</li> </ul>	<p><b>3-4</b></p> <ul style="list-style-type: none"> <li>• Demonstrates good knowledge and understanding of how key organisations/individuals can influence the scientific issue by identifying different types of organisation/individual (including any references/acknowledgments in footnotes) from all three articles.</li> <li>• An explanation of how these organisations/individuals may influence the issue is given, which is occasionally supported through linkage and application to the articles.</li> </ul>	<p><b>5-6</b></p> <ul style="list-style-type: none"> <li>• Demonstrates comprehensive knowledge and understanding of how key organisations/individuals can influence the scientific issue by identifying and selecting different types of organisation/individual (including any references/acknowledgments in footnotes) from all three articles.</li> <li>• An explanation of how these organisations/individuals may influence the issue is given, which is supported throughout with linkage and application to the articles.</li> </ul>

### Indicative content

Learners may cover a number of examples from the list below but would not be expected to cover all to get full marks.

Learners may:

- include other valid suggestions, not listed below, which should be credited
- cover a number of examples from the list below
- would not be expected to cover all points to get full marks.

<b>Government and global organisations</b>	
<b>Organisation</b>	<b>Influence on scientific issue</b>
National Aeronautics and Space Administration (NASA)	Research/development/construction infrastructure in space/ education/launch facilities/human physiology monitoring (article 1)
United Nations (UN)	Provide legal framework for cooperation/settling disputes/treaty negotiation
International Academy of Astronautics (IAA)	Funding/research and development (article 2 and 3)
European Research Commission (ERC)	Funding/research and development/education (article 1)
European Space Agency (ESA)	Providing platform for discussion of publicising/materials/nanotechnology/launch facilities/human physiology monitoring. (article 1)
National governments	Funding/personnel/research facilities/planning strategy
Universities	Education/research/development of technologies
Commercial organisations (British Aerospace) Google Exxon DARPA	Research/development of technologies Help with funding (article 2) Help with funding (article 2) Help with funding (article 2)

### Individuals

<b>Individuals</b>	
Arthur C Clarke	Author/media personality/thinker (article 2)
Colin McInnes	Professor of Engineering, Works for the University of Strathclyde and is developing nanospacecrafts (article 1)
Meyya Meyyappan	Chief Scientist for Exploration Technology at the NASA Centre for Nanotechnology (article 1)
Jay Pearson	Author Working on developing space elevators
Laurent Marchand	Head of Components Technology at the European Space Research and Technology Centre, Noordwijk, Netherlands (article 1)
Constantinos Mavroidis	Professor of Engineering, Northeastern University, Boston, Massachusetts
John Knapman	Author of Article 3, specialist in the field.
Stuart Clark	Author Article 1 (non-specialist) writing for the general public helps shape the general public's view.
Graham Templeton	Author Article 2, specialist journal for those interested in knowing about recent innovations in the field.

**Question 3:** Discuss whether Article 3 has made valid judgements. (12 marks)

Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
Interpretation, analysis and evaluation of scientific information	<b>0</b>	<b>1-3</b>	<b>4-6</b>	<b>7-9</b>	<b>10-12</b>
	Level of response not worthy of credit	<ul style="list-style-type: none"> <li>• Vague statements about the validity of Article 3 are made with limited attempt to consider:               <ul style="list-style-type: none"> <li>- how the article has interpreted and analysed the scientific information to support the conclusions/judgements being made</li> <li>- the validity and reliability of data</li> <li>- references to other sources of information.</li> </ul> </li> <li>• The discussion will be unstructured and limited to basic points made.</li> </ul>	<ul style="list-style-type: none"> <li>• The validity of Article 3 is discussed, which is partially supported by a consideration of:               <ul style="list-style-type: none"> <li>- how the article has interpreted and analysed the scientific information to support the conclusions/judgements being made</li> <li>- the validity and reliability of data</li> <li>- references to other sources of information.</li> </ul> </li> <li>• The discussion shows some structure and coherence.</li> </ul>	<ul style="list-style-type: none"> <li>• The validity of Article 3 is discussed, which is mostly supported by a consideration of:               <ul style="list-style-type: none"> <li>- how the article has interpreted and analysed the scientific information to support the conclusions/judgements being made</li> <li>- the validity and reliability of data</li> <li>- references to other sources of information.</li> </ul> </li> <li>• The discussion shows a structure that is mostly clear, coherent and logical.</li> </ul>	<ul style="list-style-type: none"> <li>• The validity of Article 3 is discussed and is consistently supported throughout by the consideration of:               <ul style="list-style-type: none"> <li>- how the article has interpreted and analysed the scientific information to support the conclusions/judgements being made</li> <li>- the validity and reliability of data</li> <li>- references to other sources of information.</li> </ul> </li> <li>• The discussion shows a well-developed structure that is clear, coherent and logical.</li> </ul>

**Indicative content.**

Learners should consider how the article has analysed the scientific information to support the conclusions/judgements being made; the validity and reliability of data; references to other sources of information.

**Learners may:**

- include other valid suggestions, not listed below, which should be credited
- cover a number of examples from the list below
- would not be expected to cover all points to get full marks.



## **Judgements**

- A space elevator is possible to build in practice.
- To make it a realistic project it will need to be a complex four-stage construction.
- Further work is needed to develop the technology of lifting the loads.
- Some materials will still need to be developed to act as the tether.
- There are issues with the current strengths of some materials.
- The economic argument remains to be made.
- Producing long lengths of tether using emerging technology.
- Making long-lasting materials because of difficulty of replacement.
- Considering security issues and a target for terrorism.

## **Validity and Reliability**

- Wide enough range of sources used.
- Good agreement about the feasibility of construction based on current technology.
- Much of the research remains theoretical and still needs testing.
- The research is supported by data and mathematical modelling.
- The data used is from current research that has been corroborated by other institutions. (Peer Reviewed)
- The paper identifies ways forward, but also identifies problems.
- Findings are supported by references to other work in the field.
- The paper gives an optimistic view that a space elevator will be built despite the issues that are currently preventing it.
- The paper provides an attempt to balance but the paper focuses strongly on the practicalities of the information presented.
- The paper focuses on the key practicalities of each identified issue.

## **References**

- The paper is referenced throughout.
- Professional bodies are referred to throughout.
- Some references are contemporaneous with the article.
- Some references are more than 30 years old.
- References are from a range of journals, but a few are from the same organisation.
- Three references are the same person as the author, so has quoted his own work in the paper.
- The article was edited and so may have originally included material that supported a particular point of view that is no longer known.

**Question 4:** Suggest potential areas for further development and/or research of the scientific issues from the three articles. (5 marks)

Assessment focus	Band 0	Band 1	Band 2	Band 3
Interprets, analyses and evaluates articles to identify potential areas for further development and/or research	<b>0</b>	<b>1</b>	<b>2-3</b>	<b>4-5</b>
	Level of response not worthy of credit	<ul style="list-style-type: none"> <li>Areas for further development and/or research of the scientific issue are identified but these are usually vague descriptions with limited analysis/evaluation of the articles to support the statements being made.</li> </ul>	<ul style="list-style-type: none"> <li>A description for further areas of development and/or research of the scientific issue is given.</li> <li>Provides occasional evidence from the analysis/evaluation of the articles and attempts to synthesise and integrate relevant knowledge.</li> </ul>	<ul style="list-style-type: none"> <li>A description for further areas of development and/or research of the scientific issue is given.</li> <li>Consistently provides evidence from the analysis/evaluation of the articles and demonstrates throughout the skills of synthesising and integrating relevant knowledge.</li> </ul>

#### Indicative content for Question 4

Learners may:

- include other valid suggestions, not listed below, which should be credited
- cover a number of examples from the list below
- would not be expected to cover all points to get full marks.

### **Further development/research**

- Making tether material in sufficiently long quantities for the elevator.
- Further continuous manufacturing techniques for a tether.
- Means of keeping the tether in place for a space elevator.
- Producing mini satellites for monitoring nearby planets.
- Producing self-repairing spacesuits.
- Producing spacesuit monitors for vital signs in astronauts.
- New propulsion techniques.
- Finding construction techniques in space.
- Developing protocols to manage research across different countries into the uses of nanotechnology.
- Improving space tether materials.
- Testing the properties of materials to be used in the space elevator.
- Lengthening the lifetime of materials.
- Testing materials used in space environments for the effects of strong electromagnetic fields.
- Looking at the use of nanotechnology and nano materials in the colonisation of nearby planets.
- Applications to monitoring changes to the environment on Earth.
- The effects on the human body of increased exposure to conditions in space.
- Possible ways of developing a traction system to lift the elevator.
- Looking at the possible effects of using nanotechnology with people in the form of body function sensors and to monitor everyday activities.

Credit any other valid suggestions

**Question 5:** You are a research assistant for the UK Space Agency. You have been asked to write a report on the advantages and disadvantages of participating in an international project to build a space elevator. Your task is to write a report for the UK House of Commons committee. (15 marks)

Assessment focus	Band 0	Band 1	Band 2	Band 3	Band 4
Synthesises content ideas and demonstrates an understanding of scientific reporting and its relationship with reporting medium and target audience	<b>0</b>	<b>1-4</b>	<b>5-8</b>	<b>9-12</b>	<b>13-15</b>
	Level of response not worthy of credit	<p>Identifies some of the main points and evidence from the three articles with limited attempt to summarise these.</p> <p>Shows little awareness of audience or purpose.</p> <p>The article will be unstructured and limited to basic points made.</p>	<ul style="list-style-type: none"> <li>Summarises the main points and evidence, including any supporting and conflicting statements, from the three articles.</li> <li>Shows an awareness of audience and purpose.</li> <li>The article shows some structure and coherence.</li> </ul>	<ul style="list-style-type: none"> <li>Summarises and attempts to synthesise the main points and evidence, including any supporting and conflicting statements, from the three articles.</li> <li>Selects material to suit audience and purpose, with appropriate use of tone, style and scientific terminology.</li> <li>The article shows a structure that is mostly clear, coherent and logical.</li> </ul>	<ul style="list-style-type: none"> <li>Summarises and synthesises the main points and evidence, including any supporting and conflicting statements, consistently from the three articles.</li> <li>Consistently selects and organises material for particular effect, with effective use of tone, style and scientific terminology.</li> <li>The article shows a well-developed structure that is clear, coherent and logical.</li> </ul>

### Indicative content for Question 5

#### Learners may:

- include other valid suggestions, not listed below, which should be credited
- cover a number of examples from the list below
- would not be expected to cover all points to get full marks.

#### Tone and style show awareness of the audience

- Audience will be varied, MPs from various backgrounds.
- Not all the audience will have a detailed scientific understanding.
- A range of professionals.
- Scientific terms explained.

## **Main Points**

### **Introductory Comments**

- What is a space elevator? (article 2 and 3)
- Why would it be useful. (all articles)
- A means of showing off new and developing technologies.(article 1)

### **Advantages**

- Carbon nanofibre technology is advanced beyond the laboratory and is in use in a variety of small-scale applications.(article 1 and 3)
- Small-scale production has been shown to work. (article 3)
- Current costs of R&D for satellite launches are high, costs would be lower. (article 2 and 3)
- Exploitation of resources on other planets and the Moon would give wide-ranging advantages to society. (article 1)
- More efficient monitoring of Earth's environment.(article 1)
- Medical spin-offs, similar to those that followed from earlier space missions.(article 1)
- Improvements to solar cell technology.(article 1)

### **Disadvantages**

- International cooperation would be difficult, some countries may not be willing to invest in the development. (article 2 and 3)
- Questions about the ownership of space.(article 2)
- Treaties relating to dispute resolution may be very difficult to manage. (article 2 and 3)
- The overall technology is very much in its infancy, and so far nothing has progressed beyond modelling. (article 3)
- Risks of collisions with meteorites and man-made space debris remains high.
- Risk of terrorist attack high. (article 3)
- Possible issues with damaging the ocean environment at the place where the tether for the elevator is based on Earth. (article 3)
- The whole four- or five-stage process of putting a payload into space is very complex. (article 3)

### **Conclusion**

- Building a space elevator may or may not be feasible.
- Use of supporting/conflicting statements from the articles.

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