

## **MARK SCHEME for the October/November 2015 series**

### **9694 THINKING SKILLS**

**9694/42**

Paper 4 (Applied Reasoning), maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9694	42

1 Make five criticisms of the data presented and/or the inference that “women watch more science fiction than men”. [5]

1 mark for any of the following:

- More women than men might have been asked.
- A higher proportion of women may have returned the questionnaires.
- y-axis scale truncated to exaggerate differences.
- Numbers are, in fact, very close (not likely to be significantly different).
- The sample may not be representative of general population because [any valid reason].
- Only data from returned questionnaires is represented – students who wanted to dispel stereotypes may have been more likely to return the form.
- The three shows selected could have been particularly “female-friendly”.
- It is not clear if other science-fiction shows were included on the questionnaire.
- “enjoy” is not the same as ‘watch often’.
- “watch more” is ill-defined – could be number of programmes, frequency of watching, total hours watched per period etc.

2 Briefly analyse Oswin’s argument in Document 1: *Futile Frontier*, by identifying its main conclusion, intermediate conclusions and any counter-assertions. [6]

1 mark for each element (maximum 4 marks if MC not identified).

**CA** – (Earth is no longer a mystery and, since mankind needs constant challenges,) space becomes the obvious next step.

**IC** – (But) there is no reason to look beyond Earth for challenges.

**CA** – Many people highlight glory and fame as sufficient reasons to explore space.

**IC** – All of these projects amount to nothing more than an expensive folly.

**IC** – This money would be much better spent funding organisations that improve life on Earth

**IC** – The various space programmes represent a significant cost in human life.

**IC** – Space exploration serves no useful purpose.

**MC** – It [space exploration] should be curtailed.

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9694	42

- 3 Give a critical evaluation of the strength of Oswin’s argument in Document 1: *Futile Frontier*, by identifying and explaining any flaws, implicit assumptions and other weaknesses.

[9]

2 marks for a developed version of any of the following points.

1 mark for a weak or incomplete version of any of the following points.

#### Paragraph 1

**Straw man** – ‘Those that defend it claim that Earth is no longer a mystery’ is an easily discreditable misrepresentation of the basis of the counter-position.

#### Paragraph 2

**Straw man** – ‘Many people highlight glory and fame as sufficient reasons to explore space’ is a misrepresentation of the basis of the counter argument that is easy to argue against.

#### Paragraph 3

**Straw man** – Nobody is suggesting that a visit to Mars is necessary to produce artificial satellites.

**Significance** – The author implies that the various figures quoted (\$20 billion etc.) represent significantly large sums, but without comparison to national budgets we do not know the significance of these numbers.

**Question-begging** – To describe these projects as mere “folly” simply reasserts the author’s view that they are of no real benefit.

**Selective examples** – Deliberately ridiculous example of the purpose of the Voyager space probe.

#### Paragraph 4

The phrase “does nothing but gaze at stars” implies that gazing at stars is not a sufficient purpose for a telescope.

**Equivocation** – The author asks how, with all the advanced technology on board, could something be faulty? ‘Advanced’ is used here also to mean ‘reliable’.

**Straw man** – The author parodies the purpose of SETI as ‘listening out for little green men’.

**Contradiction** – Having earlier stated that artificial satellites are “useful, productive and lucrative”, the author here implies that the Hubble Space Telescope, which is an artificial satellite, is expensive and useless.

**Significance of figures / inconsistency** – Given that the figures quoted for the other projects were in the billions, ‘millions’ or ‘\$5 million per year’ seem small in comparison.

<b>Page 4</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – October/November 2015</b>	<b>9694</b>	<b>42</b>

### Paragraph 5

**Significance of numbers** – Without data on the relative risk of other endeavours it cannot be concluded that 120 is a significant number.

### General

Loaded language: the author frequently uses loaded language and rhetorical questions.

**Circular reasoning** – Having already decided that space exploration is worthless, the author does not allow that any expenditure on it is worthwhile.

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9694	42

4 'We should explore space.'

Construct a reasoned argument to support or challenge this claim, commenting critically on some or all of Documents 1 to 5 and introducing ideas of your own. [30]

Level	Structure	Max 8	Quality of argument	Max 8	Use of documents	Max 8	Treatment of counter positions	Max 6
4	<p>Precise conclusion and accomplished argument structure with consistent use of intermediate conclusions. Likely to include at least two of the following:</p> <ul style="list-style-type: none"> <li>• strands of reasoning</li> <li>• suppositional reasoning</li> <li>• analogy</li> <li>• evidence</li> <li>• examples</li> </ul> <p>Argument is structured so the thought process is made clear. Uses vocabulary of reasoning appropriately and effectively to support argument.</p>	7–8	<p>Cogent and convincing reasoning which answers the question which was asked. Subtle thinking about the issue. Use of relevant own ideas and ideas from documents. Very few significant gaps or flaws.</p>	7–8	<p>Perceptive, relevant and accurate use of documents to support reasoning. Sustained and confident evaluation of documents to support reasoning. (Two or more valid <b>evaluative</b> references to documents). Able to combine information from two or more documents and draw a precise inference.</p>	7–8	<p>Consideration of key counter arguments and effective response to these. Use of own ideas in response to counter arguments. Use of valid critical tools to respond to counter arguments. Effective use of appropriate terminology.</p>	5–6
3	<p>Clear conclusion that is more than "I agree". Clear argument structure, which may be simple and precise or attempt complexity with some success. Appropriate use of intermediate conclusions. Use of other argument elements to support reasoning. Generally makes thinking clear. Appropriate use of vocabulary of reasoning.</p>	5–6	<p>Effective and persuasive reasoning which answers the question which was asked. (Although there may be some irrelevance or reliance on dubious assumptions.) Use of own ideas and ideas from documents. Few significant gaps or flaws.</p>	5–6	<p>Relevant and accurate use of documents which supports reasoning. (Must reference 3+ documents.) Some evaluation <b>and</b> comparison of documents to support reasoning. Inference drawn from ≥ 1 document.</p>	5–6	<p>Consideration of key counter arguments and effective response to these. Some use of appropriate terminology.</p>	3–4

<b>Page 6</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – October/November 2015</b>	<b>9694</b>	<b>42</b>

<b>Level</b>	<b>Structure</b>	<b>Max 8</b>	<b>Quality of argument</b>	<b>Max 8</b>	<b>Use of documents</b>	<b>Max 8</b>	<b>Treatment of counter positions</b>	<b>Max 6</b>
2	Conclusion stated but may be “I agree”. Sufficient clarity for meaning to be clear throughout. Structure may be easy to follow but brief or a longer argument which has a less clear structure. Uses reasons. Some appropriate use of vocabulary of reasoning.	3–4	A reasoned stance which attempts to answer the question which was asked. Some support for the conclusion. (Although there may be considerable irrelevance or reliance on dubious assumptions.) Some thinking/own ideas about the issue. Use of rhetorical questions and emotive language. Some significant gaps or flaws.	3–4	Some relevant use of documents to support reasoning, but some documents used indiscriminately. Some (perhaps implicit) comparison of documents or some critical evaluation of documents.	3–4	Inclusion of counter argument or counter assertion but response to this is ineffective.	2
1	Attempt to construct an argument. Unclear conclusion, multiple conclusions or no conclusion. Disjointed, incoherent reasoning. Use of examples in place of reasoning. Possibly a discourse or a rant. Reasons presented with no logical connection. Documents considered sequentially. Substantial irrelevant material.	1–2	Attempt to answer the general thrust of the question. Attempt to support their view. Excessive use of rhetorical questions and emotive language. Ideas which are contradictory.	1–2	Some use, perhaps implicit, of documents. No attempt at critical evaluation. No comparison of documents.	1–2	Inclusion of counter argument or counter assertion with no response.	1

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9694	42

## Example Level 4 Answers

### Support (760 words)

It is often said that humans are a curious species and this, in turn, is often cited as sufficient reason to spend money on space exploration – indeed, it is mentioned early on in Document 2 from NASA who, although they have a bias towards promoting the business in which they operate, undoubtedly have a lot of expertise. Satisfying human curiosity, however, is unlikely to convince everyone. We should explore space, and the reasons for this go well beyond mere curiosity.

It should be made clear that by ‘explore space’ I mean send crafts and people beyond the immediate confines of Earth’s orbit for the purpose of gathering information about what is ‘out there’. It is almost a given that the continued use of Earth-orbiting satellites is a worthwhile exercise, but we should not limit ourselves to this.

Space exploration has produced, and is likely to produce, benefits in terms of technological advancement that can be used on Earth. The author of Document 1 claims the Apollo programme had no practical results and asks rhetorically of the Voyager space probe, “What benefits has it brought?” The Apollo claim is plain wrong – most people are aware of the oft-cited Teflon and there are many other benefits from this and other space programmes. However, even if this claim in Document 1 were correct, the absence of success in the past would not mean that future exploration would not bring benefits.

Document 1 cites what are, on the face of it, more pressing problems here on Earth – diseases to cure, pollution to control, crops to improve. A flippant response would be that if we cure more diseases we will further increase an ageing population which would lead to more pollution and the requirement for more crops. More optimistically, it is possible, perhaps equally so, that technology or knowledge that helps with some of these problems would come from the space exploration or its development. Many discoveries are made along the way as an unexpected by-product of scientific research.

Space exploration will bring economic benefits to the countries involved. Many gainsayers, including Document 1, cite the enormous sums of money involved. This is somewhat misleading as much of the ‘wasted’ money goes in wages to the people employed in the space programme which then feeds back into the economies of nations throughout the world, many of which are less wealthy. However, Document 3 shows that it may well be possible to do things much more cheaply than the most commonly cited counter examples. The exploration technology can then be sold to anyone who wishes to, for example, launch a commercial satellite.

Furthermore, space exploration might reduce our tendency to go to war with one another. Document 5 presents some figures about spending on space programmes around the world. While Wikipedia is a notoriously unreliable source, ‘hard’ facts like this can be easily checked and are therefore likely to have some truth in them. The list seems to suggest that many of the agencies with smaller budgets will have to cooperate with one another or the larger agencies to bring any projects to completion, perhaps in the style of the ESA, thus increasing international cooperation. Moreover, if it can be discovered that there is intelligent life outside the solar system, and it is very different from us, this might be reason for nationalistic squabbles over petty differences to subside.

Most governments like to keep the general public on side, particularly around elections and so many do not want to risk large proportions of their annual budget on uncertainly successful space missions. However, Document 4 does imply that, in the UK at least, the public are on the side of space exploration. The research company YouGov is likely to have some expertise in the accurate collection and representation of statistics and, as a commercial company, would not want to risk their reputation by publishing false or misleading statistics. It might be considered weak to generalise results from the

Page 8	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – October/November 2015	9694	42

UK but the UK, as a reasonably affluent country, might well share opinions in common with the main players in space exploration, all of whom are reasonably affluent.

For many reasons, in addition to human curiosity, we should explore space. Indeed, one pressing Earth-based problem not mentioned by Document 1 is that of global climate change, the consequences of which could be that the Earth becomes uninhabitable. If that happens our only solution as a species, or community of species, will be to go and live somewhere else, which will be hard to do if we do not explore space.

### Challenge (770 words)

It is often said that humans are a curious species and this, in turn, is often cited as sufficient reason to spend money on space exploration; indeed, it is mentioned early on in Document 2. However, Document 2 is written by NASA who, although likely to have some expertise, has a bias towards promoting the business in which it operates. Satisfying human curiosity is not a good enough reason to justify space exploration – we would never justify similar levels of spending on, for example, butterfly identification. We should not explore space, as it diverts precious resources from more pressing concerns here on Earth.

It should be made clear that by ‘explore space’ I mean send crafts and people beyond the immediate confines of Earth’s orbit for the purpose of gathering information about what is ‘out there’. It is true that the continued use of Earth-orbiting satellites is a worthwhile exercise.

Space exploration has brought few tangible benefits. There exist many reports of serendipitous discoveries arising from space exploration but, when pressed, Teflon is the only example people ever come up with. Document 1 claims there have been no benefits; this is a slight exaggeration but, despite Document 1’s hyperbole, the point remains that, in over 50 years, practical developments have been few. Spending similar sums in other spheres of innovation is just as likely to have yielded technological benefits. Indeed, Earth-bound projects have a higher probability of producing solutions to Earth-bound problems. Documents 1 and 5 cite enormous sums of money and none of the documents, even NASA, mentions specific commercial benefits from space exploration. Any commercial research and development project here on Earth with a budget in the \$millions would soon be cancelled if it brought few tangible effects. Therefore, if space programmes were subject to the same constraints as commercial research and development programmes, they would presumably have been cancelled long ago.

Document 1 cites some more-pressing problems here on Earth – diseases to cure, pollution to control, crops to improve. Although the author of Document 1 is clearly biased, the point still stands. The money would be much better spent here on Earth, such as on the ‘poor sanitation’ in India mentioned in Document 3.

Space exploration is very expensive, deep-space exploration even more so. Document 3 suggests that affordable space travel might be upon us with the launch of the Indian Space Agency’s Mars mission. However, it is likely that the Mars mission itself is merely an expensive shop window display with which to advertise much more commercially viable low-Earth-orbit space technology. With this sort of project, India could really make money and do something about its sanitation problem.

Most governments like to keep the general public on side, particularly around elections and so most do not want to risk large proportions of their annual budget on uncertainly successful space missions. Document 4 does imply that, in the UK at least, the public are on the side of space exploration. However, the question “How important, if at all, do you think it is for human beings to explore space?” is meaningless unless the relative cost is taken into account. A respondent might think space exploration is worth doing as long as the annual budget is less than \$10000, or as long as health-spending is not cut. This means the graph in Document 4 cannot be used to claim that space



<b>Page 9</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – October/November 2015</b>	<b>9694</b>	<b>42</b>

exploration is supported by informed public opinion. In any case, it would be hasty to generalize results from a UK poll to other countries with space programmes.

It has been said that space exploration might reduce our tendency to go to war with one another. India and Pakistan are famous rivals; Russia and China are close neighbours of India. According to Document 5, all four countries have expensive space programmes (Pakistan less so). While Wikipedia is a notoriously unreliable source, 'hard' facts like the cost of a national space programme can be easily checked and are therefore likely to have some truth in them. The space race in general and the Indian Space programme in particular seems likely to provide just another opportunity, or excuse, for petty nationalist posturing. While having a slightly shinier space rocket than your neighbour might not immediately lead to a declaration of war, it is unlikely to promote the spread of peace and harmony.

Humans are curious, but there are other ways to satisfy curiosity. The Earth is in trouble, the temperature is rising, the population is expanding, people are starving, biodiversity is reducing, and nuclear weapons have not gone away. We cannot afford to explore space and so we shouldn't.