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Mark Scheme (Results)

June 2018

BTEC Level 3 National in Applied
Science

Unit 7: Contemporary Issues in Science
(31629H)



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Unit 3: Science Investigation Skills – sample marking grid

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

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 issue identified in the articles. (12 marks)

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

Possible indicative content for Question 1:

Learners:

- may include other valid suggestions, not listed below, which should be credited.
- may cover a number of examples from the list below.
- would NOT be expected to cover all points to get full marks.
- will not necessarily specify whether the points they are making are economic/social/environmental/ethical

| Issue | Implication | Factor |
|--|---|--|
| Drug-resistant infections are spreading and increasing worldwide | Economic productivity reduced as people are ill | social economic |
| Chaotic practices/ misuse: people not completing a course of antibiotics/ given when not needed | <ul style="list-style-type: none"> • Decreases their effectiveness. • More antibiotic-resistant superbugs/ bacteria. • Difficulty in treating infections • • Cost to NHS for ill-prescribing antibiotics | social ethical economic |
| <p>Used prophylactically or as growth promoters in animal feed</p> <ul style="list-style-type: none"> • Overuse of antimicrobials e.g. colistin. Antibiotics are used in agriculture and their use is expected to increase | <ul style="list-style-type: none"> • Resistant bacteria selected as a result can enter the food chain and infect humans • • Animal right concerns • | social economic environmental ethical |
| <ul style="list-style-type: none"> • Hospital acquired infections directly cause 5000 deaths per year in the UK and contribute to another 15 000 deaths annually. • Most health procedures in humans and animals rely on antibiotics. • | <ul style="list-style-type: none"> • Hospital acquired infections are likely to get worse. • Routine procedures may become untreatable/ carry a greater risk due to overuse and misuse of antibiotics. • | social ethical economic |
| <ul style="list-style-type: none"> • Reference to natural selection/antibiotics as agents of selection/selection pressure. | Bacterial resistance is inevitable. | environmental |
| <ul style="list-style-type: none"> • Trade, travel and human migration also contribute to the spread of antimicrobial | <ul style="list-style-type: none"> • People take their resistant bacteria with them when they travel | social environmental |

| | | |
|---|--|--|
| <ul style="list-style-type: none"> resistance. Travel will increase. | | |
| <ul style="list-style-type: none"> Access to effective antibiotics are less available in LEDC | <p>Many people die needlessly of infections because bacteria are already resistant at the point of introduction.</p> | <p>ethical economic</p> |
| <ul style="list-style-type: none"> Overreliance, by the medical profession on antibiotics rather than practising good hygiene to prevent infection | <p>Many patients infected by unhygienic staff and dirty equipment in hospitals. Surgical procedures will be very dangerous/unable to be carried out due to subsequent infections being untreatable.</p> <p>Minor injuries, routine surgery/treatment and common infections could become fatal.</p> <p>Cost of effective healthcare will also increase.</p> <p>Increase in sepsis</p> | <p>social ethical economic</p> |
| <ul style="list-style-type: none"> Need to look for other microbiocidal agents, e.g. honey | <p>As antibiotic resistance increases infections will become untreatable without alternatives</p> | <p>social ethical economic environmental</p> |

Question 2: Identify the different organisations and individuals mentioned in the articles and suggest how they may have an influence on the scientific issue. (6 marks)

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

Indicative content

Learners:

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

Credit reference to **patients as individuals** – responsibility to finish the course of antibiotics/not demand them when not needed

Credit reference to **GPs/hospital doctors as individuals** or as part of an **organisation (NHS)** to prescribe antibiotics appropriately/ to tell patients to finish the course of antibiotics

Credit reference to **farmers** contributing to antibiotic resistance through use of antibiotics on livestock

| Government and global organisations | |
|--|---|
| Organisation | Influence on scientific issue |
| United Nations (UN) (2) | fund research into antibiotic resistance; know how important the issue is and can co-opt all the member states to take their share of responsibility address the needs and capabilities of the health systems of countries to deal with issue help preserve global antibiotic resources |
| Queen Margaret University, Edinburgh (3) | Research into the antimicrobial activity of Scottish Portobello honey. The authors concluded that honey is a superior antimicrobial agent. |
| Department of Vet Medicine, University of Glasgow (3) (Carnwath et al.) | Research into the effect of different concentrations of Scottish heather honey and Manuka honey. |
| FAO (Food and Agriculture Organisation) (2) | <ul style="list-style-type: none"> • Endorsed the World Health Organisation global action plan into antimicrobial resistance • part of the UN • deals with improving food production and sustainability/security so can help reduce overuse of antibiotics in agriculture. |
| World Trade Organisation (WTO) (2) | intergovernmental organisation that regulates international trade; negotiates to reduce tariffs tariffs could restrict access to antibiotics in poorer countries. |
| World Health Assembly (2) | Discussed options for a global development and stewardship framework on antimicrobial resistance. the decision-making body of the WHO (World Health Organisation) . |
| World Health Organisation (WHO) (1, 2 and 3) | Preserve antimicrobials by controlling their distribution and use. Develop new health technologies for preventing antimicrobial resistance. Promote affordable access to existing antimicrobials and diagnostic tools. |

| | |
|---|--|
| | <p>WHO has a global action plan on antimicrobial resistance (GAP-AMR) – to improve knowledge and awareness, reduce incidence of infection, optimise use of antibiotics, develop new antimicrobials and effective vaccines.</p> <p>WHO has launched global antibiotic R and D partnership to work with pharmaceutical and biotech companies, academia, and the health authorities of many countries to address the problem.</p> |
| WIPO (World Intellectual Property Organisation) (2) | Patenting - this can influence accessibility of antibiotics – patents make them more expensive. |
| NICE (National Institute for Health and Care Excellence) (1) | <ul style="list-style-type: none"> • Executive non-departmental public body of the UK Department of Health (formerly National Institute for Clinical Excellence). • Publishes guidelines on use of new and existing medicines • Can give advice to medical staff re appropriate use of antimicrobials and cost effectiveness. • Has published info that 1 in 16 patients on NHS wards are becoming infected due to poor hygiene among staff or by dirty equipment. |
| Public Health England (1) | <ul style="list-style-type: none"> • To protect and improve the nation's health and wellbeing, and reduce health inequalities. • Inform the public about health issues and antimicrobial resistance. |
| World Organisation for Animal Health (OIE) (2) | <ul style="list-style-type: none"> • The GAP-AMR has been endorsed through resolutions with the Food and Agriculture Organization of the United Nations (FAO) |

| Individuals | |
|---|--|
| (Professor Dame) Sally Davies, Chief Medical Officer of the UK (1) | <ul style="list-style-type: none"> • High ranking civil service post; • Has influence over National Health Service policy; • Raises profile of antimicrobial resistance. (Formerly Chief Scientific Adviser to government; scientific evidence informs policy making.) • Says "we are going to see people with untreatable infections" and "doctors should not needlessly dish out antibiotics". |
| Dr Danilo Lo Fo Wang Senior Adviser to WHO (1) | <ul style="list-style-type: none"> • Raising awareness by saying 'A child falling off their bike and developing a fatal infection would be a freak occurrence in the UK, but that is where we are heading.' |
| Dr Keiji Fukuda – WHO Assistant Director for Health Security (1) | <ul style="list-style-type: none"> • 'Minor injuries which have been treatable for decades can once again kill' |

| | |
|--|---|
| <p>Prof Laura Piddock, microbiologist at University of Birmingham (UK) (1)</p> | <ul style="list-style-type: none"> Has stressed need for concerted world effort. <p>'The world needs to respond as it did to the AIDS crisis.'</p> <p>'We still need a better understanding of all aspects of resistance as well as new discovery, research and development of new antibiotics.'</p> |
| <p>Jenna and Andrew Hannah (1)</p> | <p>Lost sons to infection acquired in hospital. Have used their story to raise awareness among public (along with The Daily Mail).</p> |
| <p>Jennifer Cohn, MSF (1)</p> | <p>Alert people to fact that problem has spread to many areas in the world, to field hospitals and surgical units in Syria.</p> |
| <p>Pauline McLoone, (3)</p> <p>Mary Warnock (3)</p> <p>Lorna Fyfe (3)</p> | <p>Authors of article 3, carried out a review of lots of research into honey as an anti-microbial agent for skin disorders.</p> |
| <p>Pimentel et al. (3)</p> | <p>Demonstrated 'the influence of seasonality on the Antibacterial activity of honey.'</p> |
| <p>Kuncic et al. (3)</p> | <p>'Reported that Slovenian honeys from diverse floral origins had antibacterial activity against E. coli, P. aeruginosa, and S. aureus. Slovenian chestnut and pasture honeys were found to be most active.'</p> |
| <p>Muller et al. (3)</p> | <p>'Reported that Manuka honey worked synergistically with the antibiotic rifampicin to inhibit the growth of MRSA'</p> |
| <p>Gunaldi et al. (3)</p> | <p>'Investigated the antimicrobial activity of Manuka honey in clearing MRSA infection in MRSA-inoculated spinal implants inserted in rats</p> |
| <p>Jenkins et al. (3)</p> | <p>'Reported that Manuka honey reduced the expression of α-toxin in MRSA.'</p> <p>Reducing virulence.</p> |
| <p>Kronda et al. (3)</p> | <p>'Reported that sub-lethal concentrations of Manuka honey reduced siderophore production, a virulence factor that scavenges iron for bacterial growth.'</p> |

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

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

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**
 - **may cover some of the examples from the list below**
 - **would NOT be expected to cover all points to get full marks.**
-
- Article 3 attempts to validate the use of medical-grade honey as a possible treatment for antimicrobial resistance for disorders of the skin.
 - reviews lots of research by various organisations/research teams.
 - In respected scientific journal so should have been peer reviewed and edited.
 - Well referenced.
 - This review is useful as it shows results of tests on types of honey other than Manuka
 - Tests carried out against bacteria and fungi.
 - Ranges of concentrations used without giving reasons for the choices and are the ranges large enough and number of intermediates enough?
 - Considered the need to test both Gram positive and Gram negative bacteria
 - Researchers concluded that Portobello honey (Scottish) is a superior antibacterial agent, however the MIC (minimum inhibitory concentration) was not calculated.
 - Not told how many replicates used so difficult to assess reliability, although synopses of many studies here and many of them agree with each other, which is another way to check reliability.
 - (Gethin and Cowman) found:
 - This study had a large sample.
 - Not told which stats tests carried out and no raw data available.
 - Not told lengths of study – presumably only as long as it takes to get a result when treating the leg ulcers, not longitudinal studies.
 - Not given much information about control variables and any information about when honey was made
 - the effectiveness of honey can vary according to the season and climatic conditions when it was made by bees, and the health of the bee colonies making it;
 - no information on effect of colony collapse disorder on quality of honey;
 - storage may also affect the honey, although some studies show that it remains effective after storage in the dark for up to 7 years.
 - More *in vitro* than *in vivo* studies but *in vivo* more difficult to carry out
 - Some honey is contaminated with bacteria and fungi so medical-grade honey has to be used.

Question 4: *Suggest potential areas for further development and/or research of the scientific issue 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 | 0 | 1 | 2-3 | 4-5 |
| | Level of response not worthy of credit | <ul style="list-style-type: none"> 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. | <ul style="list-style-type: none"> A description for further areas of development and/or research of the scientific issue is given. Provides occasional evidence from the analysis/evaluation of the articles and attempts to synthesise and integrate relevant knowledge. | <ul style="list-style-type: none"> A description for further areas of development and/or research of the scientific issue is given. Consistently provides evidence from the analysis/evaluation of the articles and demonstrates throughout the skills of synthesising and integrating relevant knowledge. |

Indicative content for question 4

Learners:

- may include other valid suggestions, not listed below, which should be credited
- may cover some of the examples from one or more of the lists below
- would NOT be expected to cover all points or select material from all the lists to get full marks.

Further research needed on:

Future of antimicrobials

- Effectiveness of existing antimicrobials.
- Responsible use in agriculture.
- Need to improve hygiene and infection control.
- Develop new antimicrobials to which bacteria are not resistant.
- Develop better methods of diagnosis and train medical staff to not prescribe antibiotics if not needed.
- Only 2 new classes of antibiotics became available in the last 50 years – need more innovation (and incentives to pharmaceutical industry) to develop more effective vaccines.
- Lack of financial incentive for pharmaceutical companies to do research and development as new antimicrobials will not be widely used.
- Also need other types of antimicrobial.
- Encourage innovation in antibiotic development.
- Raise awareness among public of the issue.
- Develop surveillance and regulatory systems on the use and sales of antimicrobial medicines for humans and animals.
- How to incentivise pharmaceutical companies to do R&D into new antibiotics.
- Should governments subsidise/fund their development?
- Better understanding of how resistance arises and spreads.

Honey research

- Research into what makes honey effective e.g.:
 - osmotic effects of sugar
 - low pH
 - Methylglyoxal (MGO)
 - hydrogen peroxide
 - flavonoids
 - antioxidants
 - polyphenols.
- Research into why MRSA treated with Manuka honey has fewer proteins so cannot reproduce or grow.
- More research into how honey can be used with antibiotics to reverse the resistance and/or have a synergistic effect.
- Research into why microbes don't develop resistance to honey.
- Research to find out optimum concentrations/dilutions of honey to use.
- Test wider range of bacteria and fungi.
- Compare honey to other treatments with wider range of microbes.
- More clinical trials on different groups of people.
- Investigate whether honey has any antiviral properties (some research says effective against HPV).
- Effect of honey on virulence factors made by bacteria/on expression of genes in bacteria.
- Effect of honey on biofilm production by bacteria.
- Effect of honey on bacterial toxins.

Research into behaviour of patients and health professionals

- Why health professionals do not always practice good hygiene
- Why visitors in hospitals do not use the hand gels
- Why some doctors overprescribe antibiotics
- Why some patients not complete their course of antibiotics

More research

- Research into other possible sources of microbials (e.g. garlic, tea tree, etc)
- Development of more effective vaccines
- Research phages

Question 5: You are an infection control nurse. Write an article for district nurses about the possible benefits and limitations of using medical-grade honey dressings to treat skin infections such as leg ulcers. (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 | 0 | 1-4 | 5-8 | 9-12 | 13-15 |
| | Level of response not worthy of credit | <ul style="list-style-type: none"> Identifies some of the main points and evidence from the three articles with limited attempt to summarise these. Shows little awareness of audience or purpose. The article will be unstructured and limited to basic points made. | <ul style="list-style-type: none"> Summarises the main points and evidence including any supporting and conflicting statements from the three articles. Shows an awareness of audience and purpose. The article shows some structure and coherence. | <ul style="list-style-type: none"> Summarises and attempts to synthesise the main points and evidence including any supporting and conflicting statements from the three articles. Selects material to suit audience and purpose, with appropriate use of tone, style and scientific terminology. The article shows a structure which is mostly clear, coherent and logical. | <ul style="list-style-type: none"> Summarises and synthesises the main points and evidence including any supporting and conflicting statements consistently from the three articles. Consistently selects and organises material for particular effect, with effective use of tone, style and scientific terminology. The article shows a well-developed structure which is clear, coherent and logical. |

Indicative content for question 5

Learners:

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

Written for a scientifically literate audience. Article is for people who know about the subject so can use technical terms but should explain some of the abbreviations

Comment that antibiotic resistance is an issue and so alternatives, such as honey are being used indicates that information from all three articles has been considered by the learner.

Benefits

- Comments on how honey reduces pathogenicity of bacteria by reducing their virulence and cell division.
- Honey reduces microbial toxins.
- Honey reduces reliance on antibiotics.
- Some antibiotics are ineffective due to resistance.
- Honey is effective with no resistance shown.
- Honey flavonoids can damage the membranes of some microbes.
- Honey may reverse antibiotic resistance.
- It can be used in combination with antibiotics to have a synergistic effect.
- No known side effects to honey

Limitations

- Honey can't be used to treat internal infections.
- Honey must be the correct medical grade and type.
- Only applicable to topical infections at present.
- Effective component unknown at present.
- Uncertain if effective against all microbes.
- Uncertain of minimum inhibitory concentrations.
- Seasonality and the health of the bees can influence the antibacterial effect of the honey.
- Potential supply problems of medical grade honey
- Honey could be contaminated (by bacteria or fungi)
- Don't know full potential/ further research is required

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