###

### Semester Two Examination, 2022

### Question/Answer booklet

# MATHEMATICS METHODS

**UNIT 3 & 4**

## Section One:

## Calculator-free

|  |  |
| --- | --- |
| **Your Name:** |  |
| **Your Teacher’s Name:** |  |

## Time allowed for this section

Reading time before commencing work: five minutes

Working time: fifty minutes

## Materials required/recommended for this section

***To be provided by the supervisor***

This Question/Answer booklet

Formula sheet

***To be provided by the candidate***

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: nil

## Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Question | Marks | Max | Question | Marks | Max |
| 1 |  | 8 | 5 |  | 6 |
| 2 |  | 10 | 6 |  | 13 |
| 3 |  | 8 |  |  |  |
| 4 |  | 8 |  |  |  |

**Structure of this paper**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Working time (minutes) | Marks available | Percentage of examination |
| Section One:Calculator-free | 6 | 6 | 50 | 49 | 35 |
| Section Two:Calculator-assumed | 10 | 10 | 100 | 100 | 65 |
|  |  |  |  | **Total** | 100 |

**Instructions to candidates**

1. The rules for the conduct of the Western Australian Certificate of Education ATAR course examinations are detailed in the *Year 12 Information Handbook 2019*. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet.
3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Additional pages for the use of planning your answer to a question or continuing your answer to a question have been provided at the end of this Question/Answer booklet. If you use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number.
5. **Show all your working clearly.**Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.
6. It is recommended that you **do not use pencil**, except in diagrams.
7. The Formula sheet is **not** to be handed in with your Question/Answer booklet.

**Section One: Calculator-free (49 marks)**

This section has **six** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

● Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.

● Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

Working time: 50 minutes.

**Question 1 (5 marks)**

The graph with equation is shown below.



If the area of the shaded region is , determine the value of .

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| * Writes at least one definite integral to determine area.
* Recognises that the area from to is a signed area, and deals with this correctly.
* Correctly integrates using chain rule.
* Correctly substitutes boundaries and simplifies.
* Determines the value of .
 |

**Question 2 (10 marks)**

A random experiment can either result in a success with a probability of or a failure.

In an event, this random experiment is conducted twice. Each experiment is independent of the other. Let the number of successes be represented by .

(a) State the distribution, and its parameters, that can be used to model the event described above. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| * Identifies the distribution as binomial.
* Writes down the correct parameters. .
 |

The graph below shows of the variance for the distribution in part (a) for various values of .



(b) Explain why the graph is continuous, despite the distribution being discrete. (1 mark)

|  |
| --- |
| **Solution** |
| The probability is any value between and , and hence the graph is continuous. |
| **Specific behaviours** |
| P Explains why the graph is continuous.  |

(c) (i) State the value of for which the standard deviation of is maximised. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P States value of .  |

 (ii) Hence determine the exact value of the standard deviation, for the value of
 in part (c)(i). (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P Determines standard deviation  |

For the distribution in part (a), the probability that at least one of these experiments results in a success is .

(d) (i) Show that (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P Uses complement to .PShows that .  |

 (ii) Hence show that the value of is . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P Correctly square roots and determines .  |

(e) Determine for this distribution. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P Correctly determines expected value.  |

A second random variable is defined as .

Given that .

(f) Explain why . (1 mark)

|  |
| --- |
| **Solution** |
| The distribution of is a reflection of . |
| **Specific behaviours** |
| P Explains using a reflection.  |

**Question 3 (10 marks)**

(a) Determine whether the following represent or do not represent a probability distribution. Justify each answer.

(i)  (1 mark)

(ii) (1 mark)



 (iii) (1 mark)

|  |
| --- |
| **Solution** |
| (i) Not a probability distribution, sum of probabilities1 (ii) Does represent a probability distribution; Area = 1 and *p*(*x*) is always positive (iii) Not a probability distribution.  *f*(*x*) < 0 (negative)  |
| **Specific behaviours** |
| P explains above for (i)P explains above for (ii)P explains above for (iii) |

b) A probability distribution of a random variable *X* is given by

  .

 (i) Graph the probability function on the axes below. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P plots two dots correctlyP plots all dots correctly  |

(ii) Determine the probability of obtaining a value of X less than 3. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P determines prob  |

 (iii) Determine . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P numeratorP denominator  |

 (iv) State the cumulative probability distribution for *X*. (2 marks)

|  |
| --- |
| **Solution** |
|

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *x* | 1 | 2 | 3 | 4 | 5 |
|  |  |  |  |  | 1 |

 |
| **Specific behaviours** |
| P determines at least two correct probsP all probs correct  |

Question 4 (8 marks)

Determine the following:

(a) . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P correct antiderivative, with constant of integration  |

(b) . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P correct antiderivativeü correct value  |

(c) when . (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P correctly uses quotient ruleü correctly differentiates all trig termsü correctly evaluates  |

(d) . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P correct result  |

(e) . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P correct result  |

Question 5 (8 marks)

Components A and B form part of an electronic circuit, and properties of these components are measured seconds after the circuit is turned on.

(a) The rate of change of temperature, , of component A is given by . Determine, in simplest form, the increase in temperature of this component during the first seconds. (4 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P writes integral to evaluate total changeü integrates rate of changeü substitutes limits of integralü correct increase, simplified (also accept )  |

(b) The current, amps, flowing through component B reaches a peak very quickly and then declines as time goes on, as modelled by . Determine, in simplest form, the maximum current that flows through this component. (4 marks)

|  |
| --- |
| **Solution** |
| Maximum current is amps. |
| **Specific behaviours** |
| P uses quotient rule ü obtains correct derivative and equates to zeroü obtains root of derivativeü calculates maximum current in simplified form  |

Question 6 (8 marks)

Let , where and are constants.

The graph of intersects line with equation when and .

(a) Determine the value of the constant and the value of the constant . (3 marks)

|  |
| --- |
| **Solution** |
| Using : Using :  |
| **Specific behaviours** |
| P calculates two points on curve (Must state paired coords)ü value of ü value of  |

(b) Sketch the graph of on the axes below. (3 marks)

|  |
| --- |
| **Solution** |
| <EFOFEX> id:fxd{3cf4089e-f92b-42c0-89d9-b061ff07352c}  FXData:AAAwsnic7VpbU+O4En7fX5HN1tQys3ZiyfIlIaLKCZgEAgQIw8y85QZkyI3gnSQsZ+u8nr95fsnK7pZjEyeBWWZqLwFM23K31Pr6s9SSXXg867R44XGXa4qm2EZwPO4UHvdEobxV9wtcHpSXuOsLhxsa6mkZI9Xq++dFX9P/LTzuR8yZX1DmKgF7oQ8adbA3oPbgqsL9/weh8Z5sjYBSwxfoUAkKi76ARg+X2jVX2lWX2rVW2h0ttWuvtDteatdfaedACIq+EZSIm3mElUINsmYHYC9ygylUV6gl/vyC37VQxY24Ic+K4BDQQfxCsxT9EbX4h27aCsnZccgD58CrclJhJanwIKnQTSrcTyqc+12W3ZXQgfuKqUF3qIZdQdIh24LO1qKgjTyFKNQwAmshoToDKrdlw6cRE5JkUpw7+T7UPYCIOhxIIB4EYUrRUzTcBZ8uoT8VoWQZQQMxrXPQqkOFhxCgI3CzynVfnGD9etyy/ASajwDFqYQiis++fPIDcQEqZyCKQScacIGDwntw+gPof4LC5py/lxskEIkPGyQQiY8bJBCJTxskEInGBglEorlBApFobZBAJNobJBCJzgYJROIsmo/6LmmaQrR5+ktw4YBLuHCZVg/txLpMSYk/P49NxRFzuAnW+uICpgJV1ri0i9dwIpcTTwJV5UQsNVPzf6h/DAhXAPZDP20X9+b/QOsItERWz8A/xC2KWB3EKSB2HkMY8d7DOBLFd0Ee2IYb3vRbDg8D164rLMurLE9WWdaWW0rcSUbXgRAuIBGIA4jC3K0YMV1g7x4olTny3AGYioBICfBJrOBUIiujiDx8D2G6QHpdythGF1dl6WhQeLOsgUAMwcNbMGlA4Ueo9RNcfZHRDaobgRhDYRvEMXj1ObmpA3T2kKtwcgL1d5PVHT71xYSfdbYe3kb4tc9LjX5z3G0ohCgqUQzFwCWzgstmeI53JdfWqU9BsQ9dGsgBYp1ZC3C5B+sOmJ1J1gfiGsSvoHIH4goKe3IokQT0hQeFMxAaPP4PcI8EvaJ8vifxTFK4SaRwv5oU7KWk0FeSIoecyH0dJep/A0q4r0KJ+npKHIrQa9jffwQ5TCSH+RxyzIAclf6GHEnkqCI54Oo8shlpAn7rYYJEZZ4OlJJDgTvLu9wG/MOkZ75te7gkbTn4PmlLHfrzj09bKmHaUpaJCrxkcH08oU91wFfUxCyLitR6fmLqlBkmIKiKrF2ziGYp8xOIgJZhzKKEKeGJr2sxI2cBorgB/M1zGJI0Ir04h/mm09XfIYOJj0hu0ojkrh+RnpHBIHxn/GVT1tcThH4HgvzJKWtDkAhBahxfsX1zZlivwoxXXf48ADc2tHhCCzl2SE6IpblCdSN4DxhIpkFon5nWlOTws05xD558XNTvyyQntjMlpmmdKcQ2lBydR34MHa0DIS0gq3cDdPCAtFMg7Ux28CKSKzHwk0HzJrTLwCcGdjq0hDtsOjTBwFEG/UM8wlepbmxH7ADEYSxU1XnuFnl9He75zbhKt3qDrekv5tu3Wf9MSPja4Gu2AgmxvvdmoAtARLO8cDNQpe+2xI/sn+gg9vCt7OTLtgp/J4sITnGieBlc+l8SLvOlkAAsJexVpL/+SoPq84MhWuTpOPn0Y4QixwQ/8snCfPEiH3cF92aDkwV2O5wZIotm+JlNODzUE+IoXLLWKNMFZUKWa+tP3ViqLDeBWOymTPIZ9JDQBKfdyMiCG5Nho02IlNPCpP1SDnYYFz3SmjNB+SvKGfDOmeL1F2T5qZxf1o2wM+iNJhgRNORhBQcLK09n/SwVzwP0JW8dcLPDKS80gXsjjOMyxwUmu/CUuBFCNySvA9GKJQWd2HiK0+KJ3GEJRBfEZxC3sUmyL59DN/JUhlNtdOF6IZ84HDGgWxiJMcoRSg/lPco7BPqE3129mfIttfmLej/ealKVNVpi5KONN6Mv1hs9QxgxctQSV1QLL01DN+ycldOpbjPzTVDTBdZYl5+rOeeYAEl2YNrvfADWPIAgMvbCtQzMWLhOd6qLLFif4jil2KDlPCDBa3KrJWjjC9cD7QnP4dhgg/XhQps5rGh3fdP4esQ55q2+cttX+n2lqvSrSquq3FaVI3F+rdxe+yoGeGOBgQlXNoghFI5iqRRmng4O1w6G3aks+IsTOk7vFJ5n52gRy/XZpfOJYyIktxkdpL6joR/IV2eAwR36GxDB2RW3KYWA3nLb1oAeN+JUh/Z73LYIlHbFwAWq16KQwZj+WZzCZoRDsBXK///f/wVnbWy/Mx9LE+aVffm1n5x2kycaMZ/8uHtSqn+s7aXK9aNqqnZRrFZKqbSazV7qpWx2t74LN1hGy2b3jtOp9I3njfLZ7GQyyUz0zHB8na2fZc/2SuqN1+8xLXvvjbstL9P22umdHwp+4U7hptNo7xT6Ha+RGjT6HZ6+Ezo3XmfqpVOt4cDrDDyeJulUdqdw7816nZQ3GwktXyHbur8XFY2UVK+b+i01uel6HfV+1Gh18qnRuKNOxo3Rduo/PxSygeVOIQuNNYftWSoo4unUlWhDvWr0u71Z/mcM/s/bUHzffejkiZhw8XrS6V7feHmmaVLBryQ/GI77jd6236dRWG+/Mb7uDlRvOMpro+m2vG4OPW/YjxX1OlderGActBKUqHee2uwNW7dqd9AWUORFy37Xw0uhlBbIjBqDsOXWsDcc538S7NQsQ9z14ywgECoCgZE4/P77YPj4wyQBU1aQWmjxqQHf7VWTvnp8nUTD0g1dIRrR5Qe6UEFypmHba5TpgjJZrqwvuLFMeWWiQXFjlegJbkQ/cw1gLj9j0k7aY37yGOMSaJ8vf4QP5KYjWVxdLMaSvkYszZymiBFMf0YoRRpoZahlMsNWbIOZmZzNqM1WoU8S0bcQfZYQ138V+kQ877mMRf0fJWdQmjE0m2k2mItVOfV7rMrkjxjyBOW72nn9Xb52UmHbo6kYaUazvEq3/fE2T7avBqLkakDzKtnutv27jbEYr73OOL96baBZOUPJMZtmTKoTK5EazwuwEVeGcELIcHqff04CNYCKrAfMdmvqaW3van//EExx4Y+7RS62ZQr4DJ2a+KIg9PMPVUlx3A==  </EFOFEX> |
| **Specific behaviours** |
| ü through two points from (b)ü asymptote, correct curvature nearby ü smooth curve, concave up throughout |

(c) Given that , determine the value of where the slopes of and line are the same. (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| P correctly differentiates ü solves for -coordinate and fully simplified Note- no follow through if mistake makes solving too easy |

**End of questions**