Time allowed

- Perusal time: **10 minutes**
- Working time: **3 hours**

Examination materials provided

- Paper One — Question book
- Paper One — Response book

Equipment allowed

- QSA-approved equipment
- non-programmable calculator

Directions

You may write in this book during perusal time.

Paper One has **three** parts:

- Part A — Deductive Logic (Propositional Logic)
- Part B — Deductive Logic (Monadic and Dyadic Logic)
- Part C — Critical Reasoning (Probability and Causation)

Attempt **all** questions.

Suggested time allocation

- Part A: 60 minutes
- Part B: 60 minutes
- Part C: 40 minutes

The suggested time allocation allows 20 minutes for checking responses.

Assessment

Assessment standards are at the end of this book.

After the examination session

Take this book when you leave.
Planning space
Part A — Deductive Logic (Propositional Logic)

Part A has five questions. Attempt all questions.
Write your responses in the response book.
Suggested time allocation: 60 minutes.

Question 1

Let:  

P = I put the eggs in cold water  
V = I add vinegar to the water  
M = I cook the eggs for 5 minutes  
C = The shells crack  
B = I put the eggs in boiling water

a. Translate each of the following into a single well-formed formula of Propositional Logic, using only the dictionary provided.
   i. Either I put the eggs in cold water or I add vinegar to the water, or the shells crack.
   ii. If I do not add vinegar and I cook the eggs for five minutes, the shells will crack.
   iii. It’s not the case that my putting the eggs in cold water is equivalent to my putting the eggs in boiling water and adding vinegar.
   iv. I either put the eggs in boiling water or I did not add vinegar (but not both) because the shells crack.

b. Translate each of the following into a single meaningful English sentence, using only the dictionary provided.
   i. \(~ (V \lor M) \land C\)
   ii. \((~ C \land ~ M) \Rightarrow P\)
   iii. \(C \equiv (B \lor (P \land (~ V \lor M)))\)
   iv. \((P \land (V \land M)) \Rightarrow ~ (~ B \Rightarrow C)\)

Question 2

Use truth tables to determine whether each of the formulas below is a tautology, a contradiction or a contingency.

a. \(~ (P \Rightarrow Q) \equiv ~ (P \lor Q)\)

b. \((P \land (~ R \neq Q)) \land ~(Q \lor (~ P \Rightarrow Q))\)

Note: Each response must contain a clearly identified full main column. Responses which are not complete truth tables must contain in every row sufficient truth value entries to provide evidence of the reasoning supporting the main column value.
Question 3

The main columns of Propositional Logic formulas (a) to (e) were established as follows:

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<th></th>
<th>(a)</th>
<th>(b)</th>
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a. Determine the logical relationship between the following pairs of formulas:

i. (a) and (b)
ii. (c) and (d)
iii. (d) and (e)
iv. (a) and (d)

Note: Types of responses required are:

(m) is equivalent to (n)
(m) is contradictory to (n)
(m) is contrary to (n)
(m) is subcontrary to (n)
(m) implies (n)
(m) is implied by (n)
(m) is indifferent to (n)

b. What logical relationship exists between (b) and (d)? Explain, in English, the reasoning supporting your response.
Question 4

Use truth trees (or any other appropriate method) to determine whether each of the symbolised arguments below is valid or invalid.

Set out clearly the reasoning supporting your decisions. If invalid, provide a counter-example. No test of any counter-example is required.

a. \(~ ((R & S) \supset T)\)
   
P \equiv Q
   
S \supset P
   
\hline
   R & Q

b. A \supset \sim (B \lor C)
   
(B & C) \supset D
   
\sim (B \supset F)
   
\hline
   \sim A \neq D

Question 5

Consider the following formula:

\((\sim K \lor (L \supset M)) \supset \sim (P \& Q) \lor R\)

Which method — a truth table or a truth tree — would be more efficient in determining whether the formula is a tautology, a contradiction or a contingency?

Give reasons for your decision, showing that you understand the relevant differences between the two methods.

End of Part A
Part B — Deductive Logic (Monadic and Dyadic Logic)

Part B has four questions. Attempt all questions.
Write your responses in the response book.
Suggested time allocation: 60 minutes.

Question 6

Let:

- \( Rx = x \) is a romance novel
- \( Dx = x \) is a detective story
- \( Px = x \) is a person
- \( xRy = x \) reads \( y \)
- \( xEy = x \) enjoys \( y \)
- \( xWy = x \) writes \( y \)

a. Translate each of the following into a single well-formed formula of Predicate Logic (QT) using only the dictionary provided.

i. Everyone who reads \( Pride and Prejudice \) enjoys it.

ii. Christie wrote many detective stories, but no romance novels.

iii. Julia enjoyed \( Murder on the Orient Express \), a detective story, but does not enjoy all detective stories.

iv. There is a detective story written by Christie that is read and enjoyed by all detective story writers.

b. Translate each of the following well-formed formulas of Predicate Logic (QT) into a single meaningful English sentence, using only the dictionary provided.

i. \( \neg (\exists x)(Rx \land Dx) \)

ii. \( Dm \land jRx \land \neg jEx \)

iii. \( (\forall x)((Dx \land jRx \land jEx) \supset cWx) \)

iv. \( (\forall x)(\exists y)((Rx \land Py \land yWp \land yWx) \supset (jRx \land jEx)) \)

Question 7

a. Test

<table>
<thead>
<tr>
<th>( R )</th>
<th>( H )</th>
<th>( a )</th>
<th>( b )</th>
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<tr>
<td>b</td>
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</tbody>
</table>

to determine whether the values provided form a counter-example to the formula below.

Set out clearly the reasoning supporting your decision.

\( (\forall x)(\exists y)(Ry \land xHy) \)
b. Test

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<tr>
<th></th>
<th>L</th>
<th>P</th>
<th>Z</th>
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<tbody>
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<tr>
<td>b</td>
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</table>

to determine whether the values provided form a counter-example to the argument below. Set out clearly the reasoning supporting your decision.

\[(\forall x)(Lx \supset Px)\]
\[(\exists x)(Lx & Zx)\]
\[\quad \quad \quad (\exists x)(Px & Zx)\]

**Question 8**

a. Use a truth tree to produce a counter-example to the argument below. No test of your counter-example is required.

\[\sim (\exists x)(Fx & \sim Gx)\]
\[\quad \quad \quad (\forall x)(Sx \supset Gx)\]
\[\quad \quad \quad \quad \quad \quad (\forall x)(Fx \supset Sx)\]

b. Use a truth tree to test the argument below for validity. Set out clearly the reasoning supporting your decision. If it is invalid, set out as much of a counter-example as the tree provides. No test of any counter-example is required.

\[\sim (\exists x)(Fx & Gx)\]
\[\quad \quad \quad (\forall x)(\sim xLa v Fx)\]
\[\quad \quad \quad \quad \quad (\forall x)((Ax & \sim (\exists y)(Gy & yLx)) \supset Cx)\]
\[Aa\]
\[Ca\]

**Question 9**

Consider whether the true meaning of each of the sentences below can be conveyed by a symbolic logic language. For each sentence, either provide a dictionary and symbolise the sentence or explain (in 1–2 sentences) why the true meaning cannot be conveyed with a symbolic logic language.

a. Have you eaten dinner yet?
b. The eagle spread its wings and soared into the sky.
c. I was caught between a rock and a hard place.
d. Yabba dabba doo!
e. His anger was a smouldering fire, ready to burst into flames at the slightest provocation.

**End of Part B**
Part C — Critical Reasoning (Probability and Causation)

Part C has **two** questions. Attempt **both** questions.

Write your responses in the response book.

Suggested time allocation: **40 minutes**.

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**Question 10**

a. A bag contains four red, three green, six blue and one black ball.

   i. You draw twice from the bag, replacing the first ball before drawing the second. What is the probability that you will draw the black ball exactly once?

   ii. What is the probability of drawing the black ball if you draw twice from the bag but **do not** replace the first ball before drawing the second?

   **Note:** Your response should be in the form of fractions, for example $\frac{1}{4} \times \frac{1}{2}$, $\frac{2}{3} \times \frac{1}{8}$ etc. No further calculation from this form is required.

b. For a particular breed of dog, if a dog has a German bloodline the probability of it developing hip problems is $\frac{1}{3}$. If it does not have a German bloodline, then the probability of hip problems is $\frac{1}{6}$.

   Three-quarters of the dogs of that breed in Australia have a German bloodline. What is the probability that a dog of that breed in Australia will have hip problems?

   **Note:** Your response should be in the form of fractions, for example $\frac{1}{4} \times \frac{1}{2}$, $\frac{2}{3} \times \frac{1}{8}$ etc. No further calculation from this form is required.

c. An article recently appeared in a newspaper listing the most and least frequently drawn Lotto numbers over the last 12 months.

   Bill reads the article and decides to enter Lotto using the six most frequently drawn numbers, reasoning that they must be particularly lucky. Joan, on the other hand, decides to enter using the six least frequently drawn numbers, reasoning that their appearance among the winning numbers is well overdue.

   Comment on the reasoning of Bill and Joan, including the probability, relative to each other, of their winning Lotto.
Question 11

Fang Wei wants to play violin next year in the Queensland Youth Orchestra. She surveys several other musicians to find out what it takes to succeed in the audition, and constructs the following observation table:

<table>
<thead>
<tr>
<th>Musician</th>
<th>T</th>
<th>Y</th>
<th>R</th>
<th>N</th>
<th>P</th>
<th>Y&amp;~N</th>
<th>RvP</th>
<th>Z</th>
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Key:  
- T = catches the train to the audition  
- Y = was in the orchestra in the previous year  
- R = is related to a professional musician  
- N = uses new strings  
- P = practises twice daily  
- Z = is accepted into the orchestra  
- 1 = the condition is present  
- 0 = the condition is absent

Use only the simple conditions or complex conditions (conjunctions and disjunctions) listed in the table.

a. In your response book, reproduce the two columns for the complex factors Y&~N and RvP, and fill in the values.

b. Based on the information in the table:
   i. Was any listed simple condition (or the absence thereof) a possible necessary condition for good results? If so, list all these conditions.
   ii. Was any listed complex condition a possible necessary condition for good results? If so, list all these conditions.
   iii. Was any listed simple condition (or the absence thereof) a possible sufficient condition for good results? If so, list all these conditions.
   iv. Was any listed complex condition a possible sufficient condition for good results? If so, list all these conditions.
   v. Was any listed simple or complex condition a possible both necessary and sufficient condition for good results? If so, list all these conditions.

c. Identify and explain one mistake in reasoning that Fang Wei would be making if she based her audition preparation on the results of this survey.

End of Part C

End of Paper One
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<tbody>
<tr>
<td>Knowledge</td>
<td>The candidate demonstrates accurate recall and extensive understanding of a comprehensive range of concepts, ideas, procedures and principles. Occasional minor errors may be made, but do not indicate fundamental misunderstandings.</td>
<td>The candidate demonstrates accurate recall and understanding of a range of concepts, ideas, procedures and principles.</td>
<td>The candidate recalls and describes most concepts, ideas, procedures and principles.</td>
<td>The candidate recalls and describes some concepts, ideas, procedures and principles.</td>
<td>The candidate describes few concepts, ideas, procedures and principles.</td>
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</tbody>
</table>
| Application  | The candidate:  
- applies appropriate techniques and procedures of deductive reasoning to simple and complex tasks with facility and accuracy  
- classifies and evaluates a wide range of simple and complex artificial arguments and constructs well-supported arguments drawing on a wide range of inductive skills. | The candidate:  
- applies appropriate techniques and procedures of deductive reasoning with accuracy to simple (and some complex) tasks  
- classifies and evaluates a range of simple and complex artificial arguments and constructs, with some support, arguments that draw on a range of inductive skills. | The candidate:  
- uses prescribed techniques and procedures of deductive reasoning in most simple tasks and applies them with accuracy  
- classifies and evaluates simple arguments and constructs arguments drawing on some inductive skills. | The candidate:  
- uses prescribed techniques and procedures of deductive reasoning in some simple tasks, with some lapses in accuracy  
- classifies some simple arguments; few inductive skills are evident. | The candidate:  
- uses prescribed techniques and procedures of deductive reasoning inaccurately and incompletely  
- occasionally classifies some simple arguments. |
| Communication| The candidate:  
- consistently organises and presents information cogently and coherently, and communicates both evident and implied meaning effectively  
- produces explanations, descriptions, arguments and justifications that are precise, pertinent and purposeful. | The candidate:  
- organises and presents information coherently, and communicates meaning effectively  
- produces clear and purposeful explanations, descriptions, arguments and justifications. | The candidate:  
- organises and presents information so that meaning is usually evident  
- produces explanations, descriptions and arguments that are adequate to convey intention. | The candidate:  
- presents information and produces explanations that lack detail and clarity. | The candidate:  
- presents disjointed information and descriptions. |