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)
  Section 1 — Multiple choice
  Section 2 — Short response
- Part B — Deductive Logic (Monadic and Dyadic Logic)
  Section 1 — Multiple choice
  Section 2 — Short response
- 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

Paper One assesses the following assessment criteria:

- Knowledge
- Application
- Communication

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 17 questions. Attempt all questions.
Suggested time allocation: 60 minutes.

Section 1 — Multiple choice

Section 1 has six questions of equal value. Attempt all questions.
Each question contains four options. Select the option that you think is correct or is the best option. Respond on page 1 of the response book.

Questions 1–6 use the following dictionary.
Let: C = The construction work continues
     S = The workers go on strike
     U = The stadium will be completed on time
     P = The people complain
     H = The football club is happy
     D = Residents are disrupted due to noise

Question 1
Choose the best translation of:

~ U v (C & D)

A If the stadium will not be completed on time, then the construction work continues and residents are disrupted due to noise.
B The stadium will not be completed on time unless the construction work continues, and residents are disrupted due to noise.
C The stadium will not be completed on time, unless the construction work continues and residents are disrupted due to noise.
D It’s not the case that the stadium will be completed on time or the construction work continues and residents are disrupted due to noise.
Question 2
Choose the best translation of:

H ≡ (~ S v ~ P)

A If the football club is happy, then the workers don’t go on strike or the people don’t complain.
B The football club is happy if and only if the workers don’t go on strike, or the people don’t complain.
C Exactly one of the following is true: The football club is happy. The workers don’t go on strike or the people don’t complain.
D That the football club is happy is both necessary and sufficient for either the workers not going on strike or the people not complaining.

Question 3
Choose the best translation of:

~ ((~ P & C) ⊃ U)

A If it’s not true that people do not complain and the construction work continues then the stadium will be finished on time.
B If the people don’t complain and the construction work continues then the stadium will be finished on time … NOT!
C The stadium will be finished on time only if neither the people don’t complain nor the construction work continues.
D That the people do not complain and the construction work continues is not sufficient for the stadium to be finished on time.

Question 4
Choose the best symbolisation of:

The football club will be happy only if the stadium is completed on time.

A H ⊃ U
B U ⊃ H
C H ≠ U
D H ≡ U
**Question 5**

Choose the best symbolisation of:

If neither the people complain nor residents are disrupted due to noise, then construction work will continue.

A  \( C \supset (\sim P \& \sim D) \)

B  \( (\sim P \& \sim D) \supset S \)

C  \( (\sim P \lor \sim D) \supset C \)

D  \( \sim (P \lor D) \supset C \)

**Question 6**

Choose the best symbolisation of:

Exactly one of the following is true: The stadium will be completed on time if and only if the construction work continues. The people complain unless residents are not disrupted due to noise.

A  \( (U \not\equiv C) \lor (P \lor D) \)

B  \( (U \equiv C) \not\equiv (P \lor D) \)

C  \( (U \supset C) \not\equiv (P \supset D) \)

D  \( \not\equiv (U \equiv C) \lor (P \supset D) \)

End of Section 1
Section 2 — Short response

Section 2 has 11 questions. Attempt all questions.
Write your responses in the response book.

Questions 7–10 use the following dictionary.

Let:  
C = The construction work continues  
S = The workers go on strike  
U = The stadium will be completed on time  
P = The people complain  
H = The football club is happy  
D = Residents are disrupted due to noise

Question 7
Translate the following formula into a single meaningful English sentence using only the dictionary provided.

C ≠ (S v (P & D))

Question 8
Translate the following formula into a single meaningful English sentence using only the dictionary provided.

(((D ⊃ P) & (P ⊃ S)) & (S ⊃ ~ U)) ⊃ ~ H

Question 9
Symbolise the following sentence into a single well-formed formula using only the dictionary provided.

If it is not the case that both the football club is happy and the people don’t complain, then the workers will go on strike.

Question 10
Symbolise the following sentence into a single well-formed formula using only the dictionary provided.

The football club will be happy even though the stadium will not be completed on time, unless the continuation of construction work is not sufficient for the residents to be disrupted due to noise.
**Question 11**

In the truth table below, the main operator is missing.

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
<th>(P v Q)</th>
<th>(P &amp; ~ Q)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Identify which of the following symbols could be the missing main operator, and explain why.

a. v  

b. ⊃  

c. &  

d. ≢  

**Question 12**

Use a truth table to determine whether the formula below is a tautology, a contradiction or a contingency.

\[(P & (Q v R)) \equiv \neg ((P & Q) v (P & R))\]

**Note:** Your truth table must contain a clearly identified full main operator 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 operator column value.

**Question 13**

Use a truth table to determine whether the argument below is valid or invalid. If it is invalid, state a counter-example.

\[A \equiv (W v (C v N))\]

\[N \supset \neg C\]

\[\therefore \neg W \supset \neg A\]

**Note:** Responses which are not complete truth tables must contain sufficient truth value entries to provide evidence of the reasoning supporting the main operator column values.


**Question 14**

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

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
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<tr>
<td>1</td>
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<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Determine the truth-tabular relationship between the following pairs of formulas:

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

**Question 15**

Use the truth tree method to determine whether the following formula is a contradiction, a tautology or a contingency.

\((\neg A \vee (\neg C \supset \neg B)) \equiv ((A \& B) \supset C)\)

**Question 16**

Use the truth tree method to determine whether the following symbolised argument is valid or invalid. If it is invalid, provide a counter-example.

\[ A \supset \neg (E \& F) \]
\[ (G \equiv H ) \supset D \]
\[ A \vee (H \supset \neg G) \]
\[ \therefore \neg E \vee (\neg F \vee D) \]

**Question 17**

Explain (in a paragraph) why the conclusion is negated when using the truth tree method to test for validity.

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**End of Section 2**

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

Part B has 15 questions. Attempt all questions.
Suggested time allocation: 60 minutes.

Section 1 — Multiple choice

Section 1 has six questions of equal value. Attempt all questions.
Each question contains four options. Select the option that you think is correct or is the best option. Respond on page 1 of the response book.

Questions 1–6 use the following dictionary.

Let:  
Bx = x is a boat  
Mx = x is a motorboat  
Sx = x is a sailboat  
Fx = x functions properly  
xFy = x is faster than y  
xOy = x owns y  
w = William  
c = Catherine

Question 1
Choose the best translation of:

\(\sim (\forall x)(Mx \supset (\forall y)(Sy \supset xFy))\)

A  Some motorboats are fast sailboats.
B  All sailboats are faster than motorboats.
C  Not all motorboats are faster than sailboats.
D  It’s not the case that all sailboats are faster than all motorboats.

Question 2
Choose the best translation of:

\((\exists x)(Sx \& cOx) \& (\exists y)(My \& wOy)\)

A  William and Catherine own many boats.
B  Catherine owns some sailboats, and William owns a motorboat.
C  Some sailboats owned by Catherine are motorboats owned by William.
D  Some sailboats are owned by Catherine, and some are owned by William.
Question 3

Choose the best translation of:

$\forall x((Mx \land Fx) \supset (\forall y(Sy \supset xFy))$)

A  All motorboats that function properly are faster than sailboats.
B  All motorboats function properly and are faster than all sailboats.
C  Whenever a boat is faster than a sailboat, it is a well-functioning motorboat.
D  If every boat is a motorboat that functions properly, then it is faster than every sailboat.

Question 4

Choose the best symbolisation of:

No motorboats are sailboats.

A  $\neg (\exists x)(Mx \land Sx)$
B  $\exists x(Mx \land \neg Sx)$
C  $\forall x(Mx \land \neg Sx)$
D  $\neg (\exists x)(Mx \land \neg Sx)$

Question 5

Choose the best symbolisation of:

Catherine does not own any motorboats.

A  $(\forall x)(Mx \land \neg cOx)$
B  $\neg (\forall x)(Mx \land cOx)$
C  $(\exists x)(Mx \land \neg cOx)$
D  $\neg (\exists x)(Mx \land cOx)$

Question 6

Choose the best symbolisation of:

All boats are either motorboats or sailboats, but never both.

A  $(\forall x)((Bx \land Mx) \neq (Bx \land Sx))$
B  $(\forall x)((Bx \supset Mx) \neq (Bx \supset Sx))$
C  $(\forall x)(Bx \land (Mx \neq Sx))$
D  $(\forall x)(Bx \supset (Mx \neq Sx))$

End of Section 1
Section 2 — Short response

Section 2 has 9 questions. Attempt all questions.
Write your responses in the response book.

Questions 7–10 use the following dictionary.

Let:  
Bx = x is a boat  
Mx = x is a motorboat  
Sx = x is a sailboat  
Fx = x functions properly  
xFy = x is faster than y  
xOy = x owns y  
w = William  
c = Catherine

Question 7

Translate the following formula into a single meaningful English sentence using only the dictionary provided.

(∀x)(Sx ⊃ Fx)

Question 8

Translate the following formula into a single meaningful English sentence using only the dictionary provided.

(∃x)(∃y)(((Bx & By) & (wOx & cOy)) & ¬ xFy)

Question 9

Symbolise the following sentence into a single well-formed formula using only the dictionary provided.

Some motorboats that do not function properly are not faster than any sailboats.

Question 10

Symbolise the following sentence into a single well-formed formula using only the dictionary provided.

William owns a boat called “Catherine”.
**Question 11**

Test:

<table>
<thead>
<tr>
<th></th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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

\[
\begin{align*}
(\forall x)(Ex \supset Fx) \\
\sim (\forall x)(Fx \supset \sim Gx) \\
\sim (\exists x)(Gx \supset Ex) \\
\therefore (\forall x)(Gx \supset (Fx \& \sim Ex))
\end{align*}
\]

**Question 12**

Test:

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

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

\[
(\exists x)(\forall y)(xLy \& (xLy \supset yLy))
\]

**Question 13**

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

\[
\begin{align*}
(\exists x)(Ox \& Mx) \\
(\forall x)(Mx \supset Ix) \\
\therefore (\exists x)(Ix \& Ox)
\end{align*}
\]
Question 14

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

\[(\forall x)((Px & xGa) \supset Sx)\]
\[(\forall x)((Px & Sx) \supset (Ex \equiv Ix))\]
\[\sim (\exists x)((Px & xGa) & Ex)\]
\[\therefore (\forall x)((Px & xGa) \supset Ix)\]

Question 15

Explain the difference between \((\forall x)(Px \supset Qx)\) and \((\forall x)(Px & Qx)\).

End of Section 2

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

Part C has four questions. Attempt all questions.
Write your responses in the response book.
Suggested time allocation: 40 minutes.

Question 1
Your sock drawer contains four blue socks, two black socks, three green socks and one red sock.
You randomly select two socks at the same time.

a. What is the probability of selecting two socks that are the same colour?
b. What is the probability of selecting the red sock?
c. What is the probability of selecting one black sock and one blue or green sock?

Question 2
A family is planning a trip to the snow.
If the airfares are cheap, they will be able to afford accommodation for two extra days and extend their stay. If there’s a blizzard, they will be snowed in and will have to extend their stay anyway. The chances of cheap airfares are approximately 1/5. The chances of a blizzard are approximately 1/20.

What is the probability that the family will extend their stay at the snow?

Question 3
A game is being operated at a carnival stall. Each customer pays $2 to roll a standard 6-sided die. If they roll a 6, they win $10. If they roll any other number, they get nothing.

How much can the stallholder expect to profit, over time, for each roll of the die?
Question 4

A group of friends dines out at an “Adventure Restaurant”, where the menu contains exotic and sometimes dangerous items. Each diner makes a selection from two entrees (Tongue or Liver), three main meals (Scorpion, Puffer fish or Brains), three desserts (Black pudding, Eel jelly or Casu Marzu cheese) and two drinks (Red wine or White wine). Following the dinner, several of the friends fall ill.

A summary of the menu items selected by each of the friends is shown below.

<table>
<thead>
<tr>
<th>Entree</th>
<th>Main meal</th>
<th>Dessert</th>
<th>Drink</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amal</td>
<td>Tongue</td>
<td>Scorpion</td>
<td>Black pudding</td>
<td>White wine</td>
</tr>
<tr>
<td>Bianca</td>
<td>Liver</td>
<td>Puffer fish</td>
<td>Eel jelly</td>
<td>White wine</td>
</tr>
<tr>
<td>Callum</td>
<td>Tongue</td>
<td>Puffer fish</td>
<td>Black pudding</td>
<td>Red wine</td>
</tr>
<tr>
<td>Deirdre</td>
<td>Tongue</td>
<td>Brains</td>
<td>Eel jelly</td>
<td>White wine</td>
</tr>
<tr>
<td>Euan</td>
<td>Liver</td>
<td>Brains</td>
<td>Casu Marzu cheese</td>
<td>Red wine</td>
</tr>
<tr>
<td>Frederica</td>
<td>Tongue</td>
<td>Puffer fish</td>
<td>Black pudding</td>
<td>Red wine</td>
</tr>
<tr>
<td>Gollum</td>
<td>Liver</td>
<td>Scorpion</td>
<td>Casu Marzu cheese</td>
<td>Red wine</td>
</tr>
<tr>
<td>Henrietta</td>
<td>Liver</td>
<td>Puffer fish</td>
<td>Eel jelly</td>
<td>Red wine</td>
</tr>
<tr>
<td>Indigo</td>
<td>Tongue</td>
<td>Scorpion</td>
<td>Black pudding</td>
<td>Red wine</td>
</tr>
<tr>
<td>Jehssikah</td>
<td>Tongue</td>
<td>Puffer fish</td>
<td>Eel jelly</td>
<td>Red wine</td>
</tr>
<tr>
<td>Kit</td>
<td>Tongue</td>
<td>Scorpion</td>
<td>Casu Marzu cheese</td>
<td>Red wine</td>
</tr>
<tr>
<td>Ledasha</td>
<td>Tongue</td>
<td>Brains</td>
<td>Black pudding</td>
<td>White wine</td>
</tr>
</tbody>
</table>

Based on the information in the table:

a. Was any menu item a possible necessary condition for falling ill? If so, list all such menu items.

b. Was any menu item a possible sufficient condition for falling ill? If so, list all such menu items.

c. Was any menu item possibly both necessary and sufficient for falling ill? If so, list all such menu items.

d. Was any combination of main meal and drink possibly both necessary and sufficient for falling ill? If so, list all such combinations.

End of Part C

End of Paper One
## Assessment standards derived from the Philosophy & Reason Senior External Syllabus 2004

### Paper One

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Knowledge</strong></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>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>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.</td>
<td>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.</td>
<td>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.</td>
<td>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.</td>
<td>The candidate: • uses prescribed techniques and procedures of deductive reasoning inaccurately and incompletely • occasionally classifies some simple arguments.</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>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.</td>
<td>The candidate: • organises and presents information coherently, and communicates meaning effectively • produces clear and purposeful explanations, descriptions, arguments and justifications.</td>
<td>The candidate: • organises and presents information so that meaning is usually evident • produces explanations, descriptions and arguments that are adequate to convey intention.</td>
<td>The candidate: • presents information and produces explanations that lack detail and clarity.</td>
<td>The candidate: • presents disjointed information and descriptions.</td>
</tr>
</tbody>
</table>