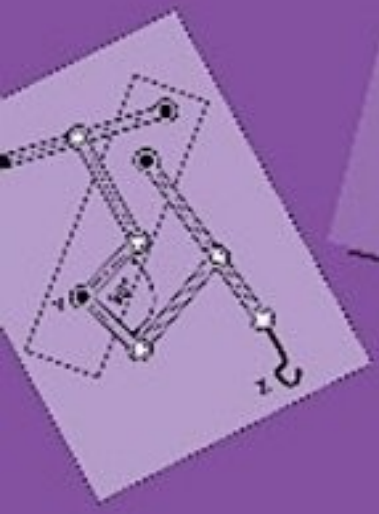
Mechanical, Spatial & Abstract Reasoning



Police Force
Fire and Rescue Service
Ambulance Service
Defence Forces
Government Departments
Mining and Resources
Universities
High Schools

General Aptitude & Psychometric Testing Preparation

Mechanics In Motion Software Available
from: www.paragontraining.com.au

Craig MacKellar
Paragon Visual Education

Paragon Visual Education

Mechanical, Spatial & Abstract Reasoning

by
Craig MacKellar

Suitable for:
Police Force
Fire and Rescue Service
Ambulance Service
Defence Forces
Government Departments
Mining and Resources
Universities
High Schools

Mechanics in Motion
Software Available from:
www.paragontraining.com.au

C4, 58

Newcastle Street PERTH WA 6000

Australia

ph/fax +61 8 9227 5125

email craig@paragontraining.com.au

ISBN: 978-1-925209-35-8

(ebook edition)

Published by Vivid Publishing

P.O. Box 948, Fremantle

Western Australia 6959

www.vividpublishing.com.au

Cataloguing-in-Publication data is available from the National Library of Australia

To order copies of the print edition, find out more about the book or contact the author, please visit:

www.paragontraining.com.au

Subjects include: Mechanical Reasoning, Spatial Reasoning, Abstract Reasoning, Aptitude Testing, Psychometric Testing

For downloadable animation features for Mechanical, Spatial & Abstract Reasoning click on this link:

www.paragontraining.com.au/msar

To run this Animation Software on an Apple Computer you will need to have installed Windows Emulation Software.

About the Production Team

Craig MacKellar B.A. (Training & Development), Cert IV Assessment & Workplace Training is an experienced trainer, instructor and author and the Managing Director of Paragon Corporate Training.

Craig was an officer in the Western Australian Police Service for fifteen years and a WA Police Academy Instructor from 1992 – 1995. Craig has continued to work closely with police, emergency, and other public services in WA through his Security and Training businesses, as well as providing training to the private sector. Paragon Corporate Training is a Registered Training Organisation. Craig has authored a number of successful training books in the fields of numerical reasoning, language use, and mechanical, spatial and abstract reasoning.

Jill Luha B.A., Grad. Cert. Ed., Grad. Dip. Curric. & Ed. Tech., Grad. Dip. Computing is an experienced teacher, trainer and instructional designer.

Jill has held posts as Senior Tutor in Educational Computing in the Faculty of Education at the Western Australian Institute of Technology (now Curtin University), and Teacher in charge of Computing at All Saints' College, Bull Creek, Western Australia. She has written several successful computer training books, which are in widespread use throughout Australia, and contributed to the instructional design of a videodisk training project.

Tony Luha B.Sc., D. Phil., Grad. Dip. Ed. (Higher & Further) is an experienced lecturer and trainer.

Tony worked as a university lecturer in biochemistry, and industrial trainer in the U.K. before coming to Australia. Since arriving in WA, he has held posts as Education Officer (Educational Computing) in the Education Department of WA (Now Department of Training), and as lecturer in Educational Computing at Curtin University. He has also held a contract post at Curtin University as Lecturer in On-Line Learning Development.

Jill and Tony retired from their publishing business in 2002 to pursue interests in multimedia through their new business Katamanti Media. The chance to work with Paragon Visual Education and Paragon Corporate Training, and contribute to Paragon's fine product range has been a fulfilling and worthwhile experience.

Contents

Answers

Preface

A note from the author

The specific industry skills identified as essential for entry into the various emergency services can be elusive for many people. Yet, the skills required to demonstrate a sound aptitude for learning are inherent in us all. What often remains dormant is the commitment to take on a challenge. It is the challenge and commitment that inspires people to do great things.

I have heard people say that you cannot prepare for these types of tests but that is simply not true. You can learn strategies and techniques to apply to these types of tests and actually score higher than you would have done without any preparation.

In most cases where an applicant has failed a general ability test or physical assessment, they were unprepared.

People's literacy and numeric skills, test taking skills, behavioural skills as well as fitness level, all diminish through lack of use or practice. Many adults, especially adults of indigenous and non-English speaking background, may not have had the opportunity to gain the skills, such as numerical problem solving and work place English, demanded by industry as pre-requisite for employment.

This book is not about making you smarter but rather using your intelligence in a better way; being smarter about how you approach abstract problems for example.

The book provides a generous amount of questions for mechanical, abstract and spatial reasoning. The questions are all very similar to psychometric tests used throughout the world.

Craig MacKellar
BA VET (Vocational Educational Development)

The competitiveness factor

Selection for that special job or position may be partly based on the highest scores over the entire selection process. This is called norm referencing. We discuss this later on in the book. It may not be good enough to pass in each test area. You may need to be competitive with the front-runners, in all areas.

Paragon Visual Education's 'Mechanical, Spatial and Abstract Reasoning' book has been developed to help you become super competitive in general aptitude tests involving these disciplines.

This program will:

- Bridge the gap between your existing knowledge and skills; and the skills and knowledge required to meet the selection criteria for the police, ambulance, prison and fire & rescue services.
- Allow graduates to perform to their full potential and therefore reflect a sound and competitive aptitude for learning.
- Focus on long term retention and competent application of knowledge and skills in a workplace context.

Introduction

Learning Outcomes: Skills you can apply after completing this text

This text provides an overview of key principles associated with psychometric testing relating to spatial and abstract thought.

By applying the principles outlined in the examples to other abstract problems the candidate should more readily identify rules and relationships.

Our aim is to facilitate the following learning outcomes.

- **Identify individual elements** within a group of elements;
- **Identify a rule** connecting a set of figures;
- **Complete a number of test questions** by applying a rule connecting a set of figures;
- **Apply techniques aimed at increasing the speed at which logical rules are generated** (the faster a person generates solutions, the higher the probability of a correct answer—in a given period of time);
- **Increase the number of elements a person can keep track of in responding to an item (span capacity).** Someone with a larger span capacity than someone else can take into account more figures without making errors and hence has a larger probability of a correct answer.

Assessment criteria

The assessments at the end of this program are intended to measure general intelligence as demonstrated by the ability to see relationships and to solve problems presented in a spatial or abstract context. The tests in this book utilise a number of types of item which are judged to contribute to an assessment of the general ability factor as described by *Spearman.* *(see page 7)*

Norms

Did you know that your assessment relates to your percentile ranking, not percentage scores?

Percentile rankings relate to how your score compares to others who have completed the same test.

For example when dealing with percentages, a score of 17 out of 34 would mean that the candidate got 50% of the questions correct.

When dealing in ***percentiles*** a score of 17 out of 34 may equate to ***80 percentile***. This means that 20 % of the candidates who did the test got a better mark than 17; ***80% of***

the candidates got a mark lower than 17.

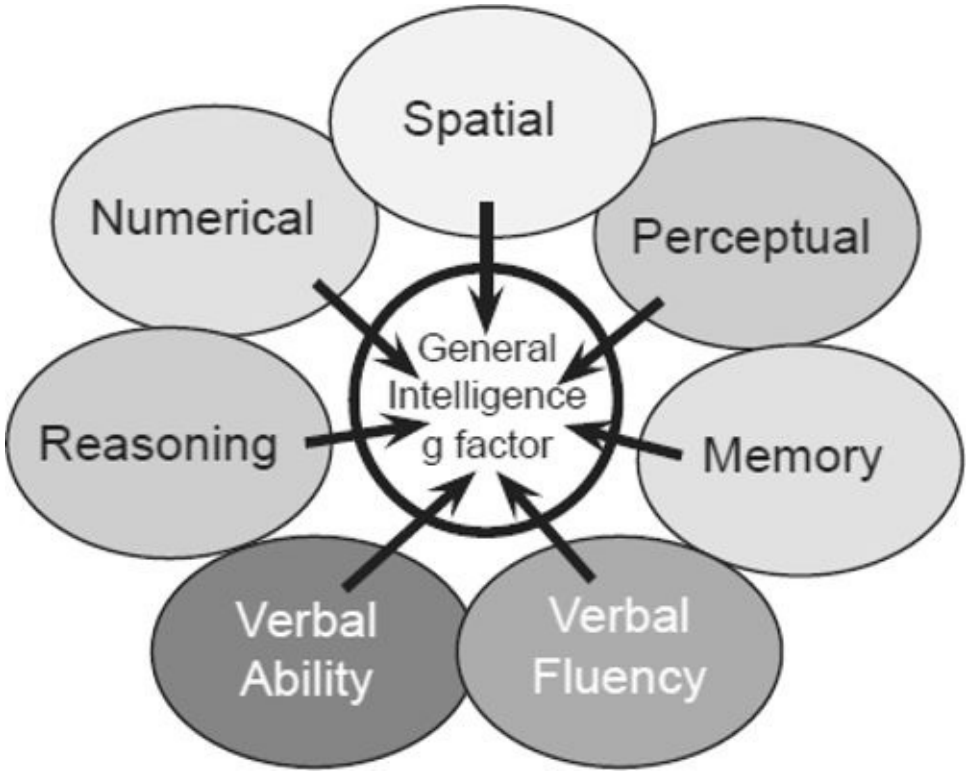
About Progressive Matrices

Spatial and Abstract Reasoning ability is a key element in identifying a person's general intelligence. That is why the vast majority of psychometric tests will have a component that relates to abstract and spatial reasoning.

> *'The Standard Progressive Matrices is a test on non-verbal reasoning ability. It was developed from work carried out in Britain in the 1930s (Penrose and Raven, 1936). It was designed as a measure of Spearman's g factor (see illustration on page 7). This factor is assumed to underlie general reasoning ability and to account for the strong positive relationship between all measures of cognitive functioning. Spearman (1927) identified two distinct processes in measures of* ***g: eductive ability, or the ability to educe relationships and correlates (i.e. inferring a general rule from specific instances and recognising specific instances from the general rule); and reproductive ability, which is based on recall of acquired information.***
>
> *The Progressive Matrices provide a measure of eductive ability or fluid intelligence which is relatively independent of specific learning acquired in a particular cultural or educational context. The test loads heavily on the g factor, and has been recognised as one of the purest single measures of g available. (Jensen, 1980)'.*
>
> **Australian Council of Educational Research**

Thurstone and Spearman's Concept of General Intelligence

The diagram below illustrates the concept of general intelligence incorporating *Thurstone and Spearman's* theories. The so-called seven primary mental abilities provide a sound model to describe the various disciplines and thought processes that contribute to a person's general intelligence.



Raven Progressive Matrices

The Raven Progressive Matrices (RPM) test is a widely-known intelligence test in many research and applied settings. In each item of this test, the candidate is asked to find a rule connecting a set of figures, and to complete this set according to the rule.

The goal of research is to decompose performance on this test; it is assumed that, essentially, two distinct abilities are relevant in RPM items. The first one is the speed at which logical rules are identified. The faster a person generates solutions, the higher their probability of a correct answer (in a given period of time). The second is the number of elements a person can keep track of in responding to an item (span capacity). Someone with a larger span capacity than someone else has a larger probability of a correct answer.

Hints for completing Spatial and Abstract Reasoning tests

1. The test is generally timed so you cannot afford to spend too much time on any one particular problem. You do not lose marks for an incorrect answer and each question is only worth 1 mark so you don't get extra marks for completing the harder problems. Do as many as you can within the time limit. Set your watch and manage your time carefully.
2. Do not leave any answers blank on multiple choice tests.
3. When looking at a matrix with lots of shapes and symbols, some running vertically and some running horizontally, it is tempting to look at all of the elements that make up the symbols and shapes that are characteristic of the rule or principle. People with an above average span capacity may be able to identify the rule or

principle fairly quickly by doing this, however most people may find breaking the shapes and symbols down to their individual elements an easier way of solving these matrices.

Our brain is a marvelous phenomenon, yet the average person when shown ten objects on a table for about 10 seconds, can only remember about 7 of the items when asked to write them down on a list.

When dealing with matrices you may find it easier to identify the rule by breaking the task up into individual elements and establish what is happening to each individual element. If you do this for all of the elements that make up the matrix you should be able to work out the rule/principle associated with the question. As you become more confident you can increase your span capacity to include more than one element at a time in your analysis.

Obviously the quicker you identify the rule and apply it to the matrix, the more questions you are likely to answer in the time frame and the higher probability of a competitive mark.

Good luck !!

Spatial Reasoning

Directions

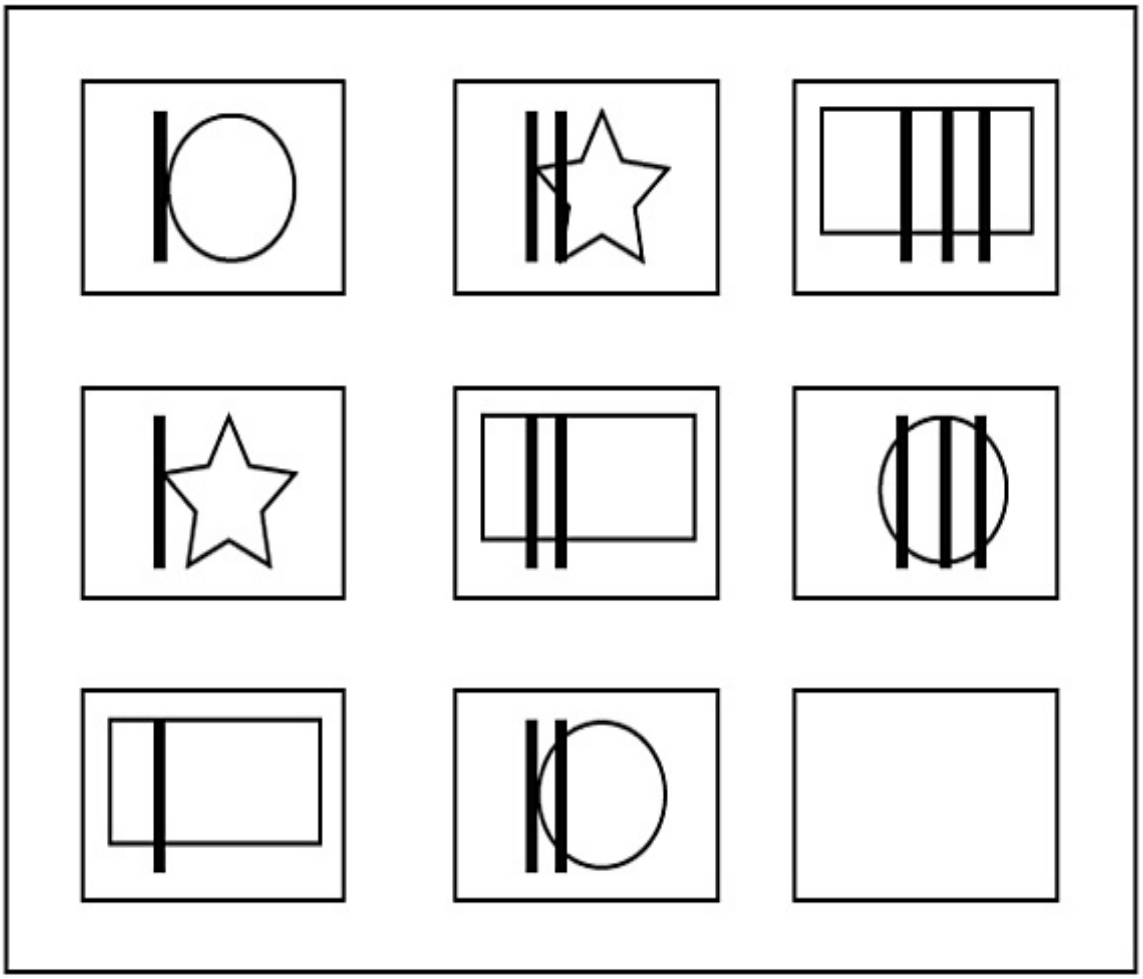
In the tests that follow, you are presented with a matrix of shapes. Your task is to recognise patterns in the matrix that run across the rows and down the columns and thereby identify the shape or shapes missing from the bottom right position of the matrix.

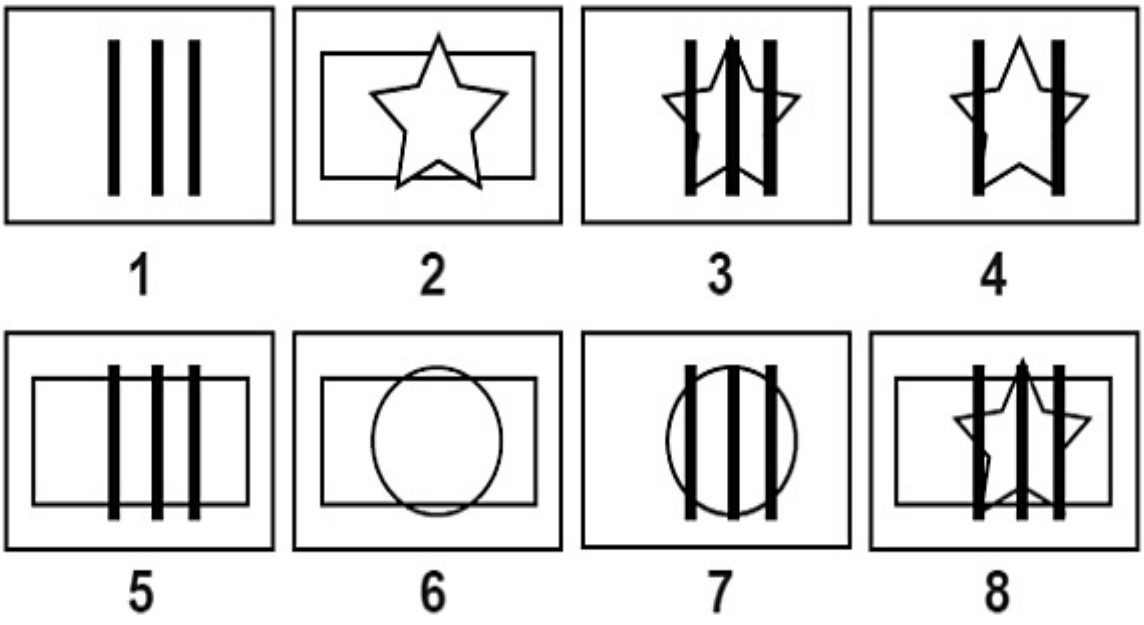
There are four examples, with written explanations, to help you. Examples 2 and 4 illustrate one common principle of spatial reasoning matrices: i.e. each element appears twice and twice only both across the rows or down the columns.

These tests differ from real-world tests only in that you can work them at your own pace. In a typical aptitude test there will be a strict time limit.

Read through and understand the examples and then move on to work the questions.

Example 1





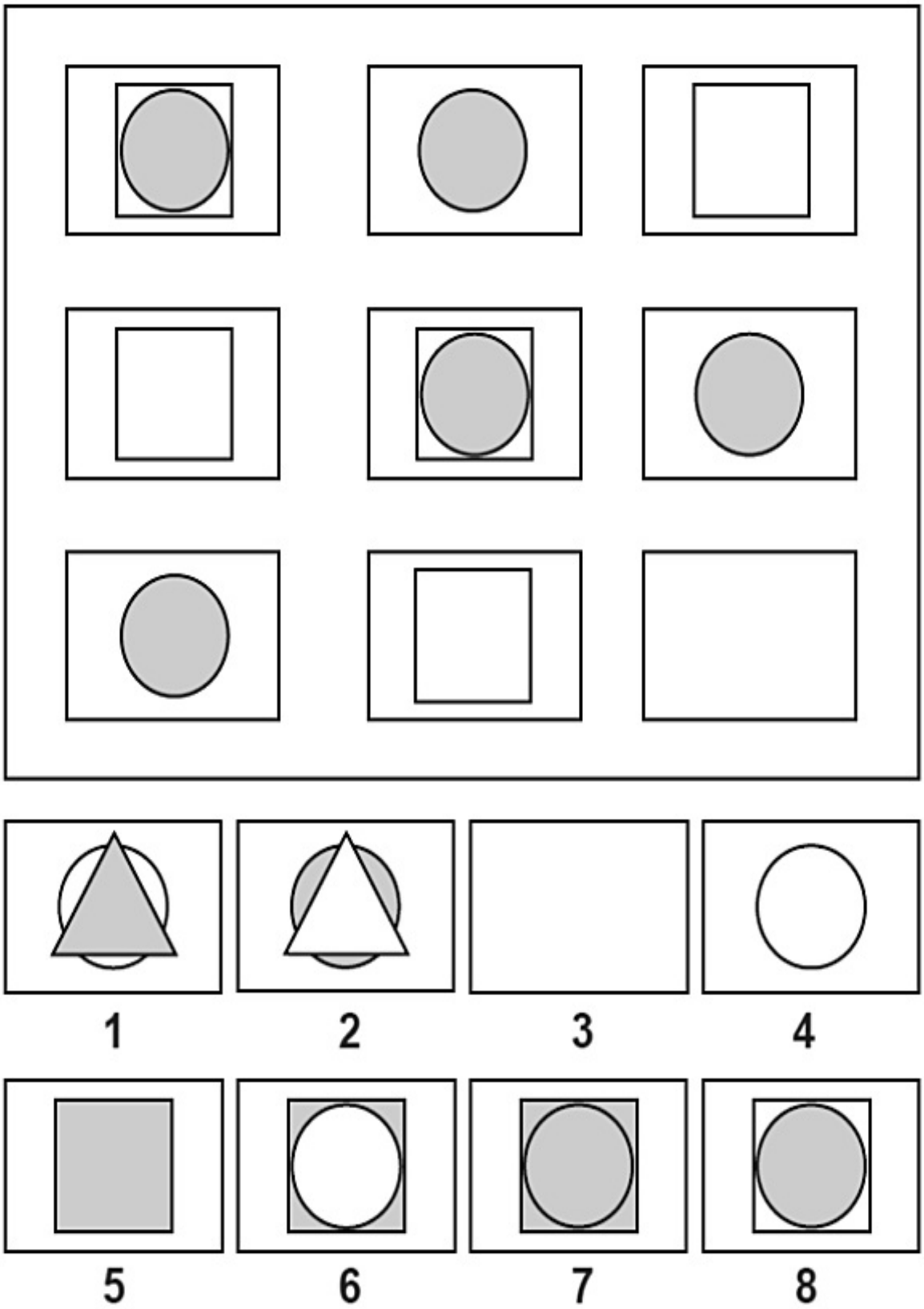
Explanation: The **elements** that make up example 1 are as follows:

Circle, Star, Rectangle, Solid lines and Quantity (1 to 3)

Looking at the top row from left to right we have a **circle**, **star** and **rectangle**. The middle row from left to right shows a **star**, **rectangle** and **circle** and the bottom row from left to right shows a **rectangle**, and a **circle**, so therefore a star is needed as the missing shape. If you look at the columns from left to right you will notice that the solid line is going up in quantity (1—2—3).

Our answer therefore is a Star with 3 vertical solid lines (No. 3).

Example 2



Explanation: The **elements** that make up example 2 are as follows:

Square, Circle, Shading and Quantity.

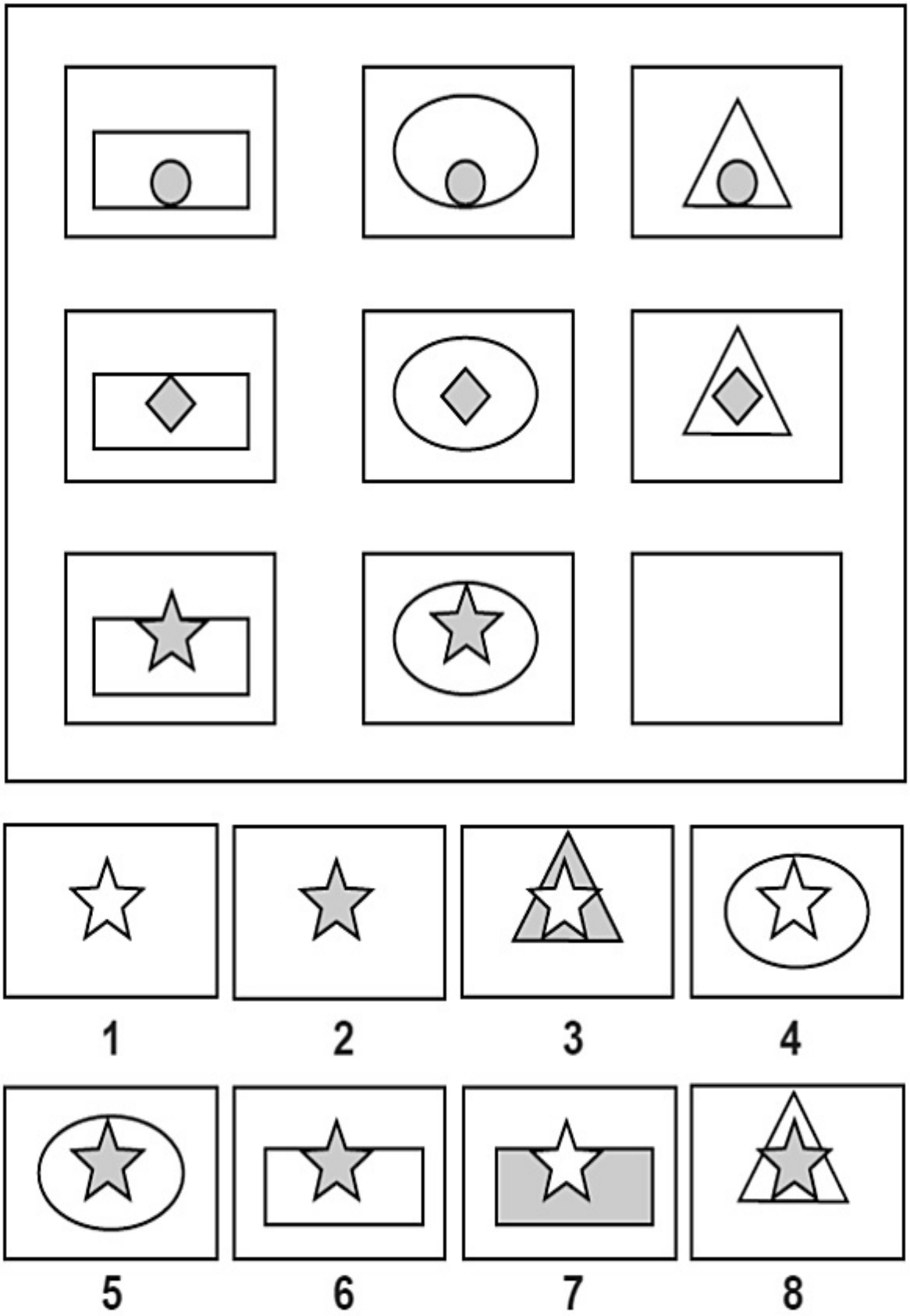
Each element appears twice, and twice only, either across the columns from left to right or down the rows from top to bottom.

In the top row the **left frame** is made up of the two elements from the middle and right frames. The **centre frame** in the middle row is made up of the left and right elements and the **right frame** in the bottom row is made up of the elements in the left and centre frames.

i.e. one frame + one frame = the other frame

Our answer is a shaded circle inside a clear square (No. 8).

Example 3



Explanation: The **elements** that make up example 3 are as follows: