



Gem-A Diploma in Gemmology Specifications

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Gem-A, The Gemmological Association of Great Britain Introduction

Introduction

The Gem-A Gemmology Diploma Course leads to the Gem-A Level 6 Diploma in Gemmology qualification.

This course is designed to encourage and enable students to:

- Build upon a student's existing knowledge of gemmology
- Expand the specialist skills required for the testing and identification of gemstones
- Develop a student's ability to recognise the usefulness, and limitations, of testing methods
- Support students wishing to improve their job opportunities in gemmology and related fields
- Prepare students continuing their studies in specialist fields of gemmology and related studies
- Expand their knowledge of gem materials and their properties
- Broaden their appreciation of the characteristic and identifying features of a wide range of gemstones
- Gain an appreciation and understanding of the various topics and areas of gemmology and their importance in the study and testing of gemstones
- Encourage the presentation of information and ideas appropriate for different audiences and purposes
- Develop attitudes relevant to gemmology such as accuracy and precision, objectivity, integrity, enquiry, initiative and insight.

Entry Requirements

Students require a foundation in gemmology to study this course. This can be provided through Gem-A's Foundation in Gemmology.

Certification Title, Level and Learning Hours

This course leads to Gem-A's Diploma in Gemmology (Ofqual 600/7105/9).

This qualification is Level 6 on the UK Regulated Qualifications Framework.

There will be a minimum of 54 Guided Learning Hours, and the total qualification time is up to 550 hours.

Learning Outcomes

The Gem-A Diploma in Gemmology course builds on the Gem-A Foundation in Gemmology course, the learning outcomes of the Diploma course take into consideration that the Foundation syllabus has been studied, and the content of both courses is part of the Diploma assessment.

By the end of the course, students should be able to demonstrate that they can:

1. Knowledge and understanding

- Recognise, recall and show understanding of specific gemmological knowledge, including;
 - Understand different types of inclusions and the importance of magnification.
 - Define and explain chemical bonding and crystallography.
 - Explain and describe durability and specific gravity.
 - Describe and explain optical properties and causes of colour.
 - Describe examples of advanced testing equipment and the types of results and information they can provide.
 - Describe and explain geological formation of various rock types and occurrence of gemstones.



- Explain principles and processes of coloured gemstones fashioning and diamond manufacture.
- Explain various treatments applied to gem materials and the production of artificial gem materials.
- Apply scientific principles and concepts in solving problems relating to gemmology.

2. Practical skills

- Demonstrate a logical approach to gem testing by selecting appropriate techniques for the material under test.
- Demonstrate safe and skilful practical techniques.
- Make, record and communicate reliable and valid observations and test results with appropriate precision and accuracy.
- Interpret, explain and evaluate results from gem testing equipment clearly and logically showing gemmological knowledge, understanding and using appropriate specialist terminology.

Scheme of assessment

Students need to complete coursework and end-of-course examinations.

Students need to pass both the theory and practical components to pass this course.

Title	Mode of Assessment	Duration	Weighting
Theory Component			
Assessed coursework	Coursework	-	16%
Diploma paper 1	Written examination	2 hours 30 minutes	42%
Diploma paper 2	Written examination	2 hours 30 minutes	42%
Practical Component			
Practical endorsement	Coursework	-	Completion required
Diploma paper 3	Written practical examination	3 hours 15 minutes	100%

Assessed coursework

Gem-A approved Diploma tutors and/or approved practical providers assess students' Coursework and Gem-A carries out external moderation. The coursework is broken into four blocks of study and a practical endorsement.

Some of this is a continuation of the subject areas covered by the Foundation course.

Online assessment

Students complete each block of study with an online assessment.

This assessment consists of 25 short-answer questions which include computer marked questions such as multiple choice or true/false, as well as tutor-marked questions which have more open-ended responses.

Practical endorsement - Demonstrating the ability to use the standard gemmological instruments

All students will attend in-person practical sessions with a Gem-A approved tutor.

Students need to be able to demonstrate the use of standard gemmological instruments by making observations and testing gem materials with appropriate precision and recording their results accurately and methodically.



Students need to cover the following areas:

- Observation and magnification – 10x lens and microscope
- Use of specialist gemmological equipment – spectroscope, dichroscope, CCF, polariscope, conoscope, refractometer, carat balance (hydrostatic weighing), gauge, diamond probes (testers)
- Knowledge of the use of further testing techniques
- Stones include mineral, biogenic, ornamental, rough, fashioned, mounted, natural, artificial and treated materials.

The Gem-A approved tutor will record that students have observed all necessary stones and equipment and completed necessary practical tasks. This evidence is compulsory for students to achieve the qualification.

End of course assessment

The assessment at the end of the Diploma course will test students on the full Foundation syllabus as well as the full Diploma syllabus.

Students should be able to:

- Test and identify most natural gem materials on the Gem-A syllabus
- Demonstrate the use of standard gem testing equipment
- Explain the principles of gem testing
- Identify synthetic, treated and imitations used within the gem trade or, if unable to identify these using standard gem testing equipment, advise on further testing.

This assessment consists of two invigilated written examinations; one theory examination comprising two papers, and one practical examination of one paper. The exam papers at the end of the Diploma course have a common format. The theory exam papers include questions requiring more extended answers and the practical exam requires students to test and/or identify twenty stones.

- Paper D1 – Theory examination - 2 ½ hours
- Paper D2 – Theory examination - 2 ½ hours
- Paper D3 – Practical examination – 3 ¼ hours

Sample examination papers can be obtained in pdf format from the Gem-A education office by contacting education@gem-a.com, and students will have access to past papers.

Results and grades

Both the theory and practical components receive separate grades (for weighting of these grades see the information under *scheme of assessment*).

Grade	% Limits	Result
A*	80 - 100	Pass
B*	60 - 79	Pass
C	40 - 59	Re-sit final exam
D	20 - 39	Re-sit final exam
E	0 - 19	Resit Coursework and final exam

*Students with three or more stones wrong in section D of the D3 practical paper can achieve a maximum of a C grade for the practical component and would be required to resit the D3 practical paper.

A and B are pass grades; C, D and E are fail grades. Students are required to pass both the theory and practical components to pass this course.

Distinctions are awarded to students with A grades in both the theory and practical components and no stones wrong in section D of the D3 practical paper. Merits are awarded to students with an A grade and an A or high B grade (i.e. with 75% or higher) and who have one or less stones wrong in section D of the D3 practical paper.

To be eligible for a distinction or award students must sit all their theory examination within one year of first sitting their practical examination.

Students who fail one or both components of the Gemmology Diploma (theory and practical) can resit at any time. A passing grade in one component will be held indefinitely. It is advisable to attempt any needed resit within two years of your studies where possible. If there are updates to teaching materials since your first attempt, you may be required to purchase any updated notes to study from.

Following any re-sit, candidates are not eligible for a Distinction, Merit or for any award.

A Diploma in Gemmology is awarded to qualifying candidates who have passed both the theory and practical exams.

Course Contents

Diploma Block 1

- Chapter 1 – n/a (*no further information from Foundation - Gemmology and Gems*)
- Chapter 2 – Observation and Magnification
- Chapter 3 – Materials and Structures
- Chapter 4 – Durability

Diploma Block 2

- Chapter 5 – Specific Gravity
- Chapter 6 – Light and Optics
- Chapter 7 – Colour
- Chapter 8 – Advanced Testing in Gemmology

Diploma Block 3

- Chapter 9 – The Geology of Gems
- Chapter 10 – n/a (*no further information from Foundation - The Gemstone Pipeline*)
- Chapter 11 – Fashioning
- The Gemstones – New materials not covered at Foundation - See detailed syllabus below for a list of gem materials covered

Diploma Block 4

- Chapter 12 – n/a (*no further information from Foundation - Gems and Jewellery*)
- Chapter 13 – Treatments
- Chapter 14 – Artificial, Synthetic and Imitation Gem Materials
- The Gemstones – Expansion of materials already covered at Foundation - See detailed syllabus below for a list of gem materials covered

Detailed Syllabus

This syllabus indicates the possible areas of the subject which can be examined in the Diploma examinations. The Diploma syllabus comprises the whole of the Foundation (Chapters 1 to 14 and the Gemstones) as well as the Diploma (Chapters 2 to 14 and the Gemstones). For details of the Foundation syllabus, see the Gem-A Foundation in Gemmology Specifications.



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Not all content will be assessed in each exam, and the full breadth and depth of the syllabus will be covered in assessments over time to make sure our exams retain their validity. All students need to cover the full syllabus. Practical observation techniques and the use of the hand-held gemmological equipment form a very important part of the practical examination.

Due to the specialised nature of gemmology and the need for accurate and reliable study materials, Gem-A provides course notes to guide and assist students through the coursework and final examinations. Students will require both the Foundation course notes and the Diploma course notes to complete the Diploma course. For further information about the course materials provided as part of the course, please contact Gem-A.

The specific, relative level and amount of information required in the examination is also indicated by the potential marks printed next to each examination question.

- Chapter 1

No additional information to Foundation Chapter 1 required.

- Chapter 2 – Observation and Magnification

Inclusions in gemstones

- Types of inclusions

- Methods of identifying inclusions using advanced equipment

Magnification and microscopes

- Optical magnification

- Other types of microscopes

- Illumination variations

- Instruments and accessories

Photomicrography

After studying chapter 2, students will be able to:

- Show a deeper understanding of different types of inclusions and why they are important to gemmological identification.
- Understand magnification power, field of view, working distance and depth of field in relation to the loupe and the gemmological microscope.
- Describe other types of microscopes and their uses. Understand the use of immersion liquids, filters and the polariscope in combination with a gemmological microscope.
- Describe the use of different illumination variations and accessories with a gemmological microscope.
- Understand the importance of photomicrography.

- Chapter 3 – Materials and Structures

Atoms and chemical bonding

- Atoms

- Chemical bonding

- Ions and compound ions

Symmetry in crystal structures

- Elements of symmetry

- Essential symmetry in crystals

- Reference axes and essential symmetry of the seven crystal systems

Describing rough materials: forms and habits

Important features of the Diploma course crystals



Gemstone and crystal system common features

Crystallographic defects

Polymorphism

Isomorphism

Amorphous materials

Pseudomorphism

After studying chapter 3, students will be able to:

- Define and explain the different types of chemical bonding (ionic and covalent).
- Define and explain the relevance of valency in gemmology.
- Explain what ions and ionic compounds are.
- Define and explain the main elements of symmetry in crystallography (plane and axis) and their operations (reflection and rotational).
- Explain the essential symmetry of the seven crystal systems.
- Sketch, describe and name crystals on Gem-A's Gemmology Diploma course syllabus (pyrite, calcite, scapolite, apatite, gypsum, titanite, spodumene and kyanite).
- Explain how to recognise and describe distorted and fragmentary crystals.
- Explain what crystallographic defects are and describe vacancy, substitution, twinning and dislocation.
- Explain some properties of amorphous materials including devitrification, metamictisation and strain.
- Explain what a mineraloid is.

• Chapter 4 – Durability

Differential hardness

Differential hardness in diamond

Differential hardness in other gemstones

Streak test

Parting

After studying chapter 4, students will be able to:

- Explain, with examples, what differential hardness is and its importance in gemmology.
- Describe the four directions of hardness (and the sawing directions) in diamond.
- Understand the usefulness of a streak test for specific gem materials.
- Explain and recognise parting.
- Apply durability knowledge to the gemstones on Gem-A's Gemmology Diploma course syllabus.

• Chapter 5 – Specific Gravity

Archimedes' principle

Hydrostatic weighing

Method of measuring SG with a spring balance

Method of measuring SG with a single-pan digital balance

General notes on SG testing

Approximation of SG using heavy liquids

Heavy liquids

Method of testing SG with heavy liquids

Other uses of SG

SG and gemstone recovery

After studying chapter 5, students will be able to:



- Explain Archimedes' principle and specific gravity (SG).
- Explain the hydrostatic method to calculate the SG of a material and describe the process of SG measurement.
- Understand the use of high-density liquids and their limitations.
- Understand other uses of SG, notably in mining.

- Chapter 6 – Light and Optics

Optical properties of isotropic and anisotropic materials

Optically isotropic materials

Optically anisotropic materials

Vibration directions in uniaxial crystals

Vibration directions in biaxial crystals

The polariscope

How the polariscope works

Understanding polariscope results

The refractometer

How the refractometer works

Using the refractometer

Refractometer readings

Measuring RIs accurately

Gem material behaviour on the refractometer

Refractometer patterns for optically anisotropic stones

Optic sign: natural and synthetic stones

The distant vision technique

After studying chapter 6, students will be able to:

- Describe the key features of optically isotropic and anisotropic materials.
- Explain the principal vibration directions in a uniaxial crystal and define the ordinary (ω) and extraordinary (ϵ) rays.
- Explain the principal vibration directions in a biaxial crystal and define the alpha (α), beta (β), and gamma (γ) rays.
- Explain how the polariscope works with isotropic, anisotropic and polycrystalline materials.
- Explain why some observations on the polariscope can require interpretation (anomalous extinction effect (AEE), inclusions, internal reflection effects, extinction band, interference colours, composites).
- Explain how the refractometer works.
- Describe how to use the refractometer and observe and record accurate refractive index (RI) readings and birefringence (Δn) values from optically anisotropic stones.
- Explain the possible readings of isotropic, uniaxial, biaxial and polycrystalline materials on the refractometer, depending on optical orientation.
- Understand and explain the terms optically positive and negative when applied to uniaxial and biaxial stones.
- Explain how to identify the optic sign of uniaxial and biaxial stones on the refractometer.
- Describe why and how to use the distant vision method on the refractometer.

- Chapter 7 – Colour

Body colour of gemstones

Perception of colour

Light reflection, absorption and transmission

White light



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- Colour grading of gemstones
- Causes of body colour in gemstones
 - The mechanism of body colour
 - Dispersed metal ions
 - Charge transfer
 - Colour centres
- Luminescence
 - The mechanism of luminescence
 - Causes of luminescence in gem materials
 - The luminescence of gemstones in ultraviolet (UV) radiation
- Physical optics
 - Colour caused by inclusions
 - Colour caused by iridescence
 - Colour caused by scattering
- Absorption spectra and the spectroscope
 - Types of spectroscopes
 - General features of absorption spectra
 - The Diploma course spectra
- The dichroscope and pleochroism
 - Types of dichroscopes

After studying chapter 7, students will be able to:

- Understand the concept of body colour in more detail.
- Understand some aspects of colour perception.
- Define white light.
- Explain the principles, systems and limitations of colour grading coloured gemstones.
- Explain the different causes of body colour, including dispersed metal ions, charge transfer and colour centres.
- Understand and explain how luminescence works and give some examples of UV reactions.
- Explain the physical causes of colour (physical optics) such as inclusions, iridescence and scattering.
- Understand and explain iridescence caused by thin-film interference and diffraction.
- Identify and describe Gem-A's Diploma spectra.
- Explain how the prism and diffraction grating spectroscopes work.
- Explain how the calcite dichroscope works.
- Explain pleochroism and how it relates to uniaxial and biaxial stones.
- Describe the pleochroic colours of some Diploma stones.

• Chapter 8 – Advanced Testing

Laboratory equipment

Imaging

- X-Ray radiography
- X-ray computed microtomography
- X-ray fluorescence
- Fluorescence imaging

Spectroscopy

- UV-Vis-NIR spectrometer
- Photoluminescence (PL) spectrometer
- Fourier-transform infrared (FTIR) spectrometer
- Raman spectrometer

Chemical analysis



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Energy dispersive X-ray fluorescence (EDXRF) spectrometer
Laser induced breakdown spectroscopy (LIBS)
Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS)

Case studies

Diamond
Emerald
Corundum

After studying chapter 8, students will be able to:

- Describe the scientific gemmological instruments available in gemmological laboratories: their names, the principles on which they work, and what type of results and information they can provide.
 - o Imaging instruments: X-ray radiography and X-ray computed microtomography, and fluorescence imaging.
 - o Spectrometers for absorption, fluorescence and Raman spectroscopy: UV-Vis-NIR spectrometer, Photoluminescence (PL) spectrometer, FTIR Spectrometer, Raman spectrometer.
 - o Spectroscopy systems for chemical analysis: EDXRF, LIBS, LA-ICP-MS.
- Explain how to interpret some results produced by these instruments, using examples.
- Be able to discuss some case studies especially for diamond, emerald and corundum.
- Explain the main questions that laboratories are asked about gemstones and the instruments that can give scientific answers, using specific examples.
- Discuss limitations of these advanced laboratory instruments.

• Chapter 9 – The Geology of Gems

The Earth and continental formation

Plate tectonics

Rock types

Igneous rocks
Metamorphic rocks
Sedimentary rocks

The origins and occurrences of some gem species

Diamond
Gemstones from the deep Earth
Gemstones formed in pegmatites
Emerald
Corundum
Spinel
Jades
Opal and gemstones formed from hydrothermal fluids
Garnets

Geology glossary

After studying chapter 9, students will be able to:

- Explain plate tectonics.
- Explain the importance of the formation of supercontinents and orogenic belts in the genesis of gemstones.
- Explain the formation and terminology of igneous rocks.
- Describe pegmatites, explain their importance as sources of gemstones, and give examples of gemstones that form in them.
- Describe kimberlites, explaining their importance as sources of diamonds.
- Explain the formation and terminology of metamorphic rocks.



- Distinguish between contact and regional metamorphism.
 - Explain metasomatism, giving examples of gem materials formed by the process.
 - Describe the formation of sedimentary rocks, giving examples of gem materials formed or found in them.
 - Further explain geological origin and occurrence and give brief accounts of the origins and occurrences of diamond, emerald, corundum, jadeite, nephrite and garnet.
 - Describe the origin and occurrence of opal and gemstones formed by hydrothermal fluids.
 - Describe the occurrence of gemstones found in alluvial deposits.
- Chapter 10
No additional information to Foundation Chapter 10 required.
 - Chapter 11 – Fashioning

Lapidary

- Faceting gemstones
- Cabochon
- Tumble polishing
- Drilling
- Glyptic and carving

Diamond manufacture

- Planning and marking
- Dividing
- Shaping
- Polishing

After studying chapter 11, students will be able to:

- Explain the general process and the main equipment used for faceting coloured gemstones.
 - Explain the general process and the main equipment used for fashioning cabochons.
 - Explain the principles of tumble polishing.
 - Explain the principles and main equipment used for drilling pearls and gem materials.
 - Explain the principles of glyptic and carving.
 - Explain the general process and the main equipment used for diamond manufacture.
- Chapter 12
No additional information to Foundation Chapter 12 required.
 - Chapter 13 – Treatments

Heat treatment

- Heat treatment of corundum
- Detection of heat treatment
- Heat treatment with flux

Diffusion treatment

- Beryllium diffusion in corundum

Irradiation and heat treatment

- Irradiation of beryl, corundum, diamond, quartz, tourmaline, spodumene, pearls

High pressure, high temperature treatment of diamonds

- Type II diamonds
- Detection of HPHT treatment



Opal treatments

After studying chapter 13, students will be able to:

- Explain the principles of heat treatment of gem materials.
- Describe and explain the heat treatment of corundum and its detection.
- Explain the principles and detection of flux-healing of corundum.
- Explain the principles and detection of beryllium diffusion (Be-diffusion) of corundum.
- Explain the principles of irradiation and the limitations of its detection.
- Describe and explain irradiation of beryl, corundum, diamond, quartz, tourmaline, spodumene and pearls.
- Explain the principles of high pressure, high temperature (HPHT) treatment of diamond and its detection.
- Explain treatments that are specific to opal.
- Explain the use of observation and standard tests in the detection of treatments, their limits, and when further advanced testing is necessary.

- Chapter 14 – Artificial, Synthetic and Imitation Gem Materials

Crystallisation from a melt

- Verneuil flame-fusion method
- The Czochralski or crystal-pulling method
- The floating zone method
- The skull melting method

Crystallisation from a solution

- The flux method
- The hydrothermal method

Synthetic diamonds

- The high pressure, high temperature (HPHT) method
- The chemical vapour deposition (CVD) method
- Post-growth treatments of synthetic diamonds
- Advanced testing for synthetic diamonds

Sublimation and vapour transfer

Artificial materials

- Artificial opals
- Aggregated artificial materials

After studying chapter 14, students will be able to:

- Explain the terms 'melt' and 'solution' when used in relation to gem material synthesis.
- Describe and explain the principles, apparatus and process for the following methods of artificial gem material production, as well as the materials produced and their identification features:
 - o Verneuil flame-fusion (VFF) method
 - o Czochralski (crystal-pulling) method
 - o The floating-zone method
 - o The skull-melting method (used for cubic zirconia)
 - o The hydrothermal-growth method
 - o The flux-growth method
 - o The high pressure, high temperature (HPHT) and chemical vapour deposition (CVD) methods (used for synthetic diamond)
 - o The sublimation and vapour transfer method (used for synthetic moissanite).
- Describe and briefly explain the manufacturing of artificial opals ('synthetic', resin-based and plastic) and the precipitation and sedimentation process.



- Briefly describe the manufacturing of some imitations of lapis lazuli, turquoise and coral and their identification features.

- The Gemstones

Andalusite	Gypsum	Rhodonite
Apatite	Hematite	Scapolite
Beryl (Emerald)	Ivory	Serpentine
Calcite	Jade: Jadeite/Fei Cui	Shell
Chrysoberyl (Alexandrite)	Jet	Sinhalite
Coral	Kyanite	Sodalite
Corundum	Lapis Lazuli	Spodumene
Diamond	Pearl	Titanite
Diaspore	Prehnite	Tortoiseshell
Diopside	Pyrite	Turquoise
Glass (natural)	Rhodochrosite	Zoisite

* Entries in bold have a preliminary entry in the Gemstones section of Gem-A's Gemmology Foundation course.

After studying *The Gemstones*, students will be able to:

- Name and describe the gems on Gem-A's Gemmology Diploma course syllabus, including:
 - o Colours and varieties
 - o Appearance
 - o Chemistry and structure
 - o Durability
 - o Fashioning
 - o Main identifying features and tests
 - o Treatments
 - o Synthetics
 - o Materials with a similar appearance
 - o Origin, occurrence and localities
 - o Quality factors
- Understand the characteristic features of:
 - o The most relevant tests for identifying these gems.
 - o The main artificial and synthetic materials on the course syllabus, as well as being able to describe and identify these.
 - o The main biogenic materials on the course syllabus, as well as being able to describe and identify these.
- Understand when advanced testing might be required and the type of information that can be gained from advanced laboratory equipment.

Further Information

Other related information available from Gem-A:

- Course fees and examination dates – see www.gem-a.com/education
- Sample past examination papers and exam reports



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- Gem-A Student Policies including:
 - Reasonable adjustments and special considerations policy and procedures
 - Absenteeism, Engagement and Attendance policy
 - Equality and Diversity policy
 - Recognition of Prior Learning and Exemptions policy

Progression:

Other courses from Gem-A include the Level 5 Diploma in Gem Diamond.

Membership of Gem-A: Graduates of Gem-A's Gemmology Diploma course will be eligible to apply for membership of the association, which will be required in order to use the FGA post nominals. Continued membership also supports the continued professional development of graduates through continued access to our scientific publication, *The Journal of Gemmology*, as well as other workshops, events and networking opportunities.

The Federation of European Education in Gemmology (FEEG), of which Gem-A is a founding member, offers a qualification open to candidates who have already achieved a Gemmology Diploma delivered by one of the FEEG member associations.

Birmingham City University, School of Jewellery, offers a BSc (Hons) Gemmology and Jewellery, and holders of both the Gem-A Diploma in Gemmology and Diploma in Gem Diamond may apply for entrance directly into the third year of this programme.

This list is not exhaustive and is subject to change.