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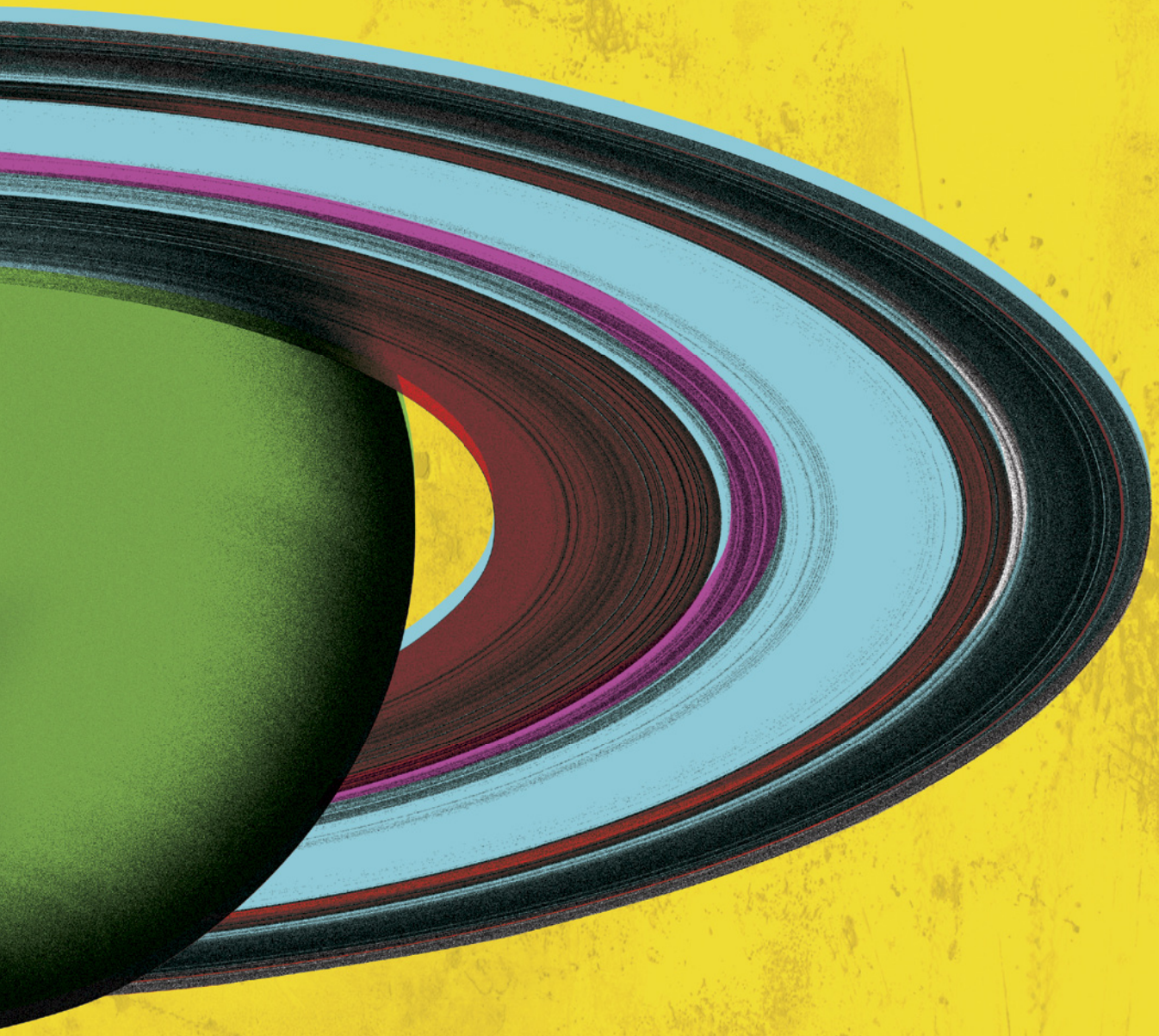

Specification

Edexcel GCSE in Astronomy (2AS01)

For first certification 2014

Issue 2

ALWAYS LEARNING

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Authorised by Martin Stretton
Prepared by Matthew Gregory
Publications Code UG031250

Introduction

The Edexcel GCSE in Astronomy is designed for use in schools and colleges. It is part of a suite of GCSE qualifications offered by Edexcel.

About this specification

- It complements the Key Stage 4 science programme of study, for GCSE Science and GCSE Additional Science. In the context of astronomy it supports students' understanding of *How Science Works*.
- It contributes to the post-16 curriculum, especially if studied alongside GCE Physics or in the context of adult education.
- It enriches the science curriculum across the full ability range, but is also suitable to provide stretch and challenge to gifted and talented students.
- Students will undertake practical observations when studying this qualification and will collect first-hand data and make observations following the same process as professional astronomers.
- There will be extensive support for teaching and learning for the internal and external assessment and the delivery of the qualification.

The Edexcel GCSE in Astronomy is an Ofqual approved science qualification.

Key subject aims

This specification is aimed at students of all ages. The specification aims to give students the opportunity to:

- develop their curiosity and enthusiasm for astronomy and to take an informed interest in current astronomical investigations, discoveries and space exploration
- acquire knowledge and understanding of astronomy theory and practice and the skills needed to investigate a wide range of astronomy contexts
- appreciate that the study and practice of astronomy are co-operative and cumulative activities and to appreciate the links between astronomy and other branches of science
- promote an awareness that the study and practice of astronomy are subject to economic, technical, ethical and cultural influences and limitations, and that the applications of astronomy and space exploration may be both beneficial and detrimental to the individual and the community
- enhance their science studies and learn about different aspects of science, alongside their other science courses
- progress to further and higher education courses in the fields of astronomy or physics.

Contents

Contents

Specification at a glance

The Edexcel GCSE in Astronomy is comprised of two units.

Unit 1: Understanding the Universe — *Unit code: 5AS01

- Externally assessed
- Availability: June series

75% of the total GCSE

Overview of content

This unit covers four topics:

- Earth, Moon and Sun
- Planetary Systems
- Stars
- Galaxies and Cosmology.

All topics include points in italics which relate to *How Science Works*. These give information on how our knowledge and understanding of the Universe has improved. The points give details on how we observe and explore the Universe. The details apply to the relevant astronomy content in each topic.

Overview of assessment

- One non-tiered 2-hour examination with 120 marks.
- The examination contains a variety of different question types, such as objective-test questions, short-and extended-answer questions and graphical and data questions.

*See *Appendix 3* for description of this code and all other codes relevant to this qualification.

Unit 2: Exploring the Universe *Unit code: 5AS02

- Internally assessed with controlled conditions
- Availability: June series

25% of the total GCSE

Overview of content

This unit focuses on observations. Students are required to complete two observation tasks: one aided and one unaided. Aided observations take place with the use of equipment. Unaided observations are with the naked eye.

The controlled assessment tasks will require students to cover the following areas:

- design
- observation
- analysis
- evaluation.

Overview of assessment

- Internally assessed with controlled conditions.
- Students complete two observations, each marked out of 20, with an overall mark of 40.
- These will be marked by the teacher and moderated by Edexcel using the assessment criteria provided on page 29.

*See *Appendix 3* for description of this code and all other codes relevant to this qualification.

A Qualification content

Knowledge, skills and understanding

Knowledge and understanding

This GCSE in Astronomy requires students to:

- demonstrate knowledge and understanding of astronomical facts, concepts, techniques and terminology
- show understanding of how astronomical evidence is collected and its relationship with the astronomical explanations and theories
- show understanding of how astronomical knowledge and ideas change over time and how these changes are validated
- apply concepts and draw conclusions related to familiar and unfamiliar situations
- show understanding of how decisions about astronomy are made, including contemporary situations and those raising ethical issues
- evaluate the impact of astronomical developments on individuals, countries and the environment.

Skills

This GCSE in Astronomy provides students with the opportunity to develop the following skills:

- plan an astronomical observation and carry it out safely and skilfully
- analyse and interpret qualitative and quantitative data from different sources
- evaluate the methods used when carrying out an observation
- consider the validity and reliability of data in presenting and justifying conclusions.

How Science Works

This GCSE in Astronomy requires students to develop the skills, knowledge and understanding of *How Science Works*, described as follows.

Data, evidence, theories and explanations

1 the collection and analysis of scientific data

2 the interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories

3 many phenomena can be explained by developing and using scientific theories, models and ideas

4 there are some questions that science cannot currently answer and some that science cannot address

Practical and enquiry skills

5 planning to test a scientific idea, answer a scientific question, or solve a scientific problem

6 collecting data from primary or secondary sources, including the use of ICT sources and tools

7 working accurately and safely, individually and with others, when collecting first-hand data

8 evaluating methods of data collection and considering their validity and reliability as evidence

Communication skills

9 recalling, analysing, interpreting, applying and questioning scientific information or ideas

10 using both qualitative and quantitative approaches

11 presenting information, developing an argument and drawing a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools

Applications and implications of science

12 the use of contemporary science and technological developments and their benefits, drawbacks and risks

13 how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions

14 how uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes.

List of contents

Unit 1 Understanding the Universe

Assessment overview

This unit is assessed via a written 2-hour examination, which is marked out of 120.

All questions in the written examination are compulsory. There will be a variety of question types, such as objective tests, short-answer questions and extended-answer questions.

Topic 1 Earth, Moon and Sun

Content overview

This topic deals with the Earth, the Moon and the Sun as separate bodies and then as a system, illustrating the relationships between them.

The Earth is treated as a body in its own right and then as an observatory from where, and above which, astronomical observations are carried out. The topic then introduces the Moon's principal features and their likely origins, and reflects on the continuing exploration of the Moon and the scientific data being collected. The Sun, our nearest star, can be observed from close quarters in all regions of the electromagnetic spectrum. The solar surface, atmospheric features and source of energy can be investigated.

The intimacy of the Earth and its key neighbours is illustrated by concepts of time and its determination, lunar phases, eclipses and aurorae.

The *How Science Works* aspects of GCSE Astronomy are indicated in italics throughout the topic.

Please refer to *Appendix 6* for more information on mathematical skills, data and formulae.

Detailed content

Topic 1.1 Planet Earth

Students will be assessed on their ability to:

a describe features of the Earth that distinguish it from other planets, including its water surface and atmosphere

b relate the blue sky to the preferential scattering of light in its atmosphere

c demonstrate an understanding of the benefits of the Earth's atmosphere to humankind

d describe some of the major causes of light pollution and demonstrate an understanding of why it is undesirable to astronomers

e *describe how Eratosthenes made the first accurate calculation of the circumference of the Earth*

f recall the shape (oblate spheroid/flattened sphere) and diameter (13 000 km) of the Earth

g *describe the evidence that the Earth is approximately spherical*

h recall the rotation period of the Earth (23 hours 56 minutes) and the time to rotate through 1 degree (4 minutes)

i demonstrate an understanding of the terms: equator, tropics, latitude, longitude, pole, horizon, meridian and zenith

j *demonstrate an understanding of the drawbacks to astronomers of the Earth's atmosphere and relate these to the need for optical and infra-red observatories to be sited on high mountains or in space*

k describe the features of reflecting and reflecting telescopes (detailed ray diagrams not needed)

l *demonstrate an understanding of why the world's largest telescopes are reflectors rather than refractors*

m demonstrate an understanding that the Earth's atmosphere is transparent to visible light, microwaves and some radio waves

n *interpret data on the effect of the Earth's atmosphere on infra-red, ultra-violet and X-rays*

o *describe where infra-red, ultra-violet and X-ray observatories are sited and explain the reasons why*

p *describe the nature and discovery of the Van Allen Belts*.

Topic 1.2 The Moon

Students will be assessed on their ability to:

a identify the Moon's principal features, including the Sea of Tranquility, Ocean of Storms, Sea of Crises, the craters Tycho, Copernicus and Kepler, and the Apennine mountain range (Latin names are acceptable)

b recall the Moon's diameter (3 500 km) and its approximate distance from Earth (380 000 km)

c recall that the Moon's rotational period and orbital period are both 27.3 days

d *demonstrate an understanding of why the far side of the Moon is not visible from Earth*

e *describe how astronomers know the appearance of the Moon's far side and how it differs from the near side*

f distinguish between the lunar seas (maria) and highlands (terrae)

g demonstrate an understanding of the origin of lunar seas and craters

h *demonstrate an understanding that the relative numbers of craters in the seas and highlands implies different ages of these features*

i describe the nature of rilles and wrinkle ridges

j relate the lack of atmosphere to the Moon's low gravity

k *describe the nature and purposes of the Apollo space programme and its experimental packages (ALSEPs)*

l describe the likely origin of the Moon (the giant impact hypothesis)

m *describe the evidence that allowed astronomers to develop the giant impact hypothesis.*

Topic 1.3 The Sun

Students will be assessed on their ability to:

a *demonstrate an understanding of how the Sun can be observed safely by amateur astronomers*

b recall the Sun's diameter (1.4 million km) and its distance from Earth (150 million km)

c recall the temperature of the Sun's photosphere (5 800 K)

d describe the solar atmosphere (chromosphere and corona) and recall the approximate temperature of the corona (2 million K)

e describe the appearance and explain the nature of sunspots

f recall that the Sun's rotation period varies from 25 days at the equator to 36 days at its poles

g *demonstrate an understanding of how astronomers use observations of sunspots to determine the Sun's rotation period*

h *interpret data (for example a Butterfly Diagram) in order to describe the long-term latitude drift of sunspots, determine the length of the solar cycle and predict the year of the next solar maximum*

i demonstrate an understanding that the Sun's energy is generated by nuclear fusion reactions at its core, converting hydrogen into helium

j *describe how astronomers observe the Sun at different wavelengths*

k demonstrate an understanding of the appearance of the Sun at different wavelengths of the electromagnetic spectrum, including visible, H-alpha, X-ray

l describe the structure and nature of the solar wind.

Topic 1.4 Earth-Moon-Sun Interactions

Students will be assessed on their ability to:

a demonstrate an understanding that the Moon and Sun appear to be the same size when viewed from Earth

b recall the period of the lunar phase cycle (29.5 days)

c demonstrate an understanding of lunar phases and deduce the lunar phase cycle from given data

d *use diagrams to explain why the lunar phase cycle is (2.2 days) longer than the orbit period of the Moon*

e describe the appearance of partial and total solar and lunar eclipses

f *describe, using diagrams, the mechanisms causing solar and lunar eclipses*

g *demonstrate an understanding that the duration of total solar and lunar eclipses are different and that they do not occur every new and full Moon*

h describe the terms 'solar day' and 'sidereal day'

i explain why a solar day is longer than a sidereal day

j *interpret simple shadow stick data to determine local noon and observer's longitude*

k *describe how a sundial can be used to determine time*

l *interpret charts and diagrams showing the variation in daylight length during a year*

m demonstrate an understanding that there are seasonal variations in the rising and setting of the Sun

n demonstrate an understanding of the terms 'apparent Sun' and 'mean Sun'

o demonstrate an understanding of the term 'equation of time' (apparent solar time — mean solar time) and perform simple calculations

p describe aurorae and recall from where on Earth they are most likely to be observed

q explain how aurorae are caused.

Topic 2 Planetary Systems

Content overview

This topic explores the Solar System, examining its lesser-known bodies in addition to the major planets. There are opportunities in this topic to discuss the similarities and differences between individual bodies and to compare the atmospheres of Earth and Venus regarding global warming. The topic emphasises the importance of space exploration and explores the threat and possible consequences of a serious collision between the Earth and an impactor.

The Solar System is also studied from an historical viewpoint, exploring the discovery of outer planets and appreciating the telescopic discoveries of Galileo.

Evidence for exoplanets surrounding other stars provides fuel for reigniting inevitable questions such as 'Are we alone in the Universe?' and the techniques and limitations of searching for life and habitable planets are explored.

The *How Science Works* aspects of GCSE Astronomy are given in italics throughout the topic.

Please refer to *Appendix 6* for more information on mathematical skills, data and formulae.

Detailed content

Topic 2.1 Our Solar System

Students will be assessed on their ability to:

a describe the location and nature of the main constituents of our Solar System, including planets, dwarf planets, asteroids, comets, centaurs and Trans-Neptunian Objects (TNOs)

b recall the names of planets and dwarf planets in order of their mean distance from the Sun

c *demonstrate an understanding of the scale and size of our Solar System using scale models (for example balls of different sizes at appropriate spacing, model Solar Systems such as the Spaced Out project)*

d recall that the ecliptic is the plane of the Earth's orbit around the Sun

e demonstrate an understanding that one astronomical unit (AU) is the mean distance between the Earth and Sun.

f recall that planets move in elliptical orbits, slightly inclined to the ecliptic

g demonstrate an understanding that the planets appear to move within a band called the Zodiac

h demonstrate an understanding of the direct and retrograde motion of planets on a star chart

i demonstrate an understanding of the terms: perihelion, aphelion, greatest elongation, conjunction, opposition, transit and occultation

j describe the main physical characteristics of the planets (including surface features, atmosphere, temperature and composition)

k discuss how the atmosphere of Venus can be used to illustrate the danger of extreme global warming.

l *describe how astronomers use space probes to gain data on the characteristics of planets and other bodies in the Solar System*

m *demonstrate an understanding of some of the problems that would be encountered by a manned exploration of our Solar System*

n demonstrate an understanding that some planets have satellite systems with a variety of origins and structures (including Mars and Neptune)

o describe the appearance, physical nature and composition of planetary ring systems.

Topic 2.2 Comets and Meteors

Students will be assessed on their ability to:

a describe cometary orbits and distinguish them from planetary orbits

b describe the location and nature of the Kuiper Belt and Oort Cloud and show an appreciation of their associations with comets

c *describe some of the evidence for the existence of the Oort Cloud*

d identify the nucleus, coma, dust and ion tails of comets

e demonstrate an understanding that the tails of comets develop when relatively close to the Sun

f demonstrate an understanding of the mechanisms for the development of cometary dust and ion tails

g describe the nature and origin of meteoroids, meteorites and micrometeorites

h demonstrate an understanding of meteors, fireballs and annual meteor showers

i relate the occurrence of annual meteor showers to cometary orbits and account for their apparent divergence from a radiant point

j describe the orbits of Potentially Hazardous Objects (PHOs)

k *demonstrate an appreciation of the need to monitor the motion of PHOs*

l *demonstrate an appreciation of the potential consequences of a collision between an impactor and the Earth*

m *describe how astronomers gather evidence of impacts between bodies within the Solar System and consider their effects.*

Topic 2.3 Solar System Discoveries

Students will be assessed on their ability to:

a *describe the contribution of Copernicus, Tycho and Kepler to our understanding of the Solar System*

b illustrate Kepler's second law of planetary motion with the aid of a diagram

c *demonstrate an understanding of Kepler's third law relating planetary distances to orbital periods and perform simple calculations using the formula:*

$T^2 = R^3$

where T is in years and R is in AU

d recall the main astronomical discoveries of Galileo related to the Solar System:

i phases and apparent size of Venus

ii relief features of the Moon

iii principal satellites of Jupiter (Callisto, Europa, Ganymede, Io)

e *describe the discoveries of Ceres, Uranus, Neptune and Pluto and the techniques involved*

f *demonstrate an understanding that gravity is the force responsible for maintaining orbits and its inverse square law nature.*

Topic 2.4 Exoplanets

Students will be assessed on their ability to:

a *describe how astronomers obtain evidence for the existence of exoplanets (including astrometry, transit observations and use of Doppler-shifts)*

b *discuss the difficulties associated with the detection of individual planets*

c demonstrate an understanding that the presence of liquid water is probably an essential requirement for life

d describe the present theories about the origin of water on Earth

e *describe methods used by astronomers to determine the origin of water on Earth (for example analysis of water on a comet by the Rosetta probe)*

f *demonstrate an understanding of the individual factors contained in the Drake Equation and their implications for the existence of life elsewhere in our Galaxy*

g *demonstrate an understanding of the existence and significance of habitable zones/Goldilocks zones*

h describe some of the methods that astronomers use to obtain evidence for life (past or present) elsewhere in our Solar System

i discuss the possible benefits and dangers of discovering extra-terrestrial life.

Topic 3 Stars

Content overview

This topic begins with a tour of the night sky, exploring constellations, clusters, nebulae, galaxies and other wonders visible with the naked eye in clear conditions. The terminology and techniques that astronomers need to plan and carry out meaningful observing sessions are introduced within this topic.

Stars are then studied from a more physical point of view, spectroscopy-featuring as an essential and versatile tool for astronomers. Stellar evolution is explored, including end-states such as supernova, neutron stars and black holes. The Hertzsprung-Russell (HR) diagram, magnitude scale and methods of determining stellar distances are examined.

The *How Science Works* aspects of GCSE Astronomy are given in italics throughout the topic.

Please refer to *Appendix 6* for more information on mathematical skills, data and formulae.

Detailed content

Topic 3.1 Constellations

Students will be assessed on their ability to:

a describe the appearance of stars, double stars, asterisms, constellations, open clusters, nebulae and globular clusters in the night sky

b demonstrate an understanding of how stars within a constellation are labelled according to brightness (using Greek letters α to ε)

c *demonstrate an awareness of how the official list of constellations became established and cultural differences in this list*

d recognise and draw the Plough, Orion, Cygnus and Cassiopeia

e *demonstrate the use of 'pointers' and other techniques to find other celestial objects, including*:

- i *Arcturus and Polaris from the Plough*
- ii *Sirius, Aldebaran and the Pleiades from Orion*
- iii *Fomalhaut and the Andromeda Galaxy from the Great Square of Pegasus*

f demonstrate an understanding that some constellations are visible from a given latitude throughout the year, but others are seasonal.

Topic 3.2 Observing the Night Sky

Students will be assessed on their ability to:

a demonstrate an understanding of the terms 'right ascension' and 'declination'

b recall the declination of Polaris (+90 degrees) and explain why Polaris appears fixed in the night sky

c demonstrate an understanding that the elevation of Polaris above the northern horizon is equal to the latitude of the observer

d describe what is meant by the term 'circumpolar stars' and explain the connection between the apparent motion of stars and the Earth's rotation

e demonstrate an understanding that a star will be circumpolar from a given latitude provided declination > 90 – latitude

f *analyse and interpret long-exposure photographs of star trails to determine the rotation period of the Earth*

g *demonstrate the use of a planisphere, star chart or computer software in order to plan an observing session*

h demonstrate an understanding of the terms 'ecliptic' and 'zodiacal band' on a star chart

i *plan the equipment needed for a naked-eye observation session (red torch, clipboard, pencil/rubber, warm clothes)*

j *demonstrate an awareness of naked-eye observing techniques (dark-adapted eye, relaxed eye and averted vision)*

k demonstrate an awareness of, and use in a qualitative way, the Messier Catalogue

l *explain the apparent east-west motion of the night sky*

m recall that stars cross the observer's meridian and culminate when they are due south

n *use star data and charts to determine the time at which a star will cross the observer's meridian.*

Topic 3.3 Physical Properties of Stars

Students will be assessed on their ability to:

a *demonstrate an understanding that stars in a constellation are not physically related but that stars in a cluster are associated gravitationally*

b distinguish between optical double stars and binary stars

c demonstrate an understanding of the apparent magnitude scale and how it relates to observed brightness of stars

d *use the scale of apparent magnitude*

e *describe the method of heliocentric parallax to determine distances to nearby stars*

f recall the definition of one parsec (pc)

g recall the definition of absolute magnitude

h demonstrate an understanding of the inverse square law nature of the intensity of light

i *demonstrate an understanding of, and perform simple calculations involving, apparent magnitude (m), absolute magnitude (M) and distance (d in pc), using this formula*:

$M = m + 5 - 5 \log d$

involving powers of 10 only (students are not required to calculate d using this equation, only M and m)

j *identify a Cepheid variable star from its light curve and deduce its period*

k *explain how Cepheid variables can be used to determine distance*

l *identify a binary star from the light curve and deduce its period*

m explain the causes of variability in the light curve of a binary star

n *demonstrate an understanding of what information can be obtained from a spectrum, including chemical composition, temperature and radial velocity*

o *demonstrate an understanding of how stars can be classified according to their spectral type*

p demonstrate an understanding that a star's colour is related to its temperature

q *sketch and recognise the main components of the Hertzsprung-Russell diagram (HR diagram).*

Topic 3.4 Evolution of Stars

Students will be assessed on their ability to:

a *associate the stages of evolution of a star:*

i *with a solar mass*

ii *with a much greater mass*

with the components of the HR diagram

b demonstrate an understanding that emission nebulae, absorption nebulae and open clusters are associated with the birth of stars

c demonstrate an understanding that planetary nebulae and supernovae are associated with the death of stars

d describe the nature of neutron stars and black holes

e *describe how astronomers obtain evidence for the existence of neutron stars and black holes.*

Topic 4 Galaxies and Cosmology

Content overview

In this topic students begin in our own Galaxy, exploring its shape and structure and examining how astronomers determine them. The distance scale increases as additional galaxies and clusters of galaxies are introduced.

The topic concludes with a study of the large-scale structure and evolution of the Universe. Cosmological models regarding the Universe's past and future are discussed, and concepts such as the nature and significance of dark matter and dark energy feature in this less-certain aspect of the subject.

The *How Science Works* aspects of GCSE Astronomy are given in italics throughout the topic.

Please refer to *Appendix 6* for more information on mathematical skills, data and formulae.

Detailed content

Topic 4.1 Our Galaxy — the Milky Way

Students will be assessed on their ability to:

a describe the appearance of the Milky Way as seen with the naked eye and with binoculars or a small telescope

b demonstrate an understanding that the observed Milky Way forms the plane of our own Galaxy

c demonstrate an understanding of the size and shape of our Galaxy and the location of the Sun, dust, sites of star formation and globular clusters

d *demonstrate an understanding of how astronomers use 21 cm radio waves rather than visible light to determine the rotation of our Galaxy.*

Topic 4.2 Galaxies

Students will be assessed on their ability to:

a demonstrate an understanding of the appearance of spiral, barred spiral, elliptical and irregular galaxies

b *draw Hubble's Tuning Fork diagram*

c recall that the Milky Way is an Sb type galaxy

d *use images of galaxies in order to classify them*

e demonstrate an understanding that some galaxies emit large quantities of radiation in addition to visible light (for example radio waves, X-rays)

f demonstrate an understanding that an Active Galactic Nucleus (AGN) is powered by matter falling onto a super-massive black hole

g recall the types of active galaxies, including Seyfert galaxies, blazers, quasars

h *demonstrate an understanding that astronomers use many regions of the electromagnetic spectrum to obtain evidence for the existence and properties of AGNs*

i describe the Local Group of galaxies

j recall the names of some galaxies in the Local Group, including the Large and Small Magellanic Clouds, Andromeda Galaxy (M31) and the Triangulum Galaxy (M33)

k demonstrate an understanding that galaxies are grouped in larger clusters and superclusters.

Topic 4.3 Cosmology

Students will be assessed on their ability to:

a *recall the Doppler principle for radial velocities*

b *demonstrate an understanding that light from distant galaxies is shifted to longer wavelengths (redshift)*

c use the equation:

$$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{v}{c}$$

to determine the radial velocity of a galaxy

d demonstrate an understanding that for galaxies in the Local Group blueshift is possible

e *recall that quasars are distant galaxies with high redshifts*

f *describe the discovery of quasars by astronomers*

g demonstrate an understanding of the relationship between distance and redshift of distant galaxies (Hubble's Law) and use the formula:

$v = Hd$

h *describe how astronomers use the value of the Hubble Constant to determine the age of the Universe*

i demonstrate an understanding of the existence and significance of cosmic microwave background (CMB) radiation

j *describe how CMB radiation was discovered*

k *describe recent observations of CMB radiation, including the Wilkinson Microwave Anisotropy Probe (WMAP), and their significance to cosmologists*

l *demonstrate an understanding of the possible nature and significance of dark matter*

m *demonstrate an understanding of the significance of dark energy*

n *demonstrate an understanding of the observational evidence for an expanding Universe*

o *demonstrate an understanding of the past evolution of the Universe and the main arguments in favour of the Big Bang*

p *demonstrate an awareness of the different evolutionary models of the Universe (past and future) and why cosmologists are unable to agree on a model.*

Unit 2 Exploring the Universe

Overview

Assessment overview

This unit is assessed through internal assessment with controlled conditions. Students must complete one unaided and one aided observational task. These tasks must be chosen from the lists provided by Edexcel, in this document. The write up of the observation report must take place under controlled conditions.

Each task will be marked out of 20, with a total mark of 40 for the two tasks, across the following areas:

- design (5 marks)
- observation (5 marks)
- analysis (5 marks)
- evaluation (5 marks).

The observation report will be marked by teachers and externally moderated by Edexcel.

Observation overview

Observations are a fundamental part of astronomy. The design of the observations must be planned to ensure that the subject of study is visible at the time and location. Analysis of the observational data and images has helped astronomers to discover more about our Universe and how it works. Evaluation of each observation is important to ensure that future observations take into account any problems encountered.

These observations link to the content studied in *Unit 1: Understanding the Universe*.

Delivery of the controlled assessment

Observation tasks

The tasks for this controlled assessment will be reviewed on a two-yearly cycle. Tasks may be removed or new tasks added. Please check our website for information on changes.

Centres can contextualise these tasks for their local area. Teachers can carry out assessment of tasks at any time during the period of study leading to the GCSE examination.

Students must complete **two** pieces of observational work. **One** unaided observation and **one** aided observation.

- **Unaided** observations are either naked eye, or with the use of rudimentary equipment (for example shadow sticks).
- **Aided** observations are undertaken with the use of binoculars, telescopes or robotic telescopes.

The two observational tasks have an equal weighting of 20 marks each.

Students **cannot** select both their observational tasks from the same **row** in the observation task table. For example, not A1 and B1, A2 and B2 etc.

Aspects of the observation and report

Design

Planning the most appropriate observing programme for the chosen task, including observing sites, times, instruments needed, and the need for any repeat observations.

Observation

The record of the range of observations taken, including any drawings of the objects observed, details of the observing session (weather conditions, location etc).

Analysis

The conclusions drawn from the observational data collected, related to the observational task chosen.

Evaluation

An evaluation of the data collected in the observation and suggestions for improvements or extensions to further observations.

Suggested timings of each aspect

Design	2 hours
Observation	dependent on task selected
Analysis	2 hours
Evaluation	2 hours

This gives 6 hours' classroom time plus observation time per task, which equals a total of 12 hours' classroom time plus observation time for the whole unit.

Controlled conditions

The preparation and writing of the observation reports must take place under controlled conditions. Students must write their reports only in lessons, supervised by a teacher. The write up may take place over several lessons, students' materials must be collected in at the end of the lesson and handed back at the beginning of the next lesson. Students' reports must be produced individually.

Levels of control

Internal assessment with controlled conditions has levels of control for task setting, task taking and task marking.

Task setting — high level of control

Tasks will be set by Edexcel and centres will choose from a list of tasks.

Task taking

a Observations — limited level of control

Observations will be carried out under limited control, including possible night-time unsupervised observations.

b Design, analysis and evaluation — high level of control

The design of the observation sessions and the writing of the report, including any analysis and evaluation, will take place under high levels of control, in centres.

Task marking — medium level of control

The marking of the tasks will be carried out by teachers and externally moderated by Edexcel.

Quality of written communication (QWC)

Opportunities for QWC have been identified within the assessment criteria, including the ability to:

- present relevant information in a form that suits its purpose
- ensure that text is legible and that spelling, punctuation and grammar are accurate, so that meaning is clear
- use a suitable structure and style of writing
- use specialist vocabulary when appropriate.

Health and safety

Attention is drawn to the need for safe practice when students carry out observation tasks. Relevant advice can be obtained from CLEAPPS. Risk assessments must be carried out for all observing tasks. It is the responsibility of the centre to carry out all risk assessments, to ensure that they are appropriate for their students, equipment and conditions.

Of particular concern is any observation of the Sun and the Moon. The Sun must not be viewed directly, either with or without optical aids. If the Moon is observed directly using a telescope at high magnification then a student's ability to make further observations directly afterwards is impaired.

Health and safety is a particular concern throughout all of the observation tasks, but particularly in A3, B3, A8 and B8, which are concerned with observing phenomena related to the Sun.

Observation task list

Students cannot select both their observational tasks from the same row in the observation task table. For example, not A1 and B1, A2 and B2 etc.

Unaided observations		Aided observations	
Choose one task from this list.		***Choose one task from this list.***	
A1	**Lunar Features** Produce a series of naked-eye drawings of three lunar surface features. Use them to show their changing appearance at different lunar phases.	B1	**Lunar Features** Produce a series of telescopic drawings and/or photographs of three lunar surface features. Use them to show their changing appearance at different lunar phases.
A2	**Meteor Shower** Observe a meteor shower. Record meteor trails on a drawing of the stellar background from sketches and estimate magnitudes of the meteors. Locate and show the position of the radiant.	B2	**Meteor Shower Photography** Use long-exposure photography to obtain photographs of a meteor shower. Estimate magnitudes of the meteors. Locate and show the position of the radiant.
A3	**Drawings of Lunar or Solar Eclipse** Using a suitable method of observation (lunar — direct, solar — pinhole projection), produce a series of drawings showing the progress of a lunar or solar eclipse. **WARNING: The Sun must NOT be viewed directly, with or without optical aids.**	B3	**Photographs of Lunar or Solar Eclipse** Using a suitable method of observation (lunar — direct, solar — projection), produce a series of photographs showing the progress of a lunar or solar eclipse. **WARNING: The Sun must NOT be viewed directly, with or without optical aids.**
A4	**Constellation Drawings** Observe and make detailed drawings of three different constellations, recording dates, times, seeing and weather conditions and noting colours (if possible) and magnitudes by comparison with reference stars.	B4	**Constellation Photography** Produce photographs of three different constellations, recording dates, times, seeing and weather conditions. Use the photographs to identify colours and magnitudes by comparison with reference stars.
A5	**Drawings of Celestial Event** Produce a series of drawings to record the passage of a suitable celestial event, for example a transit, occultation or comet.	B5	**Telescopic Drawings or Photographs of Celestial Event** Produce a series of detailed telescopic drawings or photographs to record the passage of a suitable celestial event, for example a transit, occultation or comet.
A6	**Shadow Stick** Use a shadow stick to record the direction of the Sun at different times on at least two days and hence determine (a) the time of local noon and (b) the observer's longitude.	B6	**Sundial** On at least three widely-spaced dates, compare the time shown on a correctly-aligned sundial with local mean time. Use these data to determine the accuracy of the sundial used.

Unaided observations		Aided observations	
Choose one task from this list.		***Choose one task from this list.***	
A7	**Levels of Light Pollution** Use repeated observations of the faintest stars observable to quantify the effect of light pollution at two different sites.	B7	**Photographic Measurement of Levels of Light Pollution** Use the magnitudes of the faintest stars visible in long exposure photographs to quantify the effect of light pollution at two different sites.
A8	**Sunspots** Use a pinhole to **project** an image of the Sun onto a suitable background and observe and record sunspots over a sufficiently long period of time to determine the Sun's rotation period. **WARNING: The Sun must NOT be viewed directly, with or without optical aids.**	B8	**Sunspots** Use a small telescope to **project** an image of the Sun onto a suitable background and observe and record sunspots over a sufficiently long period of time to determine the Sun's rotation period. **WARNING: The Sun must NOT be viewed directly, with or without optical aids.**
A9	**Light Curve of a Variable Star** Use a series of naked-eye estimates of the magnitude of a suitable variable star over a sufficient period of time to determine the period of the star.	B9	**Light Curve of a Variable Star** Use a series of telescopic estimates of the magnitude of a suitable variable star over a sufficient period of time to determine the period of the star.
A10	**Estimating Stellar Density** By counting the numbers of visible stars within a certain area of sky, estimate and compare the density of stars in the sky, parallel with and perpendicular to the plane of the Milky Way.	B10	**Measuring Stellar Density** Use binocular/telescopic observations or original photographs to measure and compare the density of stars in the sky, parallel with and perpendicular to the plane of the Milky Way.
		B11	**Drawings of Messier Objects** Use binoculars/telescope/robotic telescope to produce detailed drawings and/or photographs of at least three Messier/NGC objects.
		B12	**Measuring the Sidereal Day** Take long-exposure photographs of the circumpolar stars around Polaris or the south celestial pole and use them to determine the length of the sidereal day.

Assessment criteria

Teachers must mark the student's work using the assessment criteria specified below. Teachers should check carefully that the students' work is their own and is not copied from source material without any attempt by the students to put the material in their own words.

Each observational task (both aided and unaided) should be awarded a mark out of five in each of the design, observation, analysis and evaluation strands.

Design

Mark range	Descriptor
0	No procedure designed.
1	Outline a simple procedure for the observations, using basic astronomical terminology.
2–3	Astronomical knowledge and understanding used to decide on the most appropriate site, time, equipment for observations. Spelling, punctuation and grammar used with reasonable accuracy. Limited use of astronomical terminology.
4–5	Detailed astronomical knowledge and understanding used to design the most appropriate observing programme with a range of sites, times and instruments evaluated. Spelling, punctuation and grammar used with considerable accuracy. Good range of astronomical terminology used correctly.

Observation

Mark range	Descriptor
0	No observations completed.
1	Simple observations completed, providing some data. A few observational details included.
2–3	Sound observations completed and recorded, providing adequate data for the task. Clear and accurate observational details included.
4–5	Excellent programme of observations completed and recorded, providing conclusive data for the task. Full observational details included clearly and accurately.

Analysis

Mark range	Descriptor
0	No analysis on the observations.
1	Simple comments on what is shown by the observations, using basic astronomical terminology.
2–3	Conclusions or calculations derived from observational data used to address the task set. Spelling, punctuation and grammar used with reasonable accuracy. Limited use of astronomical terminology.
4–5	Full analysis of the observational data, resulting in clear conclusions related to the task set. Spelling, punctuation and grammar used with considerable accuracy. Good range of astronomical terminology used correctly.

Evaluation

Mark range	Descriptor
0	No evaluation of the observation.
1	Simple comment on the accuracy of the observations, using basic astronomical terminology.
2–3	Supported statement of the accuracy of the observational data obtained. Feasible suggestions for improvements or extensions to the observations. Spelling, punctuation and grammar used with reasonable accuracy. Limited use of astronomical terminology.
4–5	Clearly reasoned quantitative assessment of the accuracy of the observational data obtained. Detailed suggestions for improvements or extensions to the observations. Spelling, punctuation and grammar used with considerable accuracy. Good range of astronomical terminology used correctly.

Marks for both the unaided and aided observation tasks should be recorded on the Controlled Assessment Record Sheet found in *Appendix 5*.

B Assessment

Assessment summary

Unit 1 is externally assessed through an examination paper lasting 2-hours.

Unit 2 is internally assessed with controlled conditions.

Summary of table of assessment

Unit 1:	Understanding the Universe	Unit code: 5AS01

One non-tiered 2-hour examination, with 120 marks.

The examination will contain a variety of different question types, such as objective-test questions, short- and extended-answer questions, graphical and data questions.

The first examination will be in 2014 and will be available in each June series thereafter.

Unit 2:	Exploring the Universe	Unit code: 5AS02

This is internally assessed with controlled conditions. Students are required to complete **two** observation tasks: one unaided and one aided.

The controlled assessment tasks will require students to cover the following areas:

- design
- observation
- analysis
- evaluation.

These will be marked to the assessment criteria by teachers and moderated by Edexcel. Each observation is marked out of 20, with a total mark of 40 for this assessment.

The suggested time to complete each observation is 6 hours plus the time required to complete the observations. This gives a total of 12 hours for both tasks, in addition to the required observation times.

The first examination will be in 2014 and will be available in each June series thereafter.

Assessment Objectives and weightings

	% in GCSE
AO1: Knowledge and understanding of science and how science works	31-40%
AO2: Application of skills, knowledge and understanding	31-40%
AO3: Practical, enquiry and data-handling skills	21-30%
TOTAL	**100%**

Relationship of Assessment Objectives to units

Unit number	Assessment Objective			
	AO1	AO2	AO3	Total for AO1, AO2 and AO3
Unit 1: Understanding the Universe	27-36%	25-34%	6-15%	75%
Unit 2: Exploring the Universe	4%	6%	15%	25%
Total for GCSE	**31-40%**	**31-40%**	**21-30%**	**100%**

Assessment Objectives descriptions

AO1: Knowledge and understanding of science and how science works

Students should be able to:

a demonstrate knowledge and understanding of the scientific facts, concepts, techniques and terminology in the specification

b show understanding of how scientific evidence is collected and its relationship with scientific explanations and theories

c show understanding of how scientific knowledge and ideas change over time and how these changes are validated.

AO2: Application of skills, knowledge and understanding

Students should be able to:

a apply concepts, develop arguments or draw conclusions related to familiar and unfamiliar situations

b plan a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem

c show understanding of how decisions about science and technology are made to different situations, including contemporary situations and those raising ethical issues

d evaluate the impact of scientific developments or processes on individuals, communities or the environment.

AO3: Practical, enquiry and data-handling skills

Students should be able to:

a carry out practical tasks safely and skilfully

b evaluate the methods they use when collecting first-hand and secondary data

c analyse and interpret qualitative and quantitative data from different sources

d consider the validity and reliability of data in presenting and justifying conclusions.

Entering your students for assessment

Student entry

Details of how to enter students for this qualification can be found in Edexcel's *UK Information Manual*, a copy is sent to all examinations officers every year. The information can also be found on Edexcel's website: www.edexcel.com

From summer 2014 onwards students will be required to sit all their examinations and submit controlled assessment work for moderation at the end of the course. Students may complete the controlled assessment task(s) at any point during the course. As the controlled assessment task(s) changes each year, centres must ensure that they use the appropriate task for the year of GCSE entry.

Forbidden Combinations and Classification Code

Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

Students should be advised that, if they take two specifications with the same classification code, schools and colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if students take two GCSE specifications that have different classification codes but have significant overlap of content. Students who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

Access arrangements and special requirements

Edexcel's policy on access arrangements and special considerations for GCE, GCSE, and Entry Level is designed to ensure equal access to qualifications for all students (in compliance with the Equality Act 2010) without compromising the assessment of skills, knowledge, understanding or competence.

Please see the Edexcel website (www.edexcel.com) for:

- the Joint Council for Qualifications (JCQ) policy Access Arrangements, Reasonable Adjustments and Special Consideration.
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

Requests for access arrangements and special considerations must be addressed to:

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Equality Act 2010

Please see our website (www.edexcel.com) for information with regard to the Equality Act 2010.

Students who have a total visual impairment can opt to take alternative controlled assessment tasks. These assessment tasks would not require the students to make any observations. They would focus more on showing their understanding of how to design and carry out an observation session and through more analysis and evaluation. This option is available only for students with total visual impairment.

Controlled assessment

In controlled assessments, control levels are set for three linked processes: task setting, task taking and task marking. The control levels (high, medium or limited are dependent on the subject) are set for each process so that the overall level of control secures validity and reliability, provides good manageability for all involved and allows teachers to authenticate the student's work confidently.

The summary of the controlled conditions for this specification is given below.

Summary of conditions for controlled assessment

The preparation and writing of the observation reports must take place under controlled conditions. Students will be allowed to write their reports only in a lesson, supervised by a teacher. The write up will take place over several lessons, so the student's materials must be collected in at the end of the lesson and handed back at the beginning of the next lesson. Students' reports must be produced individually.

Internal assessment with controlled conditions has levels of control for task setting, task taking and task marking.

Task setting — high level of control

Tasks will be set by Edexcel and centres will choose from a list of the tasks.

Task taking

a Observations — limited level of control

Observations will be carried out under limited control, including possible night-time unsupervised observations.

b Design, analysis and evaluation — high level of control

The design of the observation sessions and the writing of the report, including any analysis and evaluation, will take place under high levels of control, in centres.

Task marking — medium level of control

The marking of the tasks will be carried out by teachers and moderated by Edexcel.

Internal standardisation

Teachers must show clearly how the marks have been awarded in relation to the assessment criteria. If more than one teacher in a centre is marking students' work, there must be a process of internal standardisation to ensure that there is consistent application of the assessment criteria.

Authentication

All students must sign an authentication statement. Statements relating to work not sampled should be held securely in the centre. Authentication statements which relate to sampled students must be attached to the work and sent to the moderator. In accordance with a revision to the current Code of Practice, any candidate unable to provide an authentication statement will receive zero credit for the component. Where credit has been awarded by a centre-assessor to sampled work without an accompanying authentication statement, the moderator will inform Edexcel and the mark will be adjusted to zero.

Further information

For more information on annotation, authentication, mark submission and moderation procedures, please refer to the *Edexcel GCSE in Astronomy: Instructions and administrative documentation for internally assessed units* document, which is available on our website.

For up-to-date advice on teacher involvement, please refer to the Joint Council for Qualifications (JCQ) Instructions for conducting coursework/portfolio document on the JCQ website: www.jcq.org.uk. For up-to-date advice on malpractice and plagiarism, please refer to the Joint Council for Qualifications (JCQ) *Suspected Malpractice in Examinations: Policies and Procedures and Instructions for conducting coursework/portfolio* documents on the JCQ website (www.jcq.org.uk).

Assessing your students

The first assessment opportunity for Unit 1 and Unit 2 of this qualification will take place in the June 2014 series and in each following June series for the lifetime of this specification.

Your student assessment opportunities

Unit	June 2014	June 2015
Unit 1: Understanding the Universe	✓	✓
Unit 2: Exploring the Universe	✓	✓

Awarding and reporting

The grading, awarding and certification of this qualification will comply with the requirements of the current GCSE/GCE Code of Practice, which is published by the Office of Qualifications and Examinations Regulation (Ofqual). The GCSE qualification will be graded and certificated on an eight-grade scale from A* to G. Individual unit results will be reported.

The first certification opportunity for the Edexcel GCSE in Astronomy will be June 2014.

Students whose level of achievement is below the minimum judged by Edexcel to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Unit results

The minimum uniform marks required for each grade for each unit:

Unit 1

Unit grade	*A	A	B	C	D	E	F	G
Maximum uniform mark = 150	**135**	**120**	**105**	**90**	**75**	**60**	**45**	**30**

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–29.

Unit 2

Unit grade	*A	A	B	C	D	E	F	G
Maximum uniform mark = 50	**45**	**40**	**35**	**30**	**25**	**20**	**15**	**10**

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–9.

Qualification results

GCSE in Astronomy cash-in code: 2AS01

Qualification grade	*A	A	B	C	D	E	F	G
Maximum uniform mark = 200	**180**	**160**	**140**	**120**	**100**	**80**	**60**	**40**

Students who do not achieve the standard required for a grade G will receive a uniform mark in the range 0–39.

Re-taking of qualifications

Students wishing to re-take a GCSE are required to re-take all the units in the qualification. Students will be permitted to carry forward the results from the controlled assessment unit(s) if they wish and only re-take the externally-assessed units.

Language of assessment

Assessment of this specification will be available in English only. Assessment materials will be published in English only and all work submitted for examination and moderation must be produced in English.

Quality of written communication

Students will be assessed on their ability to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- select and use a form and style of writing appropriate to the purpose and the complexity of the subject matter;
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Stretch and challenge

Students can be stretched and challenged in all units through the use of different assessment strategies, for example:

- using a variety of stems in questions — for example analyse, evaluate, discuss, compare
- use of a wider range of question types to address different skills — for example calculations and graphical questions etc.

Malpractice and plagiarism

For up-to-date advice on malpractice and plagiarism, please refer to the Joint Council for Qualifications *Suspected Malpractice in Examinations: Policies and Procedures* document on the JCQ website www.jcq.org.uk.

B Assessment

Student recruitment

Edexcel's access policy concerning recruitment to our qualifications is that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

Progression

GCSE in Astronomy students could progress to the following:

- GCE AS and Advanced Level in Physics
- Level 3 Extended Project
- other science-related courses at Level 3.

GCSE in Astronomy provides a sound basis for the first year of degree-level astronomy-related courses.

Grade descriptions

A	Candidates recall, select and communicate detailed knowledge and thorough understanding of astronomical content and How Science Works across all areas of the specification. They use astronomical terminology appropriately and accurately. They apply appropriate knowledge and understanding of a wide range of astronomical concepts and recognise and understand the relationships between data, evidence, theories and scientific explanations. They recognise that there are areas of uncertainty in astronomical knowledge and understand that scientific theories can be changed by new evidence. They select and use effectively a wide range of mathematical skills. They select and use astronomical knowledge and understanding to plan and carry out an effective scientific task using appropriate equipment safely. They use effectively a wide range of relevant skills and appropriate techniques to collect, record and present a range of original and secondary data. They analyse and interpret information that is consistent with their evidence, and critically evaluate its validity. They reflect on the limitations of their evidence and suggest improvements to their methods that would enable them to collect more valid and reliable data.

C	Candidates recall, select and communicate knowledge and understanding of astronomical content and How Science Works across most areas of the specification. They use astronomical terms appropriately. They apply their knowledge and understanding of astronomical concepts and recognise and understand the relationships between data, evidence, theories and scientific explanations. They are aware that scientific theories can be developed by new evidence. They select and use a variety of appropriate mathematical skills. They use astronomical knowledge and understanding to plan a scientific task using appropriate equipment. They use appropriate techniques to collect, record and present original and secondary data. They analyse and interpret information, and perform some evaluation of its validity. They reflect on the limitations of their evidence and suggest improvements to their methods.
F	Candidates recall, select and communicate knowledge and some limited aspects of understanding of astronomical content and how science works across some areas of the specification. They communicate their ideas using everyday language. They apply their understanding of a limited number of simple astronomical concepts. They are aware that science can explain many phenomena. They use a limited number of basic mathematical skills. They use limited astronomical knowledge to carry out a simple scientific task. They use standard techniques to collect, record and present a limited selection of data. They interpret evidence to reach some basic conclusions.

C Resources, support and training

Edexcel resources

The resources from Edexcel provide you and your students with comprehensive support for our GCSE Astronomy qualification. This dedicated suite of resources has been written by subject experts to ensure that you and your department have everything needed to deliver the specification.

Edexcel publications

You can order further copies of the specification, sample assessment materials (SAMs) and teacher's guide documents from:

Edexcel Publications
Adamsway
Mansfield
Nottinghamshire NG18 4FN

Telephone: 01623 467467
Fax: 01623 450481
Email: publication.orders@edexcel.com
Website: www.edexcel.com

Endorsed resources

Edexcel also endorses some additional materials written to support this qualification. Any resources bearing the Edexcel logo have been through a quality assurance process to ensure complete and accurate support for the specification. For up-to-date information about endorsed resources, please visit www.edexcel.com/endorsed.

Please note that while resources are checked at the time of publication, materials may be withdrawn from circulation and website locations may change.

Edexcel support services

Edexcel has a wide range of support services to help you implement this qualification successfully.

ResultsPlus — ResultsPlus is an application launched by Edexcel to help subject teachers, senior management teams, and students by providing detailed analysis of examination performance. Reports that compare performance between subjects, classes, your centre and similar centres can be generated in 'one-click'. Skills maps that show performance according to the specification topic being tested are available for some subjects. For further information about which subjects will be analysed through ResultsPlus, and for information on how to access and use the service, please visit www.edexcel.com/resultsplus.

Ask the Expert – To make it easier for you to raise a query with us online, we have merged our **Ask Edexcel** and **Ask the Expert** services.

There is now one easy-to-use web query form that will allow you to ask any question about the delivery or teaching of Edexcel qualifications. You'll get a personal response, from one of our administrative or teaching experts, sent to the email address you provide.

We're always looking to improve the quantity and quality of information in our FAQ database, so you'll be able to find answers to many questions you might have by searching before you submit the question to us. You can access this service at www.edexcel.com/ask.

Support for Students
Learning flourishes when students take an active interest in their education; when they have all the information they need to make the right decisions about their futures. With the help of feedback from students and their teachers, we've developed a website for students that will help them:

- Understand subject specifications
- Access past papers and mark schemes
- Find out how to get exams remarked
- Learn about other students' experiences at university, on their travels and entering the workplace

We're committed to regularly updating and improving our online services for students. The most valuable service we can provide is helping schools and colleges unlock the potential of their learners.
www.edexcel.com/students

Training

A programme of professional development and training courses, covering various aspects of the specification and examination, will be arranged by Edexcel each year on a regional basis. Full details can be obtained from:

Training from Edexcel
Edexcel Head Office
One90 High Holborn
London WC1V 7BH

Telephone: 0844 576 0027
Email: trainingbookings@edexcel.com
Website: www.edexcel.com/training

D Appendices

Appendix 1 Key skills

Signposting

Key skills (Level 2)	Unit 1	Unit 2
Application of number		
N2.1	✓	✓
N2.2	✓	✓
N2.3	✓	✓
Communication		
C2.1a	✓	✓
C2.1b	✓	✓
C2.2	✓	
C2.3	✓	
Information and communication technology		
ICT2.1	✓	✓
ICT2.2	✓	✓
ICT2.3	✓	✓
Improving own learning and performance		
LP2.1	✓	✓
LP2.2	✓	✓
LP2.3	✓	✓
Problem solving		
PS2.1	✓	✓
PS2.2	✓	✓
PS2.3	✓	✓
Working with others		
WO2.1	✓	
WO2.2	✓	
WO2.3	✓	

Development suggestions

For further information on development of key skills please refer to our website: www.edexcel.com.

Appendix 2 Wider curriculum

Signposting

Issue	Unit 1	Unit 2
Ethical	✓	
Cultural	✓	
Citizenship	✓	
Environmental	✓	✓
European initiatives	✓	
Health and safety	✓	✓

Development suggestions

Issue	Unit	Opportunities for development or internal assessment
Ethical	Unit1	Ethical awareness will be developed through the context of: • whether to send manned or unmanned craft into space on particular missions.
Cultural	Unit 1	Cultural awareness will be developed through the context of: • the different cultural backgrounds of astronomers who made significant discoveries, for example Galileo • how our understanding of astronomy has developed over time, by contributions from different astronomers around the world.
Citizenship	Unit 1	Awareness of citizenship will be developed through the context of: • the organisations involved in space missions and how they work together to collect more detailed information, for example collaborations between NASA and ESA.
Environmental	Unit 1	Environmental awareness will be developed through the context of: • conservation of energy • effects of light pollution • space rubbish.
	Unit 2	Environmental awareness is primarily concerned with: • effects of light pollution.
European initiatives	Unit 1	European and global initiatives can be further investigated through students: • accessing current developments by professional astronomers • keeping up to date with the work of the European Space Agency (ESA). This dimension is also supported through: • addressing the issue of atmospheric pollution and considering the implications of European legislation.
Health and safety	Unit 1	Health and safety awareness will be developed through practical work and will include issues such as: • hazards involved in observing the Sun and the Moon • safety whilst making observations at night.
	Unit 2	Health and safety awareness will build on Unit 1 but will also require students to consider: • the safety of themselves and others • undertaking risk assessments.

Appendix 3 Codes

Type of code	Use of code	Code number
National classification codes	Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.	1690
National Qualifications Framework (NQF) codes	Each qualification title is allocated a National Qualifications Framework (NQF) code. The National Qualifications Framework (NQF) code is known as a Qualification Number (QN). This is the code that features in the DfE Section 96, and on the LARA as being eligible for 16–18 and 19+ funding, and is to be used for all qualification funding purposes. The QN is the number that will appear on the student's final certification documentation.	The QAN for the qualification in this publication is: GCSE — 500/4445/X
Unit codes	Each unit is assigned a unit code. This unit code is used as an entry code to indicate that a student wishes to take the assessment for that unit. Centres will need to use the entry codes only when entering students for their examination.	Unit 1 — 5AS01 Unit 2 — 5AS02
Cash-in codes	The cash-in code is used as an entry code to aggregate the student's unit scores to obtain the overall grade for the qualification. Centres will need to use the entry codes only when entering students for their qualification.	GCSE — 2AS01
Entry codes	The entry codes are used to: • enter a student for the assessment of a unit • aggregate the student's unit or component scores to obtain the overall grade for the qualification.	Please refer to the Edexcel *UK Information Manual*, available on the Edexcel website.

Appendix 4 How Science Works mapping

How Science Works reference	Specification reference				
	Unit 1				Unit 2
	Topic 1	Topic 2	Topic 3	Topic 4	
1 The collection and analysis of scientific data.	1.1e 1.2e 1.3j 1.4k	2.2m 2.3e 2.4a 2.4e	3.2f 3.2n 3.3k 3.3n 3.3o 3.4e	4.1d 4.2h	✓
2 The interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories.	1.1e 1.1n 1.2h 1.2m 1.3g 1.3h	2.1l 2.4f 2.4g	3.3n	4.3l 4.3m 4.3n 4.3p	
3 Many phenomena can be explained by developing and using scientific theories, models and ideas.	1.2d 1.4d 1.4f 1.4g	2.1c 2.1k 2.3c 2.4g	3.1e 3.2l 3.3a 3.3e 3.3q 3.4a	4.2d 4.3b 4.3e 4.3k 4.3n 4.3o 4.3p	✓
4 There are some questions that science cannot currently answer and some that science cannot address.				4.3l 4.3m	
5 Planning to test a scientific idea, answer a scientific question, or solve a scientific problem.			3.2g 3.2i 3.3i		✓
6 Collecting data from primary or secondary sources, including the use of ICT sources and tools.	1.2k	2.1l	3.3d 3.3i 3.3n	4.3j	✓
7 Working accurately and safely, individually and with others, when collecting first-hand data.	1.3a		3.2j		✓
8 Evaluating methods of data collection and considering their validity and reliability as evidence.					✓

How Science Works reference	Specification reference				
	Unit 1				Unit 2
	Topic 1	Topic 2	Topic 3	Topic 4	
9 Recalling, analysing, interpreting, applying and questioning scientific information or ideas.				4.3a	✓
10 Using both qualitative and quantitative approaches.	1.4j 1.4l	2.3c 2.3f 2.4f	3.3j 3.3l	4.3h	✓
11 Presenting information, developing an argument and drawing a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools.	1.1g		3.2f 3.2n 3.3j 3.3l	4.2b	✓
12 The use of contemporary science and technological developments and their benefits, drawbacks and risks.		2.1m 2.2k 2.2l			
13 How and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions.	1.1j 1.1l 1.1o	2.4f			
14 How uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes.	1.1e 1.1p	2.3a 2.4b 2.4f	3.1c	4.3f 4.3l 4.3m 4.3o 4.3p	

Appendix 5 Controlled assessment record sheet

edexcel

GCSE in Astronomy — Unit 2 (5AS02)

	Examination year
Centre name	**Centre number**
Candidate name	**Candidate number**

Two observations are to be completed: **one** unaided **and one** aided.

Unaided observation

Task title: _____

Number: _____

Design	Observation	Analysis	Evaluation	**TOTAL**
/5	/5	/5	/5	**/20**

Aided observation

Task title: _____

Number: _____

Design	Observation	Analysis	Evaluation	**TOTAL**
/5	/5	/5	/5	**/20**

MAXIMUM MARK
/40

Signed (teacher): _____ **Name of teacher:** _____

Date: _____

Please attach this controlled assessment record sheet to the student's work before submitting it to the moderator.

Appendix 6 Mathematical skills, data and formulae

Mathematical skills

Students need to have been taught, and to have acquired, competence in the areas of mathematics as set out in this appendix. This is to develop the related knowledge, understanding and skills in the subject content.

Students are permitted to use calculators in the written examination, in accordance with the current regulations.

For the purpose of this qualification it is assumed that students will have the ability to:

- evaluate expressions incorporating the four operations, +, −, ×, ÷, either singly or in conjunction with one another, quoting the answer to an appropriate number of significant figures
- evaluate expressions involving simple proportion, decimals, fractions and percentages
- understand and use logarithms (base 10) in equations and as scales to graphs
- manipulate formulae, equations and expressions
- plot and draw graphs from suitable data, selecting appropriate scales for the axes
- interpret graphs in terms of general trends and by interpolation
- interpret a range of graphs and diagrams
- use an electronic calculator in connection with any of the above as appropriate
- understand and use direct and inverse proportion.

Data	
This data is found within the topics of Unit 1. Students are expected to recall these values for use within the examination if needed.	
Diameter of the Earth	13000 km
Diameter of the Moon	3500 km
Diameter of the Sun	1.4 million km
Distance from the Moon to the Earth	380 000 km
Distance from the Sun to the Earth	150 million km
One astronomical unit (AU) is the mean distance between the Earth and Sun	150 million km
Rotation period of the Earth	23 hours 56 minutes
Time for the Earth to rotate through 1 degree	4 minutes
The Moon's rotational period and orbital period	27.3 days
The period of the lunar phase cycle	29.5 days
Temperature of the Sun's photosphere	5800 K
Approximate temperature of the corona	2 million K

Formulae
These formulae are found within the topics of Unit 1. The formulae will be given in the examination questions if needed.
Kepler's third law $T^2 = R^3$ where T is in years and R is in AU
Circumpolar stars declination > 90 – latitude
Magnitude calculations $M = m + 5 - 5 \log d$ where m is apparent magnitude, M is absolute magnitude and d is distance (parsecs).
Radial velocity of a galaxy $\frac{\lambda - \lambda_0}{\lambda_0} = \frac{v}{c}$ where v is the radial velocity, c is the speed of light, λ is wavelength and λ_0 is the rest wavelength.
Hubble's Law $v = Hd$ where v is velocity, d is distance and H is the Hubble constant.

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