Topic 4.8 Space physics Revision Booklet

ANSWERS AQA GCSE Physics 8463 · Foundation & Higher



Name _____ Class _____ Target grade _____

4.8
Space physics

Work through a topic, then come back to it on the dates in your planner. Little and often beats one long cram.

HOW THIS BOOKLET WORKS

Revise like a scientist

This booklet uses six revision techniques that research shows work best. Every activity is labelled with the technique it uses and the grade it targets.

Retrieval practice

Pulling ideas out of your memory makes them stick far better than re-reading. Brain dumps, quizzes and cover-and-recall tasks.

Spaced practice

Revisit each topic after 2 days, 1 week and 3 weeks. Forgetting a little, then remembering again, strengthens memory.

Interleaving

Mixed-topic questions train you to spot which idea a question needs, just like the real exam.

Dual coding

Words plus diagrams: graphs, ray diagrams and labelled apparatus give your memory two routes in.

Elaboration

Asking 'why?' and 'how?' and linking ideas together turns facts into understanding.

Worked examples

I do → We do → You do: study a full solution, finish a half-done one, then do one alone.

KEY

Grade pathways

GRADE 4

Secure the basics: recall definitions and units, pick the right equation from the equation sheet, and do one-step calculations.

GRADE 5

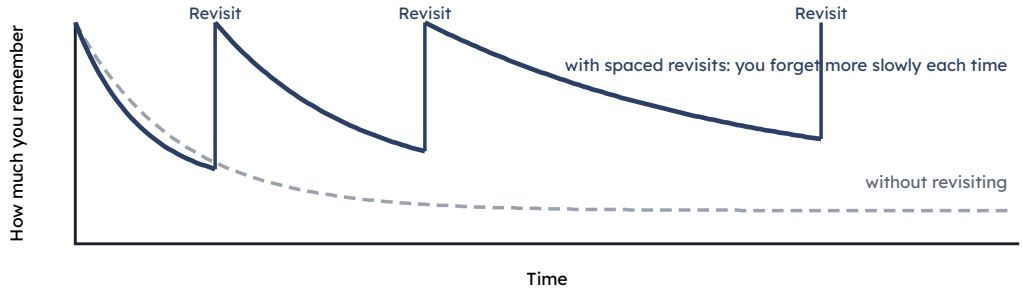
Rearrange equations, convert units, describe practicals and explain in two linked steps.

GRADE 7+

Multi-step calculations, evaluate methods and data, and write logical 6-mark answers.

SPACED PRACTICE DUAL CODING

Why spacing works



SPACED PRACTICE

My spaced revision planner

Write the date you'll do each session. Tick it off when it's done.

Topic	First go	+2 days	+1 week	+3 weeks	Before the mock
4.8 Space physics					
Final review					

What's inside

Topic 8 · Space physics (4.8)

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Final review

Final review: mixed questions	16

ROUTINE

The routine for every page

1. Try it cold. Answer from memory first, without notes. Struggling a bit is good: it's what makes learning stick.

2. Check and correct. Mark it with the answer booklet in a different colour pen. Fix every mistake.

3. Come back later. Redo anything you got wrong on your next spaced session.

ONLINE

Use it with mrsullyphysics.com

Flashcards for retrieval practice: cards you get wrong come back until you get them right.

Quizzes and Aim higher for extra Grade 5+ and 7+ questions with mark schemes.

Animations to see the physics move (dual coding).

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ Describe what happens to a star much more massive than the Sun after its main sequence, and explain how it produces elements heavier than iron. [4]

It becomes a red super giant

It explodes in a supernova

Elements heavier than iron are produced in the supernova, which distributes elements

throughout the universe

It leaves a neutron star, or a black hole if it is massive enough

2 Grade 7+ A satellite moves in a circular orbit at a constant speed. Explain why it is accelerating. [3]

Velocity is a vector: it includes direction

The direction of motion is constantly changing, so velocity is changing

Gravity provides a resultant force towards the centre of the orbit, so it is accelerating

3 Grade 5 Give two pieces of evidence that the universe is expanding. [2]

Light from most distant galaxies is red-shifted, so they are moving away

More distant galaxies show more red-shift, so they are moving away faster

Brain dump and checklist

RETRIEVAL PRACTICE | GRADE 4 | GRADE 5 | GRADE 7

Brain dump

Set a timer for 5 minutes. Write or draw everything you remember about space physics. No notes! Afterwards, add anything you missed in a different colour.

Prompts if you get stuck: solar system? · nebula → ? · main sequence? · supernova? · orbits? · red-shift? · Big Bang? · dark mass and dark energy?

METACOGNITION

How confident am I?

Rate each statement now (before) by shading R, A or G. Rate again at the end of the topic (after).

I can...	Before			After		
	R	A	G	R	A	G
Describe our solar system and the Milky Way	○	○	○	○	○	○
Explain how a star forms from a nebula	○	○	○	○	○	○
Explain why a main sequence star is stable	○	○	○	○	○	○
Describe the life cycle of a star the size of the Sun	○	○	○	○	○	○
Describe the life cycle of a star much more massive than the Sun	○	○	○	○	○	○
Explain how fusion and supernovas produce the elements	○	○	○	○	○	○
Explain how gravity keeps planets and satellites in orbit	○	○	○	○	○	○
Explain why orbiting objects accelerate and how speed affects orbit radius (Higher)	○	○	○	○	○	○
Describe red-shift and what it shows	○	○	○	○	○	○
Explain the evidence for the Big Bang and what is still not understood	○	○	○	○	○	○

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 What is red-shift? [2]

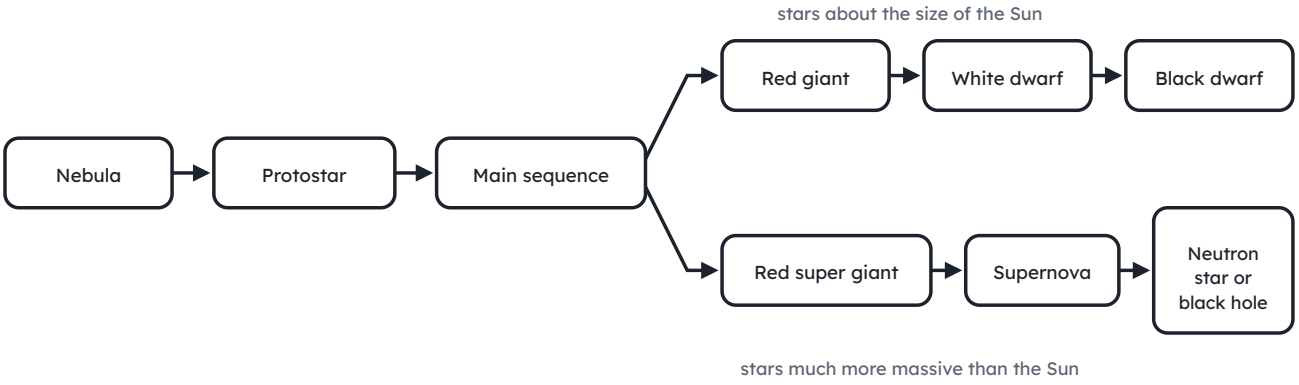
An observed increase in the wavelength of light

from most distant galaxies

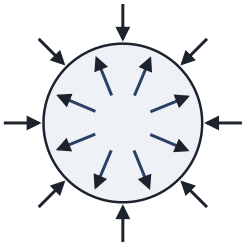
Knowledge organiser

DUAL CODING | GRADE 4 | GRADE 5 | GRADE 7

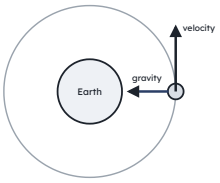
LIFE CYCLE OF STARS



STABLE STARS AND ORBITS



Main sequence star is stable:
inward gravity balances the outward force from fusion energy (equilibrium)



Gravity provides the force towards the centre, so speed stays the same but direction (velocity) changes: the satellite is accelerating (Higher)

Smaller orbit → must move faster to stay in orbit (stable orbit: if speed changes, radius changes)

RED-SHIFT



Red-shift: lines move to longer wavelengths → galaxy moving away. Further away = bigger red-shift → universe is expanding → evidence for the Big Bang

BIG IDEAS

Fusion makes elements up to iron; elements heavier than iron are made in supernovas, which distribute them through the universe.
The universe began from a very small region that was extremely hot and dense (Big Bang).
Dark mass and dark energy are still not understood.

TURN OVER

Key words, misconceptions, required practicals and Grade 7+ links are on the next page.

Knowledge organiser: key words, misconceptions, practicals

ELABORATION GRADE 4 GRADE 5 GRADE 7

KEY WORDS: LEARN THESE WORD FOR WORD (SAME AS SIDE 2 OF YOUR KNOWLEDGE ORGANISER)

Nebula: a cloud of dust and gas where stars form.
Main sequence star: a stable star: inward gravity balances the outward force from fusion energy.
Supernova: the explosion of a massive star; produces elements heavier than iron and distributes them through the universe.
Satellite: an object that orbits a larger body; moons are natural, others artificial.
Red-shift: an observed increase in the wavelength of light from most distant galaxies.
Big Bang theory: the universe began from a very small region that was extremely hot and dense.
Dark mass and dark energy: proposed to explain observations; not yet understood.

MISCONCEPTIONS: SPOT THE MISTAKE

× Common mistake	✓ What's actually true
× The Sun will become a black hole.	✓ It isn't massive enough: it becomes a white dwarf, then a black dwarf.
× Red-shift means the galaxy looks red.	✓ It means the wavelength of its light has increased.
× Satellites at constant speed aren't accelerating.	✓ Their direction changes, so velocity changes: they accelerate (Higher).

AIM FOR GRADE 7+

- Explain the life cycle of a star as a sequence of linked steps.
- Link red-shift to distance and speed, then to an expanding universe.
- Explain why orbiting objects accelerate at constant speed (Higher).

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ Explain how red-shift provides evidence for the Big Bang theory. [4]

Light from distant galaxies has a longer wavelength than expected (red-shift)
So the galaxies are moving away from us
More distant galaxies show more red-shift, so they are moving away faster
So the universe is expanding, which suggests it began from one very small, hot, dense region

2 Grade 7+ Explain what is meant by 'dark mass' and 'dark energy', and why they are unanswered questions. [3]

Since 1998, observations of supernovae suggest distant galaxies are receding ever faster
This can't be explained by the matter and energy we can observe, so dark mass and dark
energy have been proposed
Scientists don't yet know what they are, so there is still much about the universe that is
not understood

3 Fill the gap: The explosion of a massive star is called a _____. [1]

supernova. Elements heavier than iron are made in supernovas.

Cover, recall, check

RETRIEVAL PRACTICE · GRADE 4 · GRADE 5

Order it: from a cloud of dust to the Sun

Put the stages in order to describe how a star like the Sun forms and lives.

fusion of hydrogen begins · gravity pulls dust and gas together · stable main sequence star · protostar heats up · nebula (cloud of dust and gas)

Nebula → gravity pulls dust and gas together → protostar heats up

→ fusion of hydrogen begins → stable main sequence star (forces in equilibrium)

RETRIEVAL PRACTICE · GRADE 4 · GRADE 5

Fill the gaps

Use the AQA key words. No word bank: that's the point.

1. Our solar system is in the **Milky Way** galaxy.
2. A main sequence star is stable because the outward force from fusion **balances** gravity.
3. Elements heavier than iron are produced in a **supernova**.
4. Light from distant galaxies is shifted towards the **red** end of the spectrum.
5. For a stable orbit, a satellite that moves faster must orbit at a smaller **radius**. (Higher)

ELABORATION · GRADE 5

Odd one out

Circle the odd one out in each row and explain why.

1. planet · dwarf planet · moon · galaxy

Galaxy: the others are in our solar system.

2. white dwarf · black dwarf · neutron star · red giant

Neutron star: it comes from a much more massive star (the others are the Sun's life cycle).

3. red-shift · Big Bang · dark energy · plum pudding

Plum pudding: it's a model of the atom, not of the universe.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ A satellite in a stable circular orbit speeds up. Explain what must happen to its orbit. [3]

For a stable orbit, the radius must change if the speed changes

Its speed is now too high for its current radius

So it moves to an orbit with a larger radius (higher orbit)

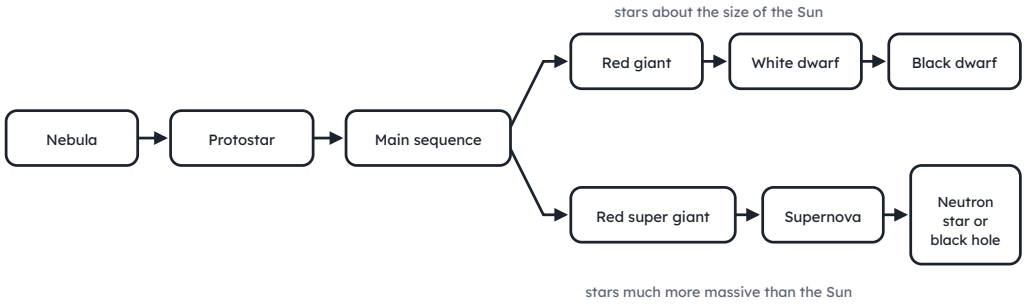
2 True or false? Fusion in a supernova produces elements heavier than iron. Explain. [2]

True. Ordinary stars only fuse elements up to iron.

Picture it

DUAL CODING | GRADE 4 | GRADE 5 | GRADE 7

The life cycle of a star



a What will happen to the Sun at the end of its main sequence? [1]

It becomes a red giant.

b What decides whether a star becomes a white dwarf or explodes in a supernova? [1]

Its mass (size)

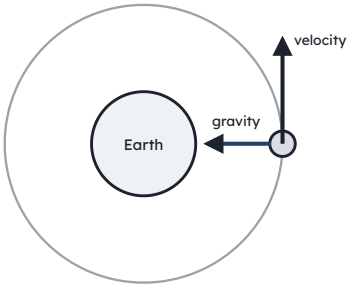
c Explain why a supernova is important for life on Earth. [2]

Supernovae make the heaviest elements

and spread them through the universe, where they form new planets.

DUAL CODING | GRADE 5 | GRADE 7

Orbits (Physics only)



Gravity provides the force towards the centre, so speed stays the same but direction (velocity) changes: the satellite is accelerating (Higher)

Smaller orbit → must move faster to stay in orbit (stable orbit: if speed changes, radius changes)

a What force keeps the Moon in orbit around the Earth? [1]

Gravity

b Explain why a satellite moving at a constant speed is accelerating. (Higher) [2]

Its direction keeps changing,

so its velocity changes: it is accelerating towards the Earth.

c What is a natural satellite? [1]

A moon (e.g. our Moon)

Picture it (continued)

DUAL CODING GRADE 5 GRADE 7

Red-shift



Red-shift: lines move to longer wavelengths → galaxy moving away. Further away = bigger red-shift → universe is expanding → evidence for the Big Bang

a What is red-shift? [1]

An increase in the observed wavelength of light from galaxies moving away.

b How does red-shift change with distance to a galaxy? [1]

More distant galaxies show bigger red-shift.

c What does this tell us about the universe? [1]

It is expanding.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 Name, in order, the stages a star like the Sun goes through after the main sequence. [3]

Red giant

White dwarf

Black dwarf

2 Grade 7+ Explain how fusion in stars and supernovas produce the elements found on Earth. [4]

Fusion in main sequence stars joins light nuclei (hydrogen) into helium

Later stages of fusion in stars make heavier elements, up to iron

Elements heavier than iron are made in supernovas

The supernova distributes these elements; they become part of new stars and planets, including Earth

3 Grade 5 What is red-shift, and what does it tell us about distant galaxies? [2]

An observed increase in the wavelength of light from distant galaxies

It shows the galaxies are moving away from us

WORKED EXAMPLES GRADE 5 GRADE 7

Using evidence: red-shift

A student compares light from three galaxies.

Galaxy	Distance (million light years)	Red-shift (change in λ ÷ λ)
A	100	0.0075
B	300	0.0225
C	500	**0.0375**

a Predict the red-shift of galaxy C if the pattern continues. [1]

0.0375

b What relationship do the data show? [1]

Red-shift is directly proportional to distance.

c Explain how these data support the Big Bang theory. [3]

Galaxies are moving away from us (red-shift),

and further galaxies move away faster,

so the universe is expanding and must once have been very small and hot.

ELABORATION GRADE 7

Evidence and theory (Grade 7+)

1 Since 1998, observations of supernovae show that distant galaxies are receding ever faster. Explain what this suggests and why scientists are uncertain about it. [4]

The expansion of the universe is accelerating.

Scientists think this is caused by dark energy,

but it has not been detected and isn't understood,

so there is still a lot we don't know about the universe.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ Explain why a satellite in a circular orbit is accelerating, even though its speed is constant. [4]

Velocity is a vector (it has direction)

The satellite's direction is constantly changing

A change in velocity is an acceleration

Gravity provides a resultant force towards the centre of the orbit

Why? How? Explaining space physics

ELABORATION GRADE 4 GRADE 5 GRADE 7

Build an explanation

Answer each question in two steps. Use the starter, then push yourself with the Grade 7+ extension.

1 Explain why a main sequence star stays the same size for billions of years.

Grade 4–5 starter: "Gravity pulls the star inwards, while…"

Gravity pulls the star's material inwards.

Fusion in the core releases energy, causing an outward pressure.

Grade 7+ extension: "Link to equilibrium:…"

These forces are balanced (in equilibrium),

so the star stays stable until its hydrogen runs low.

2 Explain how red-shift provides evidence for the Big Bang theory.

Grade 4–5 starter: "Light from distant galaxies is…"

Light from distant galaxies is red-shifted, so they are moving away from us,

and more distant galaxies show a bigger red-shift, so they are moving away faster.

Grade 7+ extension: "Link the size of the red-shift to distance:…"

So the universe is expanding,

which suggests it began from a very small, extremely hot and dense region: the Big Bang.

3 Explain why the Moon stays in orbit around the Earth instead of falling to Earth. (Physics only)

Grade 4–5 starter: "The Moon is moving at high speed, so…"

Gravity pulls the Moon towards the Earth.

The Moon is also moving at a high speed at right angles to this pull.

Grade 7+ extension: "Link to gravity changing the direction of motion:…"

Gravity changes the Moon's direction but not its speed,

so it keeps moving in a circle instead of falling inwards.

ELABORATION GRADE 5

True or false? Justify it.

Saying why is worth more marks than saying true or false.

4 "The Sun will end its life as a black hole." [2]

False: it isn't massive enough;

it will become a white dwarf, then a black dwarf.

5 "The universe is getting smaller." [1]

False: red-shift shows the universe is expanding.

ELABORATION GRADE 5 GRADE 7

Data skills: planets

The table shows data for planets in our solar system.

Planet	Distance from Sun (million km)	Time to orbit (Earth years)
Mercury	58	0.24
Venus	108	0.62
Earth	150	1.00
Mars	228	1.88
Jupiter	778	11.9

a Describe the relationship between distance and time to orbit. [2]

The further from the Sun,

the longer the time to complete an orbit.

b Suggest why planets further from the Sun move more slowly. (Higher) [2]

The gravitational force from the Sun is weaker further away,

so a slower speed is needed for a stable orbit.

c Saturn is 1430 million km from the Sun. Predict whether its orbit takes more or less than 11.9 years. [1]

More (it's further than Jupiter).

d Why is a table of data not enough to prove a relationship? [1]

There are few data points; a graph and more data would show the pattern more reliably.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 State two differences between a planet and a moon. [2]

A planet orbits a star; a moon orbits a planet

A moon is a natural satellite of a planet (planets are usually much larger)

2 Grade 7+ Explain why a satellite in a smaller orbit must travel faster than one in a larger orbit. [3]

Closer to the Earth the gravitational force is stronger

For a stable orbit, if the radius changes the speed must change

A smaller orbit needs a higher speed to stay in orbit rather than fall towards Earth

3 Red-shift is evidence that the universe is... [1]

A shrinking **B** expanding **C** cooling down **D** not changing

B: expanding. More distant galaxies are moving away faster, so the universe is expanding.

Exam practice

GRADE RADE 4

Secure the basics

1 Name the force that pulls a nebula together. [1]

Gravity

2 What is the Milky Way? [1]

Our galaxy

3 Name the type of star the Sun is now. [1]

Main sequence star

4 What is an artificial satellite? [1]

A man-made object orbiting a planet (e.g. a communications satellite).

5 Which process releases energy in stars? [1]

Nuclear fusion

GRADE RADE 5

Apply and rearrange

6 Describe the life cycle of a star much more massive than the Sun. [3]

Nebula → protostar → main sequence

→ red super giant → supernova

→ neutron star or black hole

7 What is dark mass, and why do scientists think it exists? [2]

Mass we can't see,

suggested because galaxies rotate faster than the mass we can see would allow.

8 Give one difference between a planet and a moon. [1]

A planet orbits a star; a moon orbits a planet.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 What is a nebula, and why is it important in the life cycle of a star? [2]

A cloud of dust and gas

Stars form from it when gravity pulls the material together

2 What keeps a main sequence star stable? [1]

A Gravity balanced by outward pressure from fusion **B** Constant cooling **C** Its magnetic field **D** Burning oxygen

A: Gravity balanced by outward pressure from fusion. Inward gravity and outward pressure from fusion are in bala

Exam practice (continued)

GRADE RADE 7+

Stretch

9 Explain how fusion in stars produces elements and why the heaviest elements need a supernova. (Physics only) [4]

In main sequence stars, hydrogen nuclei fuse to form helium.

Larger stars fuse helium into heavier elements, up to iron.

Elements heavier than iron need more energy than fusion in a star can provide,

so they are produced in a supernova explosion.

10 Describe the evidence for the Big Bang theory and explain why scientists still have unanswered questions. [6]

Light from distant galaxies is red-shifted, so they are moving away from us.

More distant galaxies have greater red-shift, so they are moving away faster: the universe is expanding.

Running this backwards suggests the universe began from a very small, extremely hot and dense region.

This is the Big Bang theory, and red-shift is the evidence for it.

Since 1998, supernova data show the expansion is accelerating, which suggests dark energy.

Dark mass and dark energy have not been detected, so there is still much we don't understand.

Total: _____ / 21

RETRIEVAL PRACTICE | SPACED PRACTICE | GRADE 4

Quick-fire retrieval: Space physics

Cover everything. Answer in under 3 minutes. Redo it on your next spaced session.

1 Star stage after protostar?

Main sequence

2 Biggest stars end as?

Black holes (or neutron stars)

3 Red-shift is evidence for?

An expanding universe (the Big Bang)

4 Natural satellite of the Earth?

The Moon

5 What balances gravity in a star?

Pressure from fusion energy

6 Galaxies moving away show?

Red-shift

Extra practice

Retrieval · answers in the answer booklet

1 How many planets are there in our solar system? [2]

Pluto is a dwarf planet.

Reflect and plan

METACOGNITION

Re-rate yourself

Go back to the checklist at the start of this topic and fill in the 'After' column.

METACOGNITION GRADE 4 GRADE 5 GRADE 7

Exam wrapper: why did I drop marks?

After marking the exam practice, write the question numbers you got wrong in the right row.

Reason I lost marks	Question numbers	What to do next
I didn't know or remember it (knowledge gap)		Flashcards and brain dumps
I knew it but misread the question or command word		Underline command words
Maths slip: units, rearranging, standard form		Redo the "we do / you do" pages
I ran out of time or didn't finish		Timed practice: 1 mark per minute

METACOGNITION

Two things I'm now confident about

METACOGNITION

One thing I still need to work on, and how I'll fix it

e.g. 'Rearranging equations → redo the Grade 7+ questions and use the website's Aim higher section.'

SPACED PRACTICE

Book my next spaced sessions

Write the dates in the planner at the front: +2 days, +1 week, +3 weeks.

Extra practice

Retrieval · answers in the answer booklet

1 True or false? Moons are natural satellites. Explain. [2]

True. Artificial satellites are the ones we launch.

RETRIEVAL PRACTICE | SPACED PRACTICE | GRADE 4 | GRADE 5 | GRADE 7

Final review: test yourself on the whole topic

Do these without your notes, a week after finishing the booklet. Mark them with the answer booklet and add any you got wrong to your 'still to learn' list on the reflect page.

Each question shows its target grade. Aim to get every Grade 4 and 5 question right before moving on to Grade 7+.

Extra practice

Retrieval · answers in the answer booklet

1 What will the Sun eventually become? [1]

A A black dwarf (after being a white dwarf) **B** A black hole **C** A neutron star **D** A supernova

A: A black dwarf (after being a white dwarf). The Sun isn't massive enough to go supernova.

2 A satellite moves into a smaller stable orbit. Its speed must... [1]

A increase **B** decrease **C** stay the same **D** fall to zero

A: increase. Closer in, gravity is stronger, so it must move faster to stay in orbit. (Higher)

3 Put the life cycle of a star much bigger than the Sun in order. [2]

A Nebula
B Protostar
C Main sequence star
D Neutron star or black hole
E Red super giant
F Supernova

A → B → C → E → F → D

4 Put the life cycle of a Sun-sized star in order. [2]

A Red giant
B Main sequence star
C Protostar
D Black dwarf
E White dwarf
F Nebula

F → C → B → A → E → D

5 What provides the force that keeps planets in orbit? [1]

A Gravity **B** Magnetism **C** Friction **D** Fusion

A: Gravity. Gravity acts towards the centre of the orbit.

6 Our solar system is part of which galaxy? [1]

A The Milky Way **B** Andromeda **C** The Big Bang **D** The Sun

A: The Milky Way. One of billions of galaxies.