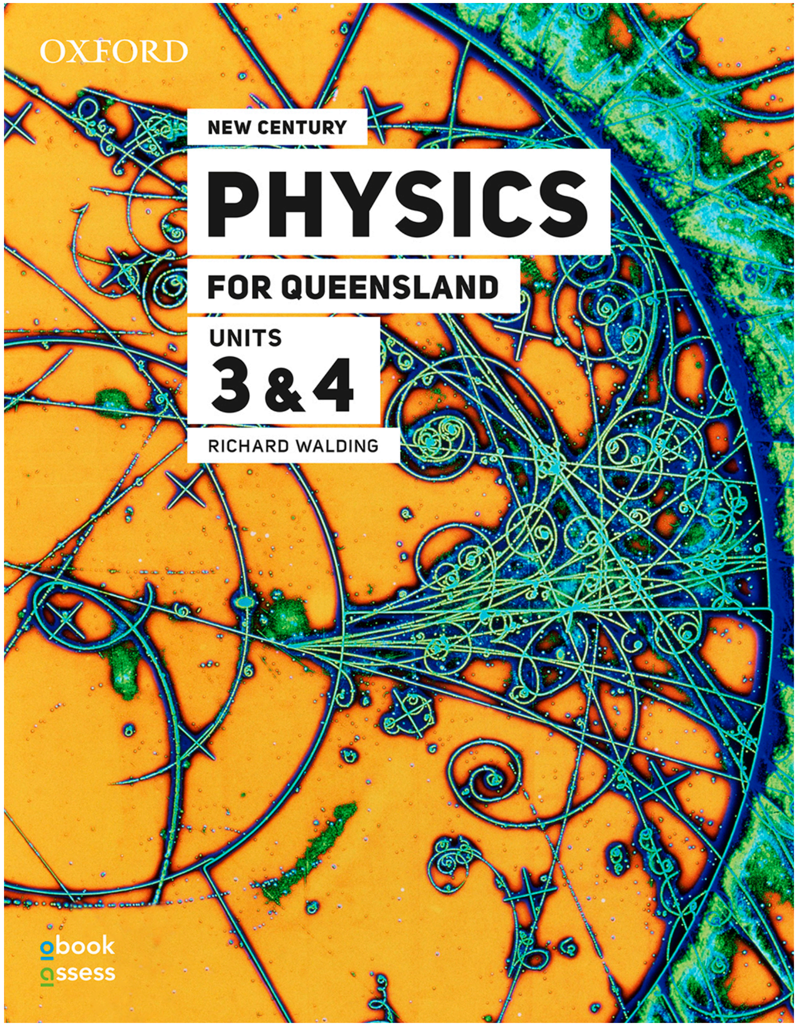
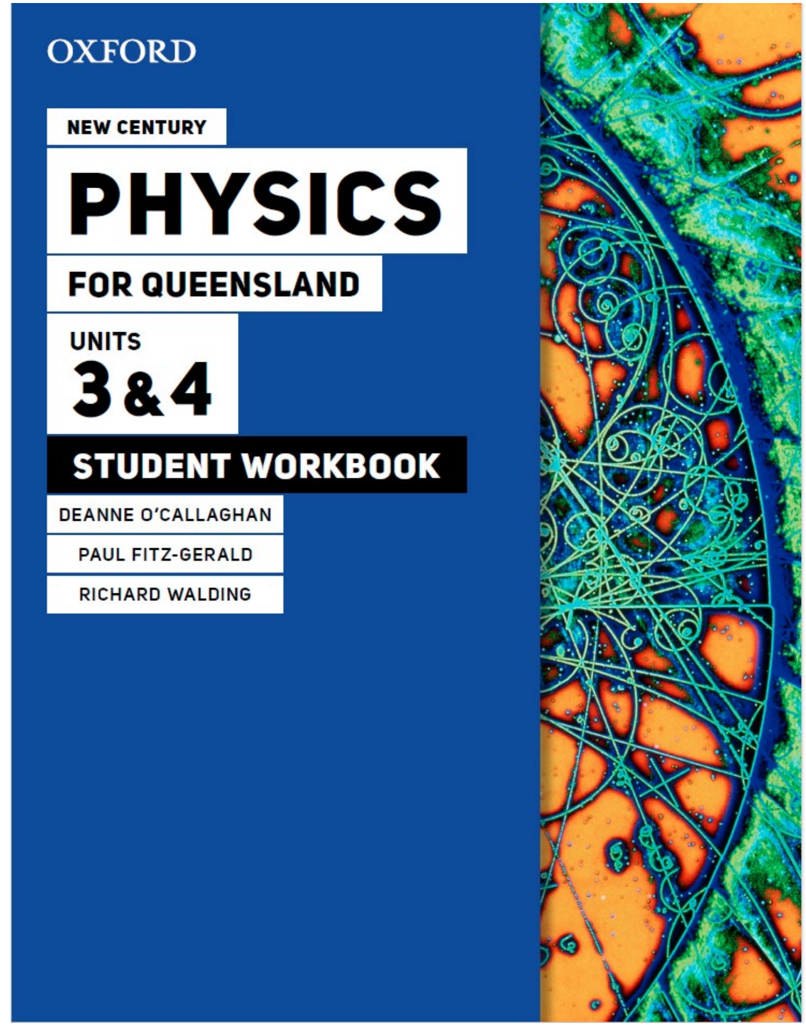




OXFORD PROFESSIONAL DEVELOPMENT

— education changes lives —

OXFORD UNIVERSITY PRESS
AUSTRALIA & NEW ZEALAND

QCE PHYSICS WORKSHOP SERIES

Are you ready for the new QCAA assessments?

May 2019

Welcome to today's workshop

PART A Brief overview of Physics General Senior Syllabus Units 3 & 4

PART B An introduction to Oxford's *New Century Physics for Queensland* series

PART C Overview of internal assessment and how Oxford is supporting you

PART D Questions and comments

Meet our authors

Richard Walding

- Dr. Richard Walding began his career as a scientist and has extensive experience teaching both Physics and Chemistry, including two decades as Head of Science.
- Richard is also a research fellow at Griffith University – for the past decade, he has been researching the history and applications of electromagnetic induction, particularly as related to harbour defence.
- Richard was elected Fellow of both the Australian Institute of Physics and the Royal Australian Chemical Institute for his lifetime contribution to these disciplines.
- He was also awarded a Peter Doherty Award for work in STEM education.

PART A

Key dates for *Physics for Queensland*

YEAR 11 – 2019	YEAR 12 – 2020
TERM 1	
	T1 W2 Endorsement IA3
UNIT 1 & 2 FIA1 Data test	UNIT 3 & 4 IA1 Data test
TERM 2	
	T2 W1 Confirmation IA1
UNIT 1 & 2 W9 SUBMIT FIA2 SE	UNIT 3 & 4 W9 IA2 SE
TERM 3	
T3 W6 Endorsement IA1, IA2	UNIT 3 & 4 IA3 RI
T3 W8 Mock EA released	W7 SUBMIT IA3 RI T3 W8 Confirmation IA2, IA3
TERM 4	
UNIT 1 & 2 FIA3 RI	T4 W4-7 External assessment
	T4 W4-7 External assessment
	T4 W4-7 External assessment
UNIT 1 & 2 Exam	

Course structure

Physics

YEAR 11

Unit 1
Thermal, nuclear and electrical physics

- Topic 1: Heating processes
- Topic 2: Ionising radiation and nuclear reactions
- Topic 3: Electrical circuits

Assessment

Formative internal assessment/s

Unit 2
Linear motion and waves

- Topic 1: Linear motion and force
- Topic 2: Waves

Assessment

Formative internal assessment/s

YEAR 12

Unit 3
Gravity and electromagnetism

- Topic 1: Gravity and motion
- Topic 2: Electromagnetism

Assessment

Summative internal assessment 1:

Data test (10%)

Summative internal assessment 2:

Student experiment (20%)

Unit 4
Revolutions in modern physics

- Topic 1: Special relativity
- Topic 2: Quantum theory
- Topic 3: The Standard Model

Assessment

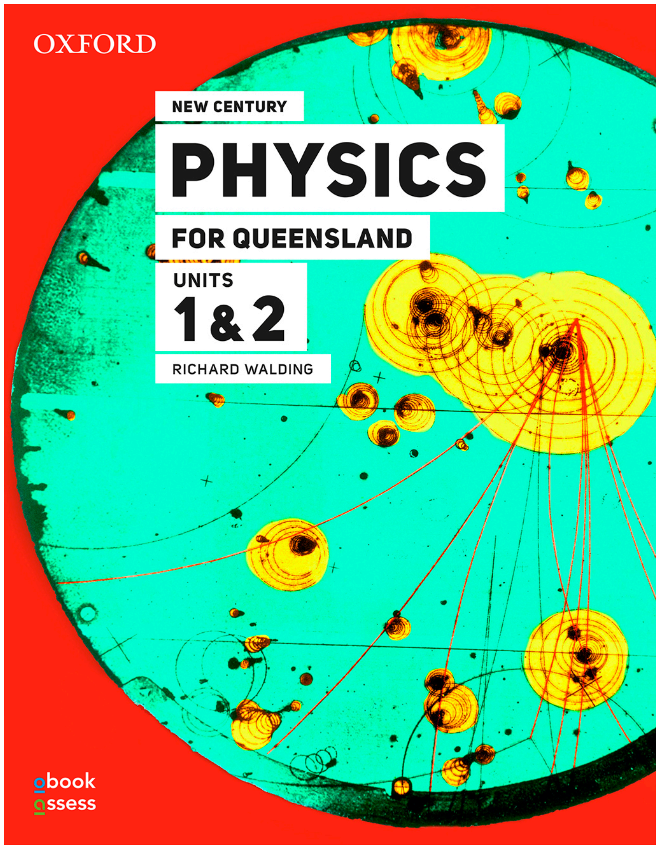
Summative internal assessment 3:

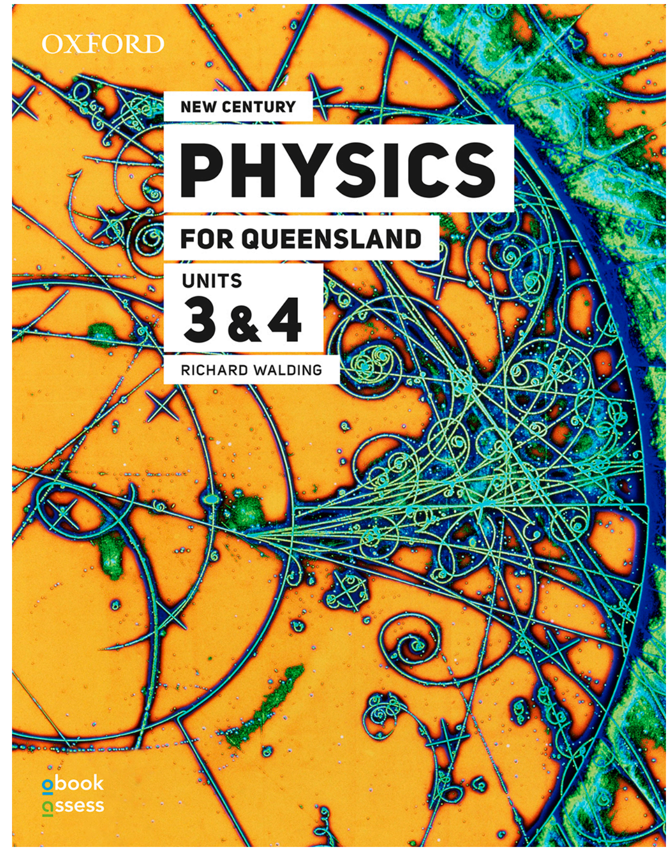
Research investigation (20%)

Summative external assessment: Examination (50%)

PART B

An introduction to Oxford's new series *New Century Physics for Queensland Units 3 & 4*





Our goal for this series is to:

- **support** teachers and students through a massive period of change
- **provide** a set of resources that give students of all abilities the chance to experience real success in science
- offer the **best content** and the most valuable and **practical support materials for assessment**.

OXFORD PROFESSIONAL DEVELOPMENT

education changes lives

OXFORD UNIVERSITY PRESS
AUSTRALIA & NEW ZEALAND

Pain points in the Physics syllabus

Unit 3 Gravity and electromagnetism	Unit 4 Revolutions in modern physics
Topic 1: Gravity and motion	**Topic 1: Special relativity**
• Depth of treatment • Endorsement of Data test	• Selecting a claim for research • Paradoxes
Topic 2: Electromagnetism	**Topic 2: Quantum theory**
• Modifying experiments • Equipment needs	• Dealing with difficult concepts
	Topic 3: The Standard Model
	• Clarifying what content is needed for the exam

OXFORD PROFESSIONAL DEVELOPMENT

education changes lives

OXFORD UNIVERSITY PRESS
AUSTRALIA & NEW ZEALAND

Top 5 things to know about Oxford's new *Physics for Queensland* series

1

We offer complete syllabus coverage

- All subject matter in the syllabus has been included and ordered **sequentially** to help scaffold learning.
- Every chapter opener clearly indicates which syllabus points are covered.
- If it's covered in the syllabus, it's covered in our book!

Top 5 things to know about Oxford's new *Physics for Queensland* series

2

We offer extensive support for the assessments

- Toolkits in both the Student book and Student workbook provide guidance for all assessments
- Complete syllabus coverage allows teachers and students to be prepared for the external exam
- **Student workbooks** provide students with engaging write-in activities that support the skills required for the internal and external assessments
- Practice Data tests, cumulative tests and exams are provided in your obook assess
- Science as a human endeavour (SHE) spreads in the Student book provide context for starting the Research investigation

OXFORD PROFESSIONAL DEVELOPMENT

education changes lives

OXFORD UNIVERSITY PRESS AUSTRALIA & NEW ZEALAND

Top 5 things to know about Oxford's new *Physics for Queensland* series

3

Our resources are easier to use and more accessible than ever before

To make our resources simple and easy to use, we have:

- a **section-based approach** to ensure our Student books are easier to navigate
- used clear, concise, instructional language throughout
- reduced the amount of text on each page and added more **graphic organisers** (i.e. tables, dot points, flowcharts) and **images** to convey meaning
- built in opportunities for teachers to support and challenge students of all abilities
- added a bright, attractive and functional design.

OXFORD PROFESSIONAL DEVELOPMENT

education changes lives

OXFORD UNIVERSITY PRESS AUSTRALIA & NEW ZEALAND

Top 5 things to know about Oxford's new *Physics for Queensland* series

OXFORD PROFESSIONAL DEVELOPMENT

education changes lives

4

We offer full coverage of all syllabus practicals

- Videos for challenging concepts
- Worked examples that explain key formulas and concepts
- Editable worksheets for all practicals in the obook assess alongside mock data and answers
- Full ethical and risk assessments for all practicals
- Mandatory practicals are included in the Student book
- All practicals are included in the Student workbooks as worksheets

OXFORD UNIVERSITY PRESS AUSTRALIA & NEW ZEALAND

Top 5 things to know about Oxford's new *Physics for Queensland* series

OXFORD PROFESSIONAL DEVELOPMENT

education changes lives

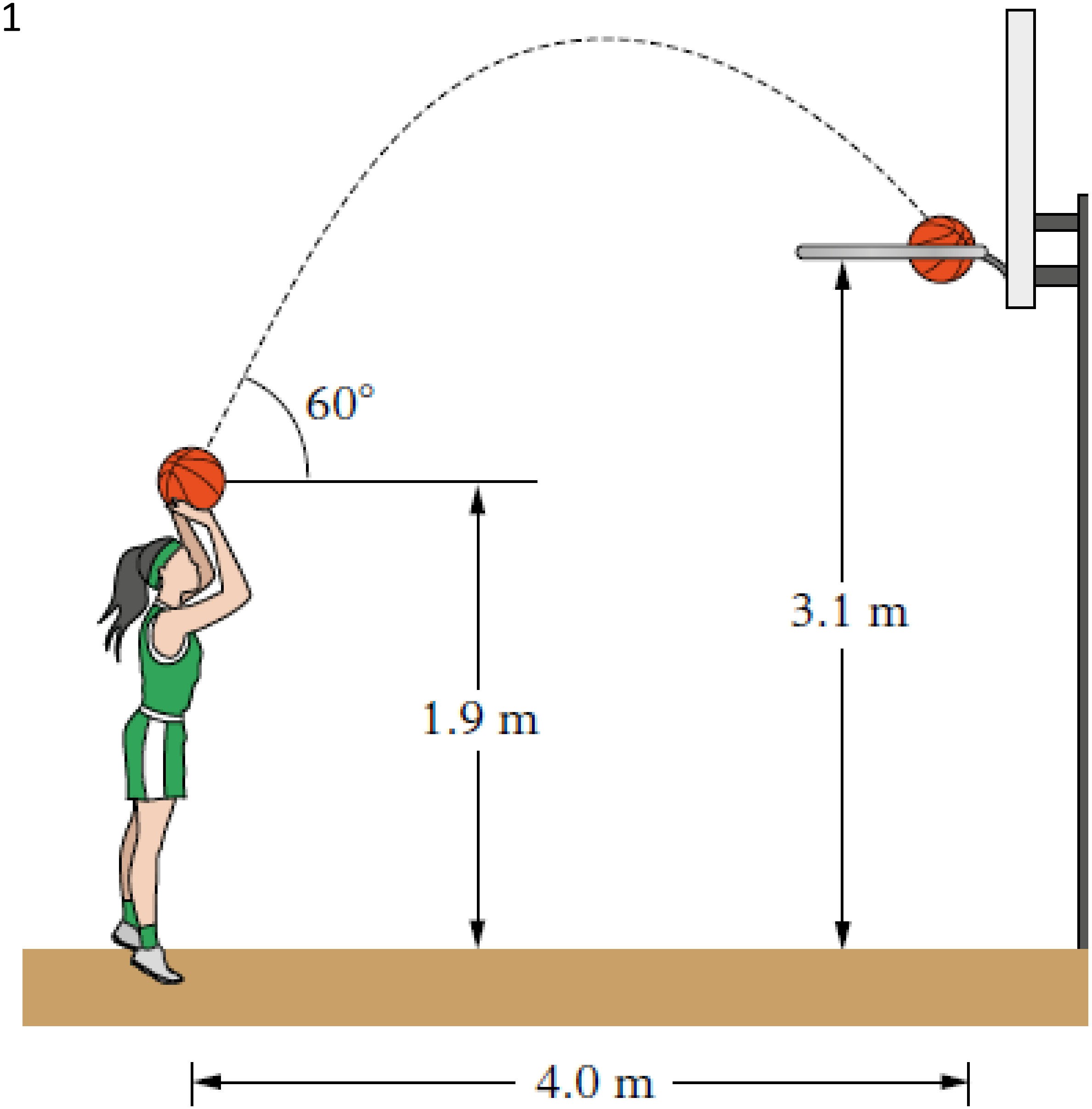
5

We offer full support for teachers to encourage student success

- Teachers are provided with a range of **additional support materials** to help them successfully implement the new syllabus (i.e. **teaching notes**, **lesson plans**, **assessment tasks** and **answers** to all questions).
- Spread-based learning
- obook content is assignable to students at the discretion of the teachers

OXFORD UNIVERSITY PRESS AUSTRALIA & NEW ZEALAND

Chapter 1



★★★**23** A man hauls a box of mass 100 kg up a 35° incline by a rope attached to the top of the box (Figure 6). The rope makes an angle of 20° to the incline and the friction between the box and the incline is 650 N. **Determine** the force applied by the man (F_A) to keep the box moving at constant speed.

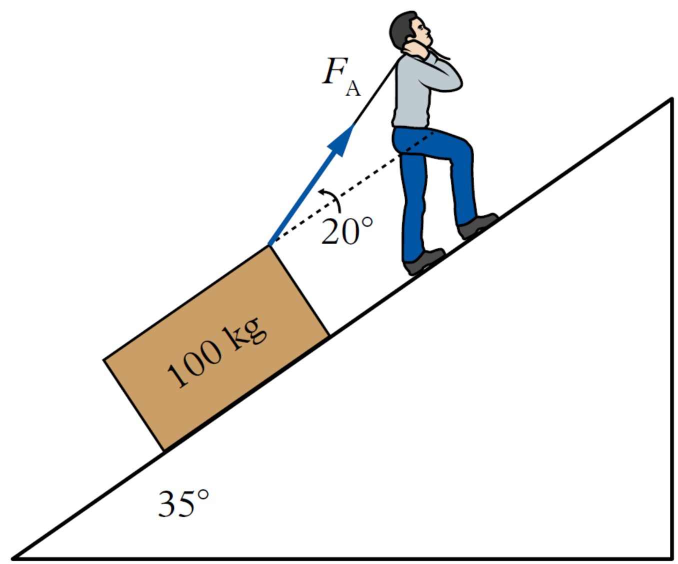


FIGURE 6 A man hauling a box up a hill

★★★ **20** A 20 kg object is attached by a thin cord to a 50 kg mass that hangs over a frictionless pulley at the top of a 25° incline (Figure 4).

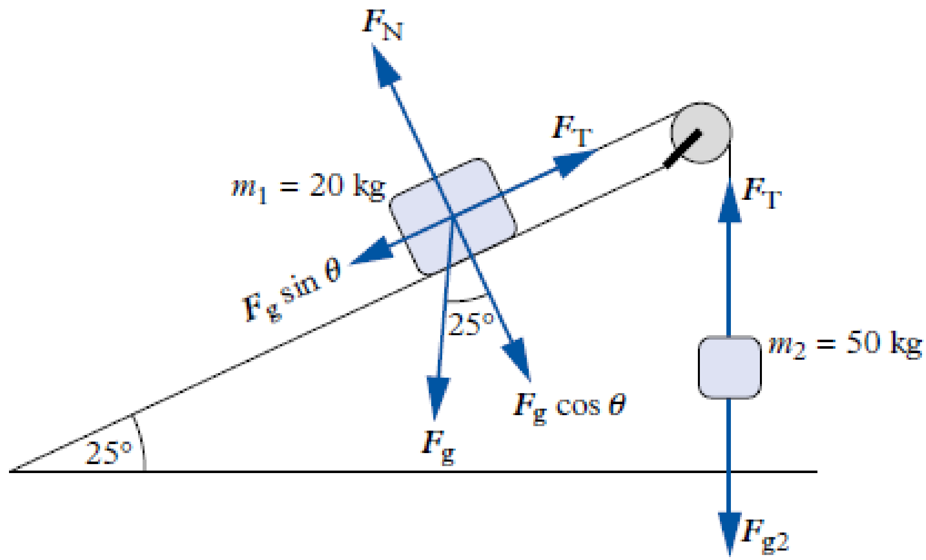


FIGURE 4 Diagram of a 20 kg attached to a 50 kg mass

Determine the:

a acceleration, if any, of the object

b tension in the string.

Chapter 3

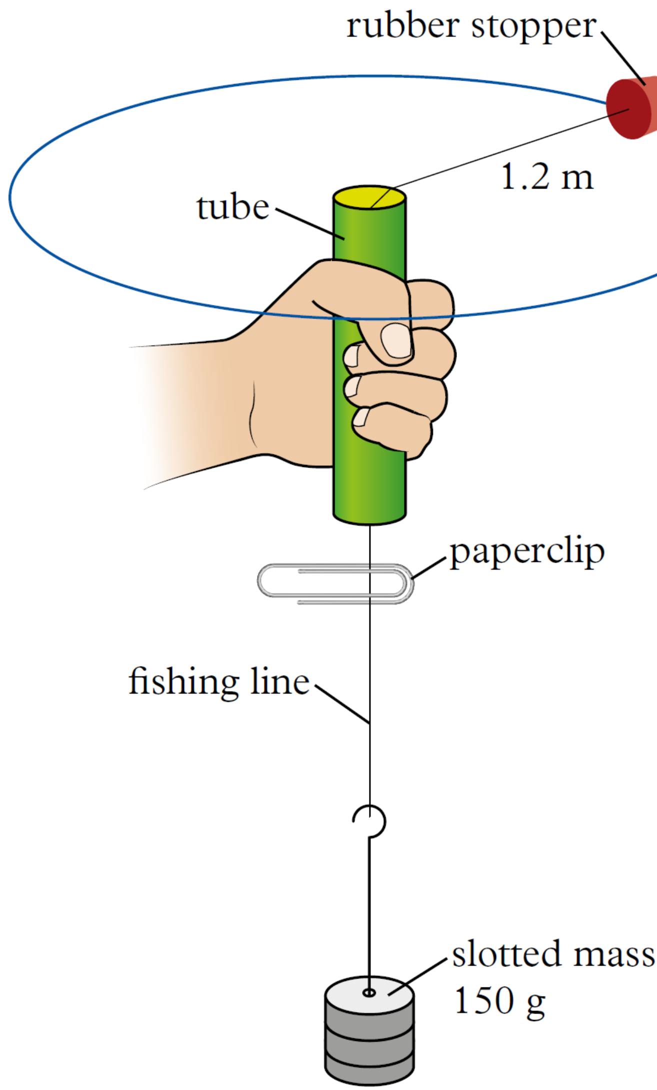


FIGURE 3 An investigation of circular motion

OXFORD PROFESSIONAL DEVELOPMENT
education changes lives

OXFORD
UNIVERSITY PRESS
AUSTRALIA & NEW ZEALAND

9 A satellite of mass m is in a circular orbit above Earth (mass m_E) at a distance h above the surface where $h = r$ (the Earth's radius). Select the expression that best states the velocity the satellite must have in order to maintain its orbit.

A $v = \sqrt{\dfrac{Gm_E}{r}}$

B $v = \dfrac{Gm_E}{2r}$

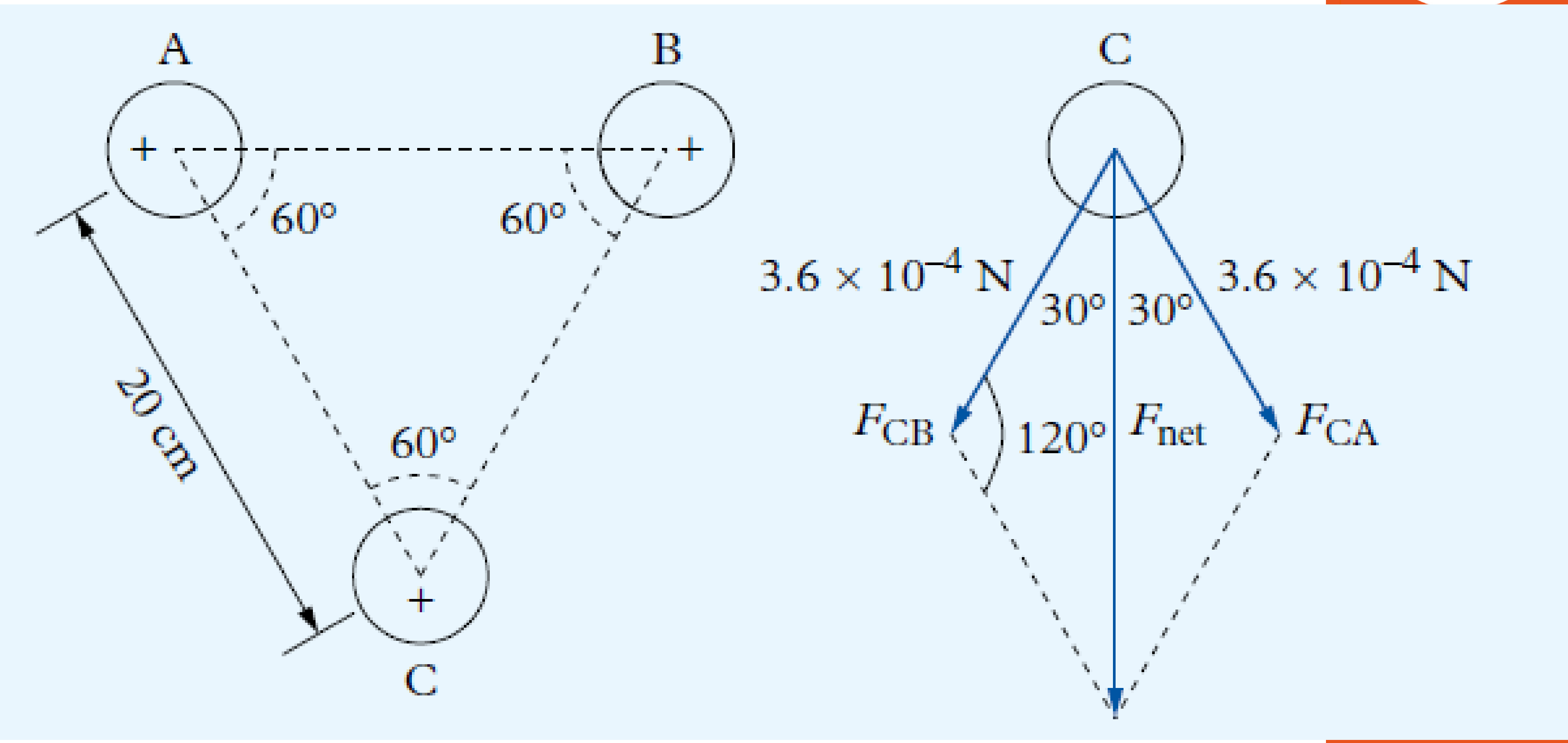
C $v = \sqrt{\dfrac{Gm_E m}{2r}}$

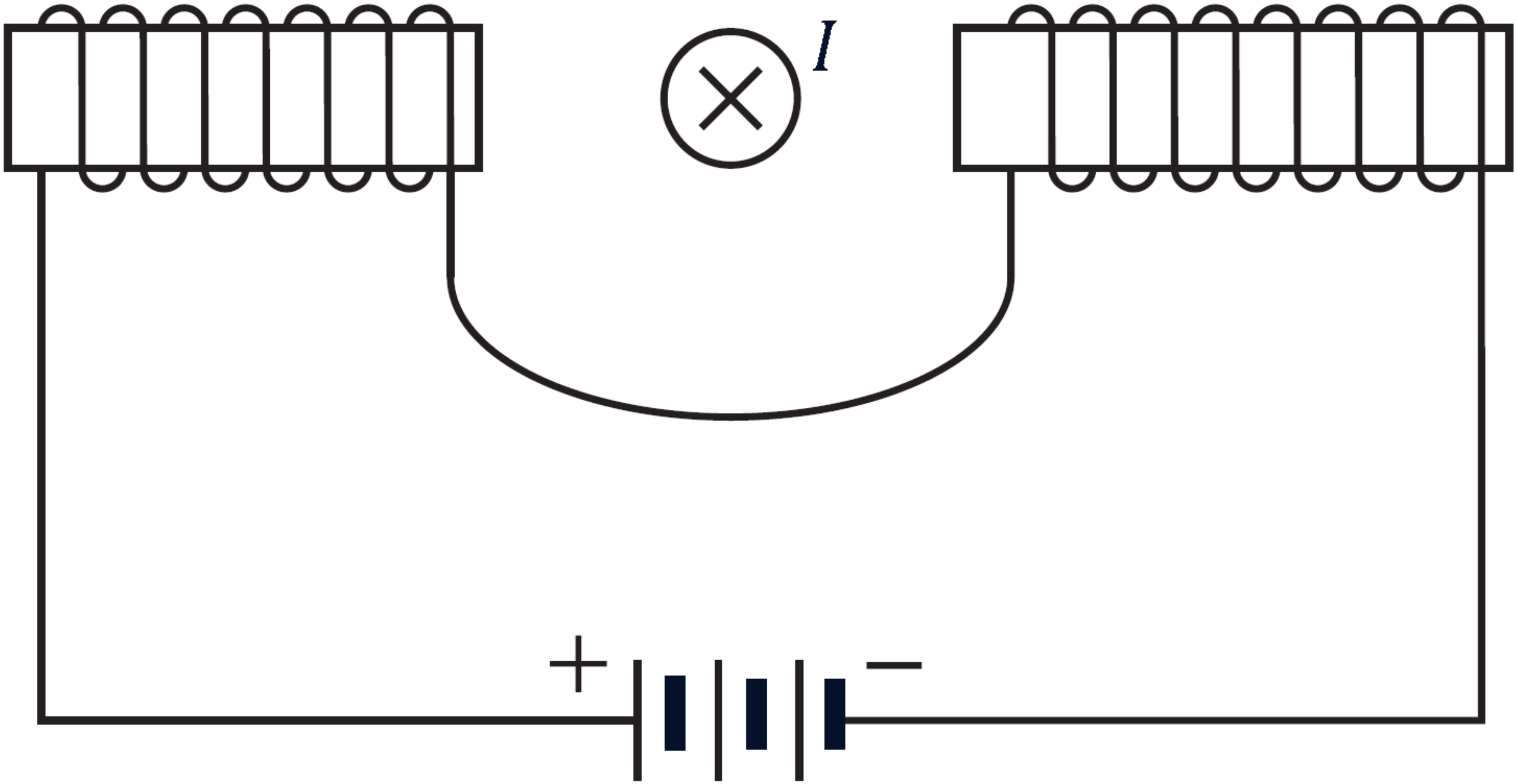
D $v = \sqrt{\dfrac{Gm_E}{2r}}$

★★★ **24** A satellite moves in a circular orbit around Earth at a speed of 6100 m s^{-1}. **Determine**:

a the altitude of the satellite above the surface of Earth

b the period of the satellite's orbit.


A
B
C
60°
60°
60°
20 cm
C
3.6 × 10⁻⁴ N
3.6 × 10⁻⁴ N
30°
30°
F_CB
120°
F_net
F_CA


I
+
−

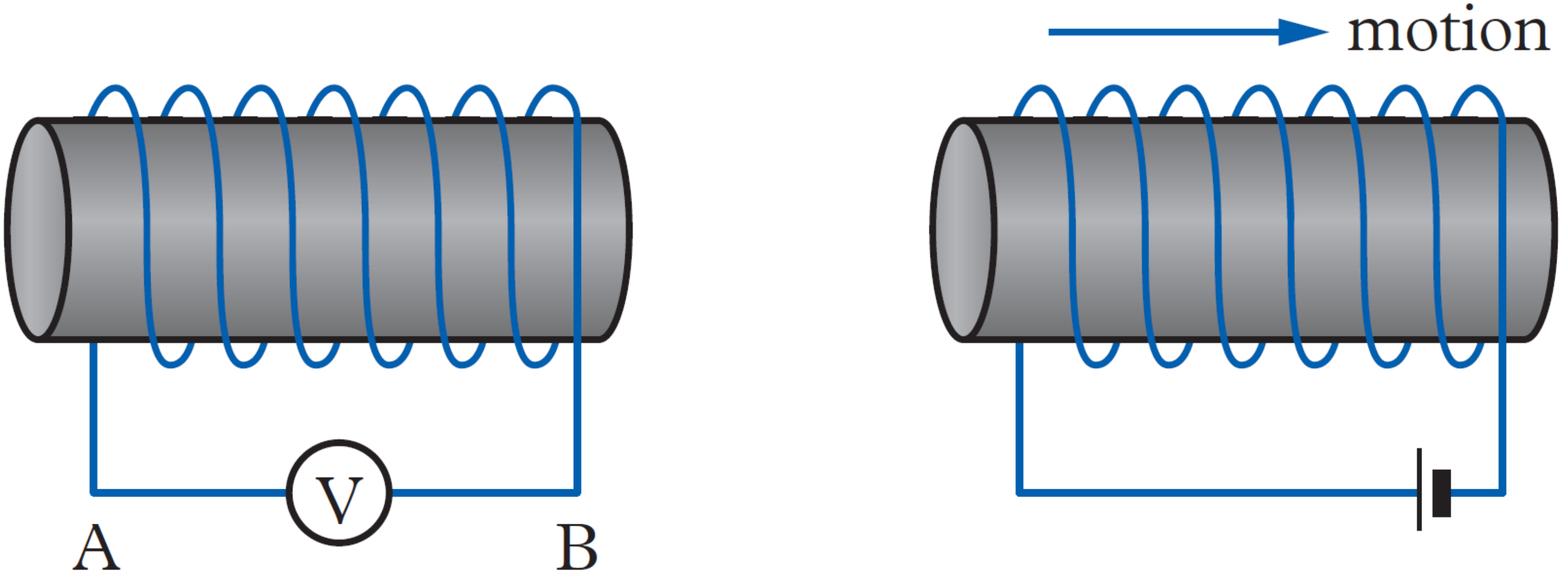


FIGURE 16 Solenoid moving away

Chapter 12

TABLE 1 Work functions for some common metals

Metal	W (eV)
Rubidium	2.05
Sodium	2.36
Calcium	2.87
Zinc	3.63
Aluminium	4.28
Copper	4.64
Gold	5.10
Platinum	5.63

Study tip

The type of graph in Figure 5 almost always appears in external exams, often in multiple-choice questions. Try to familiarise yourself with it. Learn that: gradient = h, x-intercept = f_0, y-intercept = W.

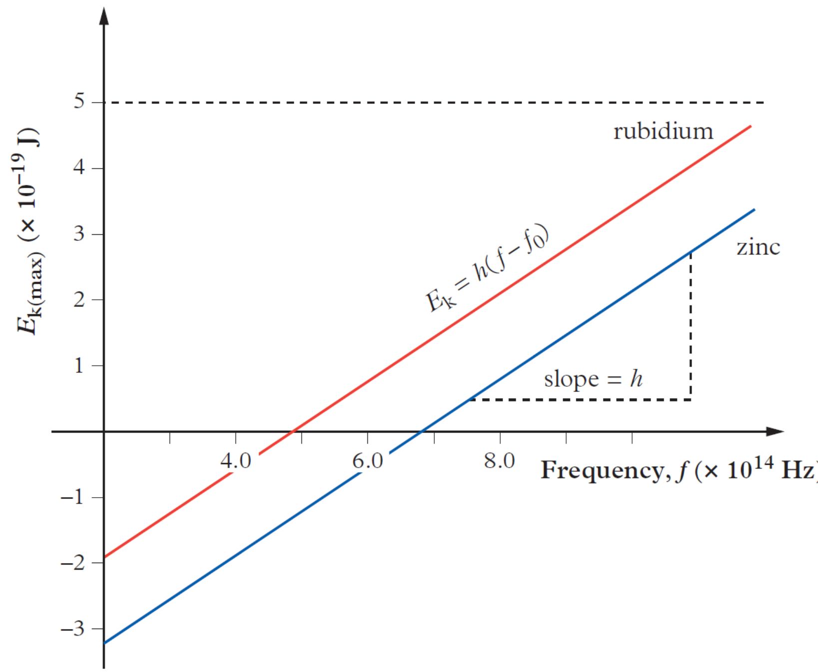


FIGURE 5 Results from photoelectric experiments: E_k versus frequency

Chapter 13

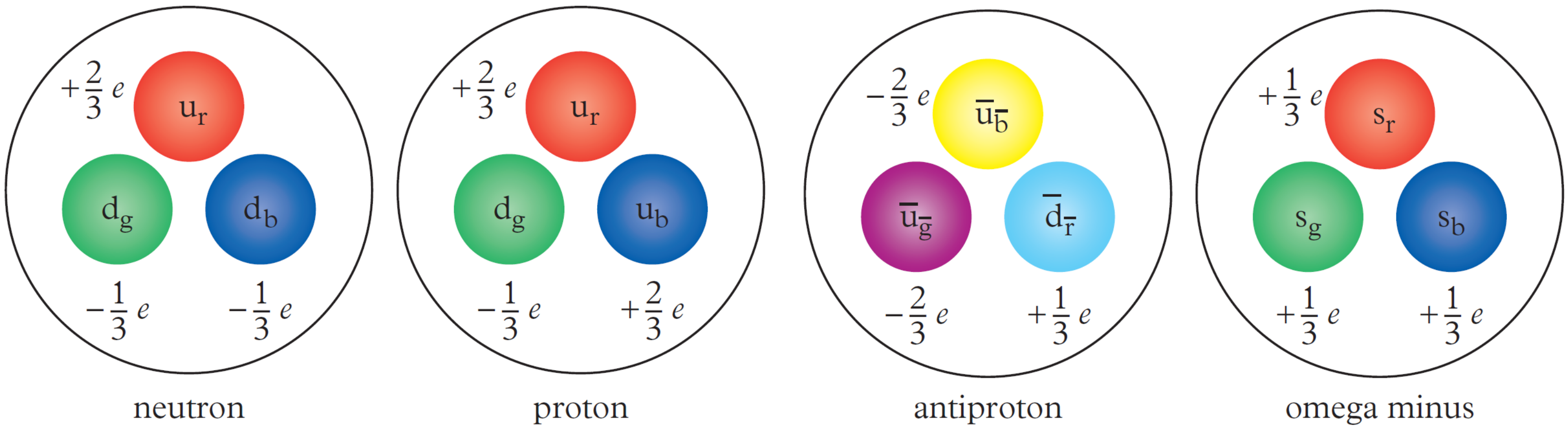
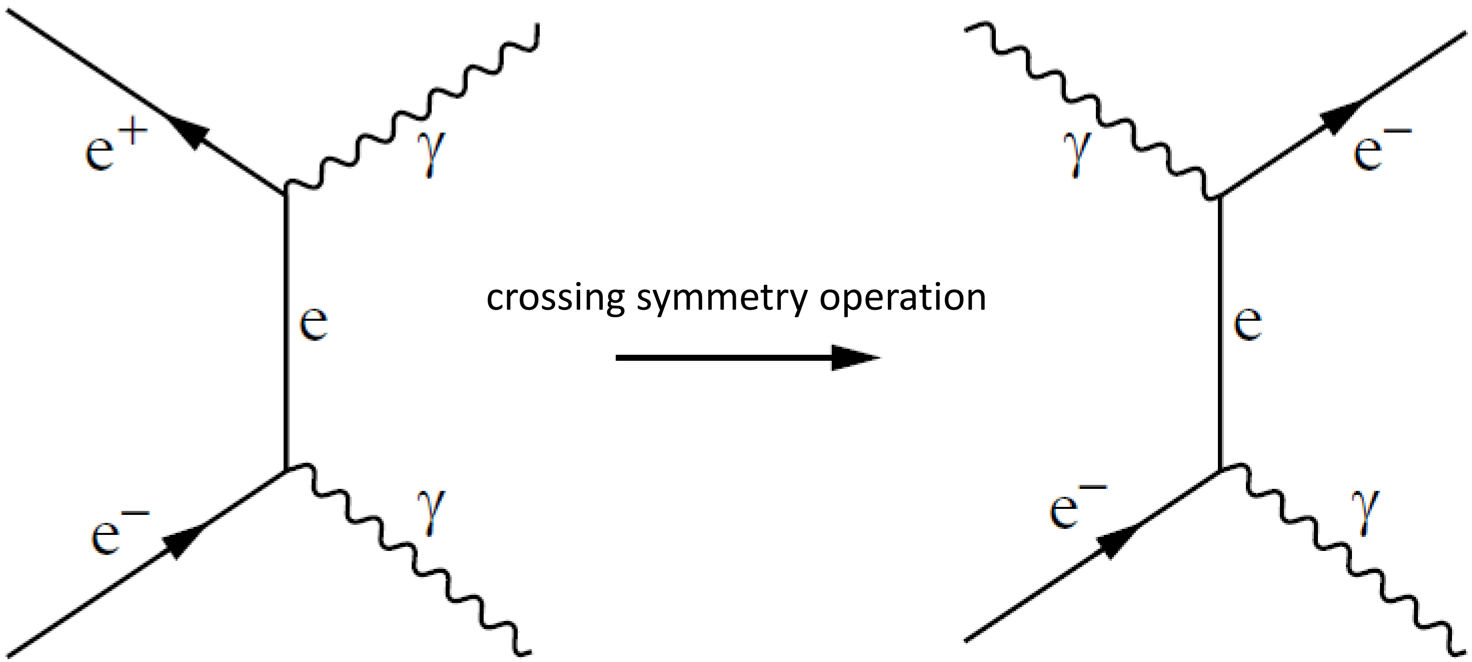


FIGURE 4 Examples of baryons. The colours have been randomly chosen, but note that they all add to white (colour neutral).

Chapter 14



Compton Scattering

Summary

One of the key objectives of this section is for you to be able to 'describe the significance of symmetry in particle interactions' (*Physics 2019 v1.2 General Senior Syllabus* © Queensland Curriculum & Assessment Authority). Here is a suitable response:

1 Three important symmetries in particle interactions are charge-reversal (C), time-reversal (T), and crossing (X) symmetry.

2 Symmetry operations are generally upheld by nature, and this enables physicists to predict new reactions although the probability of the new interaction may be unknown.

3 In any symmetry operation, conservation of energy and momentum must be obeyed.

4 In some cases symmetry is violated, which means that form of symmetry cannot be a universal law of nature.

5 Violation of a symmetry (symmetry-breaking) provides physicists with additional data with which to investigate interactions further.

Study tip

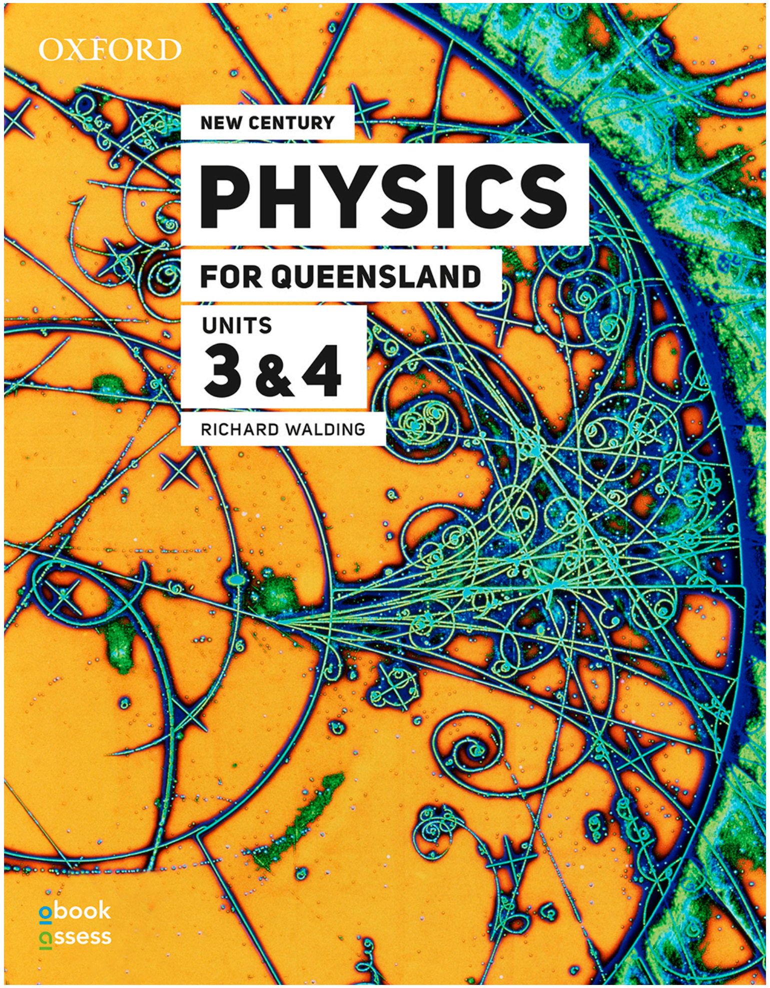
The syllabus doesn't mention any particular type of symmetry operation, so the best thing to do is learn the five points in the summary and be able to explain one operation as an example.

Physics toolkit

The Physics toolkit is a **stand-alone reference chapter** that appears at the front of each Student book. It includes:

- an overview of the course for students
- advice and step-by-step instructions on how to master relevant skills
- information about relevant assessment tasks
- study tips.

A quick tour of our new Student books

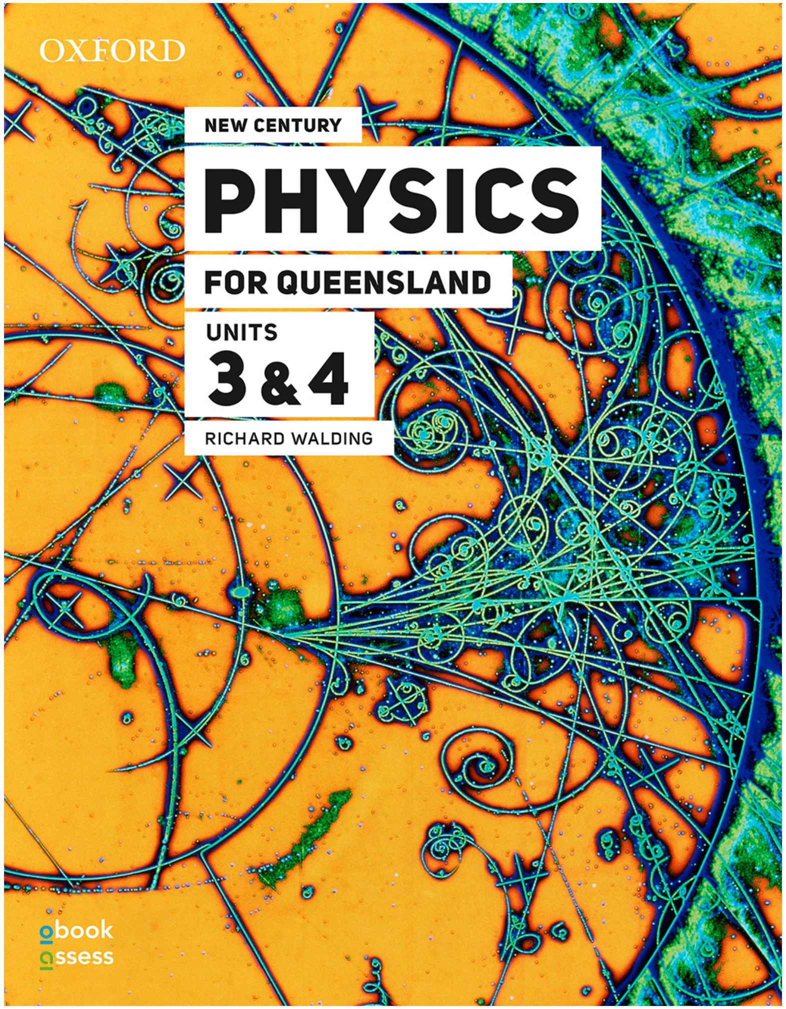


Join us on a quick walkthrough of *New Century Physics for Queensland* Units 3 & 4

A page proof is available in your welcome pack!

Key features

- Key ideas
- Case studies
- Study tips
- Margin glossary
- Check your learning questions
- Challenges
- Science as a human endeavour spreads to engage students
- Chapter review section includes revision questions and summary notes
- Unit practice exam questions
- **Physics toolkit** (skills chapter)
- **Practical manual**



Study tip

The Lorentz factor, $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$, can be used as shorthand in writing equations. For example, $L = L_0\sqrt{1 - \frac{v^2}{c^2}}$ becomes $L = \frac{L_0}{\gamma}$. Alternatively, using $\beta = \frac{v}{c}$, it can be written as $L = L_0\sqrt{1 - \beta^2}$.

Study tip

If you want to see the derivation of the length contraction formula from first principles, access your obook.

Study tips
Placed to reinforce concepts and provide students with shortcuts

Relationships between the frames

The time for the journey is t for the Earth observers and t_0 for the astronauts. The distance is L_0 for the Earth observers and L for the astronauts. They both agree that the velocity of the spaceship is v. As the relationship between t and t_0 is given by $t_0 = t\sqrt{1 - \frac{v^2}{c^2}}$, the time measured by the astronauts (t_0) is less than that measured by Earth observers (t), hence $t_0 < t$. But as they agree on the velocity of the spaceship (v), the distance travelled by the astronauts must also be less than that measured by Earth observers. In other words, $L < L_0$.

We now have two relationships:

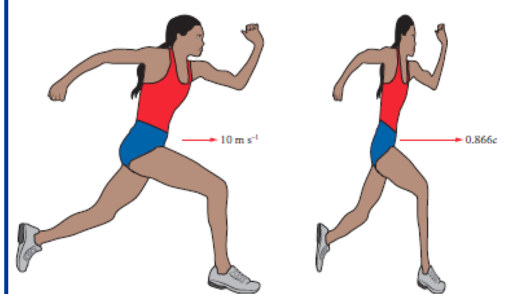
$$v = \frac{L_0}{t} = \frac{L}{t_0}$$

If we rearrange the second part we get $L = vt_0$, and if we replace the t_0 with the earlier equation we get:

$$\begin{aligned} L &= v \times t_0 \\ &= v \times t\sqrt{1 - \frac{v^2}{c^2}} \\ &= L_0\sqrt{1 - \frac{v^2}{c^2}} \end{aligned}$$

Length contraction

This length contraction applies not only to distances between heavenly bodies but also between atoms – so objects shrink as they speed up. But this contraction occurs only along the direction of motion. For example, if a car travelled forwards at high speed, it would ...o shrink in length (from say 4 m to 2 m) but its height would remain the same at ...d its width the same at 2 m. If you could run as fast, your height would remain the ...t you'd get thinner, but stay just as wide (Figure 4).



Running at 0.866c will halve your length in the direction of motion but leave your height unchanged.

...mary of relationships for length contraction (Table 1):

$$v = \frac{L_0}{t} = \frac{L}{t_0}$$

Worked examples
Explain key formulas and concepts

TABLE 1 Relationships between the frames

Frame of reference	Earth–Rigel	S
Time for journey	t	t_0
Distance travelled	L_0	L
Velocity	v	v

WORKED EXAMPLE 10.1A

A spaceship passes you at a speed of 0.80c. You measure its length to be 90 m. Calculate the length it would be to observers on board the spaceship.

SOLUTION

$v = 0.80c$

relativistic length $L = 90$ m

proper length, $L_0 = ?$

$$\begin{aligned} L &= L_0\sqrt{1 - \frac{v^2}{c^2}} \\ L_0 &= \frac{L}{\sqrt{1 - \frac{v^2}{c^2}}} \\ &= \frac{90}{\sqrt{1 - 0.8^2}} \\ &= \frac{90}{0.6} \\ &= 150 \text{ m} \end{aligned}$$

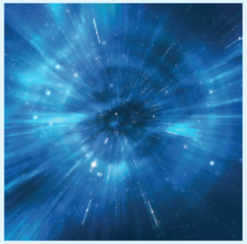


FIGURE 5 A representation of the speed of light in space

CHALLENGE 10.1B

Running a red light

A physicist driving a very fast sports car is booked for travelling through a red traffic light. The physicist argues that because he was travelling fast with respect to the light, the colour of the light had its wavelength altered and appeared green to him. The judge said that he would let him off the charge of running a red light but would fine him 1 cent for every metre per second he was ...

How much was the physicist fined?

Note: the frequency of red light is 4.5 × 10...

The transverse frequency shift formula is:

$f = f\sqrt{...}$

where f_0 is the frequency of the light with res... reference of the source (i.e. the police).

Challenge
Activities throughout each chapter that encourage students to think critically and apply concepts from each topic

Science as a human endeavour
Engaging subject matter used to support the Research investigation

SCIENCE AS A HUMAN ENDEAVOUR

10.5 Relativity and global position[ing] satellites

KEY IDEAS

In this section, you will learn about:

+ technologies such as satellites that have dramatically increased the size, accu[racy, and] geographic and temporal s[co]pe of datasets with which scientists work
+ satellites that provide experimental evidence that supports the phenomena of time dilation.

Key ideas
Placed at the beginning of each section to signpost key learning outcomes and assist students to set learning goals

... is the accuracy of the array ... light signal from Earth these ... and can pinpoint a location on ...

... this: the satellite clocks are ... This means they are travelling ... ng clocks run slow' at this speed ... ist for this loss of time and ... se GPS satellites are constantly ... nal was sent back out. There are ... Earth can get a signal from at ...

... it is possible for your GPS device to calculate the distance between it and each of the four satellites. Using simple geometry it can work out where on Earth you are. The GPS system has an accuracy of about 50ns (50 nanoseconds = 50×10^{-9} s) and in that time light can travel about 15 m, so that is the best navigational accuracy you could hope for. However, with land-based compensation systems accuracy can be increased to less than a metre.

Development

Global Positioning Satellites have an extremely valuable role in today's society. Perhaps the most important is for critical positioning capabilities to military, civil and commercial users around the world. The United States Department of Defense created the system in 1973 for use by the US military. They maintain it and make it freely accessible to anyone with a GPS receiver.

Originally, it was to get an accurate position of enemy targets in the battlefield, but it was made available to the public in the 1980s mainly for civilian aircraft, which were spending a small fortune trying to maintain a rival system. So that the enemy didn't use it against the USA, some 'fuzziness' was introduced into the system so that accuracy was limited to several 100s of metres. This made it less useful than it could have been to civilian users. In 2000 the 'selective availability' (fuzziness) was turned off. However, the US Air Force has alternative ways of blocking signals in specific locations in war zones.

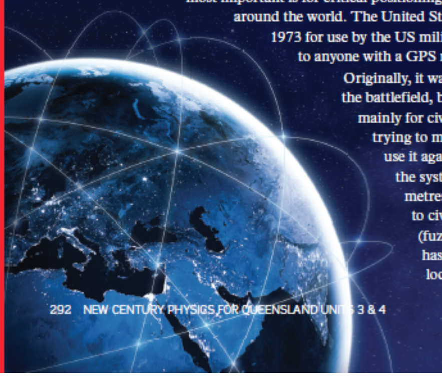


FIGURE 1 Thirty-two satellites provide complete GPS coverage of Earth.

... correction

... cies that creep into the signals. Some are random errors ... nosphere or random errors in the clocks (±0.1 μs). The most ... istic effects as defined by Einstein's theory of special relativity ... l relativity (1915). The effects of gravity on time forms a part ... beyond the scope of this chapter. However, it is known to add ... based time. This is due to the gravitational effect on time in which the stronger the gravitational field the greater the effect on time. Special relativity also accounts for a drift in time – but it is 7.2 μs in the opposite direction and together add to an error of 38.7 μs per day. Calculations for this are in your obook.

Relativity is not just an abstract mathematical theory. Our global navigation system would not work without an understanding of it.

CHECK YOUR LEARNING 10.5

Describe and explain

1 **Describe** how a difference in time signals can be used to calculate a position on Earth.

2 **Explain** which theory of relativity, special or general, has the bigger impact on the calculation of position.

Apply, analyse and interpret

3 A GPS satellite makes two orbits in 24 hours.
   a **Determine** orbital distance above the surface of the Earth. Hint: you will need to use formulas from Chapter 4. (Radius of the Earth, $R_E = 6378$ km; mass of the Earth, $M_E = 5.97 \times 10^{24}$ kg; $G = 6.67 \times 10^{-11}$ m³ kg⁻¹ s⁻²).
   b **Calculate** the time it takes light to go from Earth to the satellite.

4 The ratio of relativistic time to proper time, $\frac{t}{t_0}$, has been shown to equal:

$$\frac{t}{t_0} = \frac{GM_E}{c^2}\left(\frac{1}{R_E} - \frac{1}{R_{GPS}}\right)$$

where the gravitational constant $G = 6.674 \times 10^{-11}$, the mass of the Earth $m_E = 5.974 \times 10^{24}$ kg; Earth's radius, $R_E = 6\,357\,000$ m; and $c = 2.998 \times 10^8$ m s^{-1}. The satellites have an altitude of 20 184 000 m, making their orbital radius $R_{GPS} = 26\,541\,000$ m. Substitute these values into the equation to show that this works out to 45.850 μs per day.

Investigate, evaluate and communicate

5 If the satellites orbited in the opposite direction would the calculations change?
   Investigate and **assess** the following claims in a brief essay for each:
   a GPS is less accurate in the vertical direction than in the horizontal direction.
   b Without special relativistic correction, the navigational error of a GPS system would be much greater than 15 m.

Check your obook assess for these additional resources and more

» Student book questions Check your learning 10.5
» Weblink Uses of satellites
» Weblink ...

Check your learning
A variety of questions for students using the cognitive verbs

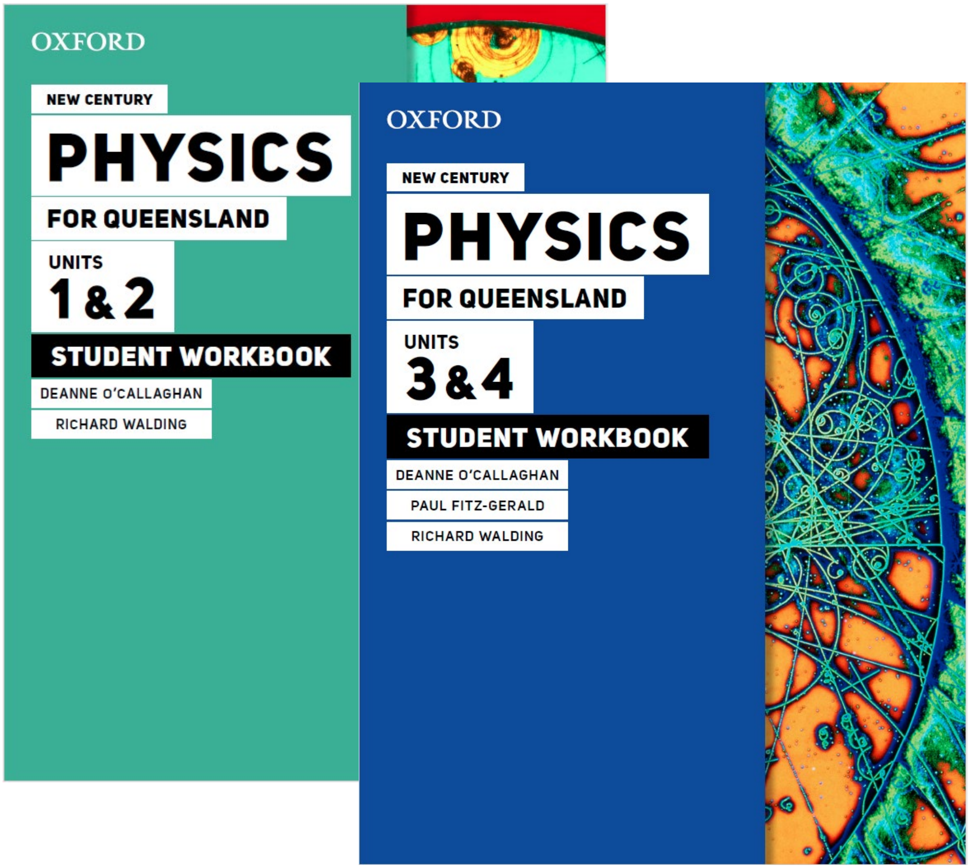
OXFORD PROFESSIONAL DEVELOPMENT

—— education changes lives ——

OXFORD UNIVERSITY PRESS AUSTRALIA & NEW ZEALAND

PART C

A quick tour of our new Student workbooks

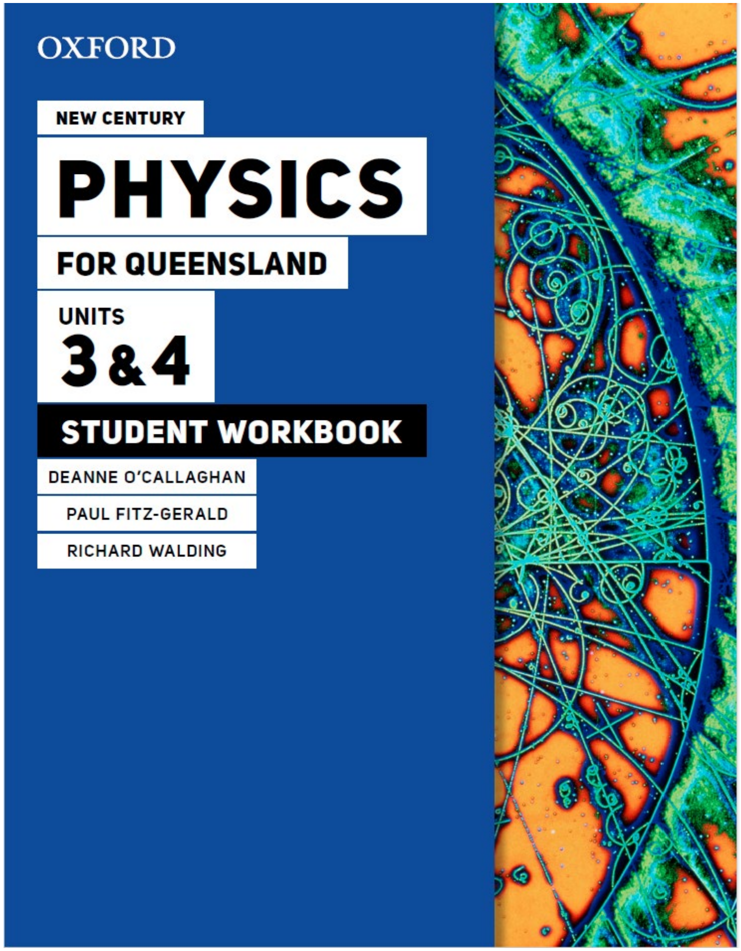


Join us on a quick walkthrough of the Student workbooks

A sample chapter is available in your workshop pack!

Key features

- Physics toolkit – overview of internal assessments
- Chapter checklists – individual student self determination of key subject matter
- Data drill – interpretation and analysis skills for the data test
- Experiment explorer – skills in modifying a practical
- Research review – evaluating a claim and conducting credible research
- Exam excellence – practice exam style questions
- Practice internal assessments
- Practical manual – all mandatory and suggested practicals
- Answers – to all questions and practice assessment



CHAPTER

7 Electromagnetism

This chapter explores magnetic fields produced by permanent magnets and moving electric charges. Magnetic fields are just one of many types of fields important to society. You have also studied gravitational and electric fields; together these three fields form the bulk of Unit 3. It is important that you have a firm understanding of fields concepts so that you are able to apply it to the internal assessments. It is particularly important that you understand how field strength varies with distance and how magnetic fields interact with moving charges.

Chapter checklists
Individual self determination of key subject matter for each chapter

CHAPTER CHECKLIST

Read this checklist before you complete this chapte... understanding before your assessments.

Once you have completed this chapter you can use the 'I can…' statements to assess your understanding and rate yourself by ticking the appropriate box in the 'rating' column.

I can…	Confidently	Partially	Not really
…summarise magnetic fields			
…represent and sketch magnetic field lines			
…determine the magnitude and direction of a magnetic field			
…understand and use the formula $B = \frac{\mu_0 I}{2\pi r}$			
…calculate the force on a wire using $F = BIL\sin\theta$			

Study tip

Sometimes a Data test question will use the words 'uncertainty' or 'percentage uncertainty', other times it will just use 'error'. You need to be comfortable using any of these terms.

DATA DRILL 7

Uncertainty and percentage uncertainty

A common Data test question will require you to analyse a set of data and perform some type of calculation. One such calculation is finding uncertainty or percentage uncertainty. Uncertainty or percentage uncertainty gives a measure of variation or error around the mean, in a similar way to standard deviation. However, uncertainty and percentage uncertainty calculations are used when there are only two repetitions, while standard deviation is used for more than two. Uncertainty and percentage uncertainty are normally used to calculate error in Physics.

The formulas for uncertainty and percentage uncertainty are:

Absolute uncertainty = δx

$$= \frac{(\text{maximum} - \text{minimum})}{2}$$

Percentage uncertainty = $\delta\%$

$$= \frac{\text{absolute uncertainty}}{\text{mean}} \times 100\%$$

Since uncertainty gives a measure of the spread of results around the mean it is reported as mean ±uncertainty.

TABLE 1 Results showing the strength of the magnetic force between two magnets at various distances.

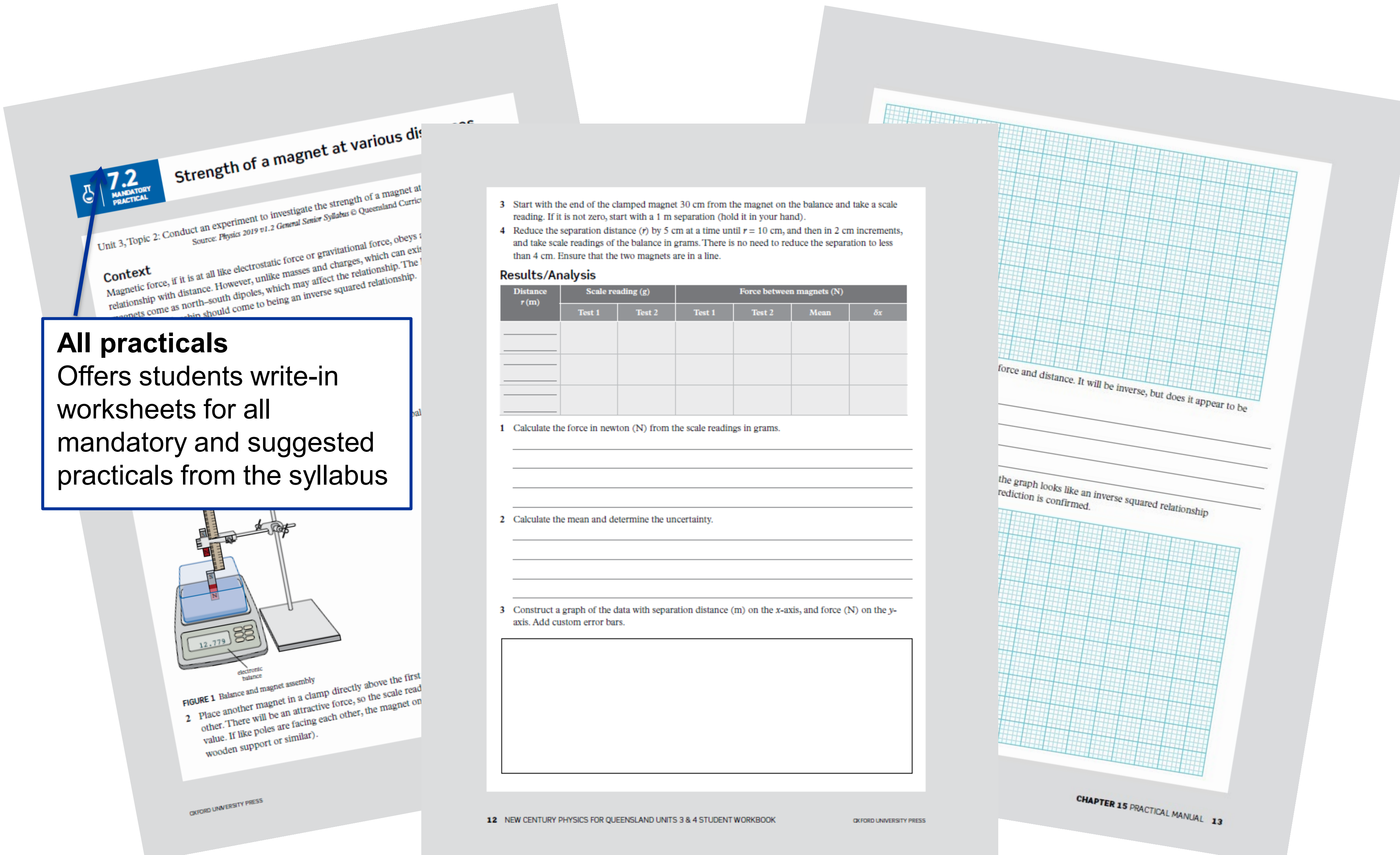
Distance	Scale reading (g)		Force between magnets (N)		
r (cm)	Test 1	Test 2	Test 1	Test 2	Mean
1	49.28	45.08	0.482 944	0.441 784	0.462 364
2	19.7	21.23	0.193 06	0.208 054	0.200 557
4	4.4	6.66	0.043 12	0.065 268	0.054 194
6	1.43	2.07	0.014 014	0.020 286	0.017 135
8	0.73	1.16	0.007 154	0.011 368	0.009 261

1 **Calculate** the percentage uncertainty for the force between the magnets when distance, *r*, is 2 cm. Show all your working.

2 **Analyse** the data and **predict** the force between the magnets when distance, *r*, is 11 cm. **Justify** your response.

3 **Identify** the relat... *F*, exerted by one magnet o...

Data drills
Interpretation and analysis of data to practice skills required in the Data test (IA1)



3 Start with the end of the clamped magnet 30 cm from the magnet on the balance and take a scale reading. If it is not zero, start with a 1 m separation (hold it in your hand).

4 Reduce the separation distance (r) by 5 cm at a time until r = 10 cm, and then in 2 cm increments, and take scale readings of the balance in grams. There is no need to reduce the separation to less than 4 cm. Ensure that the two magnets are in a line.

Results/Analysis

Distance r (m)	Scale reading (g)		Force between magnets (N)			
	Test 1	Test 2	Test 1	Test 2	Mean	δx

1 Calculate the force in newton (N) from the scale readings in grams.

2 Calculate the mean and determine the uncertainty.

3 Construct a graph of the data with separation distance (m) on the x-axis, and force (N) on the y-axis. Add custom error bars.

All practicals
Offers students write-in worksheets for all mandatory and suggested practicals from the syllabus

OXFORD PROFESSIONAL DEVELOPMENT

— education changes lives —

OXFORD UNIVERSITY PRESS AUSTRALIA & NEW ZEALAND

Unit 3 Research investigation

Note: The research investigation for the Physics course (IA3) is to be completed in Unit 4 and covers content from Unit 4. There is no assessable research investigation in Unit 3. This research investigation has been included so that you can practise skills required for the Unit 4 assessment.

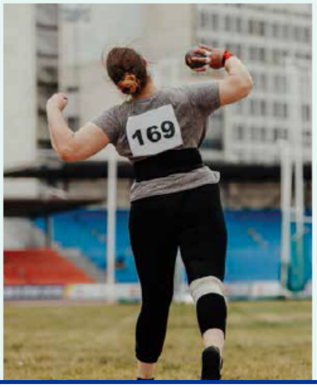
CASE STUDY

Optimum angles of projection in sport

From studying experimental data, and the physics and mathematics associated with projectile motion, physicists have determined that the optimal release angle of a projectile, to maximise its range, is 45° to the horizontal.

There is a number of sports in which an athlete has to project either their own body or an object to achieve the greatest range possible. Some examples are long jump, discus, shotput, javelin and soccer.

Sport scientists have studied the performances of elite athletes in these sports over many years. From these studies, they have found that actual performers in projectile-related sports seldom use a release angle of 45°. For example, the average projection angle of a world-class long jumper is about 25°, that of a shotputter is about 37° and that of a soccer player throwing the ball in is about 30°.



So why is there this apparent contradiction between theory and practice? Shouldn't the experimental (athletic competition) results be the same as those predicted by theory? Is there something that the theoreticians have overlooked? Your task is to conduct a research investigation about the following claim, which is related to the case study above:

- The physicists, sports scientists and athletes are all correct in their understanding and application of projectile motion – however, there are other aspects of proj... that can affect the range achie... its angle of release.

Research question

Practice internal assessments
Support the skills required in the internal assessments
**Note: these are not QCAA draft assessments and should only be used as practice for the internal assessments.*

Research

Note: this section provides space for you to investigate two sources. You will need to research further to complete the assessment.

Resource 1

- Title:
- Authors:
- Source and credibility:
- Publication date:
- Aim:
- Methodology:
  - What data was collected?
  - How was the data collected?
- ...ce support your research question?
- ...n't it support the provided claim?

Digital resources and purchasing options

obook

obook is a fully interactive digital version of every student book with note-taking, highlighting and dictionary support included. Every obook contains links to additional resources, such as videos, interactive modules and worksheets.

assess

assess is an online assessment platform that provides access to tens of thousands of additional auto-correcting questions designed to support student understanding and progression across all subjects.

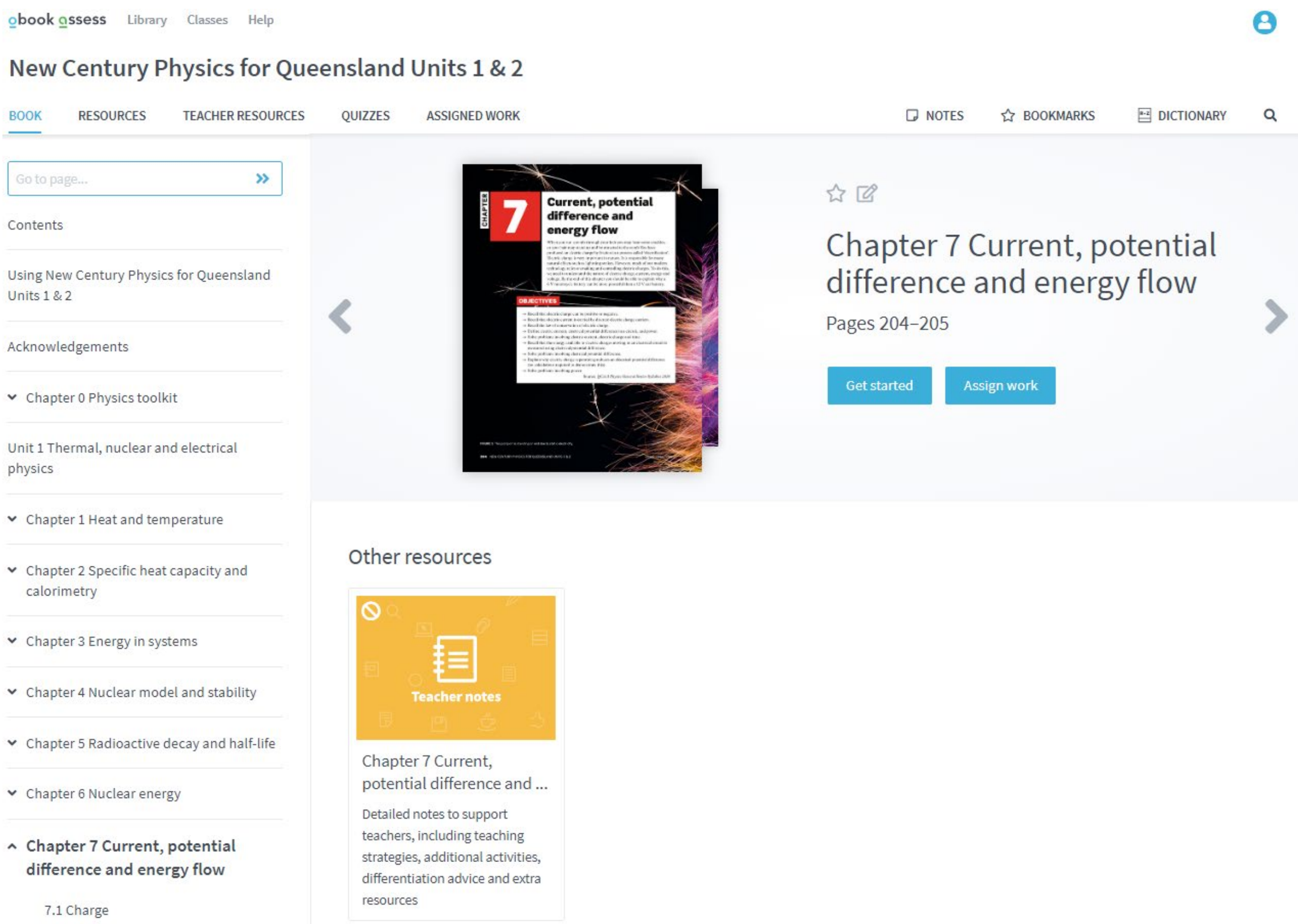
Teacher support

Additional teacher notes, answers, tests, and assessments and differentiated learning advice is all included for teachers. Teacher obook assess also allows teachers to assign work electronically, track progress, and manage results and assessment.

New Century Physics for Queensland is supported by a range of additional digital resources, including:

- **obook**
- **assess**
- **Teacher support**.

obook



obook:

- is visually integrated with the printed Student book, enabling students to move seamlessly between print and digital products
- provides a range of additional teacher and student resources.

obook

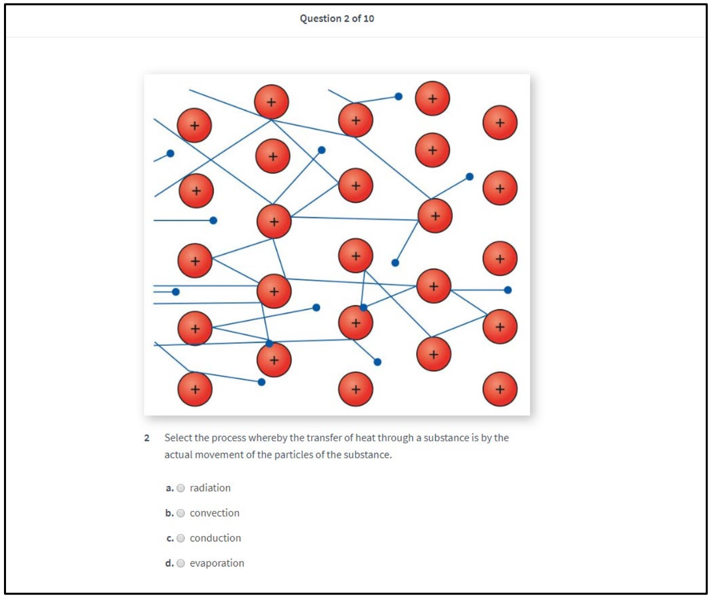
Additional resources

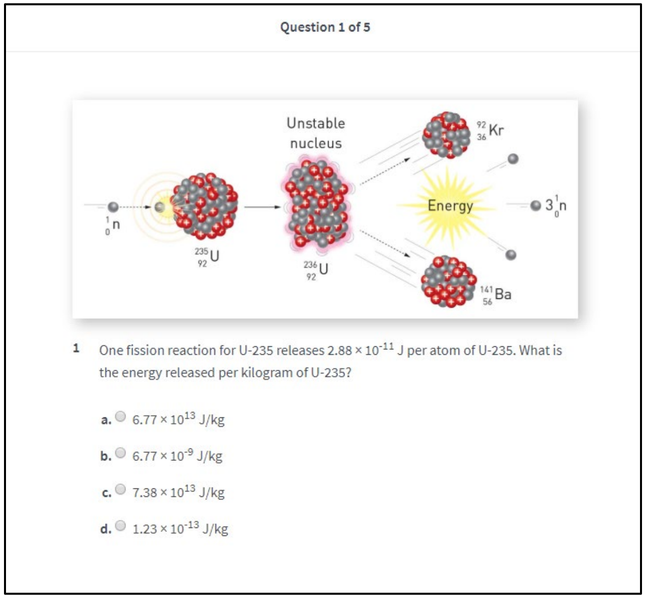
There is additional support available online, including:

- Teacher notes
- Answers
- Practice exams and cumulative tests
- Data tests
- Practical worksheets (for all mandatory and suggested practicals)
- Lab tech notes and risk assessments
- Video tutorials
- Revision notes for students
- Increase your knowledge (extra resources that consolidate and expand student understanding)

These are all designed to help you feel confident that your students will be prepared for their internal and external assessment.

assess





assess:

- provides hundreds of differentiated, auto-marked quiz questions, ideal for homework or in-class use
- questions are aligned to the syllabus and graded for different ability levels.

Teacher support

Teacher support includes:

- detailed **teaching notes** and **course planners**
- answers to **EVERY** question and activity in the Student book
- a range of **additional worksheets** (with answers)
- **editable data tests** (with suggested answers)
- **editable practice examinations** (with answers)

Students receive **digital access for 2 years** when purchasing print Student books – **ideal for revising Year 11 content in Year 12**.

Schools that purchase Oxford resources receive **FREE print Student Books for all teachers** and **ongoing access to all digital resources and teacher support**.

New Century Physics for Queensland **Units 3 & 4 (3rd edition)**	**Format**	**Price**
Student book + obook assess Print book with 2-years‘ digital access included	PRINT + DIGITAL	$69.95
Student obook assess Digital book with 2-years’ digital access included	DIGITAL	$49.95
Student obook assess MULTI Digital book that includes 3 x 2-years’ digital access	DIGITAL	$59.95
Teacher obook assess* Digital book that includes access to additional teacher only resources. Ongoing access.	DIGITAL	$299.95
Workbook 4 colour write in print book that provides assessment support	PRINT ONLY	$24.95

* FREE ongoing access to Teacher obook assess with booklist or class set purchase

Digital renewal fees	
Institution	$5 per student for an additional 15 months’ access A service fee to support annual rollover of subscriptions

If your school has a different purchasing model, ask our team about options

***New Century Physics for Queensland Units 3 & 4* (3rd edition)**	**Samples**	**Final product**
Student book + obook assess (print + digital)	Full page proofs (print) **NOW!**	**August 2019**
Student obook assess (digital only)	Full page proofs (digital) **NOW!**	**January 2020**
Teacher obook assess (digital only)	Unit 3 – Topic 1 and 2 Chapters 1-6 • Teacher notes • Student book answers **08-10-2019**	**January 2020**
Student workbooks (print only)	Units 3 & 4 **Now!** Units 1 & 2 ***NA***	Units 3 & 4 **October 2019** Units 1 & 2 **January 2020**