SURFING

Physics

Space

New Revised Edition

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Science Press

Contents

Use the table of contents to record your progress through this book. As you complete each topic, write the date completed, then tick one of the three remaining columns to guide your revision for later. The column headers use the following codes:

?? = Don't understand this very well at all. RR = Need to revise this. OK = Know this.

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Introduction

Each book in the *Surfing* series contains a summary, with occasional more detailed sections, of all the mandatory sections of the syllabus, along with questions and answers.

It is envisaged this book will be useful in class for both initial understanding and revision, while the more traditional textbook can remain at home for more detailed analysis.

All types of questions – multiple choice, short response, structured response and free response – are provided (there will be no multiple choice questions in the option questions in the HSC). Questions are written in exam style and use the verbs specified by the Board of Studies so that you will become familiar with the concepts of the topic and answering questions in the required way.

Answers to all questions are included.

A topic test at the end of the book contains an extensive set of summary questions, including multiple choice and free response questions. These cover every aspect of the topic, and are useful for revision and exam practice. Marking guidelines are supplied where appropriate.

Some questions and equations used are outside the mandatory content of the syllabus, but have been included to increase students' understanding of that content, to provide skills-based questions based on related content, and to increase students' abilities to answer in the context of the provided verbs. Where these occur, they have been indicated in the text.

Verbs To Watch

account, account for State reasons for, report on, give an account of, narrate a series of events or transactions.

analyse Identify components and the relationships among them, draw out and relate implications.

apply Use, utilise, employ in a particular situation.

appreciate Make a judgement about the value of something.

assess Make a judgement of value, quality, outcomes, results or size.

calculate Determine from given facts, figures or information.

clarify Make clear or plain.

classify Arrange into classes, groups or categories.

compare Show how things are similar or different.

construct Make, build, put together items or arguments.

contrast Show how things are different or opposite.

critically (analyse/evaluate) Add a degree or level of accuracy, depth, knowledge and understanding, logic, questioning, reflection and quality to an analysis or evaluation.

deduce Draw conclusions.

define State the meaning of and identify essential qualities.

demonstrate Show by example.

describe Provide characteristics and features.

discuss Identify issues and provide points for and against.

distinguish Recognise or note/indicate as being distinct or different from, note difference between things.

evaluate Make a judgement based on criteria.

examine Inquire into.

explain Relate cause and effect, make the relationship between things evident, provide why and/or how.

extract Choose relevant and/or appropriate details.

extrapolate Infer from what is known.

identify Recognise and name.

interpret Draw meaning from.

investigate Plan, inquire into and draw conclusions about.

justify Support an argument or conclusion.

outline Sketch in general terms; indicate the main features.

predict Suggest what may happen based on available information.

propose Put forward a point of view, idea, argument or suggestion for consideration or action.

recall Present remembered ideas, facts or experiences.

recommend Provide reasons in favour.

recount Retell a series of events.

summarise Express concisely the relevant details.

synthesise Put together various elements to make a whole.

1 Gravity and the Newton

We often use the terms 'mass' and 'weight' – the latter often incorrectly. You do not, for example, 'weigh' 60 kg. Your 'mass' may certainly be 60 kg, but if that is the case, then your 'weight' is closer to 600 N! The difference lies in these definitions:

Mass is a measure of the amount of matter in an object. **Mass** does not change, regardless of the position of the object in the Universe. **Mass** is measured in kilograms (kg) (or mg, g, tonne etc).

The **weight** of an object is a measure of the force with which it is attracted by a gravitational force. The **weight** of an object changes depending on where it is in the Universe. Because **weight** is a force, it is measured in newtons (N).

Mass and weight are connected by this equation:

Weight = mass × acceleration due to gravity

$W_F = mg$ Where W_F = weight in N
m = mass in kg
g = acceleration due to gravity
= 9.8 m s^{-2} on Earth

For You To Do

1. Contrast mass and weight.
2. Recall the units used to measure each.
3. Recall the equation connecting them.
4. Convert to weight: 100 gram, 2.5 kg, 20 kg, 1000 kg.
5. Convert to mass: 10 N, 100 N, 500 N, 10 000 N.
6. (a) Calculate the mass of a 85 kg person on the Moon. (Moon acceleration due to gravity is about 1.6 m s^{-2}.)
   (b) Calculate this person's weight on the Moon.
   (c) Predict his weight on Earth.
   (d) Calculate the weight of a 55 kg astronaut on Earth.
   (e) Calculate the astronaut's mass and weight on the Moon.
7. The table shows the strength of gravity on heavenly objects compared to Earth.
   (a) Calculate the mass of a 1 kilogram block on each heavenly object.
   (b) Calculate its weight on each object.
   (c) Account for the mass and weight difference for each object.
   (d) List reasons for the difference in the force of gravity on each heavenly object.

Heavenly object	Gravity compared to Earth
Earth	1.00
Mercury	0.41
Venus	0.91
Mars	0.38
Jupiter	2.53
Saturn	1.07
Uranus	0.88
Neptune	1.16
Pluto	0.064
Sun	28.1

2 Dropping an Object

The information in the table was obtained from an experiment where the time it took an object to fall from different heights was measured. Use the information to answer the questions.

Distance fallen (m)	Time to fall (s)
1.0	0.58
2.0	0.82
3.0	1.00
4.0	1.15
5.0	1.29
6.0	1.41
7.0	1.53
8.0	1.64

For You To Do

1. Suggest a purpose of this experiment.
2. Identify factors which would have been controlled.
3. Identify the factors that varied.
4. Graph the information (put t on the x-axis).
5. Predict the time to fall 0.5 m.
6. Predict the time to fall 3.25 m.
7. If it took 2.00 seconds to hit the ground, predict the height it fell from.
8. Can you write a conclusion from this graph? Explain.
9. (a) Copy the table into your book and add a third column headed t^2.
   (b) Calculate values for t^2 and complete your table.
   (c) Graph distance fallen against t^2 (t^2 on x-axis).
   (d) What shape graph do you get?
   (e) What does this tell you?
10. Given that twice the gradient of your graph is equal to the acceleration of the falling object, calculate this acceleration.
11. Is this object falling on Earth? Explain?
12. Write a conclusion for the experiment.
13. Suggest at least one way this experiment could be improved.

Extension

The typical acceleration involved when a car, moving at 60 kph, crashes into a wall, a pole, or another car is about 150 m s^{-2}. Imagine a mother nursing a 20 kg child in the front seat with no seatbelt holding the child.

(a) Calculate the force needed on the child to resist the deceleration of the car.
(b) If the mother applied this force to weight-lifter's weights, calculate how much she would lift.
(c) How possible is this?
(d) What implications does this have for nursing an unbelted child in a car?
(e) Identify the law involved in this example.

Additional analysis

The table shows the results of a similar experiment done on the planet Xenos.

Height object dropped from (m)	Time to fall (s)
1.0	0.63
1.5	T
2.0	0.89
P	1.00
3.0	U
Q	1.26
R	1.34
5.0	1.41
S	1.67
8.0	V
10.0	2.0

1. Analyse these results to calculate the acceleration due to gravity on Xenos.
2. Using this, or by any other means, deduce values for the missing quantities in the table.
3. Calculate the mass and weight of an 80 kg astronaut on Xenos.