Stewards Academy

Science KS4: Blended Learning Booklet

P5 Forces

Name:

Form:

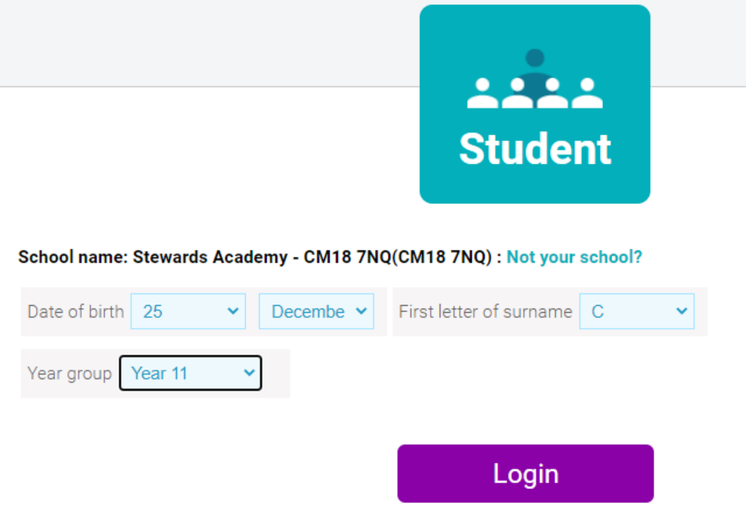
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

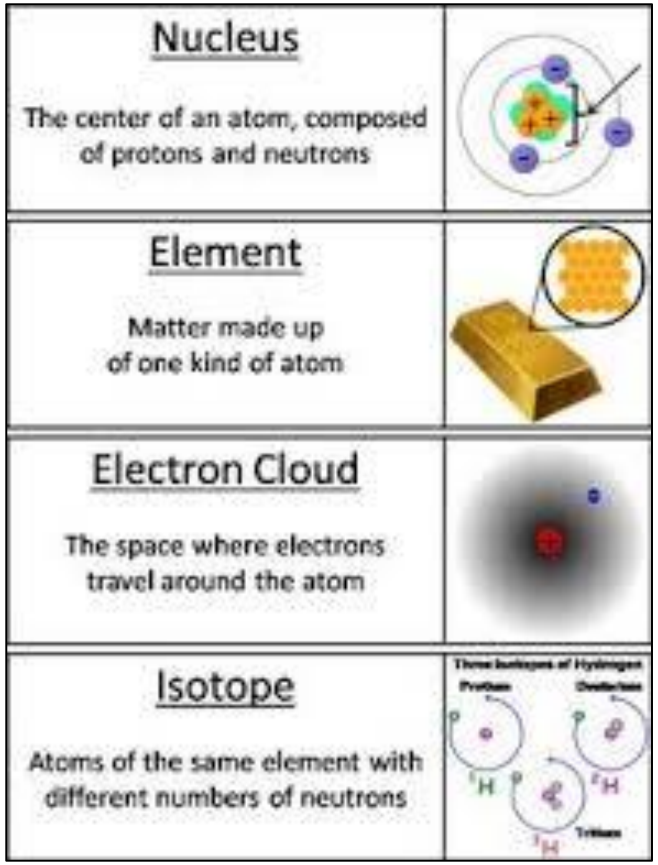
All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year





Contents

Contents

(T) = Triple scientists only

Big Picture – Year 10 Overview
Science

Year 10

UNIT B4

Health and disease

Pathogens

Malaria

Protecting the body

Plant diseases & defenses (T)

Unit Test

UNIT C4

Metal reactivity

Neutralisation

Titration (T)

Electrolysis

Oxidation and reduction)

Unit Test

UNIT P4

Atomic structure

Radioactive decay

Nuclear equations

Hazards and uses of radiation

Nuclear fission and fusion (T)

Unit Test

UNIT B5

Homeostasis

The nervous system *and the eye (T)*

The endocrine system and the kidneys (T)

Human reproduction and IVF

Plant hormones (T)

Unit Test

UNIT C5 & C6

Exo and endo thermic reactions

Reaction profiles

Cells, batteries and fuels cells (T)

Measuring rates of reaction

Factors affecting rates of reaction

Catalysts and collision theory

Reversible reactions and energy changes

Factors affecting equilibrium

Unit Test

UNIT P5

Forces, speed and acceleration

Mass and Weight

Momentum and road safety

Moments, levers and pressure (T)

Forces and energy in springs

Unit Test

UNIT B6

DNA, genes and the human genome

DNA structure and protein production (T)

Meiosis and reproduction

Genetics and gene disorders

The work of Gregor Mendel (T)

Unit Test

UNIT C7 & C8

Crude oil, hydrocarbons and fractional distillation

Combustion and cracking of alkanes

Alkenes, alcohols and carboxylic acids (T)

Polymers and poly-merisation (T)

Pure substances and chroma-tography

Tests for gases, metals, hydroxides and anions (T)

Spectroscopy and other instrumental methods (T)

Unit Test

UNIT P6

Properties of waves

Sound waves and seismic waves (T)

The electro-magnetic spectrum

Colour, lenses, images and magnification (T)

IR emission and absorption (T)

Unit Test

End of Year Exams

Nest Year

Health

I will be able to describe how lifestyle choices can affect the risk of catching a non-communicable disease. **I will** be able to explain how communicable diseases are spread and how we can control their spread. ***I will*** *be able to describe how plants are affected by and protected from disease causing organisms (T).*

Chemical changes

I will be able to describe why some metals are more reactive than others, **I will** be able to describe how neutralization occurs and how salts are formed. **I will** be able to explain how some metals are extracted by electrolysis rather than oxidation

Atomic structure

I will be able to reconise an atomic isotope and explain how one isotope can turn into another through three different forms of radioactive decay. **I will** be able to represent radioactive decay using a nuclear equation.

Homeostasis

I will be able to explain how conditions in the body, processes and organ systems are coordinated and controlled. **I will** be able to describe how hormones control sexual development and human reproduction, *as well as how hormones enable plants to respond to stimuli (T)*

Energy Changes & Reaction Rates

I will be able to describe, explain and represent energy changes in chemical reactions and link them to bond energies and the particle theory. ***I will*** *be able to explain how dells produce a voltage and how fuel cells work (T).* **I will** be able to measure and calculate the rate of a reaction and describe factors that can affect rate. ***I will*** *be able to apply Le Chatelier's principle to reactions in equilibrium (T).*

Forces

I will be able to explain how forces affect motion and how an understanding of these forces can make driving safer. ***I will*** *be able to explain the effects of forces on levers and in creating pressure (T).* I will be able to explain the effects of forces applied to springs.

Genetics

I will be able to explain how we inherit our characteristics as a result of our genes which are made of DNA. **I will** be able to explain how the DNA is replicated and packaged in a specialised way to form the sex cells. ***I will*** *be able to describe the work by Gregor Mendel around plant genetics*

Hydrocarbons & Chemical analysis

I will be able to describe the properties of hydrocarbons. ***I will*** *be able to describe the properties of alkenes, alcohols, carboxylic acids and polymers (T).* **I will** be able to use techniques to produce and identify a pure substance. ***I will*** *be able to identify positive and negative ions and evaluate different analysis techniques (T).*

Waves

I will be able to describe characteristics of waves that can be measured. **I will** be able to measure reflection and refraction of waves and explain why they occur. **I will** be able to place visible light withing the electromagnetic spectrum. ***I will*** *be able to sound waves can reveal structures (T).* ***I will*** *be able to explain how lenses work (T)*

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Forces Year: 10 Unit: P5

AIMS

In this unit students will learn by about what forces are and what they do, both contact and non-contact forces. How a force can cause acceleration, how motion can be described and calculated using Newton's three laws of motion. The turning effect of a force and what causes pressure in solids, liquids and gases. Students will also learn how we how we can make driving safer by understanding forces and how the motion of an object changes as it falls.

DEVELOPING COURAGE

C That road safety can be improved by applying the laws of physics

O To carry out scientific investigations

U Work togther to make the roads a safter place for all

R Learning when to apply each of Newton's Laws

A How Science works to find solutions for the worlds problems

G Share our scientific knowledge

E Experiencing Science in action

PREVIOUS LEARNING

This unit will build on ideas students have met before, such as: The average speed is the distance travelled divided by the time taken. If the speed of a car is increasing, it is accelerating. A journey can be represented by a distance–time graph. Forces cause acceleration. The bigger the force, the bigger the change in speed. Forces can be contact or non-contact.

WHAT WE KNOW/ REMEMBER

- ....
- ....
- ....
- ....
- ....

RECOMMENDED READING

1. Isaac Newton and the Laws of Motion by Eileen S Coates,
2. The Quest for Speed: Vehicles by Lisa Greathouse,
3. The Ascent of Gravity: The Quest to Understand the Force that Explains Everything by Marcus Chown,
4. Air and Water Pressure by Richard Spilsbury.

PERSONAL OBJECTIVES

- ....
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- ....

UP NEXT

Waves

- Describing waves
- Measuring wave speed
- Reflection and refraction
- Sound waves
- Seismic waves
- Electromagnetic spectrum
- Colour and lenses

CAREERS

- Crash Investigator
- Driving instructor
- Diver or Parachutist

Lesson 1: P5.1 – Forces

Connection

Have a look at the topic overview and the P5 zoom in.

Populate what you know and your personal objectives.

Activation

LI: Recognise the difference between contact and non-contact forces.
State examples of scalar and vector quantities.

1. https://www.youtube.com/watch?v=WCPTKRaScgE&feature=emb_logo
2. https://www.youtube.com/watch?v=iLB_4Wu2QOg
3. Make a note of the title and the LI
4. Read pages 142-143
5. Define “scalar” and “vector”
6. Using the example of the video (at 3.23 min) Draw or list examples of contact and non-contact forces

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P5 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-5
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

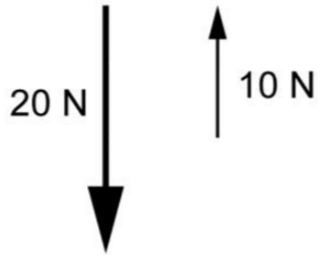
Answers: P5.1 - Forces

Connection

1 NA
2 NA
3 NA

Demonstration

1 e.g. friction between the tyres of a car and the road
2 e.g. the gravitational force pulling you down as you are falling from a tree
3a acceleration, force and momentum are vector quantities
3b These quantities have a magnitude and a direction; the other quantities only have a magnitude
4



5 Final distance = 400m; Final displacement = 0m.

Lesson 2: P1.2 Speed

Connection

Q1. Give one example each of a contact and non-contact force.
Q2 Why is acceleration described as a vector quantity?
Q3. A runner ran an 800 m race. His displacement was 0. Draw a figure representing his race.

Activation

LI: **Calculate speed using distance travelled divided by time taken**
Calculate speed from a distance–time graph

1. https://www.youtube.com/watch?v=QaU9jMHh7gE&feature=emb_logo
2. Make a note of the title and the LI
3. Read pages 144-145
4. Define "**gradient**" & "**average speed" and** for H students only "tangent"
5. Write down the speed equation in words and symbols.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P5 DIP file

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P5.2 – Speed

Connection

1 contact: e.g. air resistance, friction etc
Non-contact: e.g. magnetism, gravity etc
2 acceleration has both magnitude and direction (e.g. a rocket accelerating upwards)
3 Circle drawn with one dot to represent starting and end points at the same spot.

Demonstration

1 For example, the traffic means you have to slow down if there is a car in front of you; you need to come to a stop when you reach a junction.
2 average speed = distance / time = 50 m / (2.5 × 60) s = 0.33 m/s
3 average speed = distance / time = 10 000 m / (1.75 × 60 × 60) s = 1.6 m/s
4 distance travelled = speed × time = 0.5 mm/s × (1 × 60 × 60) s = 1800 mm = 1.8 m
5 The gradient would increase / the line would become steeper.
6 The car is slowing down (gradient decreases as the time increases)
7 The gradient of the graph is getting steeper between 0 to 10 s. This shows that the speed is getting faster. Measuring the gradient of the tangent shows that the gradient gets steeper by the same amount each second. For example, when the time is 1 s the gradient is 4 m/s and when the time is 2 s the gradient is 8 m/s. Therefore, the speed is increasing by the same amount each second (**constant acceleration**).

Lesson 3: P5.3 – Acceleration

Connection

Q1. Write down the definition and equation for speed using symbols

s, t, v

Q2. State the difference between speed and velocity.

Q3. A cyclist travelled 8000 m north, then 224 m South. It took him 1440 s. Calculate his total displacement.

Activation

LI: describe and calculate acceleration

1. https://www.youtube.com/watch?v=Kzx8GBTl5VM&feature=emb_logo
2. Make a note of the title and the LI
3. Read pages 146--147
4. Define "acceleration" & "deceleration"
5. Produce a set of notes in the style of the video of the information contained in the green and blue headed sections of the text spread.

Demonstration

Attempt questions 1-10.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P5 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P5.3 - Acceleration

Connection

1 speed is a measure of how fast an object is.
v= s/t

2 speed is a scalar and velocity is a vector quantity. Both have the same magnitude or size.

3. 8000 -224 = **7776 m North**.

Demonstration

1 Car A has the greater acceleration.

2 The ball has the force of gravity pulling it to the ground.

3 The air resistance has a greater effect on the feather's motion than it does on the ball.

4 The ball decelerates to a rest as it moves up to its highest point, then it accelerates downwards.

5 Acceleration = change in velocity / time taken = (40 m/s – 20 m/s) / 10 s = 2 m/s2

6a The velocity increases by 2 m/s each second.

6b The velocity decreases by 2m/s each second.

7 Acceleration = change in velocity / time taken = (0 m/s – 24 m/s) / 3 s = - 8 m/s2

8 Speed at the start = 72 km/h = 72 × (1000 / 3600) m/s = 20 m/s Speed at the end = 108 km /h = 108 × (1000 / 3600) m/s = 30 m/s Acceleration = change in velocity / time = (30 m/s – 20 m/s) / 5 s = 2 m/s2

9 Every year the glacier moves 4 mm/s faster than it was moving a year ago.

10 They are accelerating because the direction is changing so there is a change in velocity.

Lesson 4: P5.4 – Velocity-time graphs

Connection

Q1. Write down the equation for acceleration.

Q2. A car accelerates from rest to 20 m/s^2 in 2.5 s. Calculate its velocity during this time.

Q3. A tractor is travelling east accelerating at 0.5 m/s. After 8 s it reaches a speed of 5 m/s. Calculate the eastward velocity before it started to accelerate.

Activation

LI: Draw velocity-time graphs and calculate acceleration from the graphs

1. https://www.youtube.com/watch?v=sG6QoLxwIw4
2. Make a note of the title and the LI
3. Read pages 148-149
4. Write down what a velocity-time graph shows and draw a neatly labelled diagram of fig 5.9. Use a ruler and pencil
5. Describe what fig 5.9 a, b and c shows in terms of velocity against time (acceleration).

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P5 DIP file

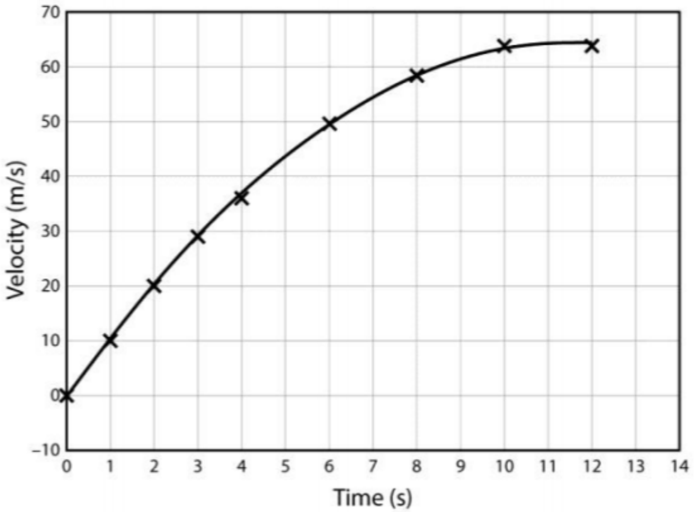
Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

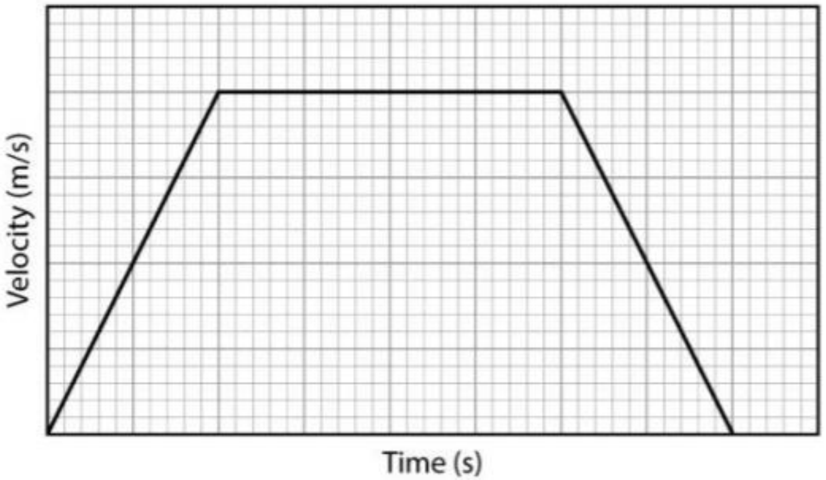
Answers: P5.4 - Changing ideas about atoms

Demonstration

1



2



Connection

1 $a = \frac{\boldsymbol{v-u}}{\boldsymbol{t}}$

2a $a = \frac{\mathbf{20 - 0}}{\mathbf{2.5}}$ **= 8 m/s²**

3. $\boldsymbol{a = \frac{v-u}{t}} \Rightarrow \mathrm{u} = v - (a \times t)$

u = 5 – (0.5 x 8) = **1 m/s**

Answers: P5.4 contd. – Velocity-time graphs

Demonstration

3 Graph (a) – acceleration = 25 / 5 = 5 m/s2 Graph (b) – acceleration = -25 / 5 = –5 m/s2 Graph (c) – acceleration = 0 m/s^2

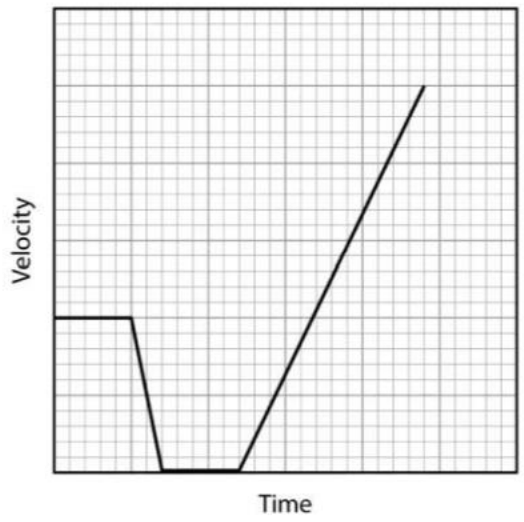
4 Acceleration = change in velocity / time = –20 / 5 = –4 m/s^2

5 Change of velocity = acceleration × time = –2 × 4 = –8 m/s. Truck moves at 25 m/s at the beginning; velocity changes by –8 m/s so the velocity after braking = 25 – 8 = 17 m/s.

6a The train accelerates constantly for the first minute, then it travels at a constant velocity of 15 m/s for the next 3 and a half minutes and it then decelerates constantly for the final half a minute.

6b Distance train travels is the area under the graph. Area of the left hand triangle = ½ × 60 s × 15 m/s = 450 m Area of the rectangle = 15 m/s × (3.5 × 60) s = 3150 m Area of the right hand triangle = ½ × 30 s × 15 m/s = 225 m So the total distance = 450 + 3150 + 225 = 3825 m

7



8 Graph (b) in Figure 5.10 could represent the motion of the stone as it moved upwards. This is because it is has an upwards velocity at the beginning of the throw which constantly reduces up to the stone’s maximum height. For the stone moving downwards, the straight line could be continued so that it carries on going downwards below the axis. This would show that the stone is gaining speed but in the opposite direction. The whole graph should have a constant gradient, as the acceleration of the stone is the same throughout the motion (acceleration due to gravity).

Lesson 5: P5.5 – Calculations of motion

Connection

Q1. What does the gradient on a velocity-time graph show?

Q2. What does the horizontal line on a distance-time graph show?

Q3. What is the acceleration of a car that goes from 5 m/s to 29 in/s in 8 seconds?

Activation

LI: Use an equation for uniform motion

1. https://www.youtube.com/watch?v=Kzx8GBTl5VM
2. Make a note of the title and the LI
3. Read pages 150-151
4. What is the acceleration equal to in "uniform motion"
5. Copy down the symbols of motion and their meanings.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the C1 DIP file

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9
PLEASE ADD MODEL ANSWERS IN BLUE

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P5.5 – Calculations of motion

Connection

1 acceleration

2 stationary object

3 $\frac{(29-5)\ m/s}{8\ s}$ = 3 m/s^2

Demonstration

1a The velocity at the beginning of the motion.

1b The velocity at the end of the motion.

2 Acceleration is change of velocity / time so its unit needs to be the unit of velocity divided by the unit of time.

3 Rearrange $v^2 = u^2 + 2as$ to give $2as = v^2 - u^2$

Dividing by 2a gives $s = (v^2 - u^2) / 2a$

So length of runway = $(v^2 - u^2) / 2a = (60^2 - 0^2) / (2 \times 2.5) = 720$ m

4 Acceleration is 3 m/s2 which means the velocity increases by 3 m/s each second. Therefore, after 4 s the velocity has increased from rest to 3 × 4 = 12 m/s. From question 3, $s = (v^2 - u^2) / 2a$

So the distance the car travels = $(12^2 - 0^2) / (2 \times 3) = 24$ m

5 $s = (v^2 - u^2) / 2a$

(a = - 2 m/s^2 since this is a deceleration) Distance train travels = $(0^2 - 40^2) / (2 \times -2) = 400$ m

6 $v^2 = u^2 + 2as$; $0^2 = 112 + (2 \times -9.8 \times s)$; $0 = 121 - 19.6s$
19.6s = 121, so s = 6.2 m (to 2 significant figures)

7 $v^2 = u^2 + 2as$ $v^2 = 0^2 + (2 \times 9.8 \times 2.5)$ so $v^2 = 49$ giving v = 7 m/s

Lesson 6: P5.6 – Heavy or massive?

Connection

Q1. what do the following symbols represent when describing motion?
S, u, v

Q2. What is the equation for acceleration?

Q3. A ball is thrown vertically upwards at 24 m/s. Ignoring air resistance, what is its deceleration and what causes it?

Activation

LI: Explain the difference between mass and weight

1. https://www.youtube.com/watch?v=PEQzAbizMYs
2. Make a note of the title and the LI
3. Read pages 152 - 153
4. Define "mass" and "weight" and "gravitational field strength"
5. What units are mass and weight measured now? Are they the same? Can you explain your answer?
6. Write down the equation for weight from the bottom of page 152.

Demonstration

Attempt questions 1-7
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P5 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P5.6 – Heavy or massive

Connection

1 displacement, initial velocity, final velocity

2) m/s for velocity
m/s^2 for acceleration
(rate of change of velocity)

3) Gravity causes the deceleration at −10 m/s^2

Demonstration

1 Yes they have lost weight as the gravitational force on them is smaller.

2 Yes, Denzil is correct. Weight is a force so a weighing scale is measuring a force.

3a $7 \times 9.8 = 68.6$ N

3b $0.5 \times 9.8 = 4.9$ N

3c 400 g = 0.4 kg, so weight = $0.4 \times 9.8 = 3.92$ N

4a $m = W / g = 30 / 9.8 = 3.1$ kg

4b The mass of the block remains at 3.1 kg. $g = W / m = 11.1 / 3.1 = 3.6$ N/kg.

5 Yes Alex is right. Weighing scales measure the weight and convert this to a mass. However the conversion assumes that you are on the Earth.

6 Her weight is 0N as there is no gravitational force.

7 E.g. a balance where a beam is placed on a pivot. A known mass is placed on one side and the mass you need to measure is placed on the other. The masses are moved so that the beam balances and the reading is made. This would give identical readings on the Earth and on the Moon.

Lesson 7 P5.7 – Forces and motion

Connection

Q1. What is incorrect about this statement: *My weight is 60 kg*

Q2. Write the equation that links weight to mass.

Q3. If a steel block weighs 100 N on Earth what is its mass?

Activation

LI: Explain what happens to an object if all the forces acting on it cancel each out

1. https://www.youtube.com/watch?v=98DXe3uKwfc
2. Make a note of the title and the LI
3. Read pages 154-155
4. Write the definition of “balanced forces”, “equilibrium” and “resultant force”
5. Write down **Newton’s first Law** and copy the sentence and two bullet points on page 155
6. Draw and label either fig 5.16 OR 5.17 to show Balanced forces in action
7. Draw fig 5.18 and label it clearly to describe when forces cancel each other out.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P5 DIP file

Demonstration

Attempt questions 1-10
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P5.7 - Forces and motion

Connection

1 weight is a force. His mass is 60 kg. His weight will be ~ 600 N

2 *w= mg*

3 10 kg

Demonstration

1 1 N

2a The drag force will increase.

2b No, the force up is larger than the force down.

3 No, the object could also be moving at a constant speed (in a straight line).

4a Their size must be the same.

4b They must be in opposite directions.

5 The forces must be the same size.

6 The weight acting downwards must have an equalsize to the reaction force acting upwards so that they balance out

7 The reaction force from the ground balances the weight of the boulder.

8 The driving force forward on the bicycle is balancing out the drag from the air.

9 The driving force will decrease but the drag force remains the same (for the same speed). This means that there is an unbalanced force opposing the motion and the bicycle slows down.

10 The Earth would move in a straight line in the direction it was moving in just before the Sun vanished. It would still be spinning on its axis though. (It would also continue to orbit round the Milky Way galaxy.)

Lesson 8: P5.8 – Resultant Forces

Connection

Q1. A car is moving forwards on a road. State the direction of the following forces acting on the car.
Air resistance and friction
Normal contact force
Weight
Driving force from the engine

Q2. In which two of these situations does Newton's First Law apply?
Choice 1) Object is stationary
Choice 2) Object is accelerating
Choice 3) Object is decelerating
Choice 4) Object moves with constant velocity

Activation

LI: Draw free-body diagrams. Calculate the resultant from opposing forces

1. https://www.youtube.com/watch?v=YGGxf6cp3Lo
2. Make a note of the title and the LI
3. Read pages 156- 157
4. Write out what the following terms mean: "free-body diagram" and "resolving a force"
5. Draw and label Fig 5.22 as an example of a free-body diagram for a jet airplane.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P5 DIP file

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
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Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher