

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric Circuits

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

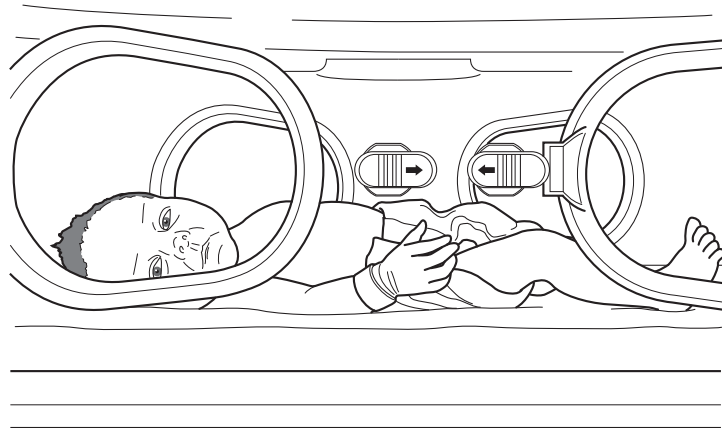
The Wave Model of Radiation

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Answer **all** the questions.

1 Sasha is a newborn baby. She is in hospital in an incubator.

The incubator keeps the temperature constant.



(a) The incubator's temperature control system has a sensor (receptor), a processing centre and an effector.

What does each part do?

.....

.....

.....

.....

..... [3]

(b) Sasha's father feels too hot in the hospital.

How does his body lose heat?

Put a **ring** around the correct answer.

- shivering** **sweating** **running**

[1]

[Total: 4]

2 Kidneys are important organs in the body.

(a) Kidneys make urine.

They filter molecules such as glucose from the blood.

(i) What happens to the glucose after it has been filtered?

..... [1]

(ii) Which two other chemicals are filtered from the blood?

Put **(rings)** around the **two** correct answers.

enzymes protein salt starch urea

[1]

(b) The amount of water in the urine depends on the concentration of blood plasma.

Here are some factors that affect the concentration of blood plasma.

- A** high external temperature
- B** drinking lots of water
- C** eating salty food
- D** doing vigorous exercise

What effect will each factor have on urine concentration?

Write each letter, **A**, **B**, **C**, and **D**, in the correct column in the table.

Makes urine more concentrated	Makes urine more dilute

[2]

[Total: 4]

3 Adrian is climbing a mountain.

The weather becomes very cold and wet.

(a) Put a tick (✓) in the box next to the correct choice to complete each sentence.

At first Adrian's body temperature stays the same.

This means his heat gain is

less than	<input type="checkbox"/>
more than	<input type="checkbox"/>
equal to	<input type="checkbox"/>

his heat loss.

Later, his core body temperature falls.

His heat gain is now

less than	<input type="checkbox"/>
more than	<input type="checkbox"/>
equal to	<input type="checkbox"/>

his heat loss.

His temperature falls below 35°C.

He now suffers from

hypothermia.	<input type="checkbox"/>
hypothalamus.	<input type="checkbox"/>
homeostasis.	<input type="checkbox"/>

[3]

(b) Adrian is treated by the mountain rescue team.

As his body temperature returns to normal, the enzymes in his cells begin to work better.

Explain why.

.....

.....

.....

..... [3]

[Total: 6]

4 Joe evaporates some seawater.

Crystals of sodium chloride (salt) begin to form.

(a) Joe writes down the colour of the salt crystals.

What colour are they?

Put a tick (✓) in the box next to the correct answer.

blue

brown

green

colourless

[1]

(b) Joe knows that salt is sodium chloride.

He does a flame test to show that there is sodium in his salt crystals.

He looks at the spectrum.

Explain how the flame and its spectrum show that sodium is present.

.....

.....

.....

..... [3]

(c) Sodium chloride is an ionic solid.

Two of these statements about sodium chloride are true.

Put ticks (✓) in the boxes next to the **two** correct statements.

Solid sodium chloride always conducts electricity.

Solid sodium chloride often conducts electricity.

Melted sodium chloride conducts electricity.

Sodium chloride solution conducts electricity.

[1]

[Total: 5]

5 Sodium is a Group 1 metal.

Here is some information about Group 1 metals.

	Melting point in °C	Boiling point in °C
Lithium	180	1342
Sodium		883
Potassium	63	760

(a) Estimate the melting point of sodium.

answer °C [1]

(b) There are 11 electrons in a sodium atom.

(i) How many **protons** are there in a sodium atom?

Put a **ring** around the correct answer.

2 8 11 23

[1]

(ii) What else are the atoms made of?

Put a **ring** around the correct answer.

crystals halogens molecules neutrons

[1]

(c) The electron arrangement of a sodium **atom** is 2.8.1.

A sodium atom loses one electron to make a sodium ion.

What is the electron arrangement of a sodium **ion**?

Put a **ring** around the correct answer.

2.8 2.7.1 1.8.1 2.8.1

[1]

(d) Sodium should be stored away from water because it will react.

When sodium reacts with water it makes sodium hydroxide and hydrogen gas.

What is the formula of sodium hydroxide?

Put a ring around the correct answer.

NaOH

Na₂OH

NaOH₂

Na(OH)₂

[1]

[Total: 5]

6 Chlorine gas is very harmful.

Tony finds out about safety procedures for working with chlorine gas.

(a) Put a tick (✓) in the box next to the **most** important safety procedure when working with chlorine gas.

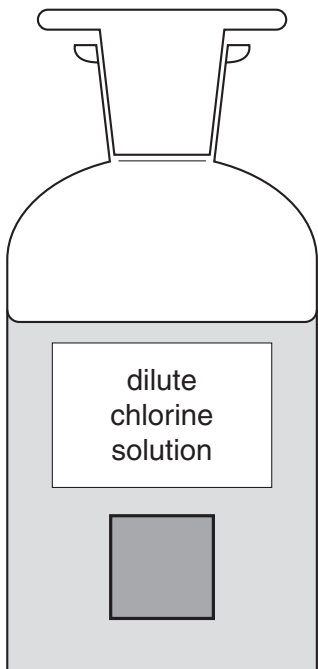




- | | |
|------------------------|--------------------------|
| wear gloves | <input type="checkbox"/> |
| wear a lab coat | <input type="checkbox"/> |
| use a fume cupboard | <input type="checkbox"/> |
| tie any long hair back | <input type="checkbox"/> |

[1]

(b) A dilute solution of chlorine is harmful, but not toxic.

Which symbol should go on bottles of chlorine solution?

Put a tick (✓) in the box next to the correct answer.

		<input type="checkbox"/>
		<input type="checkbox"/>
		<input type="checkbox"/>
		<input type="checkbox"/>

[1]

(c) Chlorine, bromine and iodine are halogens.

Some halogens will react with other halogen compounds.

Halogen added	Sodium bromide solution	Sodium chloride solution	Sodium iodide solution
Bromine	no reaction	no reaction	reaction
Chlorine	reaction	no reaction	reaction
Iodine	no reaction	no reaction	no reaction

Use the table to put the three halogens in order of their reactivity.

most reactive

.....

least reactive

[1]

(d) Chlorine reacts with sodium iodide.

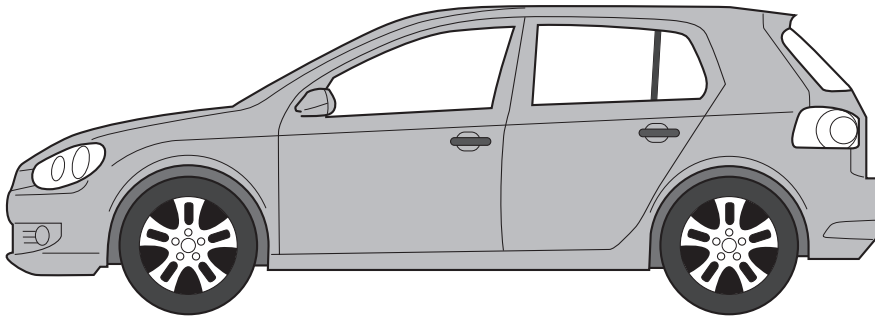
Sodium chloride and iodine are made.

Write a word equation for this reaction.

..... [1]

[Total: 4]

7 Jane chooses a new car.



(a) She takes it for a test drive.

The car seat pushes her forwards. The average resultant force on her is 200 N.

Her speed increases for 9 s.

How should Jane calculate her change of momentum?

Put a **ring** around the correct calculation.

$\frac{200}{9}$ 200×9 $\frac{9}{200}$

[1]

(b) Jane puts on the brakes.

Below are some sentences about the car as it slows down.

Put a **ring** around the correct word in **bold** to complete each sentence.

As the car slows down the counter force is **bigger** / **smaller** than the driving force.

The driving force and counter force act in the **same** / **opposite** direction.

[1]

(c) The car has air-bags, seatbelts and crumple zones.

These are safety devices.

Explain how **one** of these devices makes Jane safer.

.....

.....

.....

.....

.....

..... [3]

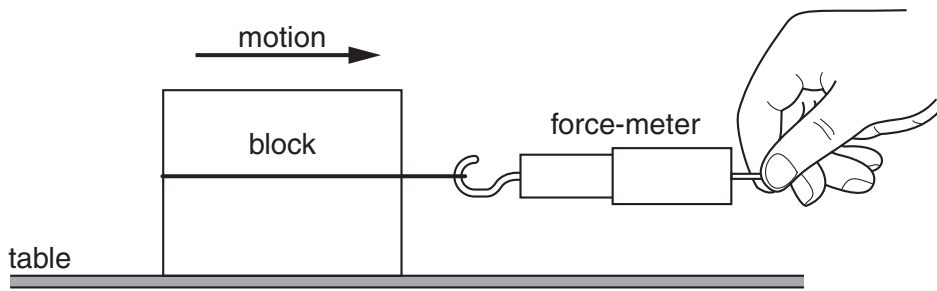
[Total: 5]

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Question 8 begins on page 14

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8 Bill investigates friction by pulling blocks across a table with a force-meter.



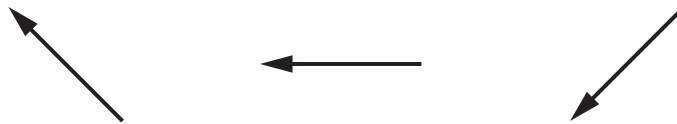
He pulls each block across the table at a steady speed.

He notes the reading of the force-meter each time.

(a) Here are some directions of forces.

The block moves to the **right**. In which direction does the friction force act?

Put a **(ring)** around the correct direction.



[1]

(b) In one experiment the force-meter reads 8.0 N.

(i) Calculate the work done when the block moves 0.6 m across the table.

work done = J [1]

(ii) Bill pulls the block across the table at a steady speed.

This increases a property of the block.

As the block moves at a **steady** speed, which of these properties **increases**?

Put a **(ring)** around the correct answer.

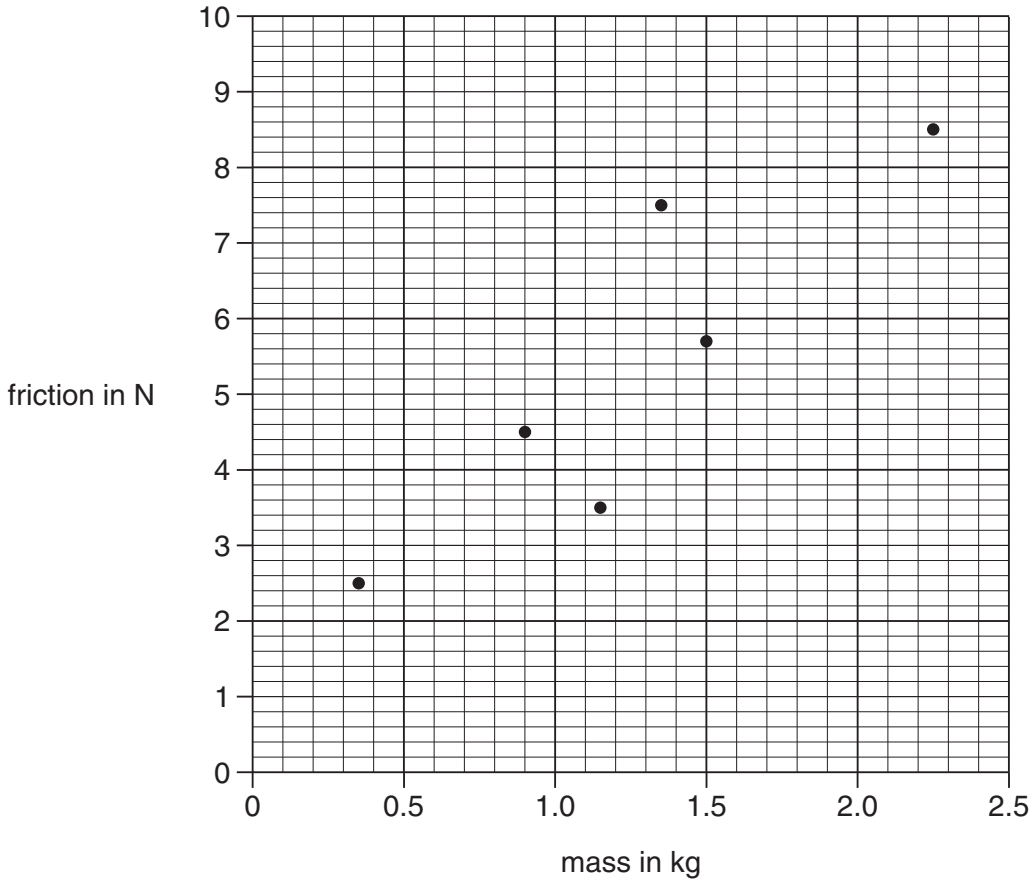
mass **momentum** **temperature** **weight**

[1]

(c) Bill repeats the experiment with blocks of different masses.

He notes the reading of the force-meter each time.

He plots the results of his experiments on a graph.



(i) Put a ring around the point on the graph for a mass of 0.9 kg.

[1]

(ii) Here are some possible conclusions for Bill's experiment.

Put a tick (✓) in the box next to the **best** conclusion.

The friction is the same for all of the blocks.

There is no link between the friction and the mass.

Increasing the mass of the block increases the friction.

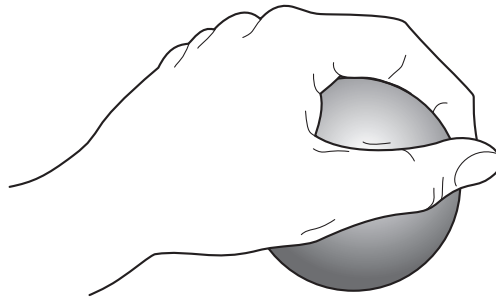
Increasing the mass of the block decreases the friction.

[1]

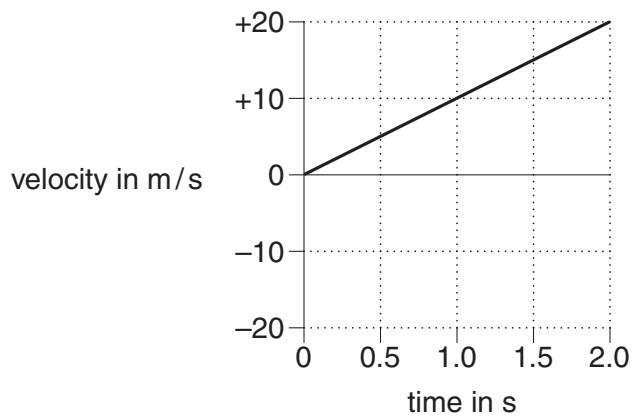
[Total: 5]

9 Chelsea stands on top of a tall building and drops a ball towards the ground.

It falls vertically and hits the ground after exactly 2.0 s.



Here is a velocity-time graph for the ball during its fall.

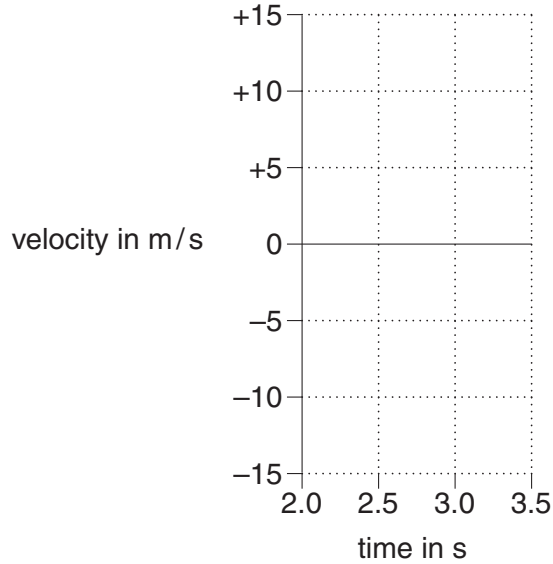


(a) What is the **average** speed of the ball on its way down?

average speed = m/s [1]

- (b) After 2 seconds the ball hits the ground and bounces upwards. It has a velocity of -15 m/s .
It slows down steadily and stops 1.5 seconds later.

Sketch the velocity-time graph for the ball after the bounce.



[2]

- (c) Complete the sentence for the ball **after** it bounces off the ground.

Choose words from this list.

decreases increases stays the same

As the ball rises through the air its gravitational potential energy

and its kinetic energy

[1]

[Total: 4]

END OF QUESTION PAPER

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