NZPQA

New Zealand Pretend Qualifications Authority

Level 1 Science AS 99999 - Demonstrate Understanding of Aspects of

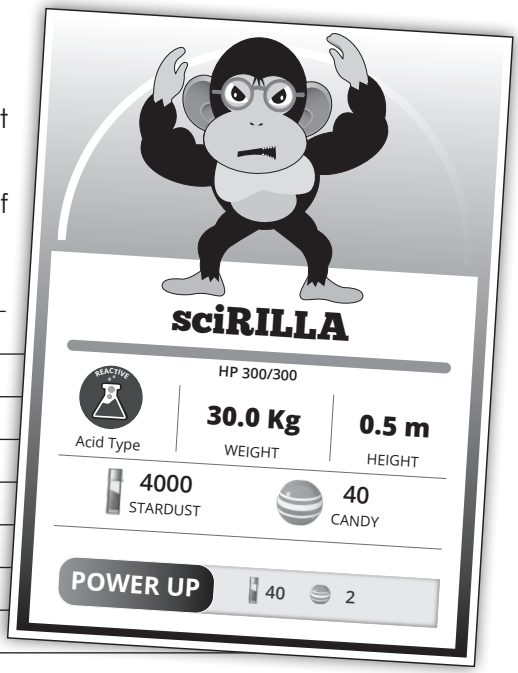
Jokémon

Gotta teach 'em all

For Assessor's use only	Achievement Criteria	
Achievement with Pichu	**Achievement with Pikachu**	**Achievement with Raichu**
Demonstrate understanding of aspects of Jokémon. ☐	Demonstrate in-depth understanding of aspects of Jokémon. ☐	Demonstrate comprehensive understanding of aspects of Jokémon. ☐
Overall Level of Performance ☐		

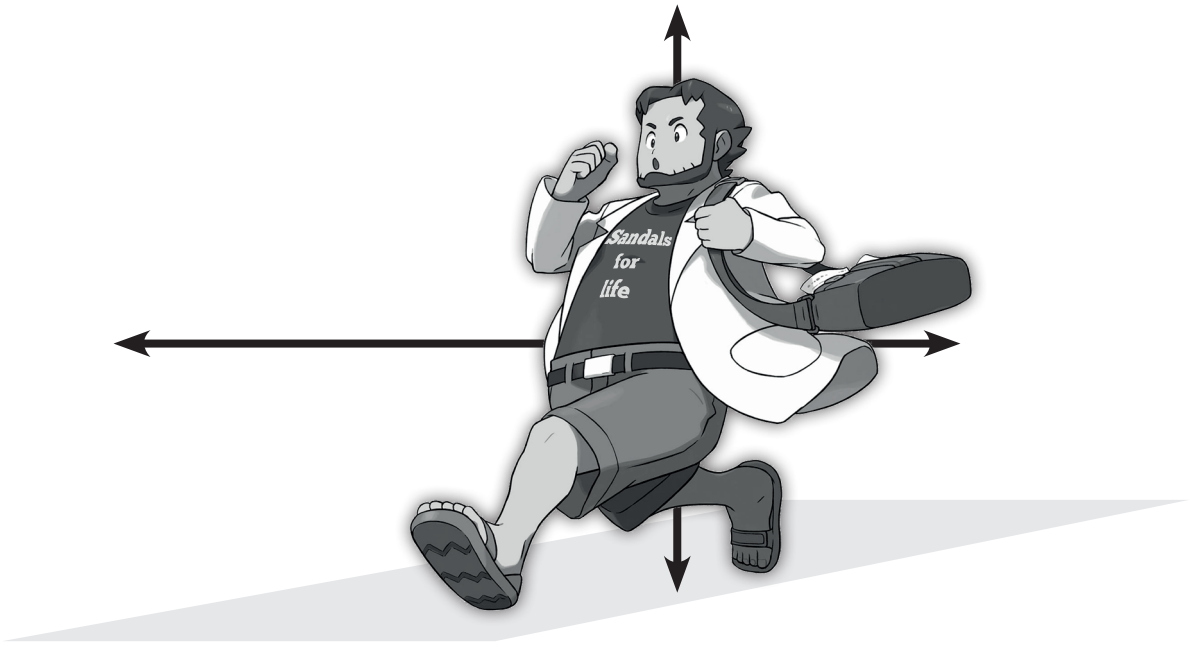
QUESTION ONE: GOTTA CATCH 'EM ALL

The card to the right is from the sciPAD Jokédex showing information about the jokémon 'sciRILLA'. On the card his *weight* is given as 30.0 kg



(a) Explain why the term '*weight*' has been used incorrectly. As part of your answer you should **calculate** his actual weight.

(b) sciRILLA is being chased by the jokémon trainer '*Teachermega-Yellmore*'. The force diagram below shows the trainer running during the chase. The vertical forces are *equal* and *opposite* (i.e. they are *balanced*). The horizontal forces are *not balanced*.

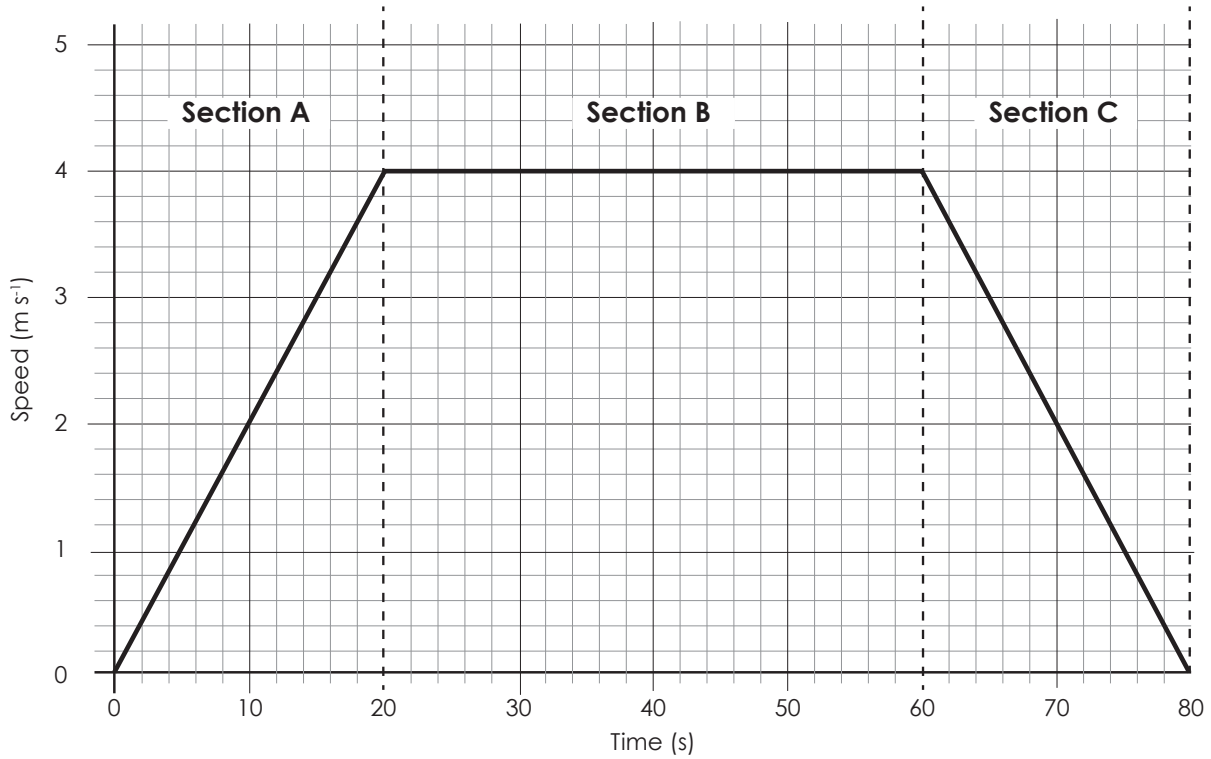


Referring to the force diagram above, explain the **link** between the **horizontal net force** acting on the trainer, and the **type of motion** produced.

In your answer you should:

- Describe what is meant by *net force*.
- Explain the link between the horizontal net force and the type of motion produced.

(c) The first 80 seconds of his chase is shown by the speed-time graph below. Use the graph to answer the questions that follow.



Describe the motion of *the trainer* through sections A, B and C. Your answers should include **descriptions** AND any relevant **calculations**.

Section A: _____

_____

_____

_____

Section B: _____

_____

_____

_____

Section C: _____

_____

_____

_____

(d) Calculate the total **distance** covered by Teachermega-Yellmore during the 80 seconds.

_____

_____

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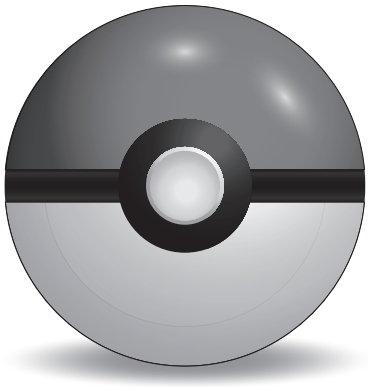
(e) Calculate Teachermega-Yellmore's average **speed** over the 80 seconds.

QUESTION TWO: JOKÉBALLS



Teachermega-Yellmore successfully captures sciRILLA with a jokéball. The jokéball now has a **mass** of 1.2 kg.

Teachermega-Yellmore picks the jokéball up from the ground and places it on a shelf that is 1.5 metres high. It takes 2 seconds to lift the jokéball.

(a) Calculate the **work** done in lifting the jokéball onto the shelf.

(b) Calculate the **power** required to lift the jokéball onto the shelf.

(c) State the **gravitational potential energy** (E_p) gained by the jokéball once it is positioned on the shelf. (*No calculation is required*).

(d) As the trainer walks away and the jokéball rolls off the shelf.

(i) State the major **energy change** that occurs as the jokéball falls.

(ii) Calculate the **speed** of the jokéball just before it hits the floor.

(e) Explain why the jokéball will actually be travelling **slower** than the speed you calculated in (d(ii)). *No additional calculations are required.*

QUESTION THREE: sciRILLA ESCAPES

Teachermega-Yellmore uses jokéballs made from sodium hydroxide (NaOH).

(a) Explain why the **ions** in sodium hydroxide combine to give the formula NaOH.

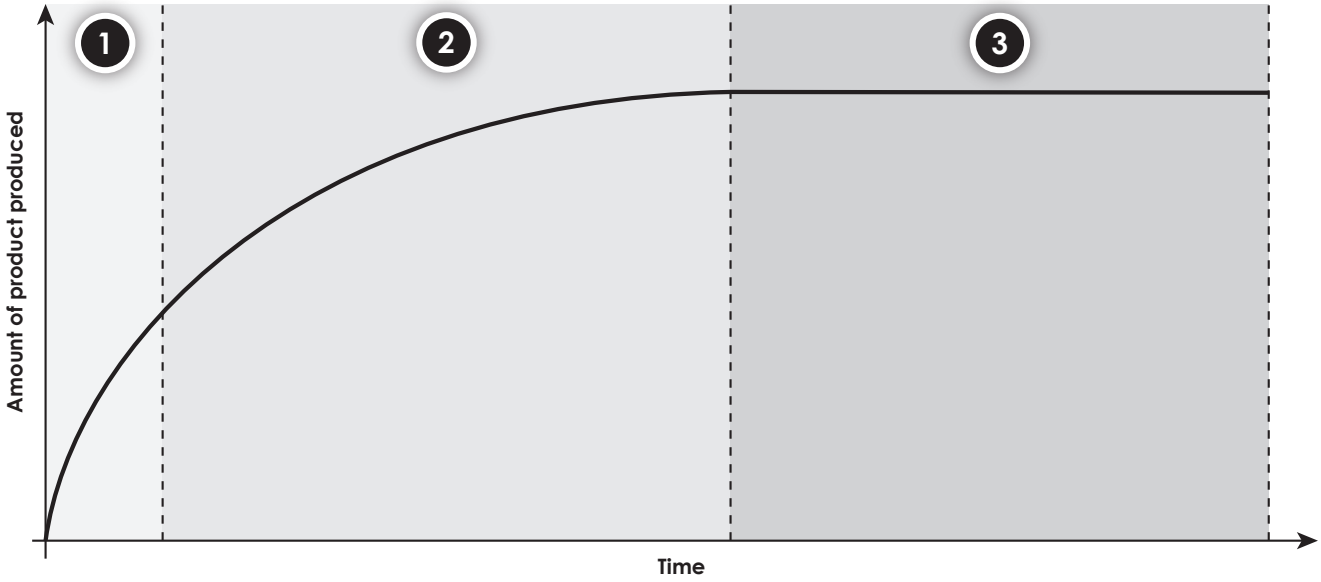
sciRILLA is an '*acid-type*' jokémon. When threatened, he is able to squirt hydrochloric acid (HCl) from his eyes. In doing so, he dissolves the jokéball.

(b) Write a word equation and a balanced symbol equation for the reaction between sciRILLAs **hydrochloric acid** and the **sodium hydroxide** in the jokéball.

Word Equation:

Balanced Symbol Equation:

The graph below shows the rate of the reaction between his acid and the sodium hydroxide in the jokéball.



(c) Explain what is happening in terms of **particle collisions** and the **rate of the reaction** in each section of the graph.

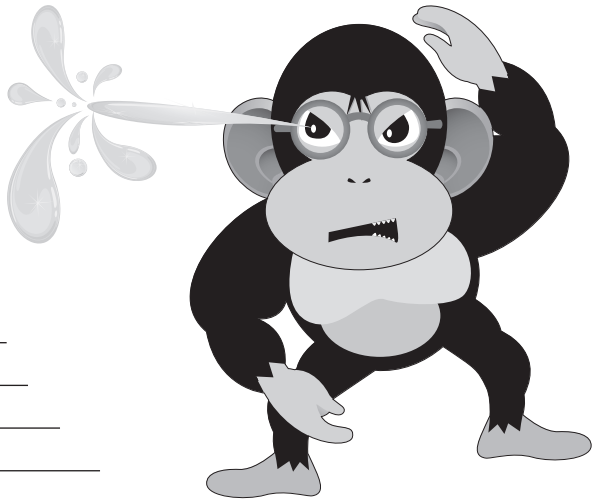
Section 1:

Section 2:

Section ❸: _____

Trainers can spend stardust and candy to powerup a jokémon. Powering up a jokémon causes them to evolve into even stronger fighters. Powering up sciRILLA causes his acid to come out at a **higher** temperature.

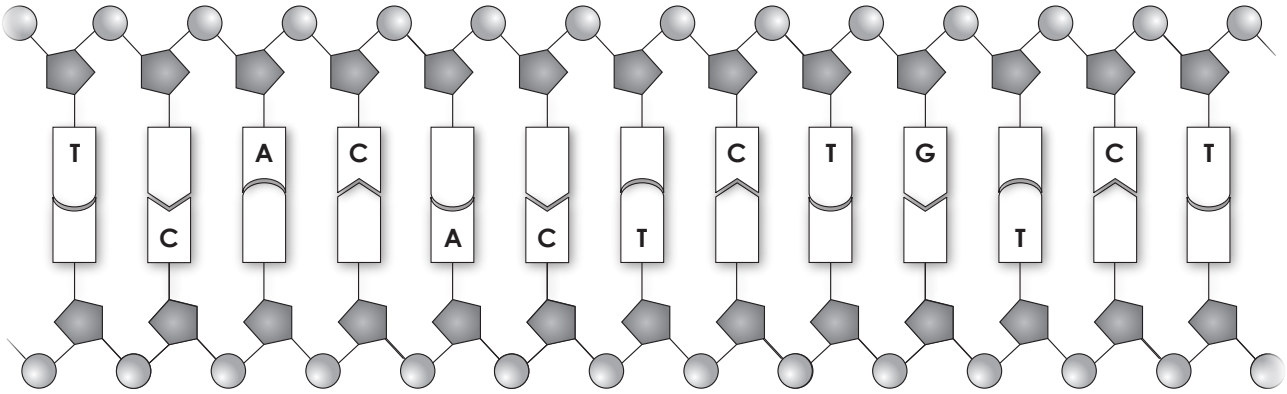
(d) In terms of **particle collisions**, explain the effect of increasing the temperature of the acid on the **reaction rate** between *hydrochoric acid* and *sodium hydroxide*.



QUESTION FOUR: BADGERTOSAUR GENETICS

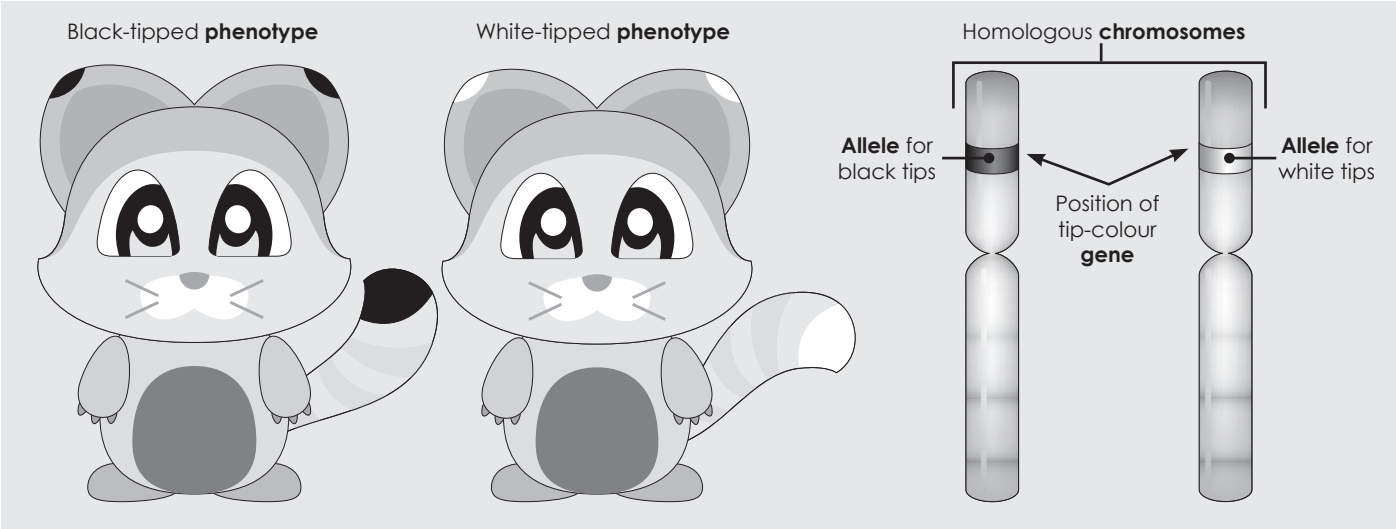
Like all living things, each jokémon has it's own set of unique genes that allows it to function in different ways. The information stored in genes is coded by DNA.

(a) Complete the diagram showing a section of DNA by adding the missing bases.



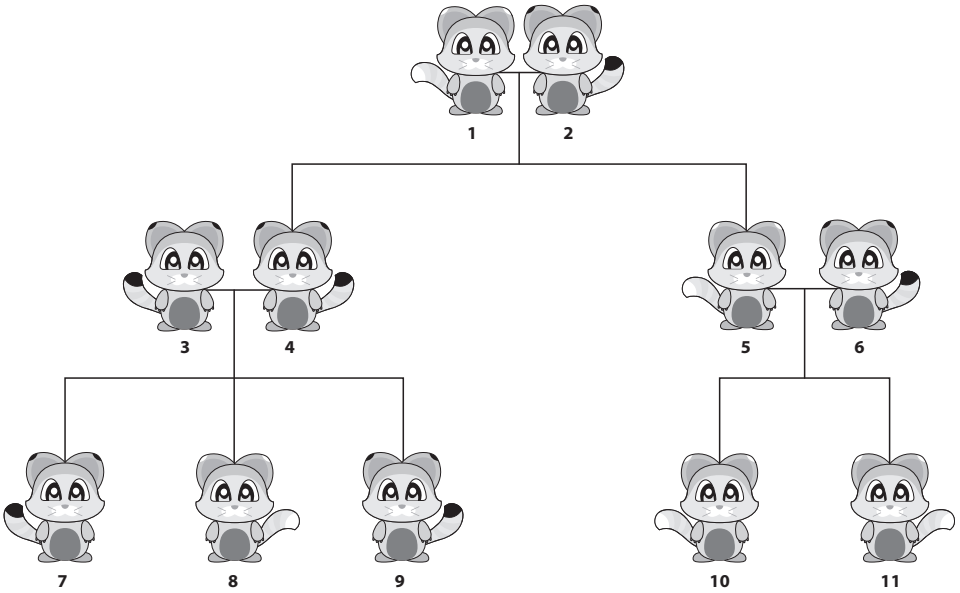
A type of jokémon called Badgertosaurs appear in two distinct forms. A **black-tipped** form and a **white-tipped** form.

The allele responsible for the black-tipped form (B) is **dominant** over the allele for white tips (b).



(b) Use the diagram above to help you explain the relationship between **chromosomes**, **genes**, **alleles**, **phenotype**, **genotype**, and the molecule **DNA**. A labelled diagram may assist you.

A badgertosaurs family tree is shown below.



Use the letters **B** and **b** to represent the alleles for black tips (B) and white tips (b).

(c) State the genotype of badgertosaur **5**. Justify your answer by explaining how you worked it out.

(d) Use the family tree to explain why badgertosaur **6** must have the genotype **Bb**.

(e) Explain why the genotypes for badgertosaurs **3** and **4** both must be **Bb**. In your answer you should:

- Draw Punnett squares.
- Explain why the genotypes of badgertosaurs **3** and **4** cannot be BB or bb.

(f) Some badgertosaurs are more susceptible to the effects of an jokémon attack than others. This is because there is genetic variation within the badgertosaur population. This genetic variation is a result of sexual reproduction.

Explain how **sexual reproduction** causes **genetic variation** AND how this leads to increased **survival** of the species.

In your answer you should consider:

- The processes of gamete formation (meiosis) and fertilisation.
- How sexual reproduction leads to variation in the population.
- The link between genetic variation and survival of a species.

You may use labelled diagrams with notes to support your answer.

SUGGESTED ANSWERS

QUESTION ONE - sciRILLA

(a) Weight is the downward force due to gravity that an object experiences due to its mass. Since it is a force, it is measured and expressed in newtons (N).

His weight can be calculated using:

$F = m\,a$

$F = 30.0\text{ kg} \times 10\text{ N kg}^{-1}$

$= 300\text{ N}$

Mass is a measure of the amount of matter that an object has. It is measured in kilograms (kg). Mass does not change when location changes while weight does. For example, if sciRILLA was on the moon his mass would not change, but the effect of the moons reduce gravity on that mass, would mean he weighs less.

(b) Net Force: When multiple forces interact, a net force is the sum (or resultant) force on that object. If the forces are pointing in the same direction, the forces add, giving a larger net force. If the forces are in opposite direction, the forces subtract, giving a smaller net force.

Net forces determine whether the trainer is accelerating, decelerating or maintaining constant speed. If the net force is pointing in the same direction as the direction of motion, he would be accelerating. If the net force is pointing in the opposite direction to the direction of motion, he would be decelerating. If there is no net force, he would maintain a constant speed (if moving) or remain stationary.

Explanation of motion: The trainer is accelerating because the forces are unbalanced and there is a net horizontal force in the forward direction.

(c) Section A: Accelerating at a constant rate for 20 seconds.

$a = \Delta v / \Delta t$

$= 4.0\text{ m s}^{-1} / 20\text{ s}$

$= 0.2\text{ m s}^{-2}$

Section B: Constant speed of 4.0 m s^{-1} for 40 seconds.

Section C: Decelerating at a constant rate for 20 seconds.

$a = \Delta v / \Delta t$

$= -4.0\text{ m s}^{-1} / 20\text{ s}$

$= -0.2\text{ m s}^{-2}$

(d) Distance travelled is found by calculating the area under the line.

Section A: Area $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 20\text{ s} \times 4\text{ m s}^{-1}$

$= 40\text{ m}$

Section B: Area $= b \times h$

$= 40 \times 4$

$= 160\text{ m}$

Section C: Area $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 20\text{ s} \times 4\text{ m s}^{-1}$

$= 40\text{ m}$

Total Area: $= 40 + 160 + 40 = 240\text{ m}$

(e) Average speed $= d / t$

$= 240\text{ m} / 80\text{ s}$

$= 3\text{ m s}^{-1}$

QUESTION TWO - JOKEBALLS

(a) $F = m\,a$

$= 1.2\text{ kg} \times 10\text{m s}^{-2}$

$= 12\text{ N}$

$W = F\,d$

$= 12\text{ N} \times 1.5\text{ m}$

$= 18\text{ J}$

(b) $P = W / t$

$= 18\text{ J} / 2\text{ s}$

$= 9\text{ W}$

(c) Gravitational potential energy gained is equal to the work done. Therefore, $E_{P(grav)} = 18\text{ J}$.

(d) (i) As the jokéball falls the gravitational potential energy is transformed to kinetic energy.

(ii) Rearrange $E_k = \frac{1}{2}mv^2$ to find v. Therefore,

$v = \sqrt{(2E_k)} / m$

$= \sqrt{(2 \times 18\text{ J})} / 1.2\text{ kg}$

$= \sqrt{(36 / 1.2\text{ kg})}$

$= \sqrt{30}$

$= 5.48\text{ m s}^{-1}$

(e) In reality there are losses of energy due to friction (air resistance). This means that some of the initial gravitational potential energy is converted into heat and sound as well as kinetic energy. As a consequence the kinetic energy is less than for an ideal case, and the ball falls slower.

Friction occurs as the ball falls, because the ball is pushing past air particles. As these air particles hit against the ball they take some of the kinetic energy. Heat and sound are also generated.

QUESTION THREE: sciRILLA ESCAPES

(a) The sodium ion has a charge of +1 and the hydroxide ion has a charge of –1. The overall charge on a compound has to be zero. Therefore, the +1 charge of sodium ion cancels out the –1 charge of hydroxide ion, and so therefore the ratio of ions is 1:1 and the formula is NaOH.

(b) Sodium hydroxide + hydrochloric acid → sodium chloride + water

$NaOH + HCl \rightarrow NaCl + H_2O$

(c) Section 1 is the start of the reaction. There is a high number of reactant particles. Therefore, there will be a large number of successful collisions. The more collisions per unit time, the faster the rate of reaction, and the more product is formed.

In section 2, there are now fewer reactants, and so there are fewer collisions per unit time. Therefore, the reaction rate will be slower so less product is being formed.

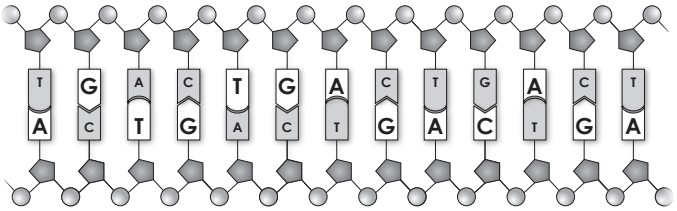
In section 3, the reaction has slowed considerably and stopped towards the end of the section. This is because one or both of the reactants has run out, so there are no particles left to react.

(d) In order for a reaction to occur, two or more particles must collide with sufficient energy.

The reaction is faster at a higher temperature because the particles have more kinetic energy as they are moving faster. When they are moving faster, there will be more frequent collisions, and more of these collisions will be effective, as the particles will collide with more energy.

QUESTION FOUR - BADGERTOSAUR GENETICS

(a)



(b) Chromosomes are made up of DNA. DNA is a large molecule that is coiled into a double helix (twisted ladder structure). Along this molecule are bases. These bases pair up; A always pairs with T, and G with C.

A sequence of bases which codes for a particular trait (e.g. tip colour) is called a gene. The different versions of each gene are called alleles. Alleles produce the different variations of each characteristic, e.g. black-tipped and white-tipped. Because chromosomes come in pairs for each trait, there will be two possible alleles. These different versions of genes (alleles) occur as the DNA base sequence is different.

This combination of alleles for each trait is called the genotype; this can be any combination of two of the available alleles. The genotype (and sometimes the effect of the organisms environment) determines the phenotype (the physical appearance) of the organism.

(c) Genotype of badgertosaur 5 = bb

If a dominant allele was present, then badgertosaur 5 would be black-tipped. Therefore they must have only both recessive alleles present.

(d) Badgertosaur 6 is a black-tipped, and so must have at least one dominant allele (B) present for black-tips to be expressed. Both of badgertosaurs 6's children are white-tipped, which means they must have both recessive alleles and be bb. Because they get one allele from each parent, and badgertosaur 5 can pass on only a recessive allele(b), this means that badgertosaur 6 must have passed on the other recessive allele.

Therefore, because badgertosaur 6 must have a dominant allele for the back-tips, they must also have a recessive allele to pass on. Therefore their genotype is Bb.

(e) Individuals 3 and 4 cannot be bb, as they are both black-tipped badgertosaurs. For them both to be black-tipped badgertosaurs, each of them must have at least one dominant allele, so this eliminates bb as a possible genotype.

It is not possible for either badgertosaurs 3 and 4 to be BB, as one of their offspring (badgertosaur 8) is white-tipped. A white-tipped badgertosaur must have the genotype bb, because if they have a dominant allele at all, they would be black-tipped.

	B	B
B	BB	BB
b	Bb	Bb

One of each allele must come from each parent, and so for the child (badgertosaur 8) to be bb, a recessive allele must have come from each parent. For this to occur, each parent must have a recessive allele. Because the parents are both black-tipped, they must each have a dominant allele, and because they both must have a recessive allele to pass on, they can only be Bb.

	B	b
B	BB	Bb
b	Bb	bb

(f) Meiosis produces gametes/sex cells which have half the normal number of chromosomes as body cells.

Meiosis leads to genetic variation via two processes. When homologous pairs of chromosomes line up during meiosis, they do so randomly. This means it is completely random which combination of alleles ends up in a particular gamete. This process is called independent assortment.

The second way meiosis leads to genetic variation is via a process called crossing over. This occurs when homologous pairs of chromosomes line up at the cell equator and swap sections of genetic material, and therefore alleles. Because of crossing over, each gamete will contain different combinations of alleles.

At fertilisation, which sperm fertilises which egg is due to chance and this results in new combinations of alleles.

Genetic variation refers to a variety of different genotypes for a particular trait within a population. The advantage of variation to a species is that it may enable some individuals to survive if some threatening event occurs (e.g. jokemon attack, disease or an environmental change). Those that survive will be able to reproduce and pass on favourable phenotypes to strengthen the species.