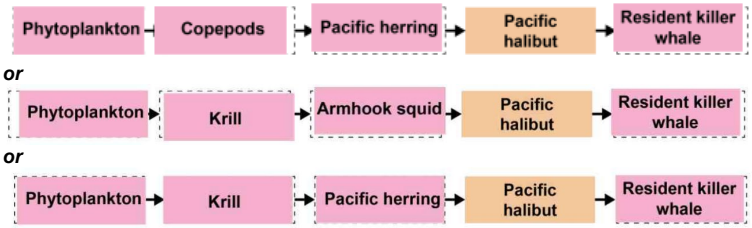
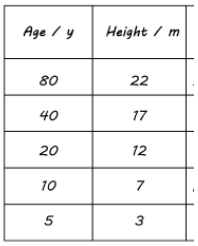
Question		Answers	Notes	Total	
1	a	Production of offspring Reproduction Permanent increase in size Growth Reaction to an internal or external stimulus Response One correct All correct		2	A
	b	***One reasonable feature, for example [max 1]*** • large size or surface area • can flap ears • thin • increased blood flow or can vasodilate ***Link to heat loss, for example [max 1]*** • large area for heat loss or evaporative cooling • can fan itself or create a breeze • smaller distance for heat exchange • increased heat exchange as blood carries heat away from body to ears	*Do **not** accept to balance body temperature*	2	A
	c	(larger surface area) means more light can be absorbed ***or*** more chlorophyll present ***or*** More stomata may be present ***Any correct justification from the list, [max 1]*** • (more) photosynthesis or glucose produced • (more) transpiration • (more) gas exchange	*Allow absorbance of CO_2, ignore reference to O_2*	2	A

	d	(smaller surface area) minimizes water loss ***or*** (cacti) can survive in areas with limited water (due to) less evaporation or transpiration	*Do **not** accept protection against being eaten*	**2**	**A**
	e	(large) surface area allows for more efficient exchange of (named) materials ***or*** heat (small) volume means fewer metabolic processes ***or*** less material required ***or*** shorter distance for materials to travel (high) SA to V ratio allows exchange rates to meet metabolic needs	*Do not award mp1 when the ratio is used.*	**3**	**A**

2	**a**	 ***or*** ***or*** All correct		**1**	**A**
	b	Killer whales feed on organisms from different trophic levels Armhook squid ***or*** pacific herring are secondary consumers ***and*** chinook salmon ***or*** pacific halibut are tertiary consumers ***or*** Killer whales are tertiary consumers when they eat armhook squid ***or*** pacific herring ***and*** killer whales are quaternary consumers when they eat chinook salmon ***or*** pacific halibut	*Mp1 can be shown through complete food chains. Allow ref to food chain in 2a.* *Mp2 gets mp1.*	**2**	**A**
	c	To reduce competition ***or*** They eat what is (abundant) in their areas	*WTTE*	**1**	**A**
	d	***Relevant differences between the whales, for example, [max 2]*** • fins size or shape • size • patches or markings • prey • communication Could stop them interbreeding However further data is needed to confirm this hypothesis	*Accept physical differences, behavioural differences, different hunting preferences, different geographical locations*	**4**	**A**

	e	(Genome mapping) compares the genetic code (of different organisms) Genetic similarities or differences can be used to decide if they are different species or not A correct use of the term base ***or*** chromosome ***or*** DNA ***or*** gene ***or*** genetic	*WTTE* *Mp2 implies mp 1* *Only award mp3 if one of the previous mp is given.*	**3**	**A** **D**
	f	(Yes) references to more than one difference between the whales ***or*** (No) not enough information or variation within a species is natural or they are still too similar	*Accept reference to sub-species or ecotype, not type.*	**1**	**A**

3	**a**	Tape measure		**1**	**B**
	b	54 years	*Check table and response box for value*	**1**	**C**
	c	***Accept any reasonable suggestion, for example [max 1]*** • values in different units will lead to incorrect estimates • depends on the units in the growth factor		**1**	**B**
	d	***Please award zero for this question***		**0**	
	e	***Accept any reasonable justification, for example [max 1]*** • wood at the top of the tree is younger • the age may be underestimated • distance between rings is bigger (so easier to count)	*ORA*	**1**	**C**
	f	Tropical one has a wider diameter ***or*** circumference ***or*** larger cross-section Faster growth due to more optimal conditions ***or*** there are fewer limiting factors Tropical one has no ***or*** less obvious growth rings Less (no) significant seasonal variation ***or*** trees grow continuously	*Accept named example, ORA* *Do not accept references to size of bark*	**4**	**C**
	g	***Accept any reasonable limitation for growth factor values, for example [max 1]*** • using growth factors only gives an estimate • growth factor values are (global) averages • growth can be affected by variables not considered in the growth factor ***Accept any reasonable limitation for counting growth rings, for example [max 1]*** • counting rings can only be done on dead trees • cannot be used for trees without growth rings (like tropical trees)	*Accept named factor like location, climate, disease or damage* *Do not accept references to human error*	**2**	**C**

4	**a**	Too long to do the whole forest (Random sample) is representative (of the forest) ***or*** avoids bias	*WTTE*	**2**	**B**
	b	***Accept any reasonable suggestion, for example [max 1]*** • use a random number generator to select coordinates on the map • drop a pin (on a map)		**1**	**B**
	c	Student B ***and*** this prediction links DV to IV ***or*** Student B and is the only one with the correct DV (measuring height)	*ORA*	**1**	**B**
	d	Given age in months ***or*** Use more significant figures ***or*** do not round (values) ***or*** Take the average height of trees for each age		**1**	**C**
	e	2 points correctly plotted All 5 points correctly plotted x axis label Age ***and*** y axis label Height Units for age and height given as y(ears) ***and*** m(etres) Title refers to age ***and*** height Title includes reference to sycamore tree	 Age / y | Height / m 80 | 22 40 | 17 20 | 12 10 | 7 5 | 3	**6**	**C**
	f	(Growth rate is) initially rapid ***or*** tree grows fast at the start (Growth rate) slows with age ***or*** plateaus (but does not stop)	*Do **not** accept references to linear or proportional relationships* *Mp2 gains mp1*	**2**	**C**

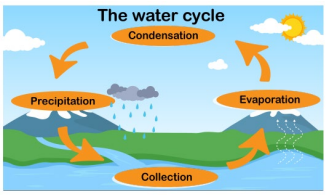
5	**a**	***IV:*** Height from which the seed is dropped ***DV:*** Time spent in the air ***Accept any two control variables, for example [max 2]*** • mass of seed ***or*** one paperclip used • length of wings • angle of wing • no wind in the testing space	*All variables must be qualified* *Accept same seed for one CV. 2nd CV must then not refer to properties of the seed*	**4**	**B**
	b	Only tested three heights Only two repeats per height	*Accept reference to number not being enough*	**2**	**C**
	c	***Accept any relevant improvement, for example [max 2]*** • increase the height • reduce the mass ***or*** size of the seeds • change the shape of the paper model • carry out the experiment outside ***Accept any correctly linked justification, for example [max 2]*** • trees are taller than 2 metres • seeds are much lighter ***or*** smaller than the paper models • (change the size) to better match the size of real seeds • (outside would give) a more realistic environment		**4**	**C**

6		16	B

	1 mark	2 marks	3 marks	4 marks	*Notes*
1.V	Explicitly states appropriate: IV ***or*** DV	Explicitly states appropriate: IV ***and*** DV	Explicitly states appropriate: IV ***and*** DV ***and*** one CV	Explicitly states appropriate: IV ***and*** DV ***and*** two CVs	*Only requirement is to state using the terminology of IV, DV and CV. No need to explain further.* *Do* ***not*** *accept reversed IV and DV.* ***Do not accept "****keeping equipment the same" as a CV.* ***Do not accept*** *calculated values as DV unless explicitly shown how calculated from measured values.*
2.H	Formulates a hypothesis connected to the variables but not explicitly linked to time	Formulates a hypothesis correctly linked to time with no explanation	Formulates a hypothesis with reasoning linked to relevant scientific ideas		*For two marks change alone is not good enough, IV and DVs need the direction of change.* *Scientific ideas might include drag, air resistance.*
3.E	Protractor ***and*** stopwatch				
4.M	Method is linked to IV ***or*** DV	Method is linked to IV ***and*** DV but is incomplete	Method linked to IV ***and*** DV and can be followed	Method linked to IV ***and*** DV and can be followed and include details on how to control main CVs	*A method that does not include how to vary the IV is incomplete and cannot be followed.* *Limited information about main CVs mean that data is unlikely to be relevant.* *If the method is repeated with a second IV, the maximum mark is 1 as there can only be one IV.*

5.D	Plans to conduct at least three trials **or** measures time for at least five different IV increments	Plans to conduct at least three trials ***and*** measures time for at least five angles	Plans to conduct at least three trials ***and*** measures time for at least five stated angles ***and*** plans to calculate averages		*The values of the five or more IV variations should be explicitly stated for 3 marks.*
6.S	A relevant comment about safety that is specific to the investigation				*Do not accept general considerations not linked to the specific investigation, e.g. wear a mask, tie hair back.* *Accept a comment about there not being any safety concerns if this is true for the planned investigation.*

7	**a**	***Excretion of waste:*** Waste builds up in the body ***or*** more water is reabsorbed (so) urine volume decreases ***or*** urine becomes more concentrated ***Temperature control:*** Sweat production decreases or less evaporative cooling (so) harder to regulate body temperature or cool down	*Accept toxins for waste.* *Accept harder stool or feces or constipation for mp1*	**4**	**D**
	b	Two arrows pointing left only Large arrow pointing left ***and*** small arrow pointing right	*Mp2 gains mp1*	**2**	**A**
	c	***Accept any two impacts on ecosystems, for example [max 2]*** • habitat destruction • space needed for equipment • disposal of concentrated waste ***Accept any two consequences of high energy use, for example [max 2]*** • emissions from fossil fuels • cost (of fuels) • fresh water produced may be expensive to buy • renewable energy source means consequences are low impact ***A concluding appraisal considering the benefits of a reliable supply of fresh water***	*Do **not** accept a decrease in sea water*	**5**	**D**

8	**a**	 All correct		**1**	A
	b	***Accept any reasonable consequence of increased precipitation, for example [max 1]*** • flooding • decrease in water quality • change in growing season • loss of habitat ***Accept any reasonable consequence of decreased precipitation, for example [max 1]*** • drought • effect on water supply (animals, humans, agriculture) • change in growing season • (fertile) land gained from lowering river levels • wildfires		**2**	D

8	**c**		**12**	D

Steps that could be taken to reduce water shortage in the home		
Mark	**Descriptor**	**Notes**
1	A statement of how water is used in the home	***Examples of statements*** • taking a shower • washing clothes • watering plants in the garden ***Examples of justifications*** • turning the shower off while using shampoo to wash your hair • using the water saving settings on the washing machine • using water left over from other task (grey water) to water the garden
2	A statement of how water is used in the home ***and*** a justification of how this use can be reduced	
3	Statements of at least two uses of water in the home ***and*** justification of how ***both*** of these uses can be reduced	

A description of how an individual's dietary choices can affect their water footprint		
Mark	**Descriptor**	**Notes**
1	A simple reference to the use of water in food production ***or*** transportation	***Examples of simple references*** • crops must be watered • 15 415 l of water are required to produce 1 kg of beef ***Examples of statements*** • meat-based diet increases water footprint • eating more vegetables reduces water footprint • buying seasonal produce decreases water footprint ***Examples of supporting evidence*** • beef requires the highest volume of water to produce 1 kg • less water is used to prepare or process the produce • less water is required to transport the food (from where it is grown)
2	A statement of the effect of one dietary choice on water footprint	
3	A statement of the effect of ***two*** dietary choices on water footprint ***and*** one supported by evidence	
4	A statement of the effect of ***two*** dietary choices on water footprint ***and*** both supported by evidence	

A suggestion of how government policies can influence water usage		
Mark	**Descriptor**	**Notes**
1	A statement of a government action	***Examples of government actions*** • educate about sustainable water use • encourage through campaigns • enforce by passing water use laws or imposing limits ***Examples of how actions would reduce water usage*** • making sustainable water use part of the curriculum would give people the tools to make sustainable decisions • subsidising water efficient technology would encourage consumers to buy it • tax or fine industries for excessive water use
2	A statement of a government action ***and*** how this would reduce water usage	
3	Two government actions ***and*** how ***both*** would reduce water usage	

Conclusion **(Concluding appraisal)**		
Mark	**Descriptor**	**Notes**
1	A basic conclusion	***Examples of a basic conclusion*** • as individuals we can make small steps to reduce the water we use daily • too much water is wasted in food production ***Examples of an appraisal*** • everyone can do their bit, but domestic usage is tiny compared to industry and agriculture. • governments actions can directly affect individual choices Imposing rules can ensure that individuals use water responsibly
2	An appraisal including actions by both individuals and groups	