scienmmoeengtz0xxm

Markscheme

May 2025

Integrated Sciences

On-screen examination

20 pages

The following are the annotations available to use when marking responses.

Annotation	Explanation
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark. For use in analytically marked questions only.
	Omission, incomplete
CON	Contradiction
	Valid part (to be used when more than one element is required to gain the mark)
	Error carried forward
	Dynamic annotation, it can be expanded to surround work
	Underline tool (can be expanded)
	Highlight tool that can be expanded to mark an area of a response

Annotation	Explanation
	Not good enough
	The candidate has given a response but it is not worthy of any marks
	Text box used for additional marking comments
	Seen; must be stamped on all blank response areas and on duplicate pages of concatenated responses
	Vertical wavy line that can be expanded
	Words to that effect
	Award 1, 2, 3, 4 marks. For use in holistically marked questions only

Marking instructions

1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses. Do not deduct marks for spelling errors.

2 Follow the markscheme provided and award only whole marks.

3 Each marking point appears on a separate line.

4 The maximum mark for each subpart is indicated in the "Total" column.

5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.

6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.

7 A question subpart may have more marking points than the total allows. This will be indicated by the word "***max***" in the Answer column. Further guidance may be given in the Notes column.

8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.

9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.

10 Alternative answers are indicated in the Answer column by "***or***". Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.

11 If two related points are required to award a mark, this is indicated by "***and***" in the answer column.

12 Words in brackets ( ) in the Answer column are not necessary to gain the mark.

13 Words that are underlined are essential for the mark.

14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA (or reverse argument)* in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.

15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE (or words to that effect)* in the Notes column.

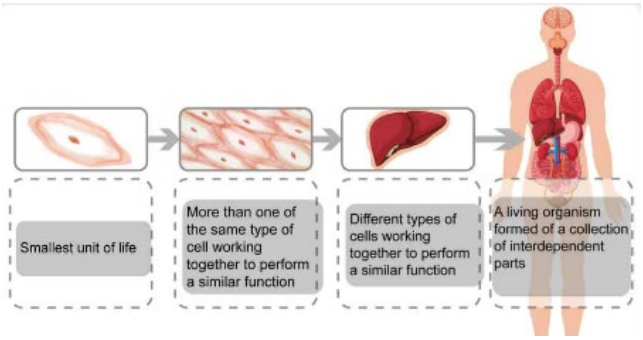
16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add ECF (error carried forward) to the candidate response.

17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.

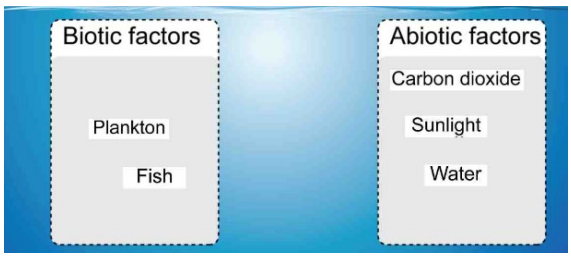
18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.

19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.

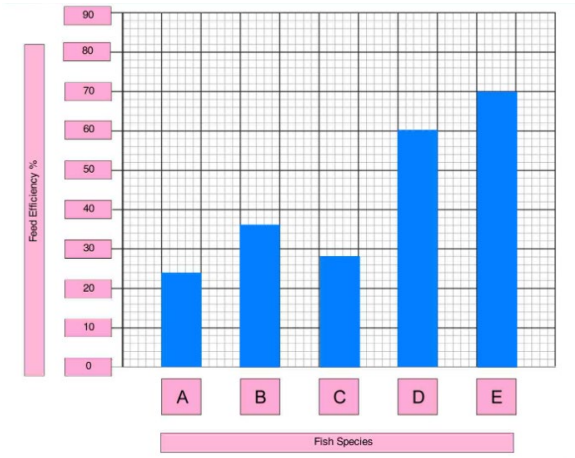
20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

Question		Answers	Notes	Total	
1	a	 All correct		1	A
	b	Mitosis		1	A
	c	***Accept any one of the following, [max 1]*** • gases <u>at room temperature</u> • colorless/odorless • low boiling points/low density • poor conductor of heat/electricity • exist as diatomic molecules		1	A
	d	(Single) covalent bond is formed By sharing of electrons To complete outer shell for both elements ***or*** to complete duet for H and octet for O ***or*** To become (more) stable		3	A

	e	***Accept any one of the following, [max 1]*** • UV • X-ray • gamma ray • infrared • microwave • radiowaves		**1**	A
	f	Lasers have only one wavelength ***or*** frequency ***or*** one colour In a laser, waves ***or*** peaks are aligned ***or*** in phase ***or*** coherent	*ORA Accept monochromatic, do not accept references to amplitude* *ORA*	**2**	A
	g	***Accept any reasonable safety precaution, for example [max 1]*** • wear protective eye wear • wear protective clothing • cover the eyes • remove shiny/reflective objects	*Accept safety glasses **or** goggles*	**1**	A

2	**a**	 All correct		**1**	A
	b	Plankton		**1**	A
	c	Plankton – krill – baleen whale – orca ***or*** Plankton – krill – penguin – orca ***or*** Plankton – krill – penguin- polar bear or Plankton – krill – silverfish – seabirds		**1**	A
	d	Number of organisms decreases as trophic level increases ***or*** Negative correlation between organisms and trophic level Number of (top) predators is less than other organisms using data ***or*** information from the graph Reference to loss of energy ***or*** inefficient transfer of energy (as you go up trophic level) ***Correct use of any of the following terms:*** trophic level, predator, producer, prey, consumer	*ORA* *Award mp1 even if scientific language is not used* *Do not award mp4 unless at least one other mark is awarded*	**4**	A D

	e	(through) <u>convection</u> (Heat from scientist bodies' warms the surrounding and) warm air rises to the top of the shelter Colder air (is denser and) sinks (replacing the warmer air)	*Do not accept heat rises*	**3**	D A
	f	A		**1**	A
	g	All correct $\mathbf{4}Fe + \mathbf{3}O_2 \rightarrow \mathbf{2}Fe_2O_3$		**1**	A
	h	***Accept any of the following, [max 1]*** • heat is being released • colour change • temperature (of the surroundings) change or increases		**1**	A

3	**a**	***Any two from:*** proteins, lipids/fats, vitamins, carbohydrates, minerals	*Accept specific examples for any two nutrients*	**1**	A
	b	36 (%)		**1**	C
	c	A ***and*** B ***and*** C	*No ECF from part b*	**1**	C
	d	 Y axis label feed efficiency ***and*** unit % ***and*** X axis label as fish species Scale of y axis, going up to at least 80, with even increments and includes zero Data correctly plotted as <u>bar chart</u> for at least four fish types	*Do not accept scatter graph for mp3 only, mp1 and mp2 can be awarded* *ECF from part b*	**3**	C

	e	(Invalid) (Although all fish were given the same mass of food) they showed different feed efficiencies Different species have different nutritional needs Use of data for at least two types of fish ***and*** their feed efficiency to support the answer	*Do not award any mark for the radio button, award zero marks for part e if valid is selected*	**3**	C

4	**a**	How does the <u>temperature of water</u> affect the <u>number</u> of (hatched) cysts ***or*** brine shrimp		**1**	B
	b	IV temperature of water DV number of <u>hatched</u> cysts ***or*** brine shrimps		**2**	B
	c	***Accept any two reasonable CV, for example [max 2]*** • concentration of salt in water • light level ***or*** light intensity ***or*** light brightness • mass of cysts • mass of salt • number of cysts • oxygen level • pH level • source of water • volume of water	*Do not accept same equipment or room temperature* *Do not accept "amount" of water or salt or light* *Do not accept "time" as a CV as this is stated in the question*	**2**	B
	d	At temperatures above the range metabolic processes decrease ***or*** reaction rate decreases ***or*** enzymes denatured (so) cysts would not hatch ***or*** would be killed At temperatures below the range, metabolic processes decrease ***or*** reaction rate slows down ***or*** enzymes are less efficient (so) cysts may not hatch ***or*** hatching would be slower ***or*** would fail to develop ***or*** would remain dormant	*WTTE* *Do not award mp2 unless mp1 is awarded* *Do not accept freeze* *Do not award mp4 unless mp3 is awarded*	**4**	B

	e	Headers with units appearing in headers only Data in increasing ***or*** decreasing temperature order All data expressed as numerals with correct number of decimal places Value at 25°C is 6 (cysts)		**4**	C
	f	6x100) / 0.05 - Correct calculation 12 000	*Award mp1 if calculation is correct but incorrect final value* *Award full marks if 12 000 is shown without calculation*	**2**	C
	g	Avoid contact between water and electricity To prevent electrocution		**2**	B
	h	***Accept any weakness [max 1]*** • only one trial (at each temperature) • only one drop of water was used • difficult to differentiate between hatching and unhatched eggs ***Accept any correctly linked improvement, for example [max 1]*** • conduct further trials and take an average • use more drops of water so sample is more representative • repeat and take an average	*Do not award mp2 unless mp1 is awarded*	**2**	C C
	i	***Accept any reasonable ethical concern, for example [max 1***] • when using living organisms, all variables should be in the limits of their normal range • reference to abnormal conditions ***or*** stress • not in their natural habitat	*WTTE*	**1**	B

5			**16**	B

	1 mark	2 marks	3 marks	4 marks	*Notes*
V	Explicitly states mass of fish food as IV ***or*** (final) length as DV	Explicitly states mass of fish food as IV ***and*** (final) length as DV	Explicitly states mass of fish food as IV ***and*** (final) length as DV ***and*** one CV ***Examples of CV*** • initial length • water temperature • salt concentration or mass • type of fish (species) • type of food • pH of the water • oxygen concentration/level • size of the tank • volume of water • frequency of feeding • light intensity ***or*** brightness	Explicitly states mass of fish food as IV ***and*** (final) length as DV ***and*** two CVs ***Examples of CV*** • initial length • water temperature • salt concentration or mass • type of fish (species) • type of food • pH of the water • oxygen concentration/level • size of the tank • volume of water • frequency of feeding light intensity ***or*** brightness	*Only requirement is to state using the terminology of IV, DV and CV. No need to explain further* *Do not accept time (1 month) as CV as it is stated in the stem* *Do not accept "size of the fish" instead of length as DV* *Do not accept calculated values as DV unless explicitly shown how calculated from measured values*
H	A simple hypothesis linking IV ***and*** DV (if, then)	A hypothesis linking IV ***and*** DV ***and*** an explanation (if, then, because)			*Accept any other DV relating to length eg growth, mass, size for this mp* *(If, then and because) as structure is not required for the marks*

E	Specified equipment considers IV ***or*** CV eg IV balance Measurable CV (linked to one of their CV)	Specified equipment considers IV ***and*** at least one measurable CV			*Accept any other DV relating to length eg growth, mass, size for this mp* *Equipment needs to be correct for the given situation and stated CVs.* *Do not accept ruler as this equipment is mentioned in the question* *Accept "scale"* *Equipment could be found in the method*
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 or monitor main CVs	*Accept any other DV relating to length eg growth, mass, size for this mp* *A method that does not include how to vary the IV is incomplete.* *Details on how to measure IV and DV with balance and ruler needed for 4 marks* *Limited information about CVs mean that data is unlikely to be relevant*
D	Any reference made to different variations of the IV	At least five variations of the IV ***or*** at least three trials	At least five values of the IV ***and*** at least three trials	At least five values of the IV ***and*** at least three trials ***and*** takes an average	*The values of the five or more variations should be explicitly stated for 3 or 4 marks* *Do not accept using 3-5 fish as trials*

6	**a**	6 breaths Breathing rate = 36 (breaths per minute)	 *Award full marks if 36 is seen*	**2**	C
	b	Data point at temperature =13 (°C) ***or*** 40 (breaths per minute)		**1**	C
	c	Breathing rate increases until 23-24 ***or*** Increases to a maximum of 59-62 breaths per minute Then begins to decrease	*Accept any answer in the range for mp1. Data is required to award the mark*	**2**	C
	d	Breathing rate decreases Fish dies ***or*** rate of respiration decreases ***or*** metabolic processes decrease	*Accept breathing rates between 0 and 5 bpm for mp1*	**2**	C
	e	Accept any value between 9.1 and 8.3 ($mgdm^{-3}$)		**1**	C

7	**a**	Using cell phones distracts drivers as take their eyes off the road Reaction time is increased ***or*** delayed reaction time So, it takes longer time ***or*** longer distance to stop the car	*WTTE*	3	D
	b	***Any reasonable environmental factor related to the weather, for example [max 1]*** • rain • fog • ice • high temperatures ***Any correctly linked justification, for example [max 1]*** • poor visibility • slippery road surface • disorientation • rubber in tires to melt ***Any reasonable car-related factor, for example [max 1]*** • braking malfunction • worn tires • headlights malfunction ***Any correctly linked justification, for example [max 1]*** • longer stopping distance • reduce traction ***or*** blowouts • loss of control • crash can happenreduce field of vision	*Accept factor and justification in any of the corresponding boxes* *Do not award mp2 or mp4 if the factor is not clearly stated* *Do not accept trees falling due to wind, the presence of animals due to environmental factors or potholes*	4	D

8	**a**	***For use with English responses only*** Convert time from nanoseconds to seconds 1.5 x 10^{-8} (s) Total distance = 4.5 (m) Correct final answer 2.25 (m)	*Award full marks for correct final answer, accept 2.3 (m)*	**3**	A
8	**a**	***For use with French and Spanish responses only*** Convert time from nanoseconds to seconds 1.5 x 10^{-9} (s) Total distance = 0.45 (m) Correct final answer 0.225 (m)	*Award full marks for correct final answer, accept 0.23 (m)*	**3**	A

8	**b**		**14**	D

Explanation of how these systems and technologies work together to affect road safety		
	Descriptor	**Examples**
1	A statement about a specific system	**Statements** • radar detects the distance of different objects and avoids collisions using radio waves • lidar sensors create a 3D map of the environment and identify different objects and their shapes, and identify road markings and the edge of the road • GNSS or GPS is used for positioning and navigation, communicating with other SDCs, and getting data from them • cameras capture visual information, traffic lights, and 360 degrees of perspective • ultrasonic radar detects nearby cars or kerbs using sound waves and helps in parking **Support** • (radar exceeds human capability) as detection of distance is more accurate than with humans • (lidar exceeds human capability) as it provides precise information about the shape and the distance of big/small objects and highly accurate points even in darkness • (GNSS or GPS exceeds human capability) as it provides with precision the location and the most efficient routes to get to the destination/automatically call for assistance after an accident • (cameras exceed human capability) by allowing the car "to see" lane markings, traffic lights, road signs, pedestrians, cyclists, and other vehicles (ultrasonic radar exceeds human capability) as it calculates the distance to an object with high precision or works in darkness or any weather condition
2	A statement with further support ***or*** Two statements about specific systems	
3	Two statements about specific systems with further support for one	
4	Two statements about specific systems with further support for both	

Ethical consequences of a self-driving car making decisions normally made by humans		
	Descriptor	**Examples**
1	A statement	**Statements** • programming cars to make life-or-death decisions • who is responsible of making the decisions? • defective data can lead to dangerous outcomes • SDC is better than a drunk driver • shifting responsibility • privacy data **Support** • not appropriate for SDC to make life or death decisions • prioritize safety of passengers/pedestrian/other vehicles • accidents caused by autonomous systems complicate liability, • extensive data collection creates privacy risks concerning its use and security • machine is not affected by human errors or human factors • who is responsible if someone is killed in an accident • professional drivers and the need for transparency in decision-making are significant ethical and societal challenges.
2	A statement with further support ***or*** Two statements	
3	Two statements with further support for one	
4	Two statements with further support for both	

<table>
<tr><td colspan="3">Positive and negative economic impacts of self-driving cars</td></tr>
<tr><td></td><td>Descriptor</td><td>Examples</td></tr>
<tr><td>1</td><td>A positive or a negative impact</td><td rowspan="4">Positive impacts
• reduced accident costs
• increase productivity
• lower transportation costs/no need of drivers
• enhanced mobility
• new industries/tech jobs
• less cost in transportation

Support
• fewer accidents mean significant savings in property damage, injuries, and fatalities.
• commuting time becomes productive, and smoother traffic flow saves time
• reduced labour/fuel costs for businesses.
• greater independence for those unable to drive themselves.
• creation of jobs in tech development, manufacturing, and support of autonomous vehicles.
• better road and parking space utilization through efficient traffic flow and automated parking.

Negative impacts
• job displacement in transportation/reduce associated jobs
• high Initial costs/more expensive to purchase and maintain
• cyber-attack-economic costs as malfunction
• increased Infrastructure investment needs
• initial research is very expensive

Support
• professional drivers would lose their jobs/unemployment
• advanced tech is expensive to maintain, repair
• vulnerable to cyberattacks that could lead to vehicle malfunctions, theft
• transition period may require significant investment in new infrastructure, such as smart roads, communication networks, and charging stations,
• reduced road repairs from accidents
• development of tech needs qualified staff</td></tr>
<tr><td>2</td><td>A positive and a negative impact
or
A positive or a negative impact with support for one</td></tr>
<tr><td>3</td><td>A positive and a negative impact

with support for one</td></tr>
<tr><td>4</td><td>A positive and a negative impact

with support for both</td></tr>
</table>

Conclusion (Concluding appraisal)		
	Descriptor	**Notes**
1	A concluding opinion	Justification should include links to themes discussed above
2	A concluding appraisal with justification	