NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

MARINE SCIENCES: PAPER II

MARKING GUIDELINES

Time: 2½ hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

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SECTION A

QUESTION 1

1.1 Multiple-choice

1.1.1	A	1.1.6	C
1.1.2	B	1.1.7	B
1.1.3	D	1.1.8	D
1.1.4	A	1.1.9	C
1.1.5	C	1.1.10	D

1.2
1.2.1 Homodontic
1.2.2 Olfactory
1.2.3 Melon
1.2.4 Tapetum
1.2.5 Bioluminescence
1.2.6 Branchiostegal membrane
1.2.7 Odontoceti/odontocetes
1.2.8 Otoliths
1.2.9 Denticles
1.2.10 Spiral valve

1.3
1.3.1 C
1.3.2 B
1.3.3 C
1.3.4 C
1.3.5 C

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SECTION B

QUESTION 2

2.1
- Shark livers are highly nutritious, containing large quantities of oils, fats and vitamins, lipids.
- Their buoyant nature makes them easily accessible to orcas.
- Targeting shark livers provides a full meal without the wear and tear associated with tearing apart shark bodies.
- Liver has the highest energetic yield.

2.2 They have rare and distinct collapsed dorsal fins and they are named for the nautical terms, as Port's fin collapses left and Starboard's collapses right.

2.3 The absence of top predators like sharks could lead to cascading effects, impacting the behaviour of prey species and disrupting the balance of the local ecosystem. With no great white sharks restricting Cape fur seal behaviour, the seals can prey on endangered African penguins or compete for the small pelagic fish they eat. Displacement of shark populations have a direct impact on populations of prey in the areas that they have now been displaced to.

2.4 Studying orcas around South Africa is challenging due to their transient nature, **and** scientists are unsure where the next attack will occur.

2.5 Video footage of Starboard performing the shark-liver extraction technique in the presence of other orcas raises questions about the potential spread of this behaviour within the orca population as they can learn from each other.

2.6 Humans are showing a greater interest in these animals.
Digital cameras and cell phones are commonplace, so encounters can be documented very easily.
Social media can spread information very quickly.

2.7 $\frac{30 \times 100}{53} = 56,6\%$

2.8 White sharks have left the area where these businesses operate, to avoid the orcas OR the white sharks were eaten by orcas, therefore, the population size / decreased / the sharks disappeared.

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2.9 Reasons for Human Intervention

Ecosystem Balance
Prevent Cascading Effects: The removal of top predators like great white sharks can lead to imbalances, affecting prey species and the overall ecosystem.
Protect Endangered Species: With great white sharks declining, prey species like the endangered African penguins may face increased predation from other predators like Cape fur seals.

Biodiversity Conservation
Maintain Biodiversity: Preserving great white shark populations helps maintain marine biodiversity and ecological health.

Research and Monitoring
Scientific Understanding: Intervention could provide more opportunities for research and monitoring of orca and shark interactions, enhancing scientific knowledge.

Reasons Against Human Intervention

Natural Behaviour
Ecological Roles: Orcas and sharks have coexisted for millions of years, and their interactions are part of natural predatory behaviour.
Evolutionary Processes: Intervening in natural predation can disrupt evolutionary processes and natural selection.

Practical Challenges
Logistical Issues: Implementing effective interventions in the open ocean can be logistically challenging and resource-intensive.
Unintended Consequences: Human intervention might lead to unforeseen ecological consequences, potentially harming other marine life.

Ethical Considerations
Non-Interference: Some argue that humans should not interfere with natural wildlife behaviours and ecosystems.
Animal Welfare: Interventions might cause stress or harm to both orcas and sharks, raising animal welfare concerns.

Lack of Long-Term Solutions
Temporary Fixes: Interventions may only provide short-term solutions and fail to address underlying ecological issues.
Complex Ecosystems: Marine ecosystems are complex, and targeted interventions may not effectively resolve broader ecological problems.

Economic Consequences

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QUESTION 3

3.1 **The answer must not be in the form of a table as the question says 'describe'.**

Defensive Strategies of Echinoidea (Sea Urchins and Sand Dollars)

Pentaradial symmetry of the nervous system is ideal for slow-moving animal – for detecting predators in all directions.

Mechanical Defence:
Sharp Spines:
- Sea urchins and sand dollars possess moveable sharp and venomous spines.
- Spines act as a physical deterrent against predators, such as fish, crabs, and birds.

Pedicellariae:
- Pincer-like structures actively capture and deter small organisms.
- May be venomous.
- Provide an additional layer of mechanical defence against potential threats.
- Can camouflage by carrying pieces of algae and debris.
- Endoskeleton of tightly fitting plates to form test.

Chemical Defence:
Venomous Substance Release:
- Venomous substances are released from spines, enhancing chemical defence.
- Deters predators and provides a chemical shield against predation.

Behavioural Defence:
Senses – sea urchins lack eyes but can see with their tentacle-like tube feet.

Active Avoidance:
- Sea urchins exhibit a defensive response by actively avoiding threats.
- Seek shelter in crevices or under rocks, displaying a behavioural strategy to escape predation.
- Change body stiffness – jelly -difficult for predator to grasp.

Hiding:
- Sand dollars can bury themselves in the sand to avoid detection.
- Behavioural adaptation to evade predators and minimise the risk of predation.

Defensive Strategies of Holothuroidea (Sea Cucumbers)
Pentaradial symmetry although bilaterally symmetrical – less able at detecting predators in all directions.

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Chemical Defence:
Holothurin Release:
- Sea cucumbers release a toxin.
- Acts as a potent chemical deterrent against various predators, including fish and crustaceans.

Behavioural Defence:
Camouflage Techniques:
- Sea cucumbers exhibit adaptive colour changes and variations in body shape and texture.
- Attach to substrate with multiple rows of tube feet – difficult to prise off the surface.
- Camouflage allows them to blend into their surroundings, reducing the risk of detection by predators.
- Cuvierian tubules – creating a sticky network composed of elongated tubules – entangle predator.

Evisceration:
- Expulsion of internal organs when threatened.
- Serves as a distraction, deterring predators while the sea cucumber escapes.

Mechanical Defence:
Spiky Tentacles:
- Some species have spiky tentacles that can be extended as a defensive measure.
- Physical deterrent against predators attempting to consume or manipulate the sea cucumber.
- Lack of calcareous endoskeleton – tough outer layer.

3.2 3.2.1 Madreporite

3.2.2 A malfunction in the madreporite, which regulates the entry of seawater into the water vascular system, would disrupt the balance of water pressure within the system. This could lead to inadequate pressure in the tube feet, impairing their ability to extend and contract properly and thus severely hindering the sea urchin's movement.

3.2.3 The sea star everts the pyloric stomach out of its mouth and digests the food externally, absorbing nutrients directly through its stomach walls, which simplifies its digestive system. Consequently, they produce minimal waste, reducing the need for an anus.

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3.2.4 The dual stomach system in sea stars provides significant advantages in terms of flexibility and specialization. The cardiac stomach's ability to evert and externally digest prey allows sea stars to consume large or hard-shelled organisms that would be difficult to handle internally. This external digestion also means that initial breakdown occurs outside the body, saving space and potentially reducing the risk of damage from sharp or large prey items.

The pyloric stomach, supported by the gastric caeca, handles further digestion and absorption internally, allowing a more controlled and efficient nutrient extraction process.

QUESTION 4

	Feature	**Sea snake**	**Sea eel**
4.1	**Class**	Reptilia	Pisces
4.2	**Breathing mechanism**	Breathes air using lungs.	Extracts oxygen from water using gills.
4.3	**Body shape**	Cylindrical body with paddle-like tail.	Elongated, body flattened laterally to aid swimming.
4.4	**Reproduction**	Gives birth to live young or lays legs on land. Oviparious.	Reproduces through egg laying in the ocean.
4.5	**Fins**	Lacks paired fins but has paddle-like tail.	Possesses paired and unpaired fins for locomotion.

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QUESTION 5

5.1 Have a cartilaginous skeleton, notochord.

5.2 Skin lacks scales, no diffusion barrier.
The skin is also filled with a third of the body's blood volume readily available transport system.

5.3 The hagfish's ability to absorb dissolved organic matter through their skin and gills allows them to efficiently utilise available nutrients in their environment, which would not be available to other organisms, providing a significant survival advantage in nutrient-scarce conditions. Expend less energy as nutrients already dissolved.

5.4 They are jawless and do not have teeth that can grasp or bite larger prey. Eyes do not form image – difficult to catch larger prey.

5.5 Frequently burrow in mud where image forming eyes would be of no use in muddy water
they primarily inhabit dark, deep-sea environments where vision is less useful
they rely on other highly developed senses, such as their acute sense of smell and touch, to locate prey and navigate their surroundings

5.6 Hagfish protect themselves from predators by producing copious amounts of slime when threatened, which can clog the gills of attacking fish and deter or incapacitate the predator, allowing the hagfish to escape.
The skin of hagfish has a loose attachment to muscles, aiding in escaping predators by slipping out of their grasp.

5.7 Hagfish play a crucial role in marine ecosystems by scavenging dead animals on the seabed, with their populations sometimes exceeding 50 000 individuals per square kilometre. This high density allows them to efficiently recycle nutrients by feeding on soft rotting carcasses and even consuming soft tissues from within large carcasses like dead whales. Their ability to absorb dissolved organic matter through their skin and gills further enhances their role in nutrient cycling and ecosystem maintenance.

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SECTION C

QUESTION 6

Marine Birds

- **Endothermy**
  - Marine birds are endothermic, maintaining a constant internal body temperature regardless of external conditions – homeothermic.
  - High metabolic rate generates heat internally.
  - Increased food intake provides energy for thermoregulation.
  - Constant body temperature allows for active hunting and long-distance migration.
  - Able to brood young with body heat.
  - Capable of living in wide range of temperature habitats.

- **Feathers**
  - Provide insulation by trapping air and maintaining body heat.
  - The outer layer of feathers repels water, while the inner down feathers trap air, creating an insulating layer that retains body heat.
  - Waterproofing through preen gland secretions keeps feathers dry and effective for insulation.

- **Counter Current Heat Exchange**
  - Blood vessels in the legs and feet exhibit counter current heat exchange, this system minimizes heat loss by allowing warm arterial blood to transfer heat to the cooler venous blood returning from the extremities, thus conserving core body temperature.
  - Minimizing heat loss in cold water – common in wading birds and penguins flippers and legs.

- **Behavioural Adaptations**
  - Seek shelter and huddle in groups to conserve heat – small surface area to volume ratio.
  - Bask in the sun to absorb heat – dark colour of feathers.
  - Penguins brooding eggs on feet off ice.

- **Blubber**
  - Some species, like penguins, that do not fly have a layer of blubber for additional insulation.

- **Vasoconstriction and Vasodilation**
  - Adjust blood flow to extremities to conserve or dissipate heat as needed.

Marine Reptiles

- **Ectothermy**
  - Marine reptiles are ectothermic, which rely on external heat sources to regulate their body temperature where body temperatures fluctuate with the environment (poikilothermic).

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- **Behavioural Thermoregulation**
  – Basking and Behavioural Thermoregulation: Marine reptiles often bask in the sun to absorb heat and elevate their body temperature. For example, sea turtles frequently come ashore to bask, while marine iguanas bask on rocks heated by the sun – dark colour for heat absorption – Galapagos iguana. Dive for graze algae.
  – Shuttling Between Environments: Marine reptiles often move between different thermal environments to regulate their body temperature. Moving between sun and shade. Sea turtles, for instance, alternate between warm surface waters and cooler depths to balance their thermal needs.

- **Physiological Adaptations**
  – Some species, like sea turtles, can slow their metabolism to conserve energy in cooler waters.
  – Large body size in some marine reptiles, like leatherback sea turtles, helps retain heat due to a favourable surface area-to-volume ratio.

- **Counter Current Heat Exchange**
  – Similar to marine birds, some marine reptiles have counter current heat exchange mechanisms, especially in flippers, to minimize heat loss.

- **Blood Flow Regulation**
  – Vasoconstriction and vasodilation in extremities help control heat distribution within the body. For example, sea snakes exhibit a degree of thermoregulation by controlling blood flow to their skin, which aids in heat absorption and dissipation.

- **Fat layer:** Some turtles have layers of fat to insulate, such as green turtle.

Evaluation of Effectiveness

Marine Birds
– High metabolic rate enables quick and sustained activities such as flying and diving.
– Ability to survive in diverse and colder environments.
– Marine reptiles cons: Vulnerability to rapid temperature changes in the environment. Limited to warmer climates and periods of inactivity in cooler temperatures.

OR

Marine Reptiles
– Lower energy requirement is advantageous in environments with scarce food resources. Can dive for longer periods and forage for extended durations without needing to surface for air as frequently.
– Marine birds cons: High energy requirement necessitates regular feeding.
– Vulnerability to fluctuations in food availability.

OR

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QUESTION 7

Marine Birds

- **Nesting**
  - Mainly ground nesting – nests built on cliffs, beaches, islands, and even in burrows.
  - Colony Nesting: Provides communal protection, reducing individual predation risks.
  - Use various materials like pebbles, grass, guano and feathers to construct nests.
  - Some species, like penguins, use pebbles for their nests.
  - Birds like terns and gulls nest directly on sandy or rocky shores.
  - Seabirds generally lay clutches of one or two eggs due to high levels of parental care.

- **Parental Care**
  - Monogamous behaviour, where a pair remains together for extended periods or even for their entire lives – important in rearing chicks.
  - Altricial / precocial
  - oviparious / internal fertilisation
  - Bird eggs – calcareous shell is less likely to break during incubation.
  - Homeothermic feathers – body warmth to incubate.
  - both parents often share incubation duties.
  - High level of parental care, with both parents involved in feeding and protecting chicks.
  - Example: Penguins carry food in their crops to regurgitate for their chicks.
  - Chicks remain in the nest until they are capable of flight (fledging).
  - Chicks often mottled camouflaged to match nesting sites.
  - Fewer offspring due to high energy expenditure of parental care.
  - Low mortality rate due to parental care.
  - Successful parents may have more than one a clutch of eggs in a season depending on food availability.
  - Adaptive Learning: Offspring learn from parents, enhancing their survival skills.

Marine Reptiles

- **Nesting**
  - Sea turtles exhibit natal homing, returning to the beaches where they hatched.
  - Nest on sandy beaches, often in tropical and subtropical regions.
  - Easily disturbed resulting in no clutch of eggs being laid.
  - Marine iguanas lay eggs in burrows on coastal areas.
  - Sea turtles dig nests with their flippers and lay eggs in deep pits.
  - Females lay several batches of eggs – not all eggs will be lost at once = ensures survival.
  - Different time periods – different temperatures = different sexes.
  - In a single nesting season, females lay between two and six clutches of eggs, each containing 65 to 180 eggs (multiple clutches) (large number per clutch).
  - Sea snakes and kraits typically 2 to 20 offspring per clutch due to limited space in the female body.
  - Sea snakes permanently aquatic – give birth to live young.

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- **Parental Care**
  - Generally absent; once eggs are laid, parents do not return.
  - Incubation: poikilothermic – unable to incubate eggs.
  - Scaly skin not suited for transfer of heat.
  - Reptile eggs also have leathery shell – not suitable as birds for incubation.
  - Some bury their eggs in warm, protected nests – sun incubates.
  - Limits nesting sites to warm environments.
  - Others carry them internally until they are ready to hatch. Some such as the sea snake do not leave the ocean so incubates the egg internally – ovoviviparous, meaning they produce eggs that hatch inside the mother's body, and the young are born live.
  - Eggs incubate in the sand, with temperature often determining the sex of the hatchlings.
  - Hatchlings emerge and make their way to the sea independently.
  - High mortality rate among hatchlings due to predation and environmental factors.

Evaluation of Effectiveness

Marine Birds: More effective in ensuring the survival of individual offspring through high parental care and protective nesting strategies, especially in environments where food sources and nesting sites can be highly variable and predators are abundant.

Bird eggs – calcareous shell, less likely to break during incubation.

Reptiles Cons: High mortality rate among young due to lack of parental protection and care. The need to return to the beaches where they hatched in turtles is disadvantageous due to disturbance and habitat destruction. Sex of offspring determined by temperature.

OR

Marine Reptiles: More effective in sheer numbers, producing many offspring to ensure species survival in environments where less parental investment is possible.

Low energy investment in parental care allows for the production of more offspring, reducing individual loss impact. The parent does not expend large amounts of energy foraging for offspring. Females do not need to remain in the nesting area after laying eggs but can return to feeding grounds.

Birds Cons: High energy and time investment in fewer offspring.

Total: 150 marks

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QUALITY OF CONTENT								
MARKS	**22–25**	**18–21**	**14–17**	**10–13**	**6–9**	**3–6**	**0–2**	**Mark**
CRITERIA	The response shows a sophisticated understanding of the topic. The content is detailed and thoroughly addresses all aspects of the essay topic. The content selected is relevant, appropriate, and accurate. Use of terminology is consistently accurate.	The response shows a clear understanding of the topic. The content is substantial and thoroughly addresses all aspects of the essay topic. There are minor flaws in the relevance/ appropriateness/ accuracy of the content selected. Use of terminology is consistently accurate.	The response shows an understanding of the topic. The content is substantial, but some gaps/ omissions are evident. **OR** Some content selected is not relevant/ appropriate/ accurate. Use of terminology is generally accurate.	The response shows a basic understanding of the topic. Gaps/omissions in content are evident. **AND** Some content selected is not relevant/ appropriate/ accurate. There are some inaccuracies in the use of terminology.	The response shows a limited understanding of the topic. Gaps/omissions in content are evident. **AND** Irrelevant and inappropriate content has been included with errors. There are significant inaccuracies in the use of terminology.	The response shows a superficial understanding of the topic. Significant gaps/omissions in content are evident. **AND** Most content is irrelevant/ inappropriate/ inaccurate.	The response shows no or little understanding of the topic. **AND** Most content is irrelevant/ inappropriate/ inaccurate.	**/ 25**
QUALITY OF DISCUSSION								
MARKS	**9–10**	**8**	**7**	**5–6**	**3–4**	**2**	**0–1**	
CRITERIA	The discussion is consistently focused, clear and concise. Flow is logical. Response is cohesive showing sophisticated understanding, integration, and linkage of all concepts.	The discussion is for the most part focused, clear and concise. Flow is logical. Response is cohesive showing sound understanding, integration and linkage of all concepts.	The discussion is focused, clear and concise, with some lapses. Flow is for the most part logical. Response is cohesive showing understanding, integration, and linkage of concepts.	At times the discussion is longwinded/ rambling/ repetitious/ vague. Linkage and integration of concepts is not always clear.	The discussion is often longwinded/ rambling/ repetitious/ vague. Linkage and integration of concepts is weak.	The discussion is longwinded/ rambling/ repetitious/vague, showing poor understanding of the concepts.	The discussion is meaningless.	**/ 10**
TOTAL MARK								**/ 35**

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