



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARINE SCIENCES P2

NOVEMBER 2024

MARKS: 150

TIME: 2½ hours

This question paper consists of 15 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of THREE sections. Answer the questions as follows:

SECTION A: COMPULSORY

SECTION B: COMPULSORY

Consists of QUESTIONS 2 and 3.

Answer BOTH questions in this section.

SECTION C: Consists of QUESTIONS 4 and 5.

It is COMPULSORY to answer ONLY ONE of the two questions in this section.

2. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Do ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams, tables or flow charts only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass, where necessary.
11. Round off your FINAL numerical answers to the SECOND decimal place, where applicable.
12. Do NOT write outside of the margins in the ANSWER BOOK.
13. Write neatly and legibly.

SECTION A**QUESTION 1**

- 1.1 Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1.1 to 1.1.10) in the ANSWER BOOK, e.g. 1.1.11 D. _

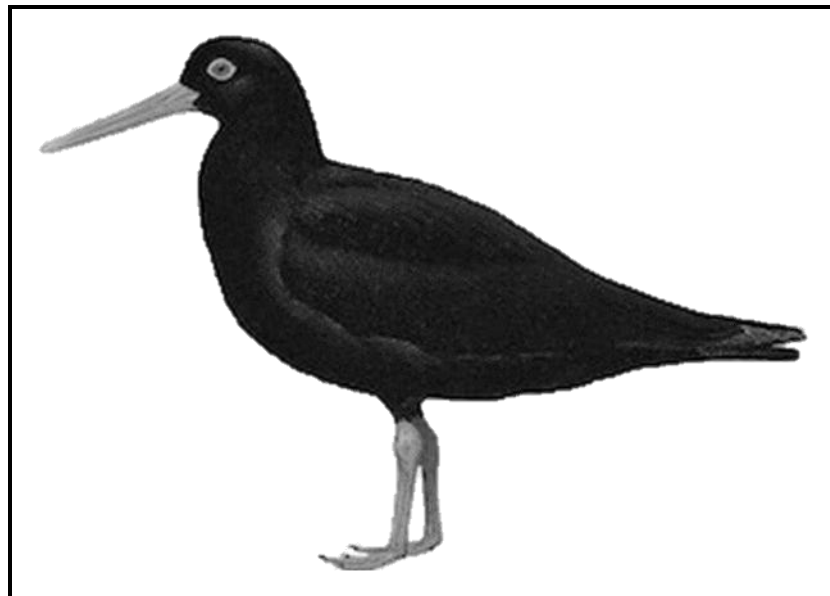
1.1.1 All echinoderms are ...

- A euryhaline.
- B isohaline.
- C thermohaline.
- D stenohaline.

1.1.2 Responsible travel to natural areas that takes the well-being of the environment and the local communities into consideration:

- A Adventure-based tourism
- B Environmental tourism
- C Ecotourism
- D Nature-based tourism

1.1.3 The image below is an example of a South African marine bird.

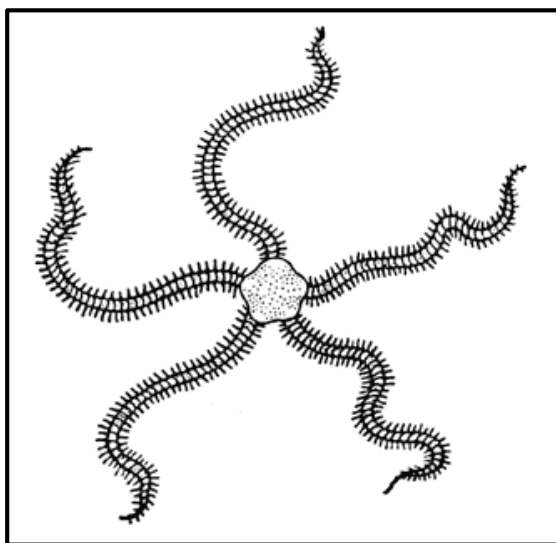


[Source: <https://cdn.download.ams.birds.cornell.edu/>]

Which ONE of the following options gives the CORRECT common name for the organism?

- A Gannet
- B Oystercatcher
- C Tern
- D Cormorant

- 1.1.4 The illustration below represents a spiny brittle star belonging to the phylum Echinodermata.



[Source: <https://teara.govt.nz/en/1966/24841/>]

Which ONE of the following combinations is CORRECT for the organism above?

	CLASS	FEEDING METHOD	MODE OF NUTRITION
A	Crinoidea	Actively hunt	Carnivore
B	Ophiuroidea	Filter feeder	Omnivore
C	Ophiuroidea	Scavenger	Carnivore
D	Crinoidea	Ambush	Omnivore

- 1.1.5 The following phrases relate to principles of ecotourism according to The International Ecotourism Society (TIES):

- (i) Financial benefits for conservation
- (ii) Interpretative experiences for visitors
- (iii) High-impact operations are permitted
- (iv) Positive experiences for both visitors and hosts
- (v) Implement practices that are unsustainable

Which ONE of the following combinations has ONLY CORRECT options relating to TIES principles?

- A (i), (ii) and (iv)
- B (iii), (iv) and (v)
- C (ii), (iii) and (iv)
- D (i), (ii) and (v)

1.1.6 An area in which there are restrictions on human activities, located between the Marine Protected Area (MPA) and the area exposed to higher impact:

- A Periphery zone
- B Biosphere zone
- C Buffer zone
- D No-take zone

1.1.7 Engineers plan on designing a building in a desert. This building will be designed with a cooling system as informed by principles inspired by nature.

Which of the following options would NOT involve the biomimicry principle of being locally attuned and responsive?

- A Consulting with communities
- B Using a solar energy plant
- C Incorporating feedback loops
- D Using local rare materials

1.1.8 Which ONE of the following is INCORRECT for mangroves?

The value of mangroves in estuaries is to ...

- A provide nutrient-rich mucus.
- B calm water turbulence.
- C promote sedimentation.
- D provide habitats for animals.

1.1.9 The following terms are associated with kelp forests:

- (i) Infratidal zone
- (ii) Nutrient-rich environment
- (iii) Intertidal zone
- (iv) Roots
- (v) Holdfasts

Which ONE of the combinations below gives ONLY CORRECT options for the characteristics of kelp forests?

- A (ii), (iii) and (v)
- B (i), (ii) and (v)
- C (ii), (iii) and (iv)
- D (i), (iii) and (v)

1.1.10 The type of circulation found in tunicates:

- A Single
- B Double
- C Closed
- D Open

(10 x 2) **(20)**

1.2 Give the correct **scientific term/phrase** for each of the following descriptions. Write only the term/phrase next to the question numbers (1.2.1 to 1.2.10) in the ANSWER BOOK.

- 1.2.1 River mouths, their associated banks and beds which are subject to the tidal ebb and flow of the sea water
- 1.2.2 Sideward extensions from the arms of feather stars
- 1.2.3 Water-filled compartments around the stomachs of brittle stars which open to the outside
- 1.2.4 Eggs which have a waterproof shell and a fluid-filled sac around the embryo, enabling the embryo to develop and hatch out on dry land
- 1.2.5 High-shore eulittoral zone, characterised by small winkles
- 1.2.6 The capacity of ecosystems to respond to pressures or disturbances
- 1.2.7 Increased biomass into areas neighbouring MPAs
- 1.2.8 Skeleton of a sea urchin
- 1.2.9 Non-living scales which are formed on the outside of an animal's skin and will be replaced by moulting
- 1.2.10 When whales drift, head down, with their tails out of the water to sail slowly with the wind

(10 x 1)

(10)

- 1.3 Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question numbers (1.3.1 to 1.3.5) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	Blastopore becomes the mouth	A: deuterostome B: protostome
1.3.2	Marine amphibians	A: caecilians B: salamanders
1.3.3	Intermediate zone	A: sea bamboo (<i>Ecklonia maxima</i>) B: split fan kelp (<i>Laminaria pallida</i>)
1.3.4	East Coast	A: oyster belt B: argenvillei zone
1.3.5	Engineering inspired by kelp holdfasts	A: using benign materials B: anchoring ocean-energy-harvesting devices

(5 x 2)

(10)**TOTAL SECTION A: 40**

SECTION B**QUESTION 2**

2.1

The sea squirt (*Didemnum sp.*) and the Star Tunicate (*Botryllus schlosseri*) are both invasive species that occur in colonies. The sea squirt lives at deeper depths than the Star Tunicate.

A study was done to determine how both species would respond to small differences in water temperature.

The following was done:

- Pieces of sea squirt and Star Tunicate colonies were collected and attached to separate PVC panels.
- These panels were placed in unfiltered, flowing sea water and left for two days at a constant temperature.
- A total of 85 sea squirts and 39 Star Tunicates colonies were successfully attached to the panels.
- These PVC panels were placed in four 20 l plastic containers at four different water temperatures: 17 °C, 21 °C, 23 °C and 27 °C.
- The container for 17 °C was submerged in a chiller bath. The containers for the 21 °C, 23 °C and 27 °C treatments were heated with heating coils. Temperatures for each container were kept constant.
- All containers were left for one week to allow the colonies to grow.
- Each PVC panel was photographed at the start and the end of the week.
- These photographs were used to calculate the change in colony size as a proportion of the initial size for each of these species.

The table below shows the data collected in this study.

TEMPERATURE (°C)	GROWTH RATE (%)	
	SEA SQUIRT	STAR TUNICATE
17	120	25
21	125	20
23	67	8
26	43	38

[Adapted from <https://repository.si.edu/bitstream/handle/>]

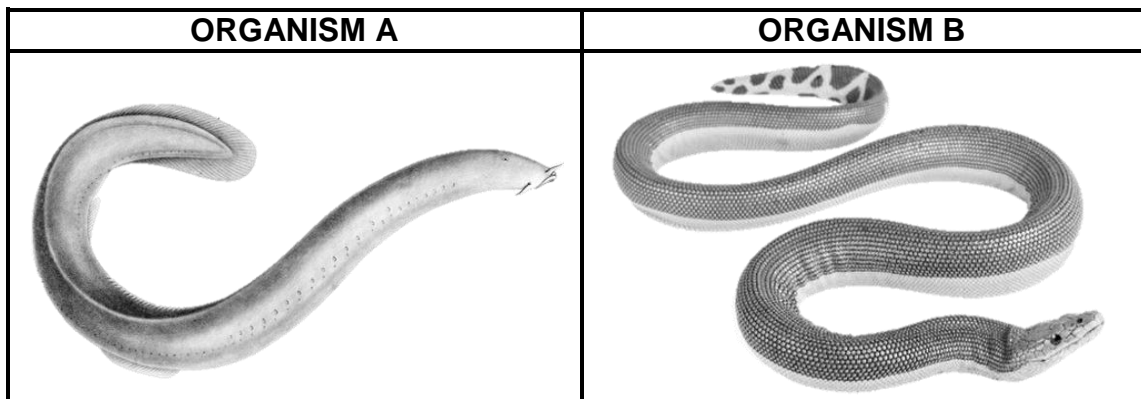
- 2.1.1 Explain how *colonial ascidian species* differ from *solitary ascidian species*. (2)
- 2.1.2 State a hypothesis for the study above. (2)
- 2.1.3 Suggest ONE way in which this study can be made more valid. (1)
- 2.1.4 Draw a double-line graph to show the data above. (10)

2.1.5 An aquarist is tasked to design a tank displaying sea squirts.

Explain how the aquarist can use the data from this study to ensure that the population of sea squirts in the tank remains stable. (1 x 2)

(2)
(17)

2.2 Study the organisms in the images below and answer the questions that follow.



[Source: <https://itaintmagic.riken.jp/>]

[Source: <https://www.reptilesOfecuador.com/>]

2.2.1 Explain why the shading pattern of Organism **A** is more uniform than Organism **B**.

(2)

2.2.2 Explain ONE way in which Organism **B** reproduces, given that they are aquatic.

(2)

2.2.3 Which organism (**A OR B**), in your opinion, is better adapted to deter predators? Substantiate your answer.

(2)

(6)

- 2.3 Read the article below and answer the questions that follow.

FROM LITTLE THINGS, GIANTS GROW

The Giant Kelp Restoration Project is the first of its kind in Tasmania, Australia. This project helps to recover Giant Kelp (*Macrocystis pyrifera*) forests at ecologically meaningful scales. Juvenile Giant Kelp are planted at 12 different sites along the East Coast of Tasmania. These kelp are cultured in a facility and then attached to the sea floor by divers.

The Nature Conservancy Australia's project coordinator said, 'The project will benefit all Tasmanians and visitors by contributing to the recovery of one of the state's most productive and iconic marine ecosystems and supporting marine biodiversity in the region'.

[Adapted from <https://www.natureaustralia.org.au/newsroom/milestone-giant-kelp/>]

- 2.3.1 How can Giant Kelp be used to mitigate the effects of climate change? (1)
- 2.3.2 This project was conducted 'along the East Coast of Tasmania'.
Explain why the East Coast of South Africa will not be a suitable location for this project. (2)
- 2.3.3 State TWO ways in which restoring the Giant Kelp can contribute to boosting ecotourism along the east coast of Tasmania. (2)
- 2.3.4 Discuss TWO ways in which this project could contribute to the environmental protection pillar of an ecotourism business plan. (2 x 2) (4)
- 2.3.5 Although this project will be of benefit to visitors, the impact of overtourism should be prevented.
Give ONE piece of advice for the Tasmanian regional authority to potentially mitigate negative impacts caused by overtourism. (1 x 2) (2)
- 2.3.6 In your opinion, should projects like the Giant Kelp Restoration Project be used as an ecotourist attraction? (2)
- (13)**
[36]

QUESTION 3

- 3.1 Read the article below about a turtle's carapace and answer the questions that follow.

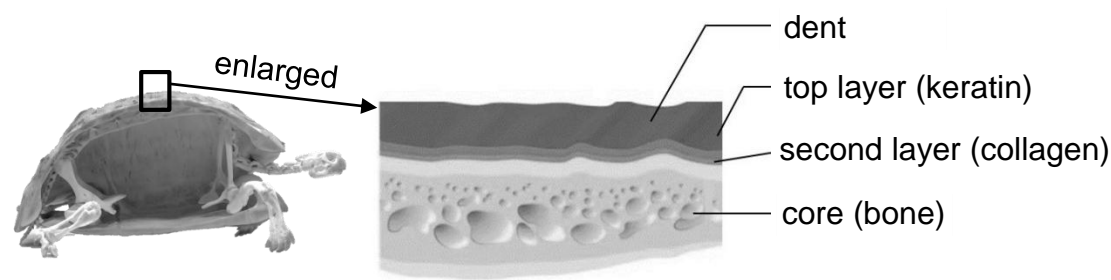
SOFT SHIELD DISTRIBUTES FORCE

The characteristics of a turtle's carapace are remarkable in that it offers protection when the turtle dives deeper. The carapace consists of two layers of skin over a hard, brittle bony core. The first, top layer of skin is made of keratin. When subjected to pressure that can result in dents, this layer acts as a protective bumper.

The second layer consists of soft collagen that acts as a buffer. It distributes forces over a greater area, significantly reducing stress on the bone. The combined effect of the bumper and buffering mechanisms prevents potential damage to the skin region, thereby protecting the underlying brittle bony core.

[Adapted from <https://asknature.org/strategy/soft-shield-distributes-force/>]

The illustrations below show a longitudinal section through a turtle and an enlargement to indicate the different layers of the carapace.



[Turtle source: <https://earthlymission.com/wp-content/>]

[Longitudinal section source: <https://bioengineering.hyperbook.mcgill.ca/>]

- 3.1.1 Other than protection, give ONE additional function of the turtle's carapace. (1)
- 3.1.2 Explain how the carapace is able to assist the turtle to deal with increased pressure while diving deeper. (2)
- 3.1.3 The turtle's carapace provides valuable inspiration for the development of new materials in deep-sea exploration.
- (a) Explain the benefit of being inspired by nature when designing modern materials. (2)
 - (b) Why should a multidisciplinary approach be used when applying biomimicry principles? (2)
 - (c) Elaborate on how the turtle's carapace can inspire a better design for safety equipment for deep-sea exploration. (2)
- (9)**

3.2

A beach along the Eastern Cape coastline experiences calm waves and current conditions. During a certain time of year, an influx of finer sediment is deposited along the intertidal zone.

White Mussels (*Donax serra*) are found in the intertidal zone of sandy beaches along the Eastern Cape coastline. They move in the sand with the rising and falling of the tides.

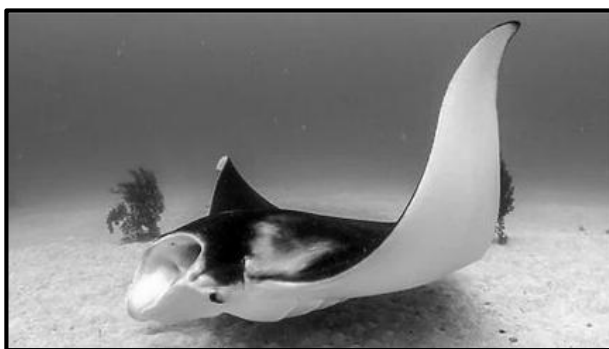
[Adapted from [statusofsouthafrican_marinefisheryresources2023.pdf](#)]

- 3.2.1 State ONE biotic factor that will cause the White Mussel to burrow. (1)
- 3.2.2 Describe the profile of this beach. (1)
- 3.2.3 State why White Mussels 'move in the sand with the rising and falling of the tides'. (1)
- 3.2.4 Explain TWO structural ways in which the White Mussel is adapted to survive the influx of sediment load. (2 x 2) (4)
- 3.2.5 Discuss the effect that the influx of finer sediment will have on the burrowing behaviour of White Mussels. (2)
- (9)**

3.3

Read the extract below and answer the questions that follow.

The Reef Manta Ray (*Mobula alfredi*) is generally found in areas with water temperatures between 20 °C and 26 °C. When diving, they venture to depths with lower water temperatures, even down to 7,6 °C in some instances.



[Adapted from <https://www.ecomagazine.com/news/research/vulnerable-manta-rays-are-diving-deeper-than-ever-before>]

- 3.3.1 How are the pectoral fins of the Reef Manta Ray adapted for movement? (1)
- 3.3.2 Rays make use of counter-current heat exchange to thermoregulate during their deep dives. Explain this mechanism. (3)
- 3.3.3 Draw a labelled diagram illustrating the blood circulation found in Reef Manta Rays. (4)
- (8)**

3.4 Read the article below and answer the questions that follow.

**CALL TO PROTECT AFRICAN PENGUINS AS
EXTINCTION THREAT LOOMS**

The Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) and BirdLife South Africa are calling on marine authorities to act to protect African Penguins (*Spheniscus demersus*). With only about 10 000 breeding pairs left, the endangered African Penguin is at risk of extinction by 2035. A SANCCOB staff member stated that the estimated population has decreased by 99% over the past 40 years.

SANCCOB clinical veterinarian, Dr David Roberts, says, 'An international panel of scientists has been put together to describe how, and what areas need to be protected, as well as the actual impact on the penguin population. We would like to see the correct areas being protected'.

[Adapted from <https://www.sabcnews.com/sabcnews/call-to-protect-african-penguins-as-extinction-threat-looms/>]

- | | | |
|-------|--|-----------------------------------|
| 3.4.1 | Why do scientists emphasise the number of 'breeding pairs'? | (2) |
| 3.4.2 | Do you think that protecting the correct areas is enough to increase the population of African penguins? Substantiate your answer. | (2) |
| 3.4.3 | Explain TWO key benefits that an increase in the size of a Marine Protected Area (MPA) could have on the African Penguin population. | (2 x 2) (4) |
| 3.4.4 | How would the scientists use data to select and decide on suitable sites for this MPA? | (1 x 2) (2) |
| 3.4.5 | Suggest which IUCN MPA category would be considered for selecting an area to conserve the African Penguin. Motivate your answer. | (3)
(13)
[39] |

TOTAL SECTION B: 75

SECTION C

Answer any ONE question in this section.

Clearly indicate the QUESTION NUMBER of the chosen question.

NOTE: Your answer must be in the form of an essay. NO marks will be awarded for answers in the form of a table, flow chart or diagram.

QUESTION 4

Read the text on the Vaquita and Bronze-striped Grunt below.

The Vaquita (*Phocoena sinus*) is a porpoise that is classified as Odontoceti. The Vaquita is endemic to Mexico's Gulf of California, where it feeds on bony fish such as the Bronze-striped Grunt (*Orthopristis reddingi*) and squid. The Bronze-striped Grunt feeds at night.

Vaquitas are the most endangered of the world's marine mammals. The main reason for the Vaquita's decline in numbers is entanglement in illegal gillnets while pursuing prey like the Bronze-striped Grunt. Scientists estimate that as of 2024, only six to eight Vaquita individuals remain in the wild.

[Adapted from <https://www.fisheries.noaa.gov/species/vaquita> and <https://www.biologicaldiversity.org/species/mammals/vaquita>]

Vaquita
(*Phocoena sinus*)



[Source: <https://www.fisheries.noaa.gov/>]

Bronze-striped Grunt
(*Orthopristis reddingi*)



[Source: <https://biogeodb.stri.si.edu/>]

Write an essay to address the following aspects:

- Describe how the Vaquita is able to sense and hunt the Bronze-striped Grunt.
- Describe how the Bronze-striped Grunt would sense predators such as the Vaquita chasing it.
- Discuss why the Vaquita are more likely to die AND why many Bronze-striped Grunts are likely to survive when trapped in the submerged gillnets.
- Discuss the physiological characteristics of the Vaquita, which enable them to dive for longer periods of time when hunting squid.
- Give your opinion and motivate whether it is worth investing resources to save a species like the Vaquita, considering the low numbers.

Content:
Synthesis:

(25)
(10)
[35]

QUESTION 5

Read the text about a rabies outbreak in Cape Fur Seals.

Cape Fur Seals (*Arctocephalus pusillus pusillus*) are social animals that live in densely populated colonies. These colonies are found between Southern Angola and Algoa Bay, South Africa. The seals feed on fish such as the Shallow-water Cape Hake (*Merluccius capensis*).

Tests done in June 2024 have shown that rabies is widespread in the Cape Fur Seal populations. Rabies infects the central nervous system of the seals. The brain becomes swollen and thereby overstimulated. Seals are then unable to interpret information from sense organs. This results in seals not being able to catch their prey and feed, leading to starvation. Several mass mortality events have been recorded with starvation being one of the reasons for this.

Conservationists are concerned that the decrease in the number of seals would result in an increase in the population numbers of the seals' prey species, causing an imbalance in the system. In an effort to reduce the effects of rabies in the Cape Fur Seal population, conservationists have proposed that all Cape Fur Seals be vaccinated against rabies.

[Adapted from <https://www.msc.org/>, <https://nahf.co.za/wp-content> and <https://www.dailymaverick.co.za>]

**COLONY OF CAPE FUR SEALS
(ARCTOCEPHALUS PUSILLUS PUSILLUS)**



[Source: <https://westcoastescape.co.za/>]

**SHALLOW-WATER CAPE HAKE
(MERLUCCIIUS CAPENSIS)**



[Source: <https://fisheries.msc.org/>]

Write an essay to address the following aspects:

- Discuss the advantages AND disadvantages of living in colonies, for seals.
- Discuss how healthy seals would hunt, eat and digest their prey.
- Describe how the seals' inability to interpret information from the sensory organs will influence seal hunting behaviour.
- As predator populations (seals) decrease, the prey populations (fish) increase. Discuss the method of reproduction of fish which promotes its survival.
- Give your opinion on whether vaccinating the Cape Fur Seals could be considered an ethical method of controlling the spread of rabies.

Content: (25)
Synthesis: (10)
[35]

TOTAL SECTION C: 35
GRAND TOTAL: 150