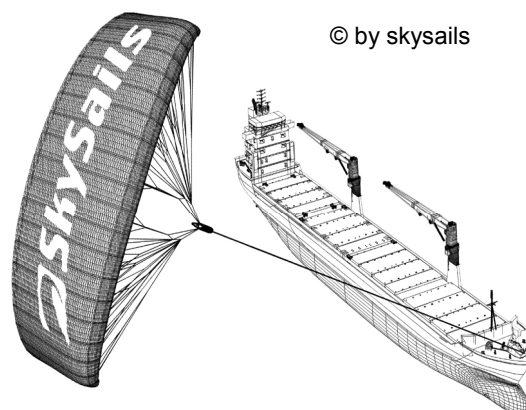

SAILING SHIPS

Ninety-five percent of world trade is moved by sea, by roughly 50 000 tankers, bulk carriers and container ships. Most of these ships use diesel fuel.

Engineers are planning to develop wind power support for ships. Their proposal is to attach kite sails to ships and use the wind's power to help reduce diesel consumption and the fuel's impact on the environment.

Translation Note: “© by skysails”: Do not adapt skysails as this is a registered label.



Question 1: SAILING SHIPS

PM923Q01

One advantage of using a kite sail is that it flies at a height of 150 m. There, the wind speed is approximately 25% higher than down on the deck of the ship.

At what approximate speed does the wind blow into a kite sail when a wind speed of 24 km/h is measured on the deck of the ship?

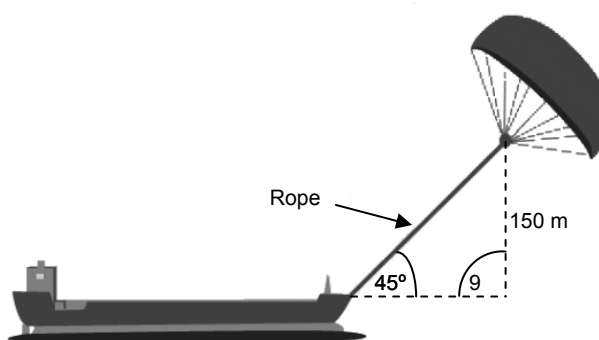
- A 6 km/h
- B 18 km/h
- C 25 km/h
- D 30 km/h
- E 49 km/h

Question 3: SAILING SHIPS

PM923Q03

Approximately what is the length of the rope for the kite sail, in order to pull the ship at an angle of 45° and be at a vertical height of 150 m, as shown in the diagram opposite?

- A 173 m
- B 212 m
- C 285 m
- D 300 m




Note: Drawing not to scale.
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Question 4: SAILING SHIPS

Due to high diesel fuel costs of 0.42 zeds per litre, the owners of the ship *NewWave* are thinking about equipping their ship with a kite sail.

It is estimated that a kite sail like this has the potential to reduce the diesel consumption by about 20% overall.

Name: <i>NewWave</i>	
Type: freighter	
Length: 117 metres	
Breadth: 18 metres	
Load capacity: 12 000 tons	
Maximum speed: 19 knots	
Diesel consumption per year without a kite sail: approximately 3 500 000 litres	

The cost of equipping the *NewWave* with a kite sail is 2 500 000 zeds.

After about how many years would the diesel fuel savings cover the cost of the kite sail? Give calculations to support your answer.

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Number of years:.....

Translation Note: In this unit please retain metric units throughout.

SAILING SHIPS SCORING 1

QUESTION INTENT:

Description: Apply calculation of percentage within a given real world situation

Mathematical content area: Quantity

Context: Scientific

Process: Employ

Full Credit

Code 1: D. 30 km/h

No Credit

Code 0: Other responses.

Code 9: Missing.

SAILING SHIPS SCORING 3

QUESTION INTENT:

Description: Use Pythagorean Theorem within a real geometric context

Mathematical content area: Space and shape

Context: Scientific

Process: Employ

Full Credit

Code 1: B. 212 m

No Credit

Code 0: Other responses.

Code 9: Missing.

SAILING SHIPS SCORING 4

QUESTION INTENT:

Description: Solve a real world situation involving cost savings and fuel consumption

Mathematical content area: Change and relationships

Context: Scientific

Process: Formulate

Full Credit

Code 1: A solution from 8 to 9 years is provided with adequate (mathematical) calculations.

- Diesel consumption per year without a sail: 3.5 million litres, price 0.42 zed/litre, costs for diesel without a sail 1 470 000 zeds. If 20% is saved with the sail this results in a saving of $1\,470\,000 \times 0.2 = 294\,000$ zeds per year. Thus: $2\,500\,000 / 294\,000 \approx 8.5$, i.e.: After about 8 to 9 years, the sail becomes (financially) worthwhile.

No Credit

Code 0: Other responses.

Code 9: Missing.