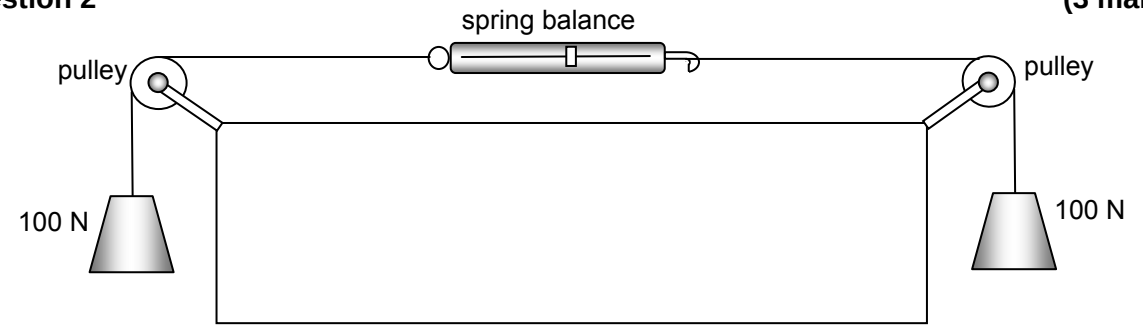
Question 2 **(3 marks)**



(a) What is the reading on the spring balance? Circle your answer. (1 mark)

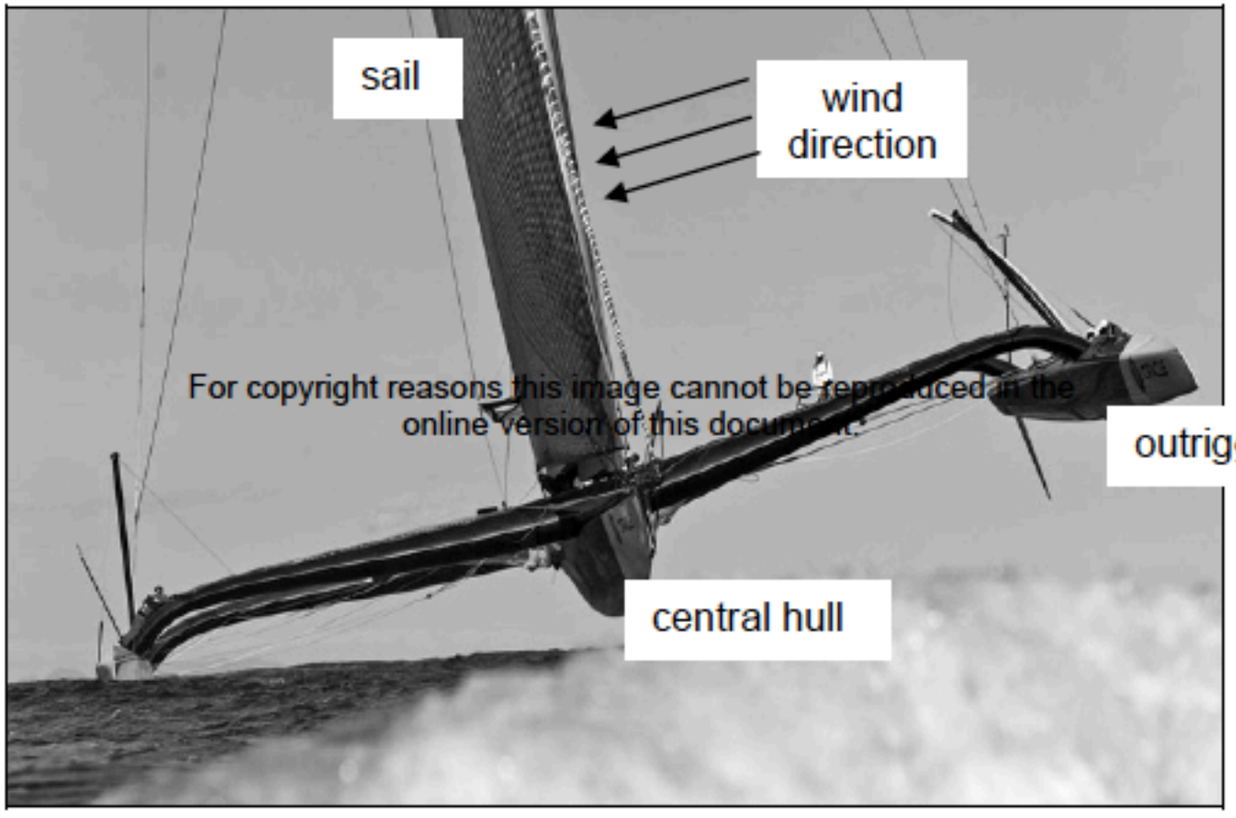
(i) 100 N (ii) Zero (iii) 200 N

(b) Choose **one** of the answers that you **rejected** and give your reason why you rejected it. (2 marks)

Answer: _____ Reason: _____

_____

Question 7 **(4 marks)**

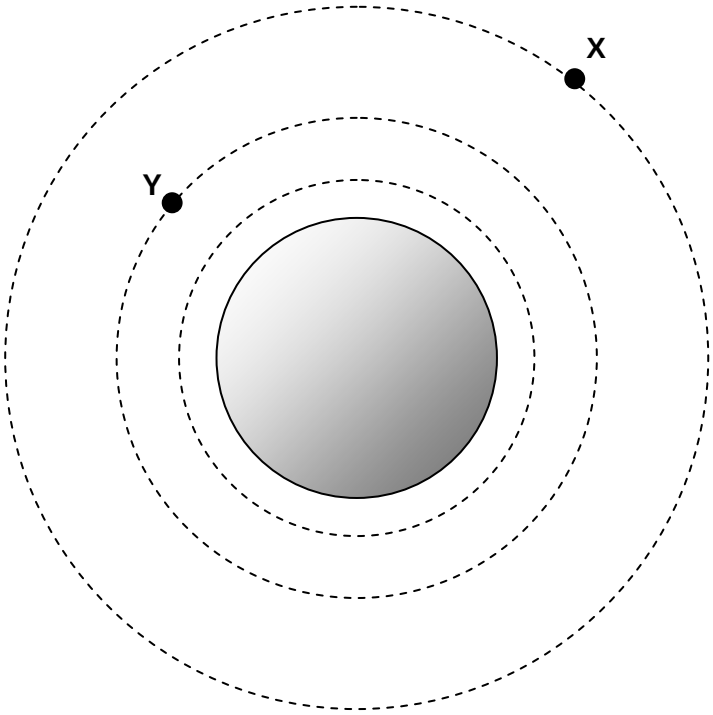


The photograph shows the yacht *BMW Oracle*, which has both a length and width of 28 m.

Estimate the torque, exerted by the wind blowing on the sails, that would just begin to tip the *BMW Oracle* as shown. The sail has a mass of 3.5×10^3 kg, the central hull 1.0×10^3 kg and each outrigger 0.5×10^3 kg.

Question 8 **(5 marks)**

This question is about the gravitational field around an asteroid. The asteroid is spherical and of uniform density. The diagram below shows lines of equal gravitational field strength as dashed lines. There is a constant difference in the value of the field strength between each line.



(a) Describe what the diagram shows about the gravitational field strength as the distance from the asteroid increases. (1 mark)

(b) Draw the gravitational field at points X and Y. (2 marks)

(c) The asteroid has a radius of 1.25×10^5 m. If the gravitational field strength on its surface is 0.194 N kg^{-1}, calculate the mass of the asteroid. (2 marks)

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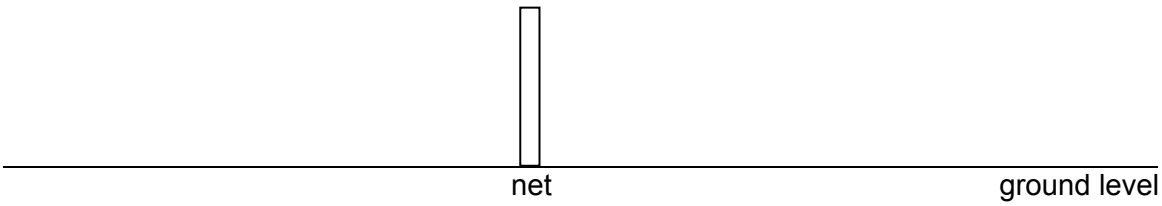
Question 17 **(11 marks)**

Clipart

While serving a tennis ball, a tennis player aims to hit the ball horizontally so that it lands in the opponent's court 5.50 m from the net. The height of the net is 0.900 m, the distance between the service point and the net is 11.9 m and the ball is hit from a height of 2.80 m. Ignore air resistance.

(a) Draw a diagram to illustrate the path of the ball with all relevant distances labelled. (2 marks)



(b) Calculate the time taken for the tennis ball to reach the net and the minimum initial speed that the tennis ball would need to just clear the net. (3 marks)

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(c) Calculate the length of time the ball is in the air. (3 marks)

(d) Calculate the distance from the net that the ball will land on the opponent's side of the court. If you were unable to determine an answer in part (c) you should assume that the time of flight is 0.900 s and if you were unable to determine an answer to part (a) you should assume that the minimum initial speed is 20.0 m s^{-1}. (3 marks)

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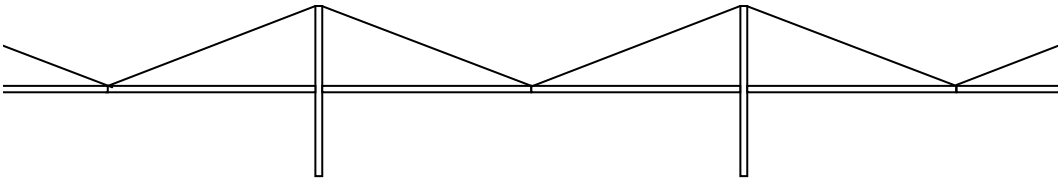
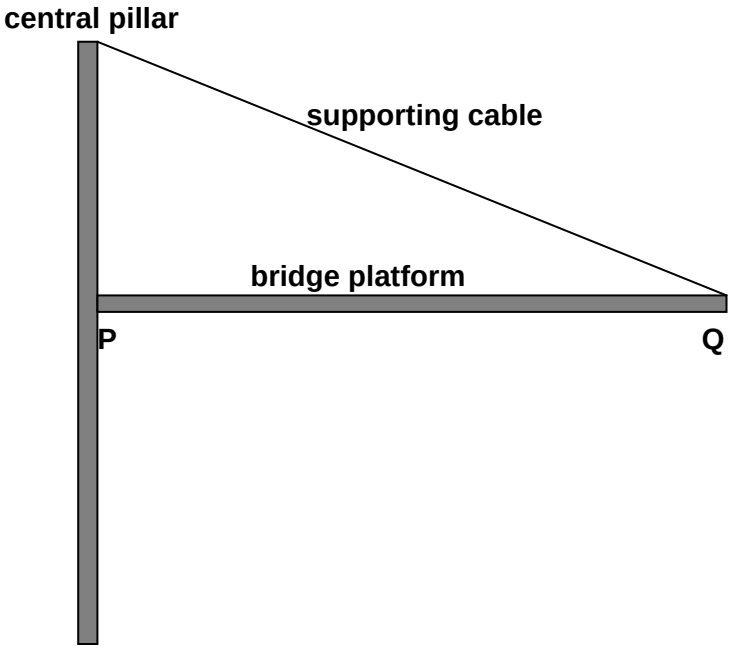
Question 19 **(9 marks)**

A concrete bridge structure is being built. It consists of vertical pillars that support horizontal platforms, as shown below.



(a) The section of bridge platform labelled PQ on the diagram below is in equilibrium even though three forces act on it. Draw and label these three forces on the diagram.

(3 marks)



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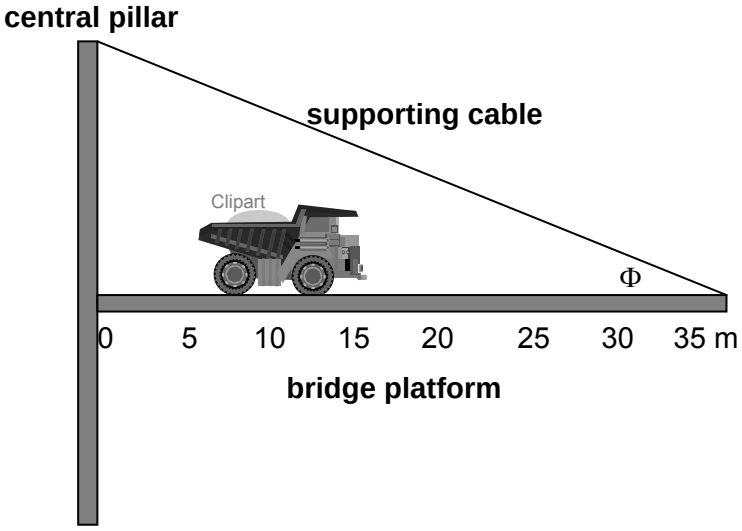
The diagram below shows a heavy truck moving along the bridge during construction. The distances in metres from the central pillar are shown on the diagram. The centre of mass of the truck is at the 10.0 m mark and the bridge platform extends to 35.0 m from the pillar, the top of which is 17.5 m above the platform.

The section of bridge platform shown has a mass of 420 tonnes and the truck has a mass of 50.0 tonnes.



(b) Calculate the angle Φ. (1 mark)

(c) By taking moments about a suitable point calculate the vertical component of the tension. (3 marks)

Vertical component = _____

(d) Using the vertical component from (c), determine the tension in the cable. If you could not calculate the vertical component, use 4.20×10^6 N. (2 marks)

Tension in cable = _____

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Question 21 **(9 marks)**

(a) The radius of the orbit of Venus around the Sun is 1.08×10^{11} m.

(i) Derive an expression that relates the orbital period of Venus to the orbital radius of Venus and the mass of the Sun. (3 marks)

(ii) Calculate the time in Earth days for Venus to orbit the Sun. (3 marks)

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The passage of the planet Venus between the Earth and the Sun is a predictable regular occurrence. It is known as the 'transit of Venus'. Captain Cook sailed to Tahiti to measure the time Venus took to cross the Sun's surface.

A is the point at which Venus appears to intersect with the surface of the Sun. This occurs at different times for observers at different positions on the Earth's surface.

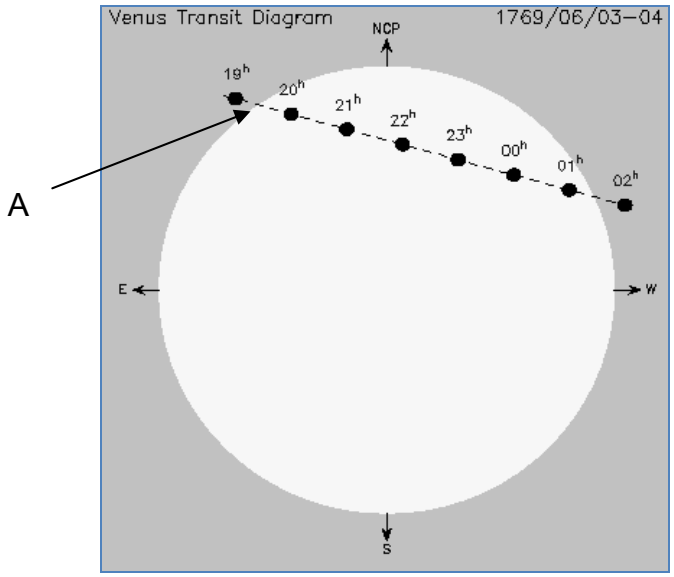
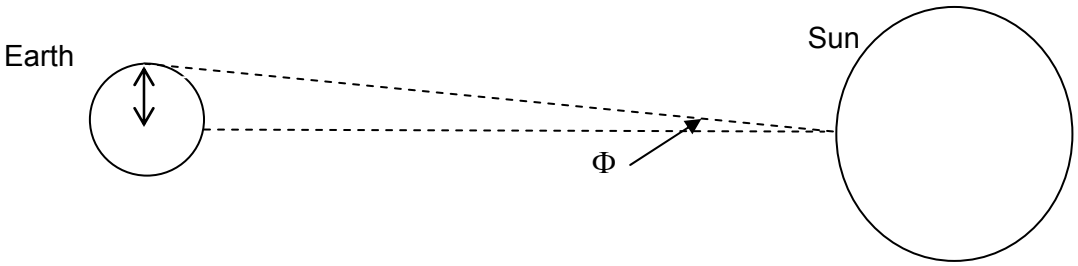


Diagram is **not** to scale

(b) By measuring the time difference between the occurrence of A at different locations on Earth (Tahiti and California) astronomers were able to measure the solar parallax angle Φ as shown in the diagram below, which is not to scale. In this way the distance from the Earth to the Sun was calculated in 1769 with amazing accuracy.



Calculate the Earth – Sun distance in kilometres if the solar parallax angle $\Phi = 0.00250°$. (3 marks)

End of Section Two

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