1)

(a) (i) State the difference between a scalar quantity and a vector quantity.

.....

.....

(1 mark)

(a) (ii) State **two** examples of a scalar quantity and **two** examples of a vector quantity.

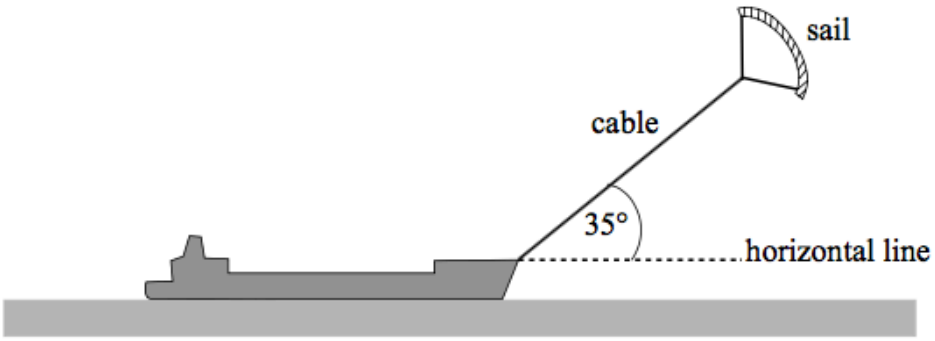
scalar quantities .....

vector quantities .....

(3 marks)

(b) **Figure 1** shows a ship fitted with a sail attached to a cable. The force of the wind on the sail assists the driving force of the ship's propellors.

Figure 1



The cable exerts a steady force of 2.8 kN on the ship at an angle of 35° above a horizontal line.

(b) (i) Calculate the horizontal and vertical components of this force.

horizontal component of force ..... kN

vertical component of force ..... kN

(2 marks)

(b) (ii) The ship is moving at a constant velocity of $8.3\,m\,s^{-1}$ and the horizontal component of the force of the cable on the ship acts in the direction in which the ship is moving.
Calculate the power provided by the wind to this ship, stating an appropriate unit.

Answer .....
(3 marks)

(c) The cable has a diameter of 0.014 m. Calculate the tensile stress in the cable when it exerts a force of 2.8 kN on the ship, stating an appropriate unit.
Assume the weight of the cable is negligible.

Answer .....
(5 marks)

2)

(a) (i) State **two** vector quantities.

vector quantity 1 .....

vector quantity 2 .....

(a) (ii) State **two** scalar quantities.

scalar quantity 1 .....

scalar quantity 2 .....

(2 marks)

(b) The helicopter shown in **Figure 1a** is moving horizontally through still air. The lift force from the helicopter's blades is labelled **A**.

Figure 1a

not to scale

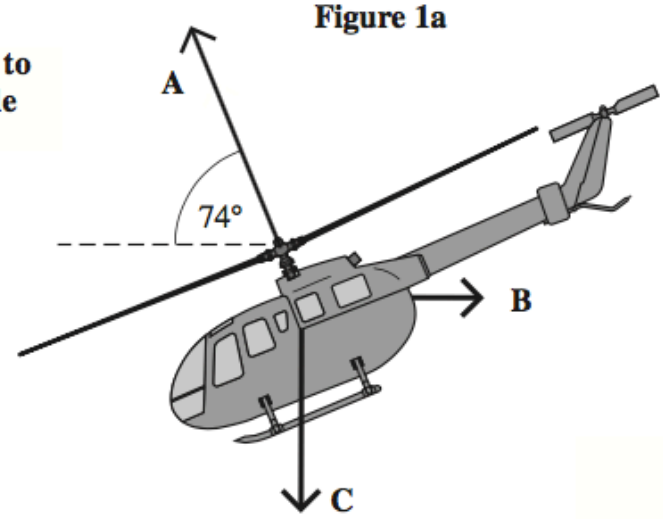
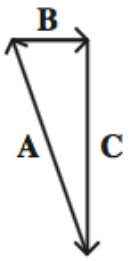


Figure 1b



(b) (i) Name the two forces **B** and **C** that also act on the helicopter.

B .....

C .....

(2 marks)

(b) (ii) The force vectors are also shown arranged as a triangle in **Figure 1b**.

State and explain how **Figure 1b** shows that the helicopter is moving at a constant velocity.

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(2 marks)

(c) The lift force, **A**, is 9.5 kN and acts at an angle of 74° to the horizontal.

Calculate the weight of the helicopter. Give your answer to an appropriate number of significant figures.

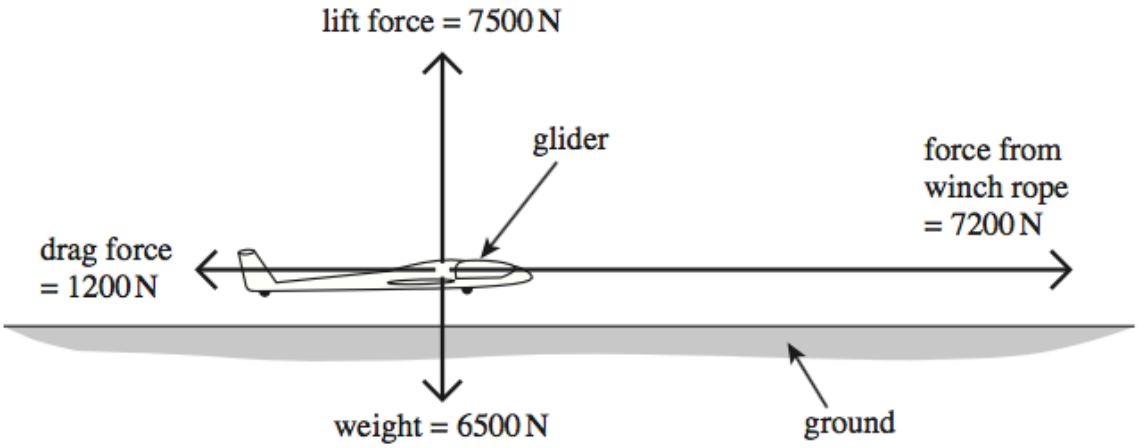
answer = ... N

(3 marks)

3)

Gliders can be launched with a winch situated on the ground. The winch pulls a rope that is attached to the glider. **Figure 1** shows the forces acting on the glider at one instant during the launch.

Figure 1



(a) The combined weight of the glider and pilot is 6500 N.

(a) (i) Show that the magnitude of the resultant force acting on the glider is about 6100 N.

(2 marks)

(a) (ii) Calculate the angle between this resultant force and the horizontal.

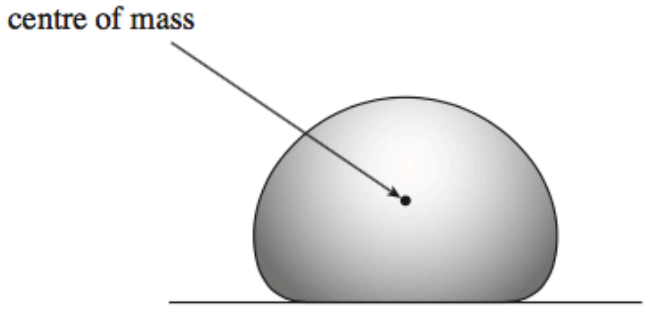
angle ..... degrees

(2 marks)

4)

(b) **Figure 2** shows the ball deforming as it contacts the ground, just at the point where it is stationary for an instant and has reached maximum deformation.

Figure 2



(b) (i) Explain how Newton's third law of motion applies to **Figure 2**.

.....

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(2 marks)

(b) (ii) Explain why there is a resultant upward force on the ball in **Figure 2**.

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(2 marks)