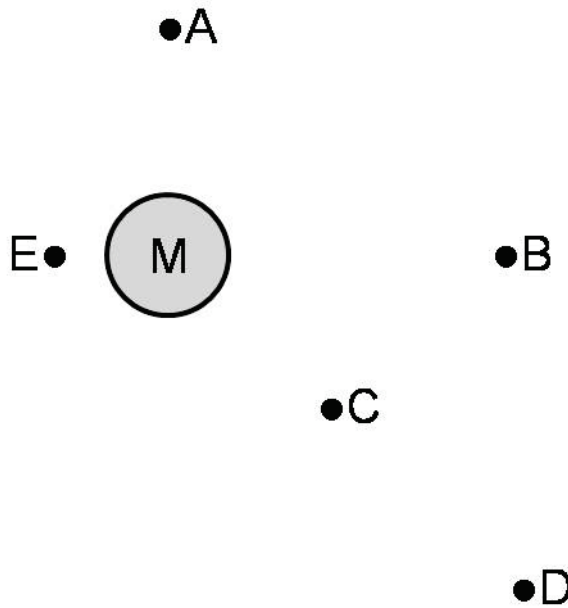**Question 2** **(4 marks)**

The diagram below shows five points, labelled 'A' to 'E', in free space around a large mass M. You may wish to use a ruler to help you answer this question.

•A

E• (M)   •B

•C

•D

	Point		Point
Which two points have the same magnitude of gravitational field strength due to M?		and	

	Point		Point
Which two points experience the same direction of gravitational field due to M (as viewed in this diagram)?		and	

	Point E		Point B
What is the ratio of the gravitational field strength at E to the gravitational field strength at B?		:	

See next page

Question 5 (4 marks)

Bathroom scales measure weight (a force) but give the reading in kilograms (mass). A particular scale shows a person's mass as being 70 kg at the Earth's equator. The spinning of the Earth contributes to the scale's reading. What would the scale read at the South Pole, with the same person standing on it? (Circle the correct answer.)

the same   less than 70 kg   more than 70 kg

Explain your reasoning:

Question 7 **(5 marks)**

Mick is watering the lawn and wants to estimate the initial velocity of the water coming from the hose. Use information from the photograph to estimate the magnitude of the initial velocity of the water. Express your answer to an appropriate number of significant figures.

Question 8 **(4 marks)**

A crane (Diagram A) lifts a mass by raising its boom (Diagram B). Explain how this affects the tension in the guy line as the crane shifts the mass from its initial position in Diagram A to its position in Diagram B.
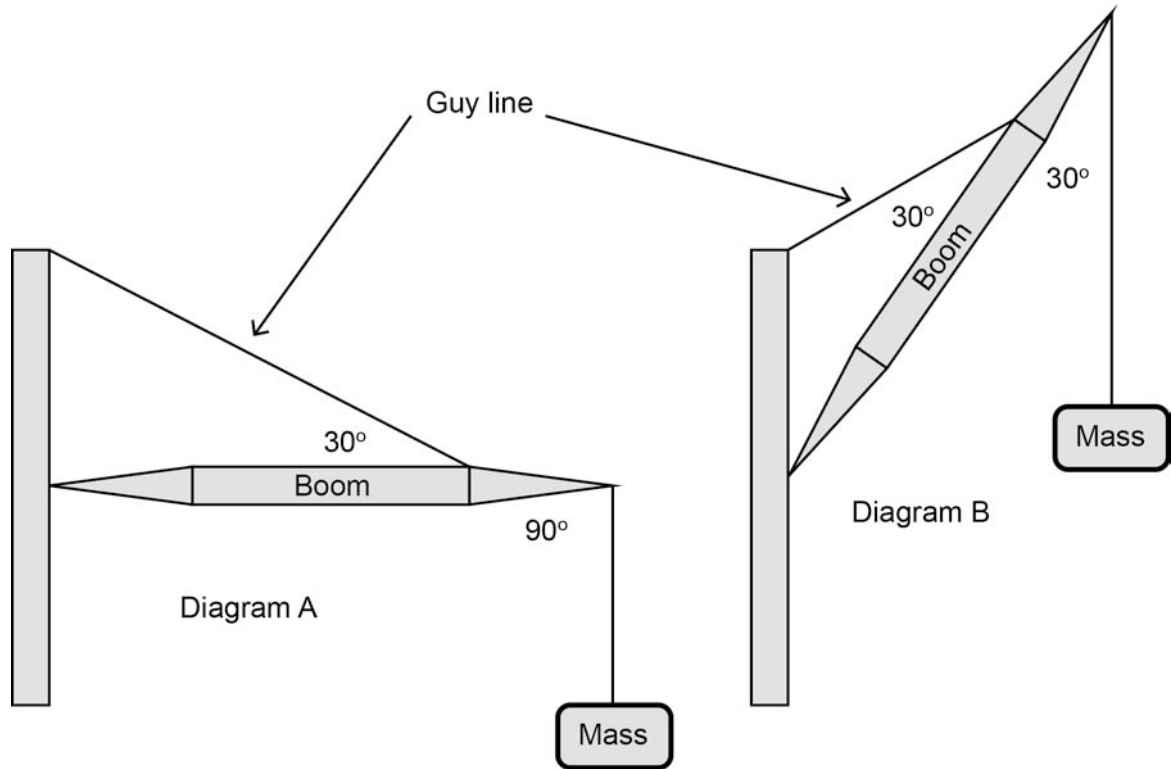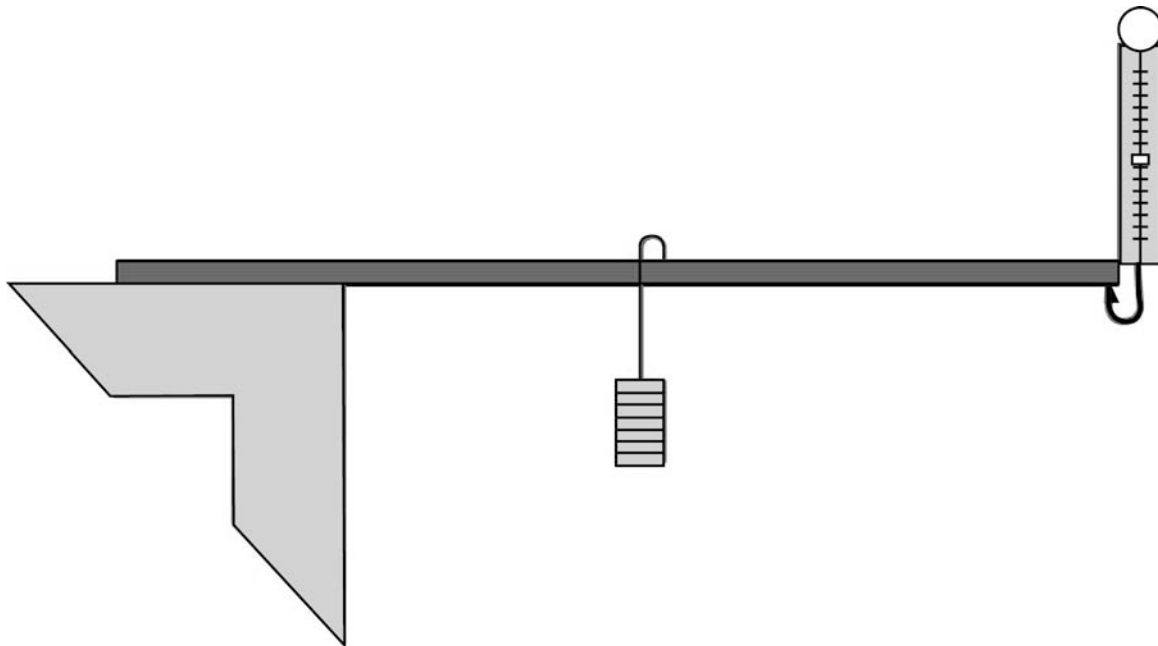
Question 10   **(4 marks)**

A uniform 100 gram, metre-long ruler is placed on a table, with most of its length overhanging the edge. A 350 gram slotted mass is placed at the ruler's 500 mm mark, and a spring balance holds it up at one end, as shown in the diagram below.

The ruler is just lifted using the spring balance so that it touches the table in only one place. At this point the spring balance reads 2.20 N. Indicate on the diagram the fulcrum, or pivot point, for this action and label it 'A'.

The ruler is then lowered slightly, changing the position of the fulcrum.

Label this new fulcrum, or pivot point, 'B'.

When the ruler is in this position, the spring balance reads 1.65 N. Determine the distance between the points 'A' and 'B'. Note that the angle that the ruler makes with the horizontal has not changed significantly and should not be considered in your calculations.

Question 12 **(5 marks)**

The diagram below shows the forces acting on a car following a curve on a banked track. The car is travelling at 17.0 m s^{-1} without slipping. Calculate the radius of the track.
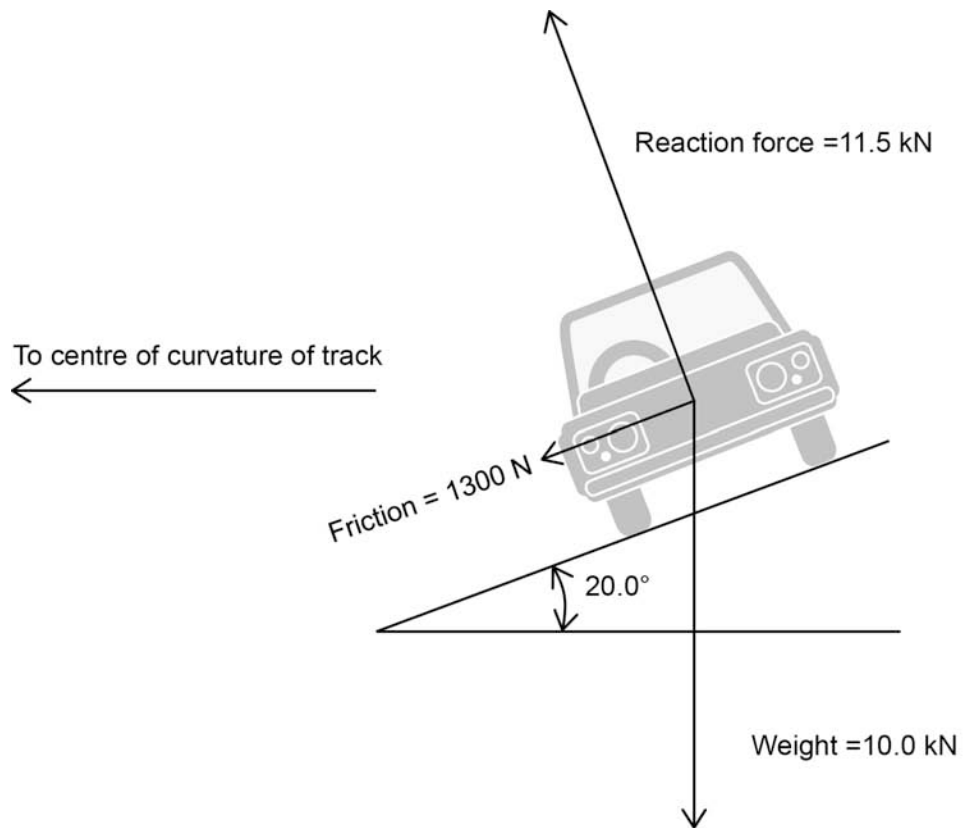
Question 17 **(12 marks)**

The planet Jupiter has a mass of 1.90×10^{27} kg, a radius of 71 500 km and many moons.

The closest moon, Metis, has a mass of 9.56×10^{16} kg and a mean orbital radius of 1.28×10^{5} km. Metis has an average planetary radius of 21.5 km.

(a) Calculate the gravitational force of attraction between Jupiter and Metis. (3 marks)

(b) Calculate the time it takes in hours for Metis to orbit around Jupiter. (4 marks)

(c)   Calculate the magnitude and direction of the net gravitational force acting on a
        1.00 kg mass resting on the surface of Metis that faces Jupiter.   (5 marks)

Question 19 **(19 marks)**

Below is a diagram of a photograph taken using a strobe light flashing at 10.0 Hz. The camera is able to take multiple photographs of a single ball moving down a frictionless inclined plane over a short period of time. Each square on the background grid measures 5.0 cm × 5.0 cm. Ignore air resistance unless instructed otherwise.
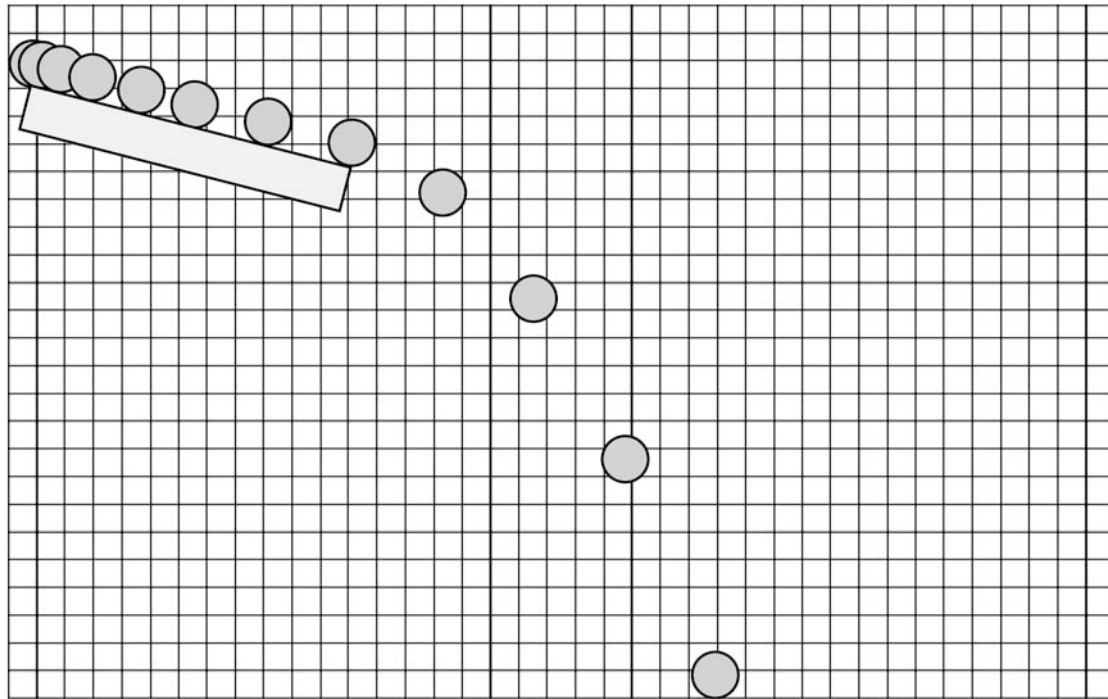
(a)   Draw and label the force(s) acting on the ball while it is on the inclined plane below.

(2 marks)
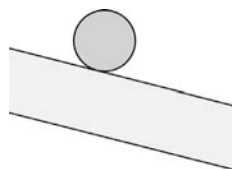
(b)   As the ball leaves the inclined plane, its motion changes.   (4 marks)

        (i)   Describe the horizontal and vertical accelerations just after the ball has left the
                 inclined plane.

        _____

        _____

        _____

        (ii)   How would each of these accelerations be affected if air resistance was
                 considered?

        _____

        _____

        _____

(c)   Use the diagram to determine the horizontal velocity of the ball after it has left the
        inclined plane. Express your answer to an appropriate number of significant figures.
                                                                                      (3 marks)

(d)   The angle of the plane to the horizontal is 14°. Determine the component of gravitational
        acceleration that acts along the inclined plane.   (2 marks)

(e)   Calculate the horizontal component of the ball's acceleration. Given that the ball starts from rest on the first strobe light flash and reaches the end of the inclined plane on the eighth flash, use the horizontal component of acceleration to determine the ball's horizontal velocity component as it leaves the inclined plane.   (5 marks)

(f)   Use the motion of the ball to calculate the length of the inclined plane.   (3 marks)