Physics ATAR - Year 12

Gravity and Motion
Test 2
2018

Name:	Mark: / 51 = %</td>

Time Allowed: 50 Minutes

Notes to Students:

1. You must include **all** working to be awarded full marks for a question.
2. Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
3. **No** graphics calculators are permitted – scientific calculators only.

Question 1 **(3 marks)**

Roger states that there are a number of situations on or near Earth's surface where a person may 'feel weightless'. Mark states that this is impossible. It is only possible to feel weightless in deep space where there is no, or infinitely little, gravitational force on a person. State who is correct with an explanation to support your answer.

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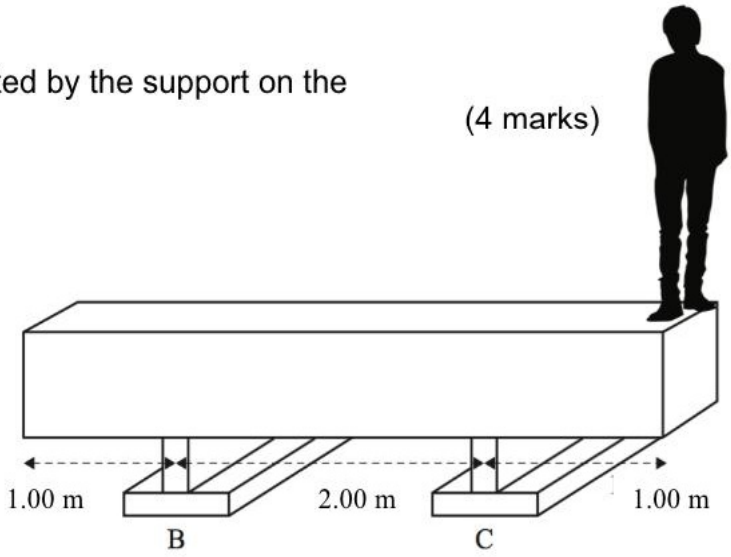
Question 2 **(7 marks)**

A 70.0 kg man stands on the end of a 125 kg park bench of uniform mass, as shown in the diagram below. The supports B and C are not rigidly connected to the ground and is held in place by its weight.

(a) Calculate the magnitude of the force exerted by the support on the bench at point C. (4 marks)



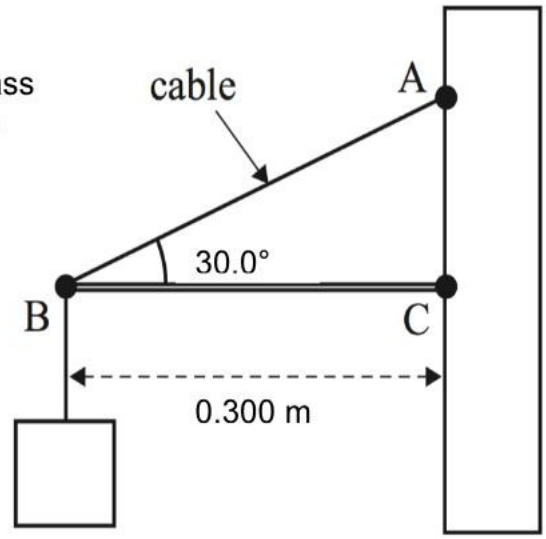
(b) Using an appropriate calculation to support your answer, determine if the bench will topple if the person stands at this point.

(3 marks)

Question 3 **(9 marks)**

A horizontal beam, C is attached to a wall, as shown below. The mass of the beam is 0.200 kg and there is a hanging mass at point B. Point C is a hinge and the cable is attached an angle of 30.0° to the beam.

(a) If the tension in the cable is 17.3 N, calculate the mass hanging at point B. (4 marks)



(b) Calculate the reaction force the hinge exerts on the beam at Point C.
(If you could not do (a), use m = 0.650 kg) (5 marks)

Question 4 **(10 marks)**

A spacecraft is placed in orbit around Saturn so that it is Saturn-stationary (the Saturn equivalent of Geostationary: the spacecraft is always over the same point on Saturn's surface on the equator). The following information may be needed.

mass of Saturn: 5.68×10^{26} kg
mass of spacecraft: 2.00×10^{3} kg
period of rotation of Saturn: 10 hours 15 minutes
equatorial radius of Saturn: 6.03×10^{7} m

(a) Show the derivation of Kepler's 3rd Law

(3 marks)

(b) Calculate the altitude of the space craft in this Saturn-stationary position.

(4 marks)

(c) Calculate the gravitational field strength 'g' at the position of the satellite.
(if you could not complete (b), use $r_o = 7.50 \times 10^{8}$ m)

(3 marks)

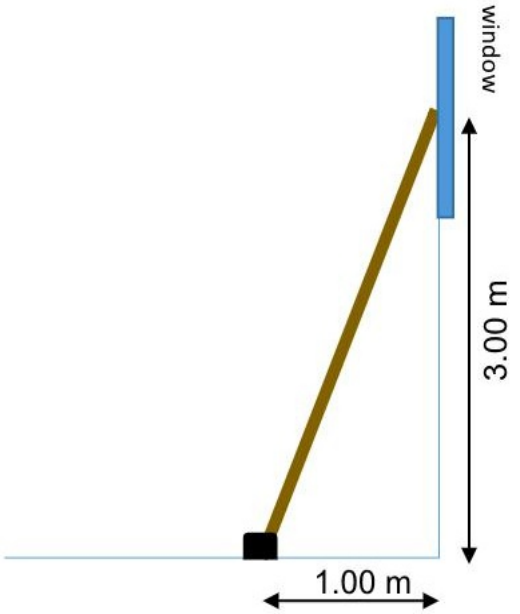
Question 5 **(3 marks)**

The diagram below shows a spacecraft S at a point between the Jupiter and Ganymede at which the pull of the Jupiter on it is equal in magnitude to the pull of the Ganymede on it. Use Newton's law of gravitation to express the mass of the Jupiter M_J as a ratio of the mass of Ganymede M_G.

Question 6 **(13 marks)**

A 15.0 kg ladder of uniform density rests against a window (no friction exists between the ladder and the window) as shown in the diagram below. A 50.0 kg painter stands 1.20 m from the bottom of the ladder.

(a) Calculate the reaction force of the window acting on the ladder to keep it stationary.
(5 marks)



(b) If the window can provide a reaction force of 150.0 N before breaking, determine, with the use of an appropriate calculation, whether the painter can climb to the top of the ladder.

(4 marks)

Ladders come with safety warnings, instructing users to not ascend to the top two steps as it may result in the bottom of the ladder slipping out when leaning against a wall

(c) Explain, using your knowledge of forces, torque and equilibrium how ascending the ladder increases the chances of the bottom of the ladder slipping out.

(4 marks)

Question 7 **(6 marks)**

A gymnast of weight 6.00 x10^2 N is balancing in equilibrium on a slackline, producing a different tension force on either side of the gymnast. The angles of the two tensions to the vertical are shown below. Calculate the magnitude of both tension forces

END OF TEST