Physics ATAR - Year 12

Gravity and Motion
Test 2
2017

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 **(9 marks)**

A future astronaut explorer standing on the surface of Mars experiences a gravitational force of 2.80 $x10^2$ N towards the center of Mars. The radius of Mars is 3.39 $x10^6$ m and its mass is 6.39 $x10^{23}$ kg.

(a) Calculate the mass of the astronaut.

(3 marks)

(b) Calculate the gravitational field strength at the surface of Mars.

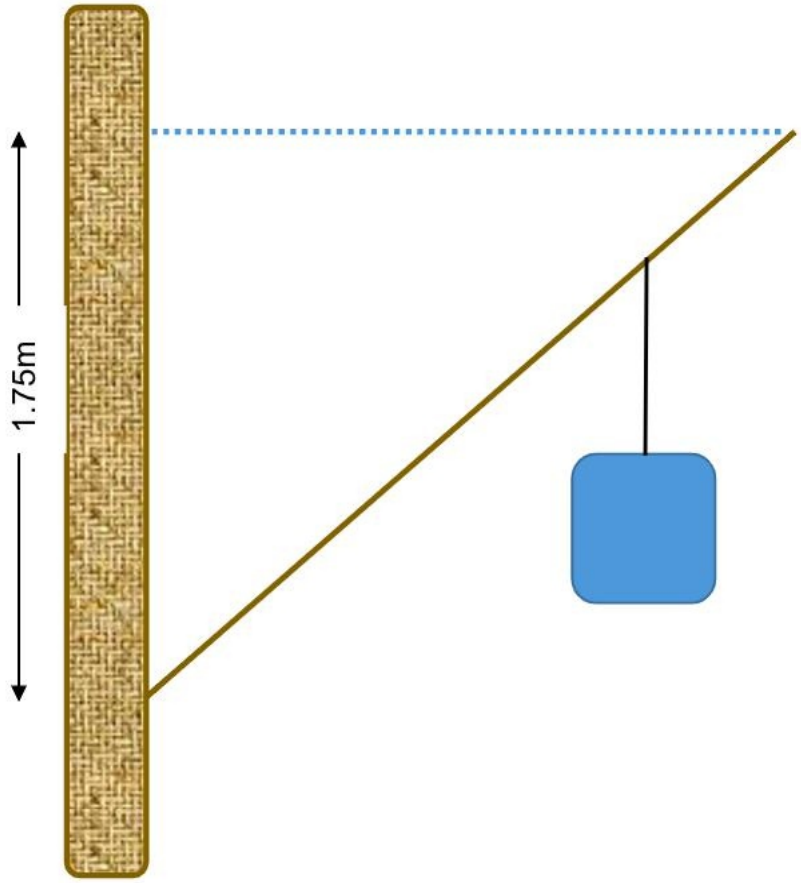
(2 marks)

(c) The astronaut then moves away from the surface of Mars to an altitude where the gravitational force is 50.0 N. Calculate how far from the centre of Mars the astronaut is in terms of the radius of Mars R_M

(4 marks)

Question 2 **(13 marks)**

A 2.50 m long beam of uniform mass of 55.0 kg is bolted to a vertical wall of a shop. A horizontal cable, attached at the end of the beam is attached at a point 1.75 m above the bolt. A 15.0 kg shop sign is hung 2.00 m from the bolt.



a. Calculate the magnitude of the tension in the cable.

(4 marks)

b. Calculate the force of the bolt on the beam.

(4 marks)

c. The shop keeper wishes to increase the visibility of the sign by mounting at the end of the beam. State the effect of this movement on the tension in the cable, including an explanation.

(5 marks)

Question 3 **(17 marks)**

A satellite is said to be in a geosynchronous orbit if it's period of revolution is the same as the rotation of the Earth.

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

(3 marks)

(b) Calculate the altitude of the geosynchronous satellite above the earths surface.

(4 marks)

(c) Calculate the orbital speed of the geosynchronous satellite.

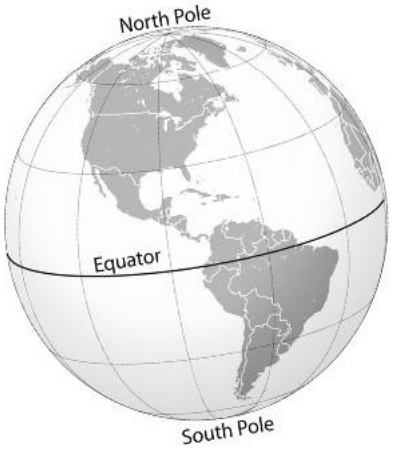
(3 marks)

(d) State, making reference to an appropriate equation, by what factor the orbital speed of this satellite would change if the mass of the Earth was half of its accepted value, providing the radius remained constant.

(4 marks)

(e) Explain and state the difference between a geosynchronous orbit and a geostationary orbit, making use of the (not to scale) diagrams below.

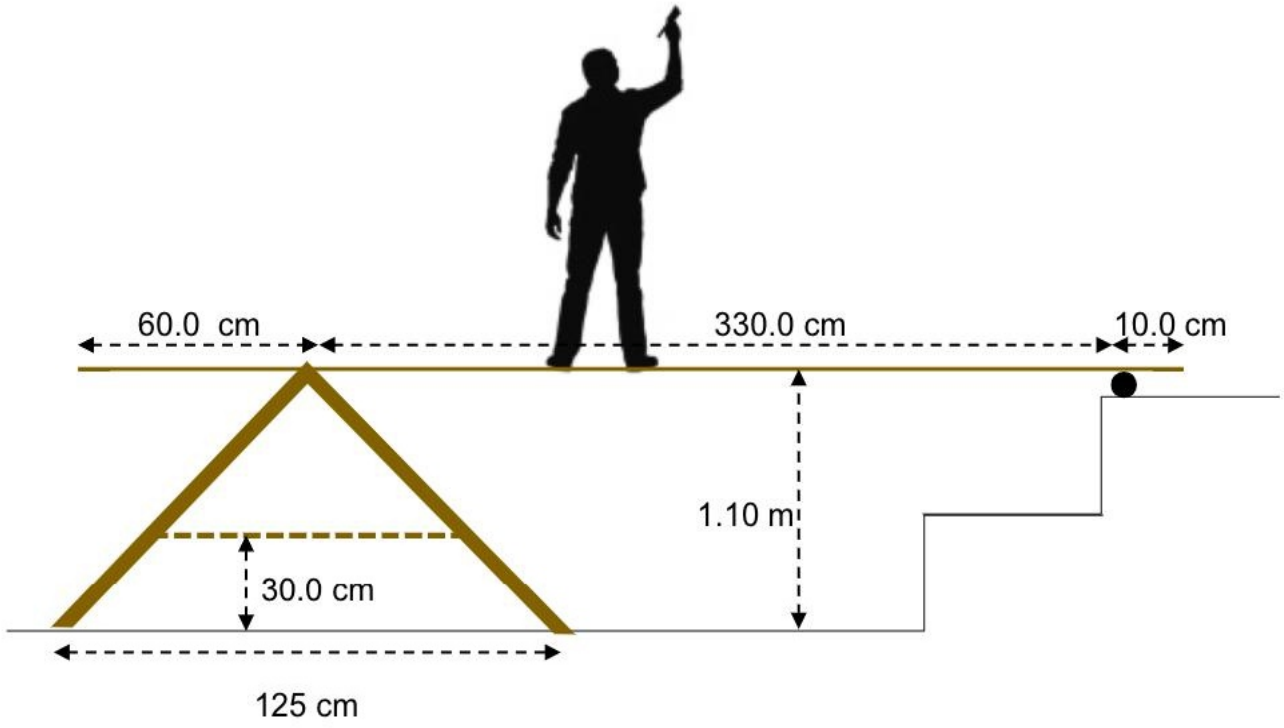
(3 marks)



Question 4 **(12 marks)**

A painter of mass 80.0 kg is painting a ceiling above some stairs. He stands on a uniform horizontal plank of mass 30.0 kg supported at one end by the edge of the stairs and at the other by a trestle. The trestle stands on polished boards across which it can slide without significant friction.

A trestle is an 'A' shaped support (like a step ladder) with two sides hinged at the top. To prevent the sides of the trestle from splaying (spreading out) when the trestle is loaded, the two sides are joined by a length of rope.



(a) If the center of mass of the painter is directly above the center of the trestle, calculate the force exerted by the edge of the step on the plank.

(3 marks)

(b) Calculate the minimum distance from the far left hand end of the plank that the painter could stand without the plank tipping.

(4 marks)

(c) The painter moves to a point on the the plank which causes the force exerted by the edge of the step on the plank to be 500 N upwards. Calculate the tension in the rope of the trestle.

(5 marks)

END OF TEST