Student Name: _____

Time allowed: 50 minutes
Total marks available: 50
Show calculation answers to 3 significant figures

1.   Future Australian astronaut Gareth Spires is in a circular orbit around the Earth within a space station. The on-board gravitometer shows a field strength reading of 7.20 N kg^{-1}. Determine the altitude of Gareth above the Earth's surface.

(3)

2.   Explain why distances between suns, planets and moons are, by default, given as the distance between their centres rather than from surface to surface.

(2)

3.   Use other equations on your data sheet to derive the following equation:

(2)

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

4.   The planet Ionas has a mass of 4.62×10^{25} kg and its moon Geogair a mass of 3.75×10^{23} kg. The gravitational force of attraction between the planet and the moon is 6.02×10^{19} N. Calculate the distance between the planet and the moon stating your answer in kilometres.

(3)

5.   A satellite of mass 950 kg is in a circular orbit at an altitude of 2500 km above the Earth's surface. Calculate the orbital speed of satellite.

(3)

6.   Artificial satellites are used for communication, navigation, remote-sensing and research.

a) Describe briefly two ways in which their orbits are classified.

(2)

b) Give three specific examples of uses of artificial satellites. (The repetition of key words used in this question will not be awarded marks).

(3)

7. The Earth rotates once per 24 hours about the axis through its poles. Assume a **perfectly spherical** Earth for this question.

For a person of mass 72.0 kg calculate their apparent weight on the equator.
You must refer to a vector diagram in your response and
indicate the sum of forces
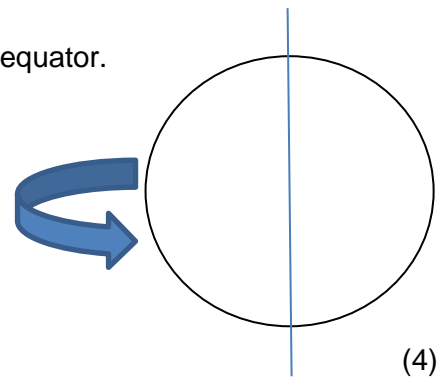
(4)

8. The planet Gashprag is the largest planet in a soon to be discovered solar system. It has a radius of 34 220 km. The largest moon of Gashprag is Nalyd which has a mass of 4.12×10^{22} kg and a diameter of 2800 km. Nalyd has an orbital period of 6.77 Earth days and an orbital radius of 414 278 km.

    a) Determine the mass of the planet Gashprag from this data.
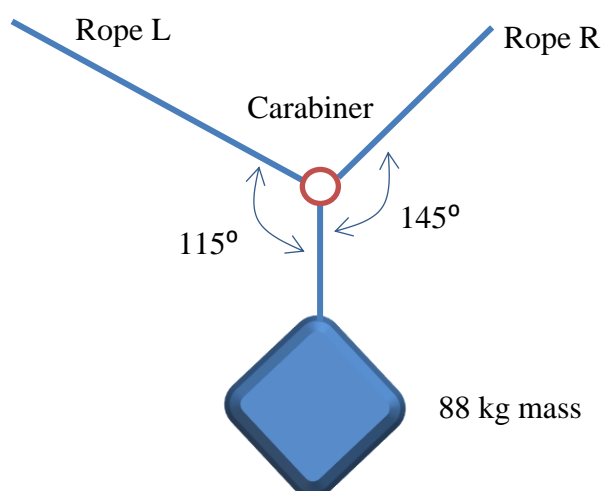
    (4)

    b) Calculate the acceleration of Nalyd relative to Gashprag.

    (3)

9. An 88 kg mass is hanging from a carabiner suspended between 2 ropes. Relevant angles are shown on the diagram. Calculate the tension in Rope L and the tension in Rope R. You must refer to a vector diagram in your solution.

(4)

Rope L   Rope R

Carabiner

145º

115º

88 kg mass

10. Amy is applying a force to turn a gas tap into the open position. She applies the force perpendicular to the gas tap handle and in the plane of rotation.

5.20 cm

Force

The gas tap handle has a length of 5.20 cm from the centre of rotation to the point where the force is applied.

a) Explain why it is easier to apply the force at the end of the gas tap handle rather than the middle.
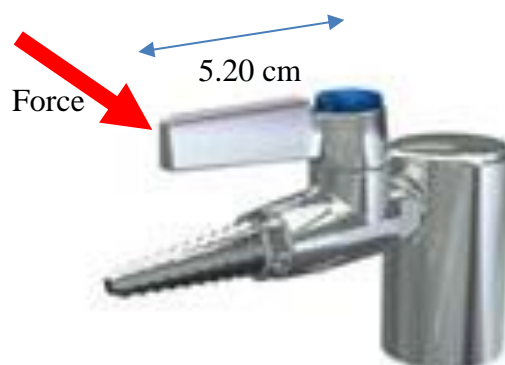
(2)

b) Amy applies a torque of 2.08 N m anticlockwise to the gas tap. Calculate the magnitude of her force.

(2)

11. A diver moves from the centre of a diving board to the right hand edge as shown in the diagram.

The board has a mass similar to that of the diver and is rigid. The board is attached to stiff springs A and B as shown. All forces acting on the board are in the vertical.

Explain what happens to the magnitude and direction of the forces acting on the board from A and B as the diver moves from the centre to the edge.

You must refer to the principles of translational and rotational equilibrium to give a reasoned and logical response.
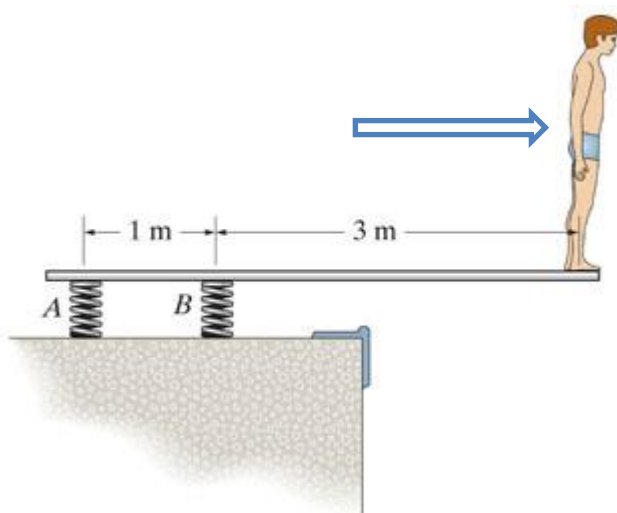
(4)

12. The diagram below shows boom PQ which is part of a crane assembly. The crane is lifting a mass of 3050 kg from point Q. A steel wire is attached to the boom at point R. The boom is free to pivot at point P. Information about the set-up is shown on the diagram and in the table.
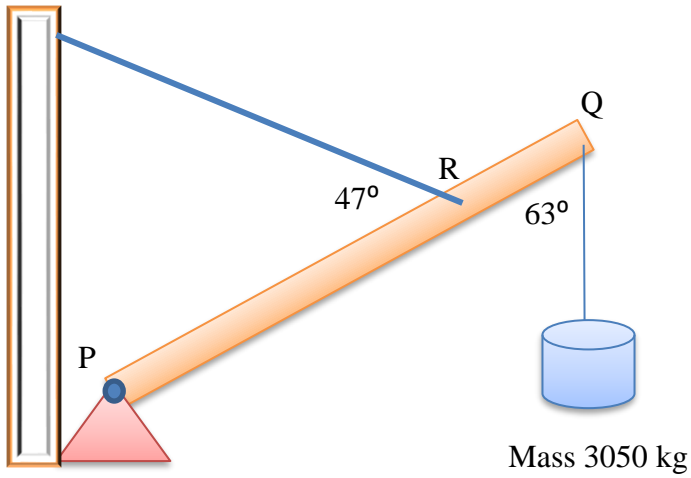
Length PQ	6.20 m
Length RQ	1.70 m
Mass of boom	5600 kg

Mass 3050 kg

a) Calculate the tension in the steel wire.

(4)

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b) Determine the reaction force acting on the boom from the pivot at point P stating both magnitude and direction. If you could not solve part a) or if you are unsure of your solution then use a tension value of 96 230 N.

(5)

END OF TEST

(5)