

# Physics 3AB

## Motion and Forces Test Two 2014

Name:

Mark: / 51

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Time Allowed: 50 minutes

Notes to Students:

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

**Question 1****(4 marks)**

A spanner is used to unscrew a small nut.

- (a) What is the maximum magnitude of torque that can be provided if the effective length of the spanner is 305 mm and the maximum force that can be exerted is 592 N?

(3 marks)

- (b) On the diagram of the spanner below, sketch where the force should be applied for maximum torque. Assume the nut must be turned in a clockwise direction.

(1 mark)



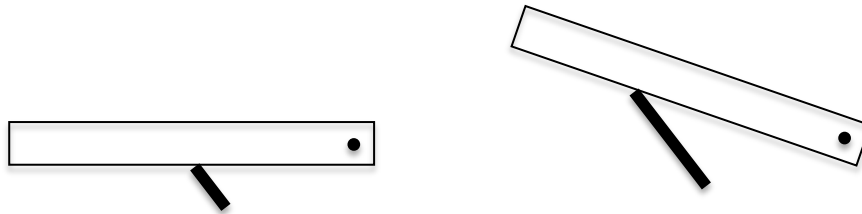


**Question 3****(4 marks)**

A fire truck has a ladder, as shown in the diagram below, that can be raised to reach windows high up on the side of buildings.



The uniform ladder is 20.0 m long and weighs 2800 N. It is pivoted at one end by a frictionless pin and raised into position by a hydraulic piston (which can extend), as shown in the diagram below. The piston contacts the ladder at a distance of 8.00 m from the pivot and there is a constant angle of  $40.0^\circ$  between the ladder and the piston.



Calculate the magnitude of the force required to just lift the ladder from its initial horizontal position?

**Question 4****(8 marks)**

An exoplanet has been detected in circular orbit around the star  $\text{Rho}^1 \text{Cancri}$ .  $\text{Rho}^1 \text{Cancri}$  has a mass 0.85 times that of our sun and the exoplanet has an orbital radius 0.11 times the Earth-Sun distance.

(a) What is the orbital speed of the exoplanet?

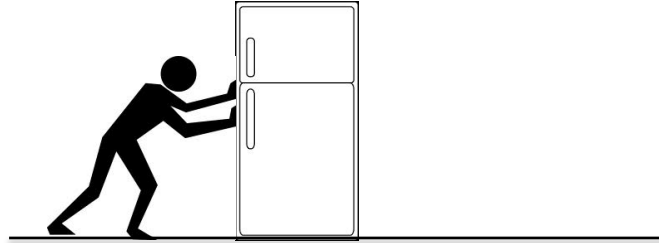
**(5 marks)**

(b) What is the orbital period of the exoplanet?

**(3 marks)**

**Question 5****(5 marks)**

A tall and heavy refrigerator is pushed across a rough floor. Assume the magnitude of the force exerted by the man and the value of static friction between the refrigerator and the floor cannot change.



- (a) State what conditions must be met if the refrigerator is to slide across the floor.

(2 marks)

- (b) The refrigerator shown above has a mass of 199 kg. A force of 520 N can be applied by the man and a static frictional force of 100 N acts between the fridge and the ground.

If the refrigerator can be considered to be uniform and with a height of 2.10 m and width of 1.00 m, calculate the maximum height above the ground the force can be applied to ensure the refrigerator does not start to tilt.

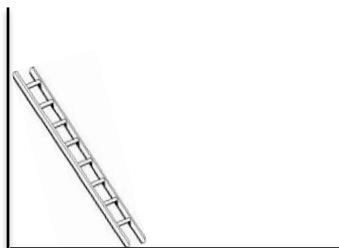
(3 marks)

**Question 6****(6 marks)**

An astronaut of mass 70.0 kg is standing on the surface of the Moon (on the side closest to the Earth). Calculate the net force acting on the astronaut due to the Earth and the Moon. Give your answer to **6 significant figures**.

**Question 7****(21 marks)**

An 80.0 kg workman leans his 5.00 m uniform ladder against a smooth wall and climbs 1.00 m up it. The foot of the ladder is 3.00 m from the base of the wall and the ladder has a mass of 10.0 kg.



- (a) Sketch a diagram below showing all the **physical** forces acting on the ladder (not net forces). Label all forces clearly.

**(5 marks)**



- (b) Calculate the magnitude of the friction force that acts on the base of the ladder.

(7 marks)

- (c) Calculate the force of the ground on the ladder. You do not need to restate any equations derived or formulae written in part (b).  
(4 marks)

- (d) As the workman climbs higher up the ladder, he becomes concerned that the ladder will slip. Explain why the ladder is more likely to slip as the workman climbs higher.

(5 marks)

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**End of Test**