

Mechanics 1 – Modelling

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

Section 1 – Review of previous topics. Please complete all questions.

- 1) A rectangle has sides of length $2\sqrt{3}$ cm and $3\sqrt{3}$ cm.

Find a) the perimeter

b) the area

c) the length of a diagonal.

- 2) A rectangle has area $(7 - \sqrt{2})$ cm² and a side of length $(\sqrt{2} - 1)$ cm. Find the length of the other side.

- 3) The hypotenuse of a right angled triangle is of length $3\sqrt{11}$ cm and the length of one of the shorter sides is $2\sqrt{6}$ cm. Find the length of the third side.

- 4) The length of the longest side of a cuboid box is x cm. The shortest side is 10cm shorter than the longest side and the third side is 2cm longer than the shortest side. Find an expression for the total volume of five of these boxes, in terms of x . Your final answer should contain no brackets.

- 5) In a scientific experiment, the temperature $T^{\circ}\text{C}$ is modelled by the equation $T = -2h^2 + 13h - 20$ where h is the number of hours after 12 noon.

a) Find the times at which the temperature is 0°C

b) Find the maximum temperature and the time at which it occurs.

Section 2 – Consolidation of this week’s topic. Please complete all questions.

- 1) Convert the following into SI units.
- a) 54kmh^{-1}
 - b) 1500 mm per minute
 - c) 24gcm^{-3}
 - d) 140 tonnes per km^2

(3 marks each)

- 2) State the assumptions you might reasonably make to model the following;
- a) A cricket ball thrown through the air.
 - b) A curling stone moving on ice.
 - c) Two bodies of different masses, attached by a string hanging over a pulley.
 - d) Two children sitting on a seesaw

(10 marks)

- 3) A ball is thrown from the top of a building. The ball’s height h metres above the ground at time t seconds after it is thrown is modelled by the equation

$$h = -3t^2 + 12t + 25$$

- a) What is the height of the building?
- b) According to the model, what is the height of the ball above the ground after
 - i) 2 seconds
 - ii) 4 seconds
- c) At what time will the ball be 10m above the ground?
- d) Comment on the appropriateness of the model 8 seconds after the ball is thrown.

(10 marks)

Total for section 2 : 32 marks

Section 3 – Extension question. If you are aiming for a top grade, you should attempt this question.

A simple pendulum is a small body attached to a fixed point by a string. When the body is displaced from hanging vertically, it swings back and forth in an arc. The period of the pendulum is the time taken for one complete cycle. Investigate the relationship between the period and the length of the string? Does this depend on the mass of the body? What modelling assumptions have you made?

