Saint Thomas More College
Girls' Junior Lyceum, Żejtun

Half Yearly Exams – Scholastic Year 2010/2011

FORM 4 **PHYSICS** **TIME: 1 h 30 mins**

Name: _____ Class: _____ Index: _____

INSTRUCTIONS

- Answer **ALL** questions on this examination paper. No extra foolscaps are needed.
- This paper carries 85 marks. Laboratory coursework carries 15 marks.
- The use of the calculator is allowed, however **ALL** necessary working must be shown.
- Where necessary assume $g = 10\ m/s^2$.

FORMULAE

$$W = mg \qquad F = ma$$

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$v = u + at \qquad s = \frac{(u+v)t}{2}$$

$$s = ut + \tfrac{1}{2}at^2 \qquad v^2 = u^2 + 2as$$

$$\text{momentum} = mv \qquad c = f\lambda$$

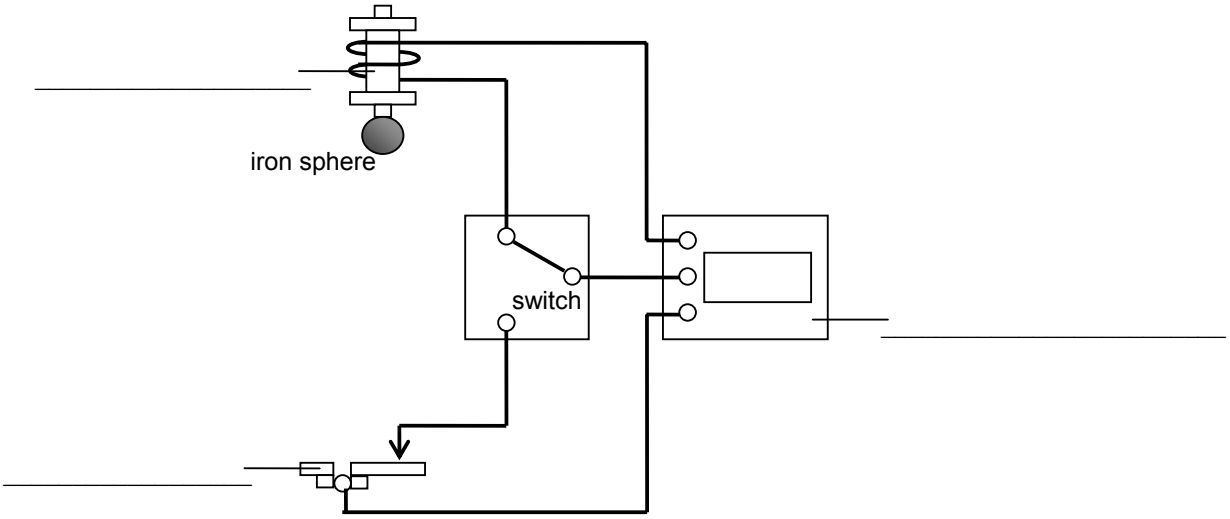
Question:	1	2	3	4	5	6	7	8	Theory	Practical	Total
Max. mark:	8	8	8	8	8	15	15	15	85	15	100
Score:											

SECTION A

(This section carries 40 marks of the total mark)

1. This question is about motion.

A group of students are conducting an experiment at school to determine the acceleration of a freely falling iron sphere. They use the apparatus shown below.



a) Label the apparatus on the above diagram in the spaces provided. [3]

b) Name two measurements they need to take during the experiment. [2]

- _____
- _____

c) Mention one instrument that is needed during the experiment which is not shown in the diagram. [1]

_____

d) Name one precaution they need to take during the experiment. [1]

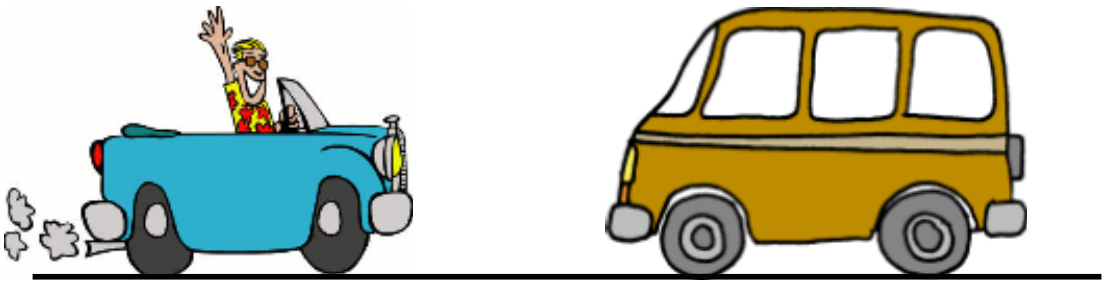
_____

e) Write down the equation they have to use in order to determine a value for the acceleration of free fall. [1]

_____

2. This question is about momentum.

A car of mass 1200 kg moving at 30 m/s collides head-on with a parked van of mass 2400 kg.



a) Complete the following: [2]

The law of conservation of momentum states that _____

_____

provided that _____.

b) Calculate the momentum **before** collision for:

i) The van. [1]

_____

ii) The car. [2]

_____

_____

c) After the collision, the car and the van moved off together.

i) What is the total momentum **after** collision? [1]

_____

ii) Calculate the common velocity with which the van and the car move after collision. [2]

_____

_____

_____

_____

3. This question is about forces and motion.

A flower pot is accidentally **dropped** off a window sill that is 25 m above the ground.

a) Complete the following: [3]

Initially, the pot has a velocity of _____. It begins to fall with an acceleration of _____. The force that gives rise to this acceleration is called the _____.

b) Calculate the time taken (to 3s.f.) by the pot to reach the ground if it **is not** affected by air resistance. [2]

_____

_____

_____

_____

_____

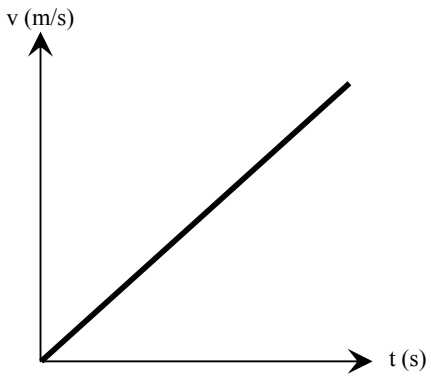
c) If the flower pot **is** affected by air resistance during its fall, it eventually reaches a constant velocity.

i) What is this velocity called? _____ [1]

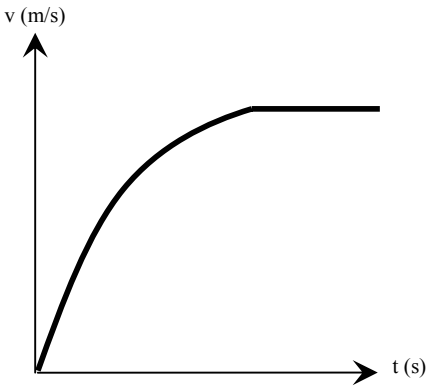
ii) What is the value of the acceleration at this point? _____ [1]

d) Draw a circle around the name of the graph showing the flower pot's fall when air resistance **is** at work. [1]

Graph A

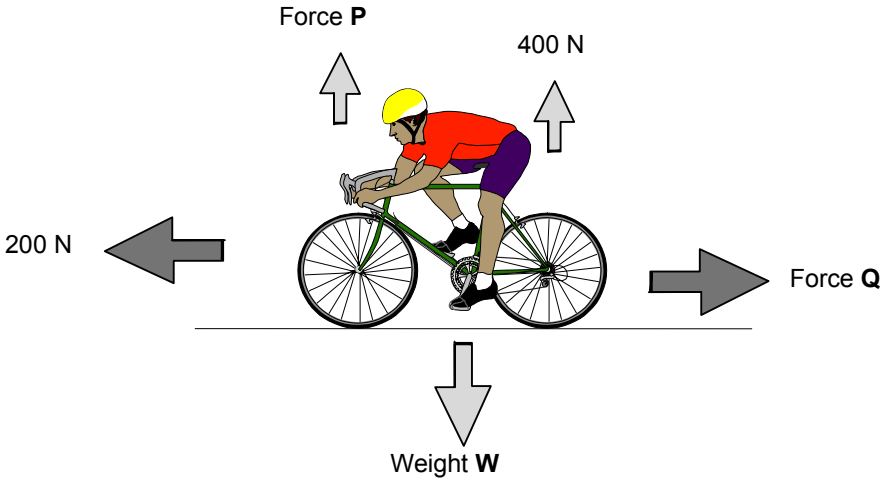


Graph B



4. This question is about forces and motion.

Rosemary, a keen racer, is cycling on her bicycle at constant velocity. The forces acting on her and her bike are shown in the diagram below. Force **P** is the upward force on the front wheel. Force **Q** is the force opposing the motion of the racer and the bike.



a) Calculate the weight **W** that Rosemary and her bicycle exert on the ground if their total mass is 60 kg. [1]

_____

b) What is the value of the reaction force **P**? [1]

_____

c) Explain why force **Q** = 200 N. [1]

_____

_____

d) Apart from the friction of the wheels on the ground, mention another possible cause for the force **Q**. [1]

_____

Rosemary wants to overtake a fellow cyclist and starts pedalling faster. The forward driving force is increased to 1400 N.

e) Calculate the resultant force acting on Rosemary and her bike now. [1]

_____

f) Would Rosemary still continue to travel at constant velocity? Why? [2]

_____

g) Calculate her motion now. [1]

_____

_____

5. This question is about motion.

a) Katrina is driving her motorcycle. She travels 100 m as the motorcycle's velocity is steadily increased from rest to 10 m/s. Calculate:

i) The motorcycle's acceleration. [2]

_____

_____

_____

ii) How long it takes to make the motorcycle accelerate. [2]

_____

_____

_____

b) As soon as her motorcycle reaches 10 m/s, Katrina pulls the brake. She stops her motorcycle uniformly in 10 s. Find the distance travelled by the motorcycle as it is being stopped. [2]

_____

_____

_____

c) Work out the motorcycle's average velocity for the whole journey. [2]

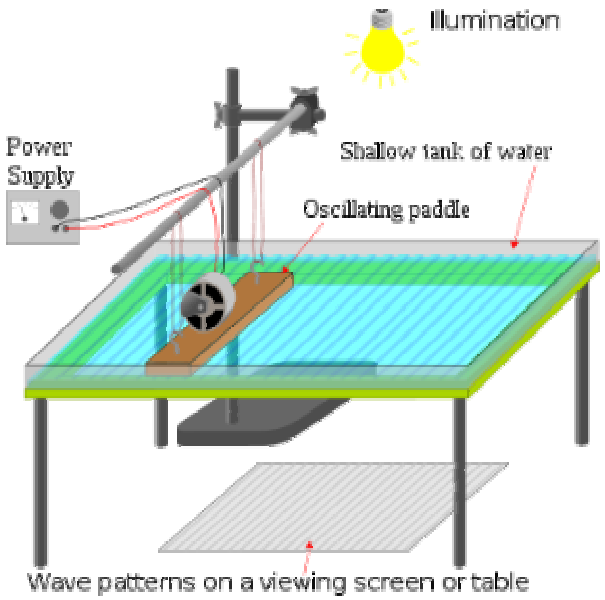
_____

_____

_____

6. This question is about waves.

a) Sonia and Rachel are performing an experiment using the ripple tank as illustrated below.



i) Explain how they can produce straight water waves in the ripple tank. [1]

_____

ii) Explain how they can increase the frequency of the waves produced in the ripple tank. [1]

_____

_____

iii) Every minute, they count 120 waves passing a certain point in the ripple tank. What is the frequency of the waves in Hz or waves per second? [2]

_____

_____

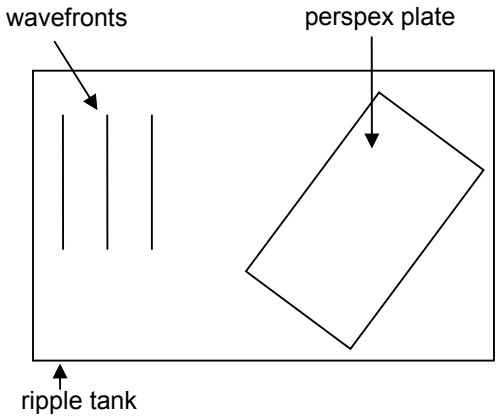
iv) Calculate the speed of these waves if their wavelength is 0·015 m. [2]

_____

_____

_____

b) Sonia then places a flat perspex plate at the bottom of the ripple tank as illustrated.



i) Complete the diagram to show how the water waves travel over the perspex plate. [3]

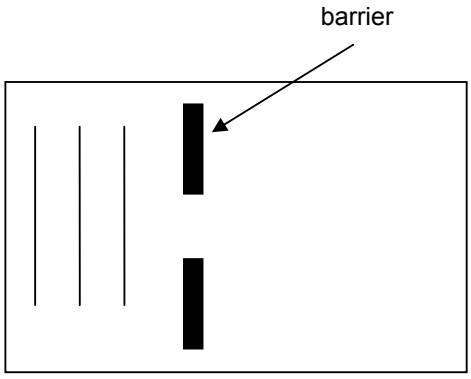
ii) Give a name for this property of waves. [1]

_____

iii) Underline the correct answer: [1]

The speed of the water waves **increases / decreases / remains the same** on passing over the perspex.

c) Rachel then removes the perspex plate and places two barriers forming a gap instead, as shown in the diagram below.



i) Complete this diagram to show the waves after passing through the gap. [2]

ii) Give a name for this property of waves. [1]

_____

iii) Name **<u>one</u>** factor that affects the shape of the waves after passing through the gap. [1]

_____

7. This question is about motion.

Joanne, tired after a day's work, is driving her car at a velocity of 6 m/s. She suddenly notices a child crossing the street 40 m ahead of her. She immediately presses the car brakes.

The table below shows the change in velocity from the time she sees the child until the car stops:

Velocity (m/s)	6	6	6	6	5	4	3	2	1	0
Time (s)	0	1	2	3	4	5	6	7	8	9

a) Plot a graph of velocity (on the y-axis) against time (on the x-axis) on the graph paper provided on page 12. [4]

b) Label using: [1]

i) XY the part of the graph which shows that the car has a constant velocity.

ii) YZ the part of the graph which shows that the car is decelerating.

c) Mark with an arrow the point on the graph when the driver started pressing the brakes. [1]

d) Calculate deceleration of the car and driver. [2]

_____

_____

_____

e) Using the graph find:

i) The thinking distance. [2]

_____

_____

ii) The braking distance. [2]

_____

_____

iii) The total stopping distance of the car. [1]

_____

_____

f) Does the driver run over the child? [1]

_____

g) Give one example how the car's braking distance may be increased. [1]

_____

8. This question is about forces, motion and momentum.

In 2009 Ferrari driver Felipe Massa was involved in an accident during the Formula 1 Hungarian Grand Prix qualifying. His 2400 kg car crashed into a rubber wall made of tyres at 35 m/s. It took 1·75 s for the car to come to rest.

a) Calculate:

i) The car's momentum before the crash. [2]

_____

_____

ii) The car's momentum after the crash. [1]

_____

_____

iii) The car's change in momentum during the crash. [1]

_____

_____

iv) The force that the car exerted on the rubber wall. [2]

_____

_____

b) i) What was the force that the rubber wall exerted on Massa's car? [1]

_____

ii) State the law used to answer question b) i). [1]

_____

_____

It is estimated that Massa's car would have taken 0·5 s to stop had it crashed at 35 m/s into a brick wall.

c) Work out the size of the force that the car would have exerted on the brick wall. [3]

_____

_____

_____

d) It is believed that the rubber wall played an important part in saving Massa's life. Explain in terms of physics principles and the above calculations. [2]

_____

_____

_____

e) Mention two other car safety features that may have also contributed to save Massa's life. [2]

- _____
- _____

END OF EXAMINATION PAPER

Please turn over for graph paper

USE THIS GRAPH PAPER FOR QUESTION 7.