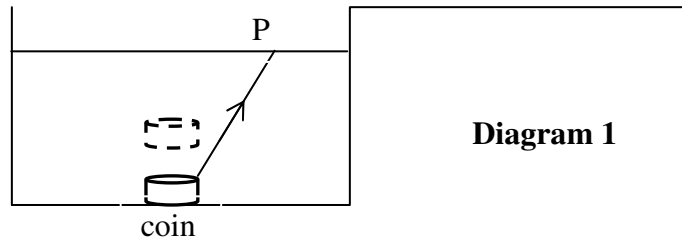


Matriculation and Secondary Education Certificate
Examination Board
University of Malta

Physics SEC Sample Paper I

Syllabus 2012

1. Joanne goes to the pool with her family. She spots a shiny coin at the bottom of the pool as shown in the **Diagram 1**.



- (a) Joanne dives in because she thinks that the coin is really close. This effect is caused by _____ (1)
- (b) On **Diagram 1** above, mark:
- (i) the ray of light as it emerges at point P. (1)
- (ii) the normal, the angle of incidence and the angle of refraction as the ray of light emerges from under the water. (3)
- (c) The pool is 2 m deep but the coin appears to be only 1.5 m below the surface of the pool. Calculate the refractive index of the water.

(2)

- (d) Calculate the speed of light in the water if the speed of light in air is 3×10^8 m/s (300,000,000 m/s).

(2)

- (e) Joanne felt very lucky to have been able to see the coin. Explain why Joanne would not see the coin if the angle of incidence in water is greater than the critical angle.

(1)

- 2.(a) Scientists believe that everything is made up of particles. These particles are arranged in different ways in solids, liquids and gases. Fill in the table below by writing the state which best describes the state of the particles.

<i>Description of Particles</i>	<i>State of Matter</i>
Large spaces between particles	Gas
Particles vibrate about a fixed position	
Particles move at random at high speed	
Strong forces of attraction between particles	
Particles are held together but not strongly	

(4)

- (b) **Diagram 2** shows a sealed container connected to a vacuum pump. Martha pumps some of the air out of the sealed container. What will happen to:

- (i) the mass of the air inside the container?

(1)

- (ii) the density of the air inside the container?

(1)

- (iii) the velocity of the air molecules inside the container?

(1)

- (iv) the number of collisions on the inside of the container?

(1)

- (c) Martha is a curious girl and she wants to try something else. She puts a sealed balloon that has air inside it on the bottom of the container as shown in **Diagram 3**. She then pumps some air out of the container. What will happen to:

- (i) the pressure of the air inside the container?

(1)

- (ii) the balloon?

(1)

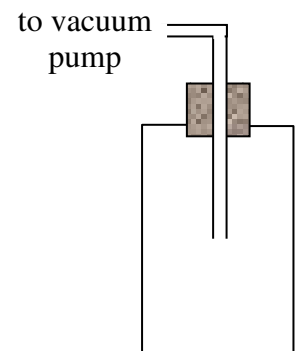


Diagram 2

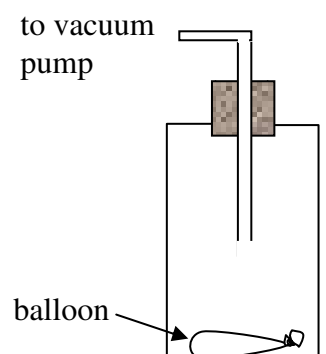


Diagram 3

3. Paul was carrying out an experiment in the school Physics laboratory. He drew a circuit diagram (**Diagram 4**) using symbols to represent the components he used to build his circuit.

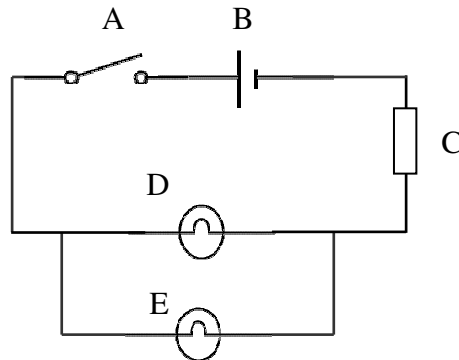


Diagram 4

- (a) In the table below, write down what each of the symbols represents. The first one has been done for you.

Symbol	Name of component
	Cell

(3)

- (b) Paul would like to measure the value of the total current flowing in the circuit and the potential difference across component C, as shown in Diagram 4 above. Name the two instruments he needs to use.

Instrument to measure current _____

Instrument to measure potential difference _____

(2)

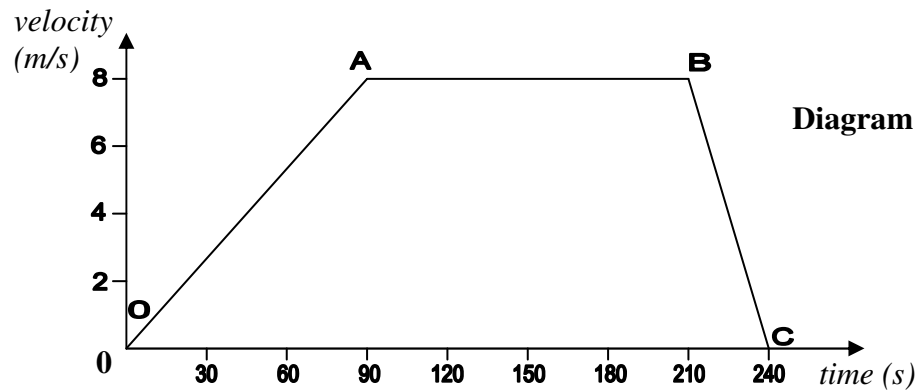
- (c) In **Diagram 4** above, draw the **two** instruments, showing how they should be connected.

(2)

- (d) Cell B has a potential difference of 24 V, components D and E each have a resistance of 5 Ω and component C has a resistance of 12 Ω . Calculate the total current flowing in the circuit.

(3)

4. A rhinoceros is running in the open savannah in search of water. **Diagram 5** shows how its velocity varies with time.



- (a) Use the graph to describe the motion of the rhinoceros between:

O and A	
A and B	
B and C	

(3)

- (b) How can you use the graph to work out the total distance travelled by the rhinoceros?

(1)

- (c) Calculate the total distance travelled by the rhinoceros.

(2)

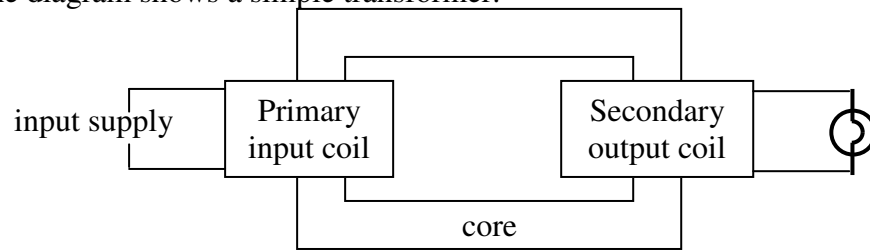
- (d) Compare the distance travelled during OA to that travelled during BC. Explain

(2)

- (e) Calculate the average speed of the rhinoceros in m/s.

(2)

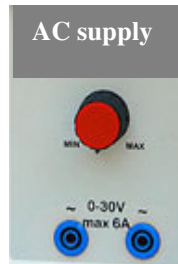
5. The diagram shows a simple transformer.



(a) Circle the **one** of the following power supplies A, B or C, required for the transformer to work.



A



B



C

(1)

Students performing an investigation on a transformer, recorded different values of potential difference across its secondary and primary coils. They tabulated the results as shown below.

p.d. across 2^o coil / V	0	4.0	8.0	12.0	15.0	20.0	24.0
p.d. across 1^o coil / V	0	0.5	1.0	1.5	2.0	2.5	3.0

(b) Plot a graph of **p.d. across 2^o coil** (*y-axis*) against **p.d. across 1^o coil** (*x-axis*) on the graph paper provided.

(4)

(c) One of the p.d. readings across the 2^o coil is **incorrect**.

(i) On your graph, draw a circle around the incorrect value.

(1)

(ii) From your graph or otherwise, determine the correct value.

(1)

(d) (i) From your graph, find the potential difference across the secondary coil when the potential difference across the primary coil is 0.75 V.

(1)

(ii) Calculate the number of turns of the secondary coil given that the primary coil has 50 turns.

(2)

6.(a) Isaac Newton is one of the most famous scientists. The legend has it that Newton saw an apple fall in his garden, thought of it in terms of an attractive gravitational force towards the earth, and realized that the same force might extend as far as the moon.



(i) Karl wanted to test Newton's idea. He took two apples, one much bigger than the other and released them at the same time from the same height. Explain why both apples take the same amount of time to reach the ground.

(1)

(ii) Karl throws one apple upwards. What is the value of the acceleration of the apple at maximum height?

(1)

(b) A toy truck of mass 0.5 kg travelling at 0.25 m/s collides with another toy truck of mass 0.45 kg initially at rest. After collision, the two trucks stick and move off together.

(i) Calculate their common velocity after collision. Name the principle used in your calculation.

Principle used _____ (3)

(ii) Calculate the total kinetic energy of both trucks **before** collision.

(2)

(iii) Calculate the total kinetic energy of both trucks **after** collision.

(2)

(iv) Explain why the value for b(ii) and (iii) above are different.

(1)

7. During the last months, the cost of non-renewable sources of energy such as oil and its derivatives has increased substantially, at times reaching record values.



(a) Describe the difference between *renewable* and *non-renewable* sources of energy.

(2)

(b) Governments are being encouraged to use renewable sources of energy instead of fossil fuels because they have a positive effect on the environment. Give **two** reasons why renewable sources of energy have a positive effect on the environment.

(2)

(c) Mention **two** things that you can do as a student to reduce the consumption of fossil fuels.

1. _____
 2. _____
- (2)

(d) You are called to advise the Minister for the Environment about the introduction of renewable sources of energy in Malta. Identify **two** types of renewable sources of energy you would suggest and explain why you think each type is particularly suitable for the Maltese islands.

Type of Renewable source of energy	Why it is suitable for Malta

(4)

8. Over the weekend, Luke and his friends went to Dingli Cliffs to perform abseiling. They tied ropes to themselves and abseiled down the cliffs.



Diagram 7

- (a) In order to climb down the rock face, Luke had to find equilibrium by keeping his *centre of gravity* in line with the rope. Explain the term *centre of gravity*.

(1)

- (b) Luke has a mass of 55 kg.

- (i) Calculate his weight.

-
- (ii) Draw the weight on **diagram 7**. Label as 'weight'.

(2)

- (c) Luke slowly abseils down the rock face. He holds on to the rope to guide him down. On **Diagram 7** above, draw

- (i) the forces which the rope and cliff exert on Luke. Label as F_1 and F_2 . (2)

- (ii) the tension in the rope. Label as 'T' (1)

- (d) Luke and his friends wear a helmet when abseiling. Describe **two** properties that a helmet must have and explain why these properties are important.

Property of helmet	Why this property is important

(4)

9. William Konrad Roentgen worked with rays emitted in closed tubes which produced marks on photographic films. He did not know what these rays were and he called them X-rays.

(a) (i) Name **one** medical use of X-rays.

(1)

(ii) Name **one** property of X-rays that make them suitable for the medical use you have described above.

(1)

(iii) Name **one** other use of X-rays outside the medical field.

(1)

(b) A doctor suspects that one of the kidneys of a patient is not working properly. The doctor injects the patient with a radioactive impurity of iodine that travels to the kidneys. A normal kidney gradually removes all the impurity from the blood in about 20 minutes.

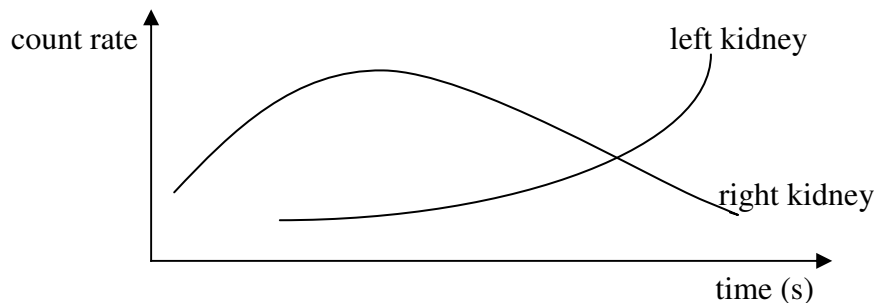
(i) Which type of radioactive material would you expect to be used, one emitting alpha or gamma? Explain.

(2)

(ii) Would you expect a radioactive source with a long or short half-life to be used? Explain.

(2)

(iii) The sketch below shows the results of the test.



Which kidney do you think is **not** working properly? Explain.

(3)

10.(a) Elena works as a ship inspector. She often uses a small device that tests the structures of metal panels. Her gauge (meter) breaks and out of it two bar magnets fall.

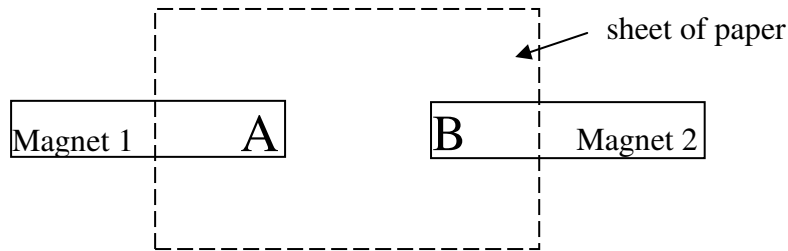


(i) Name a metal that is suitable to produce a permanent magnet.

(1)

Elena investigates the polarities of the two permanent magnets so she can fix the gauge. When the two magnets are placed on a sheet of paper as shown in **Diagram 8**, Elena feels an attraction between the magnets.

Diagram 8



(ii) What conclusion can she draw about the polarities of A and B?

(1)

(iii) Elena places a small plotting compass between the two magnets and draws the field lines on the sheet of paper. The arrow of the compass always points towards A. What is the polarity of A and B?

A = _____ B = _____

(2)

(iv) On **Diagram 8** above, sketch the magnetic field lines in the region between the two magnets clearly showing the direction of the magnetic field.

(2)

(b) (i) Describe an experiment to show that a current carrying conductor in a magnetic field experiences a force.

(2)

(ii) List **two** factors that affect the size of the force on the conductor.

(2)