PHY

PAPER 1B

B

QUEEN'S COLLEGE
PHYSICS MOCK EXAMINATION
2020

Class S.6 ____

Class Number: _____

Block: _____

PHYSICS PAPER 1

SECTION B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) **After the announcement of the start of the examination, write your class, class number and block number in the space provided on P.1.**

(2) **Refer to the general instructions on the cover of the Question Paper for Section A.**

(3) **Answer ALL questions.**

(4) **Write your answers in spaces provided in this Question-Answer Book.**

(5) **Supplementary answer sheets will be provided on request. Write your class, class number, block number and Question Number on it and fix them on this Question-Answer Book.**

(6) **No extra time will be given to candidates for writing of any kinds after the "Time is up" announcement.**

Question No.	Marks
1	8
2	7
3	9
4	11
5	10
6	11
7	10
8	8
9	10

Section B: Answer ALL questions. Parts marked with * involve knowledge of the extension component. Write your answers in the spaces provided.

1. The following items are provided for the measurement of specific latent heat of vaporization of a water.

a beaker with suitable amount of water
an electronic balance
an immersion heater connected to Joulemeter
a Joulemeter connected to power supply

(a) Using the above supplied equipment design and describe an experiment to find out the specific latent heat of vaporization l_v of the liquid. (6 marks)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Is the value of l_v found in experiment lower or higher than real value? Explain briefly. (2 marks)

.....

.....

.....

.....

.....

2. An infiltrated balloon is filled with air at 25^{o}C. Assume that the air behaves like an ideal gas.

*(a) If the balloon is a sphere of volume 5.6×10^{-3} m^3 when the pressure is 1.01×10^5 Pa, find the number of air molecules in the balloon. (2 marks)

.....

.....

.....

.....

.....

.....

*(b) In afternoon the air temperature rises to 38^{o}C, calculate the total pressure of the air inside the balloon if the volume of the balloon expands by 10%. (2 marks)

.....

.....

.....

.....

.....

*(c) A student states that the internal energy of the air in the balloon could become zero if the temperature of the air becomes very low. Explain what is meant by the internal energy of the air and determine whether the statement is correct. (3 marks)

.....

.....

.....

.....

.....

.....

.....

.....

3. An experiment is performed to demonstrate the change of mechanical energy. A large pendulum is made by suspending a 5.0 kg bowling ball from a long piece of wire. A student pulls the ball back until it just touches her nose as shown in Figure 3. Then she releases the ball and stands perfectly still while waiting for the ball to return.

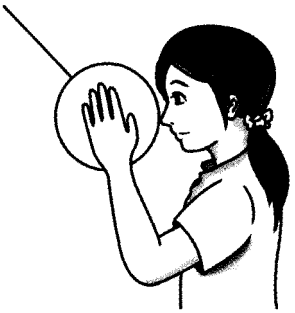

Figure 3

(a) The student is told to release the bowling ball very gently. Explain why she should do so. (3 marks)

.....

.....

.....

.....

.....

.....

(b) Explain briefly why the student is not hit by the ball when the ball returns. (2 marks)

.....

.....

.....

.....

(c) The bowling ball is raised by height of 0.25m, and the length of the pendulum is 1.5 m, calculate

(i) the maximum speed of the bowling ball. (2 marks)

.....

.....

.....

.....

.....

.....

.....

*(ii) the maximum tension in the wire holding the bowling ball. (2 marks)

.....

.....

.....

.....

.....

.....

4. The setup shown in Figure 4.1 is used to determine the speed of a bullet fired by an air rifle. When the bullet hits the plasticine, it merges with it and causes the vehicle to move on a frictionless track.

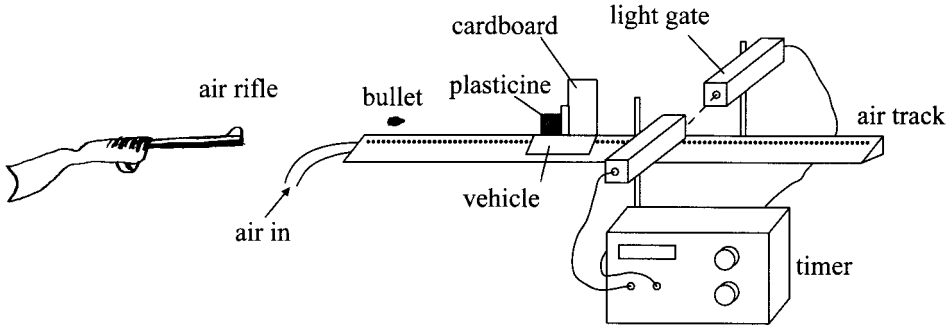

Figure 4.1

When the right edge of the cardboard reaches the light gate, the timer starts counting. When the left edge of the cardboard reached the light gate, the timer stops counting.

(a) If the width of the cardboard is 10cm and the timer reads 0.8s, Calculate the speed of the vehicle. (2 marks)

.....

.....

.....

.....

(b) The total mass of the vehicle and plasticine is 0.5 kg and the mass of the bullet is 2g,

(i) find the speed of the bullet leaving the air gun, assume negligible air resistance. (2 marks)

.....

.....

.....

.....

.....

(ii) When the bullet hits the plasticine, what kind of collision is it? Explain your answer briefly. (2 marks)

.....

.....

.....

.....

(c) The air gun is placed in front of a target such that its nozzle is at the same level as the target as shown in Figure 4.2. The gun fires a bullet horizontally and it hits a position which is 0.3 m below the target. Assume the air resistance is negligible.

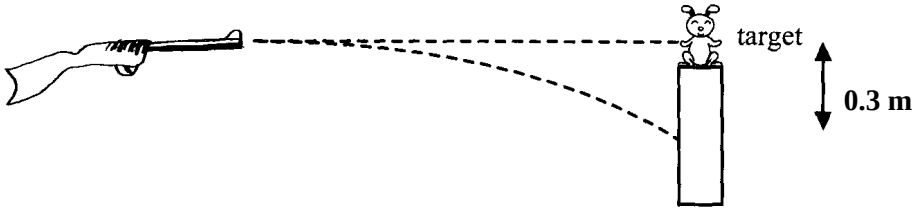

Figure 4.2

*(i) Find the distance between the nozzle of the air gun and the target. (3 marks)

.....

.....

.....

.....

.....

.....

.....

*(ii) If the position of the nozzle of the air rifle is fixed, find the angle at which the bullet should be fired such that the bullet can hit the target. (2 marks)

.....

.....

.....

.....

5. Figure 5.1 shows part of a ripple tank. A thin plastic block of length 12 cm is placed in the ripple tank. A series of water waves passes over the plastic block as shown.

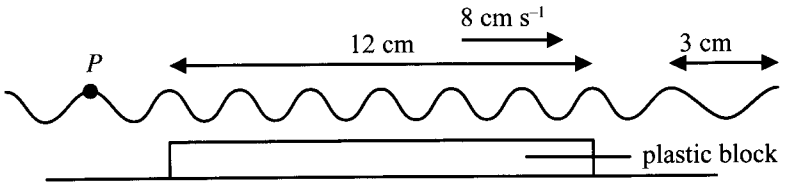

Figure 5.1

The water waves pass through the block at speed of 8 cm s^{-1}. The wavelength of the emergent water waves is 3 cm.

(a) (i) Find the speed of water wave before going over the plastic block. (2 marks)

.....

.....

.....

.....

(ii) Find the frequency of the water wave. (2 marks)

.....

.....

.....

.....

(b) A particle P is placed in the ripple tank. Describe the motion of particle *P* as the water waves propagate. (2 marks)

.....

.....

.....

.....

(c) The plastic block is now adjusted as shown in Figure 5.2. The normal of the plastic block is at an angle of 22^{o} to the direction of propagation of the water waves.

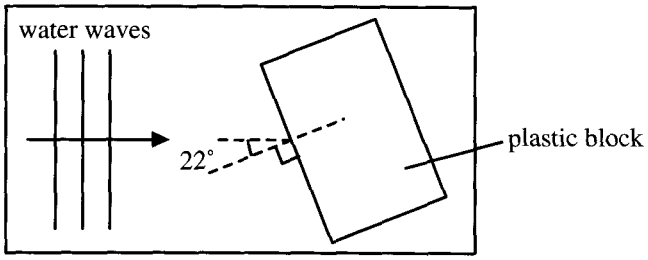

Figure 5.2

(i) Describe the motion of the water wave as it passes over the plastic block. (2 marks)

.....

.....

.....

.....

.....

(ii) Find the angle between the normal of the block and the direction of propagation of the water waves passing over the plastic block. (2 marks)

.....

.....

.....

.....

6. Figure 6.1 shows an experimental arrangement used to study the double-slit interference of light from a filament lamp. The screen is placed at a distance *D* from the double-slit. The slit spacing of the double-slit is *a*.

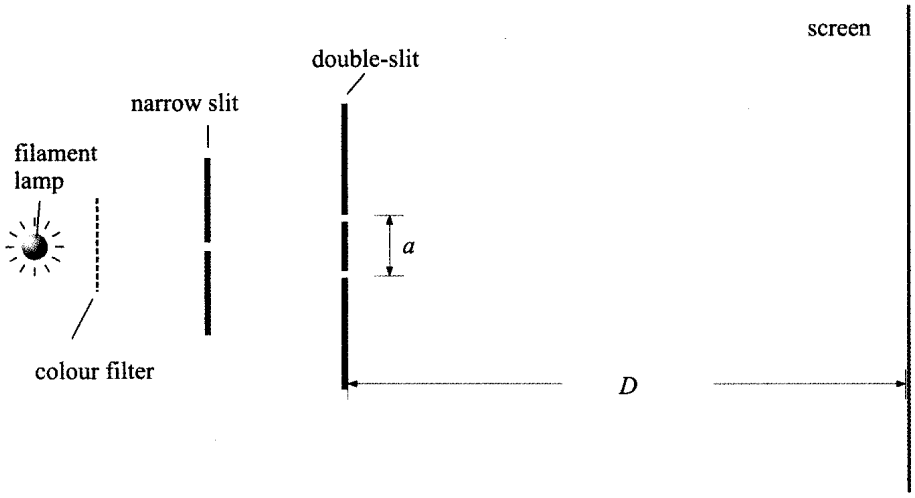

Figure 6.1

The drawing in upper part of figure 6.2 represents the resulting pattern when a yellow filter is used. Given that the wavelengths of red and blue light are 640 nm and 480 nm respectively.

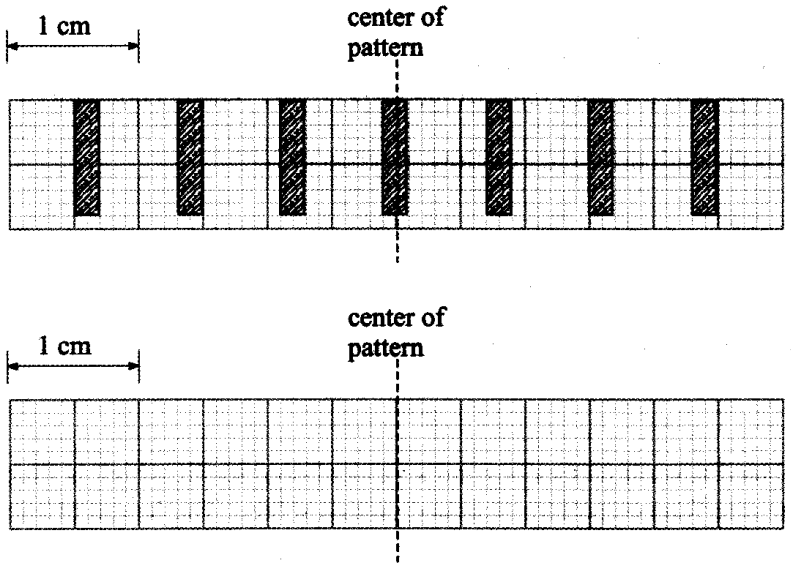

Figure 6.2

(a) Find the separation of the red fringes. (2 marks)

.....

.....

.....

.....

(b) Calculate the ratio D/a. (2 marks)

.....

.....

.....

.....

(c) If the red filter is replaced by a blue filter,

(i) determine the new fringe separation (2 marks)

.....

.....

.....

.....

(ii) sketch the expected result in the lower part of figure 6.2 (2 marks)

(d) Describe what happens to the pattern if

(i) the arrangement is immersed into water. (1 mark)

.....

.....

(ii) the colour filter is removed. (2 marks)

.....

.....

.....

.....

7. The battery of modern mobile phone has a capacity of 4800 mAh.

(a) (i) Find the maximum charge that the battery can store. (2 marks)

.....

.....

.....

.....

(ii) A charger for the battery can deliver a maximum current of 2.1A. Find the minimum time to charge up a used up smart phone battery in (a)(i) (2 marks)

.....

.....

.....

.....

(b) A mobile phone charger has the following values:

Input:	A.C. 220V/50 Hz	6W
Output:	6V	

*(i) Explain why an a.c. supply input is used rather than a steady d.c. supply input for the charger. (2 marks)

.....

.....

.....

.....

*(ii) The primary coil of the transformer has 3000 turns. Assume the transformer is ideal, calculate the number of turns in secondary coil. (2 marks)

.....

.....

.....

.....

*(c) In practice, the output voltage of the secondary coil is always smaller than 6V when connected to the smartphone for charging, explain briefly why.

(2 marks)

.....

.....

.....

.....

.....

8. Iodine- 123 ($^{123}_{53}$I) is a radioactive isotope used in nuclear medicine imaging. An I-123 nucleus decays by capturing an electron to become tellurium-123 (Te-123) which is stable. At the same time, γ ray is emitted.

(a) In the space below write down the equation to represent above nuclear transformation. (1 mark)

(b) On the chart of atomic mass (A) vs atomic number (Z) in figure 8.1, draw an arrow with labels to represent the above nuclear transformation. (1 mark)

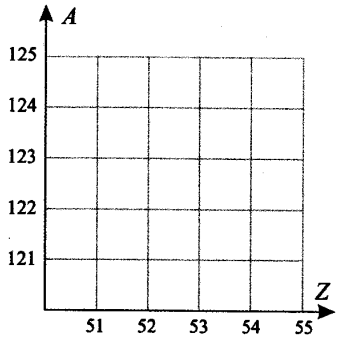

Figure 8.1

(c) I-123 is used as a tracer to monitor the functions of the thyroid which absorbs iodine. Give two reasons why γ ray is the most suitable type of nuclear radiation for this application. (2 marks)

.....

.....

.....

.....

(d) In an experiment to determine the half-life of I-123, data in figure 8.2 were collected using a sample of I-123.

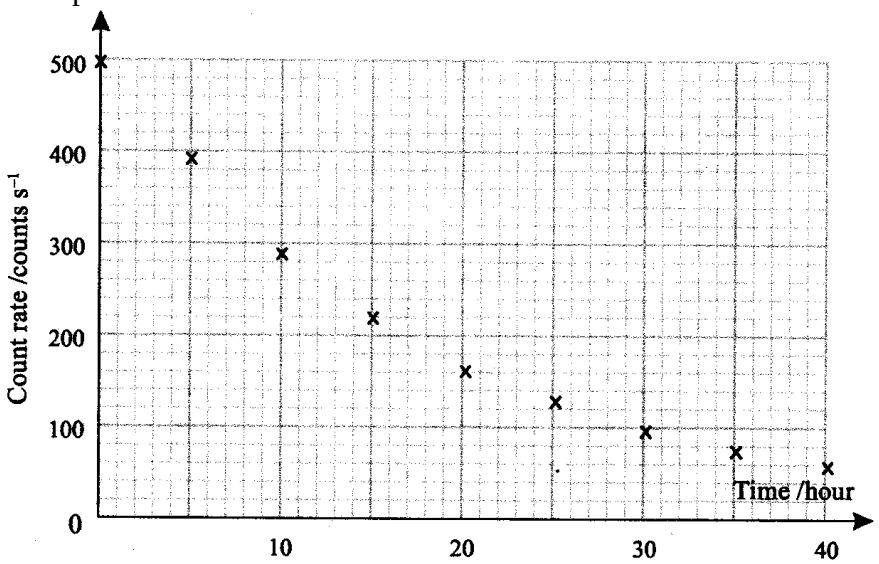

Figure 8.2

(i) Explain why, in this set of data, it was NOT necessary to correct for background radiation. (1 mark)

.....

.....

(ii) Hence, deduce the half-life of 1-123 from the graph. (1 mark)

.....

.....

.....

(e) Give TWO reasons why radioisotopes with short half-lives are particularly suitable for use as a medical tracer. (2 marks)

.....

.....

.....

.....

.....

.....

.....

9. Figure 9.1shows a DC generator which consists of a 4-turn coil *LMPQ* connected across a light bulb via a commutator. The dimension of the coil is 0.8 m x 1 m. A uniform horizontal magnetic field of flux density 0.1 T is established in the region of the coil by a pair of permanent magnets. The coil is rotating at a rate of 2 rev s^{-1} clockwise. At the instant shown, the plane of the coil is parallel to the magnetic field lines.

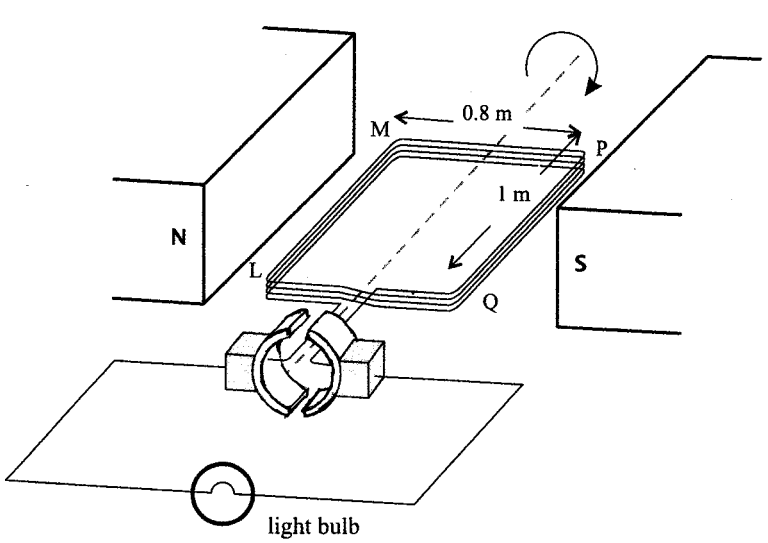

Figure 9.1

(a) Find the linear speed of the side *LM* of the coil. (2 marks)

.....

.....

.....

.....

(b) Show that the maximum output voltage of the generator is about 4V. (2 marks)

.....

.....

.....

.....

.....

.....

(c) If the resistance of the light bulb is 0.8Ω, what is the average power output of the light bulb? (2 marks)

.....

.....

.....

.....

(d) Using the axes in figure 9.2, sketch a labelled graph to show how the flux linkage $N\Phi$ varies with the angle of rotation θ as the coil rotates from the orientation shown in figure 9.1.

(2 marks)

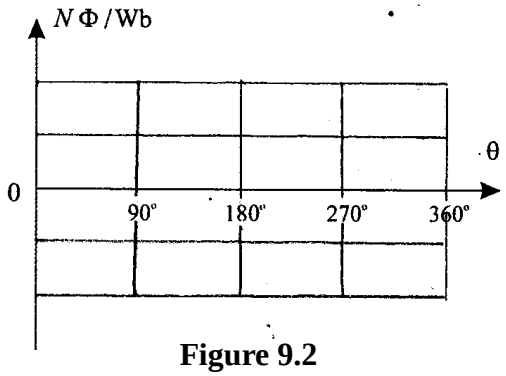

Figure 9.2

(e) Using the axes in figure 9.3, sketch a graph to show how the corresponding induced e.m.f. V varies with θ.

(2 marks)

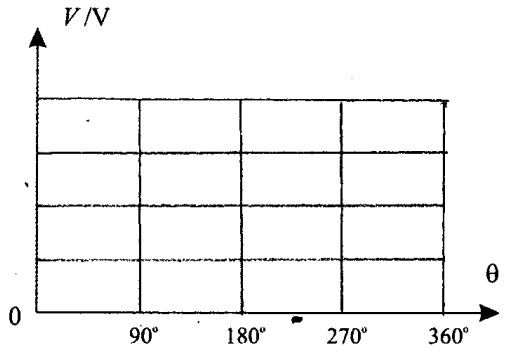

Figure 9.3

END OF PAPER