B

SACRED HEART CANOSSIAN COLLEGE
16 – 17 S6 MOCK EXAMINATION

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, you should first write your name, class, class number and block number in the spaces provided on Page 1 and other odd numbered pages.

(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 the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Graph paper and supplementary answer sheets will be provided on request. Write your name, class, class number, and mark the question number box on each sheet.

(6) No extra time will be given to candidates for filling in the question number boxes after the 'Time is up' announcement.

Name: _____

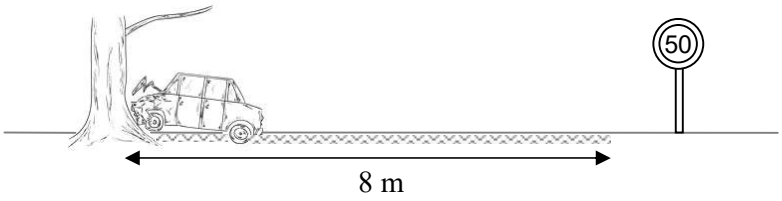
Class & No.: _____( )

Block: _____

Question No.	Marks	For markers' use
1	**8**	
2	**9**	
3	**7**	
4	**9**	
5	**8**	
6	**9**	
7	**5**	
8	**10**	
9	**6**	
10	**8**	
11	**5**	

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

1. A policeman investigates a car accident, and finds that the tyre mark left on the road is 8 m towards a tree as shown below. The mass of the car is 1500 kg, and the maximum frictional force produced by the braking system on the car is 7500 N. The driver claims that the car was initially moving at 50 km h^{-1}, and he immediately applied the brake when he saw the tree 8 m ahead.



(a) Estimate the average deceleration of the car when the brake was applied. (2 marks)

.....

.....

.....

(b) Find the speed of the car just before it hits the tree. (2 marks)

.....

.....

.....

.....

(c) When the car hits the tree, the car stops in 0.15 s. Find the average impact force on the car during the crash. (2 marks)

.....

.....

.....

(d) Suggest TWO designs in the car that the impact force on the driver can be reduced during the accident. (2 marks)

.....

.....

.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

*2. In an amusement park, a boy is rotating with constant speed inside a cylindrical 'rotor' and he remains pressed against the wall as shown in Figure A. The floor of the 'rotor' is smooth.

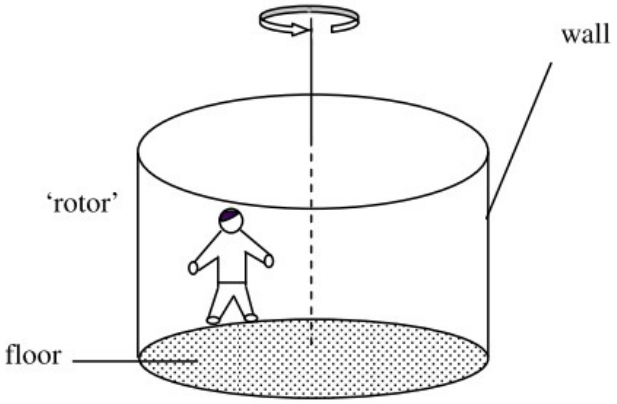


Figure A

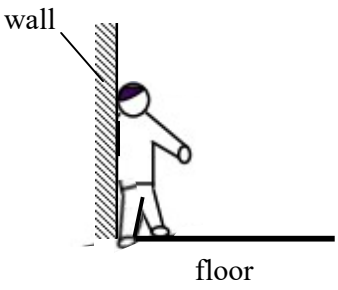


Figure B

(a) Figure B is the side view of the rotor at one instance. On Figure B, draw the free body diagram of the boy. Label the forces clearly. (2 marks)

(b) Name the force as the centripetal force for the boy. (1 mark)

.....

(c) A typical person can withstand an acceleration of about 5*g* before losing consciousness. If the radius of the rotor is 2 m, find the maximum period of the rotor's rotation for health concern. (2 marks)

.....

.....

.....

.....

.....

(d) Describe and explain the force acting on the rotor by the boy during rotation. (2 marks)

.....

.....

.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

(e) In terms of safety, explain briefly why the force mentioned in (d) is usually undesirable, and suggest a way in design to eliminate the adverse effect of such force. (2 marks)

.....

.....

.....

.....

.....

3. A student puts a thermal sensor to a boiling tube containing 200-g of liquid naphthalene as shown in Figure A. Figure B shows the cooling curve of the naphthalene obtained by the data logger connected to the sensor.

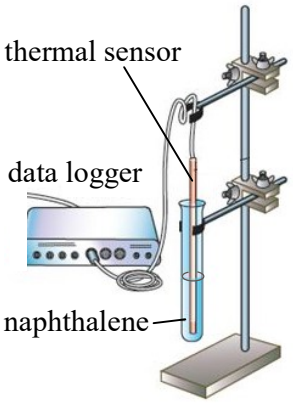


Figure A

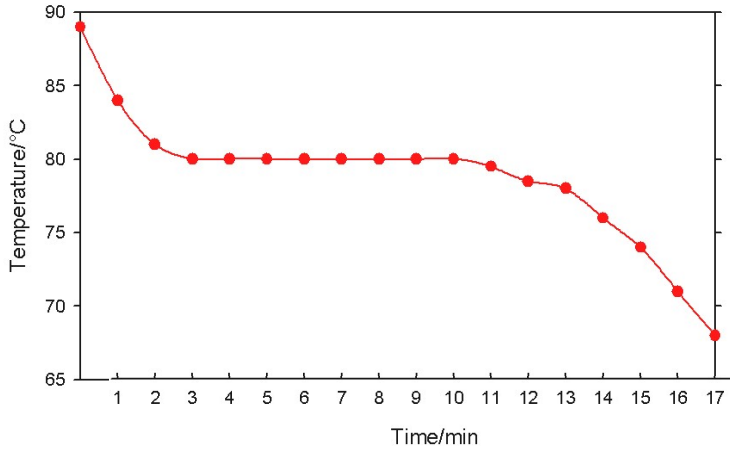


Figure B

(a) What is the melting point of naphthalene? (1 mark)

.....

(b) Describe how the molecular KE and the molecular PE of the naphthalene change during the first 10 min of the experiment. (2 marks)

.....

.....

.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

(c) If the naphthalene losses its energy to the surroundings at a constant rate of 1.5 kJ s^{-1}, estimate the specific latent heat of fusion of naphthalene. (2 marks)

.....

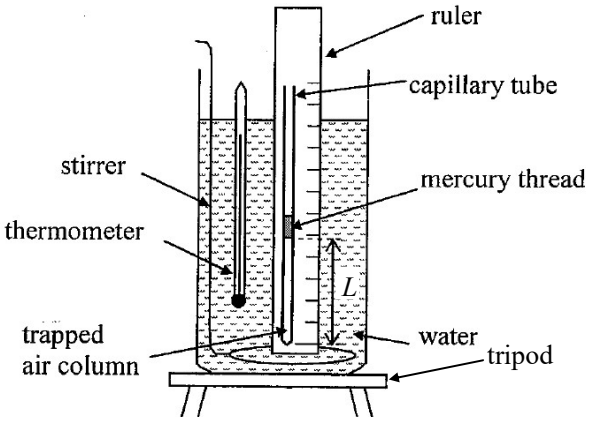
.....

.....

.....

(d) On Figure B, sketch the cooling curve of the naphthalene if the same boiling tube is put in ice water instead of air at room temperature for cooling. (2 marks)

*4.



As shown in the figure above, an air column trapped by a small mercury thread inside a uniform capillary tube is put in a water bath. At room temperature of 22°C, the length of the air column L is 10 cm. The water bath is then heated by Bunsen burner and the water temperature rises to 90°C. The value of L becomes 12 cm. You may assume air in the tube behaves as ideal gas.

(a) In terms of kinetic theory, explain briefly why the air column expands when the temperature rises. (3 marks)

.....

.....

.....

.....

.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

(b) Suggest two precautions that should be done to ensure the temperature of the air column and that of the water are the same before taking a reading of length L. (2 marks)

.....

.....

.....

(c) Estimate the value of absolute zero (in °C) from the experimental data. (2 marks)

.....

.....

.....

.....

.....

.....

(d) Suggest TWO advantages of using a thin air column over a thick one. (2 marks)

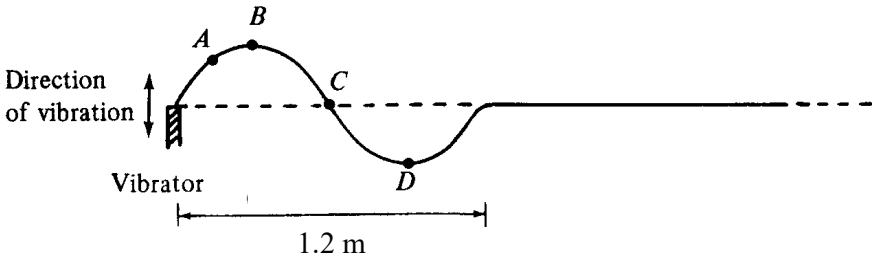
.....

.....

.....

.....

5. A vibrator produces transverse waves on a string. The figure below is the shape of the string 0.4 s after the start of the vibrator.



(a) In terms of direction of motion, state the characteristic of transverse waves. (1 mark)

.....

.....

(b) Find the frequency and the speed of the waves. (2 marks)

.....

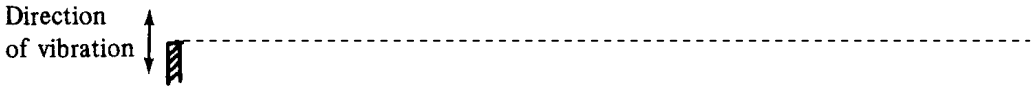
.....

.....

(c) Which particle(s) is/are at rest at the moment shown in the figure? (1 mark)

.....

(d) On the figure below, sketch the shape of the string 1 second after the start of the vibrator. You should show the positions of particles *A*, *B*, *C* and *D*. (2 marks)



(e) With the same vibrator and the string, describe briefly how the above setup can be modified to produce stationary waves. (2 marks)

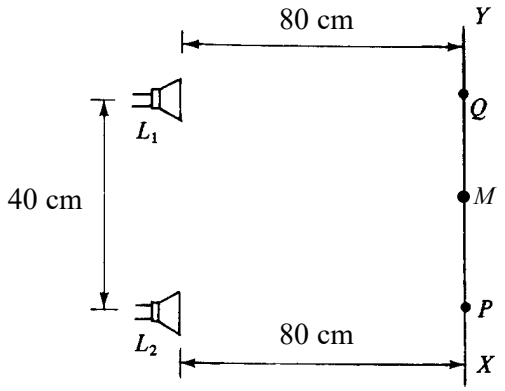
.....

.....

.....

.....

6. In a silent room, a teacher puts two identical loudspeakers, namely L_1 and L_2, which are 4 m apart as shown below. The sounds produced by the two loudspeakers are in phase and of the same frequency. When he walks along *XY*, he detects very soft sounds at *P* and *Q* respectively, and a loud sound at *M* (the midway of *PQ*). The speed of sound in air is 340 m s^{-1}.



Answers written in the margins will not be marked.

(a) Suggest a way to ensure the sounds produced by the two loudspeakers are in phase and of the same frequency. (1 mark)

.....

.....

(b) Determine the frequency of the sounds emitted by the loudspeakers. (3 marks)

.....

.....

.....

.....

.....

.....

(c) Suggest any change in the separation PQ upon the following adjustments respectively.

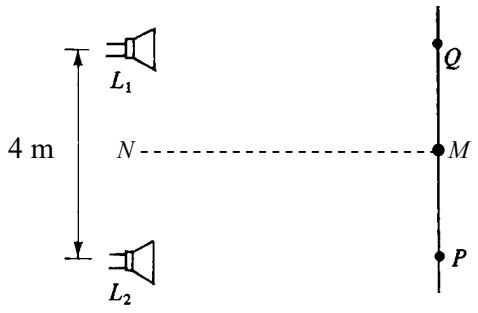
(i) L_1 and L_2 are put closer. (2 marks)

(ii) Sound of higher pitch is used.

.....

.....

(d) A student claims that alternating loud and soft sounds would be detected if he moves along MN as shown below. Comment on his statement. (3 marks)



.....

.....

.....

.....

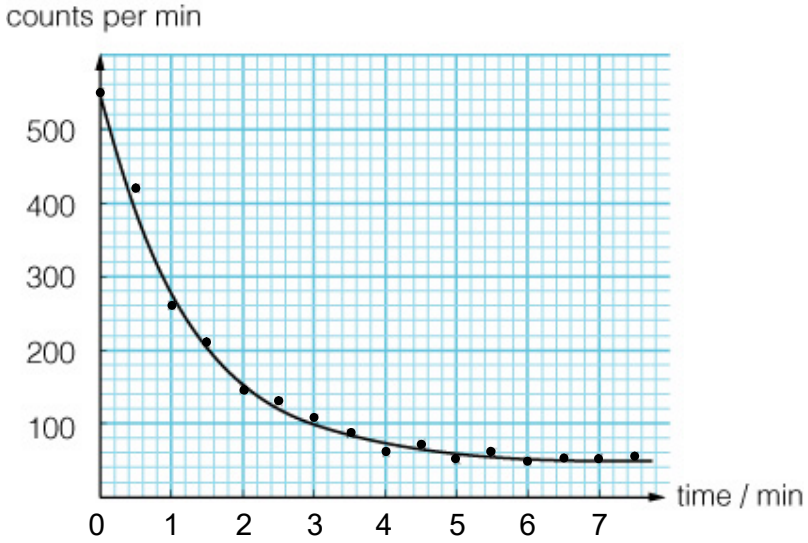
.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

7. The graph below shows the variation of the activity, measured in counts per min, of a radioactive sample of radium-224 ($^{224}_{88}Ra$) with time.



(a) Estimate the background radiation from the data. (1 mark)

.....

(b) Explain briefly why the data do not fix exactly into the exponential curve. (1 mark)

.....

.....

(c) Estimate the half-life (in minute) of radium-224 from the graph. (1 mark)

.....

.....

(d) It is known that only one α particle is emitted in the decay of radium-224. Write down the reaction equation representing the decay of radium-224, using *X* to represent the daughter nuclide. (2 marks)

.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

8. Radium has a radioisotope radium-226, which is commonly used as a backup energy source in an artificial satellite. In each decay of radium-266, there is only one α particle emitted, and the α particle possesses kinetic energy of 4.8 MeV. The half-life of radium-226 is 1620 years.

(a) Briefly explain the origin of the kinetic energy of the α particles emitted. (1 mark)

.....

(b) Estimate the decay constant (expressed in s^{-1}) of radium-226. (2 marks)

.....

.....

.....

.....

(c) If the radium-226 source in a satellite can steadily provide a power of 100 W, show that the activity of the source is 1.30×10^{14} Bq. (2 marks)

.....

.....

.....

.....

.....

*(d) Hence, calculate the mass of radium-226 in the source. (3 marks)
(Given the mass of one mole of radium is 226 g.)

.....

.....

.....

.....

.....

.....

(e) Suggest TWO reasons that radioactive source is an excellent candidate as a power source in a satellite. (2 marks)

.....

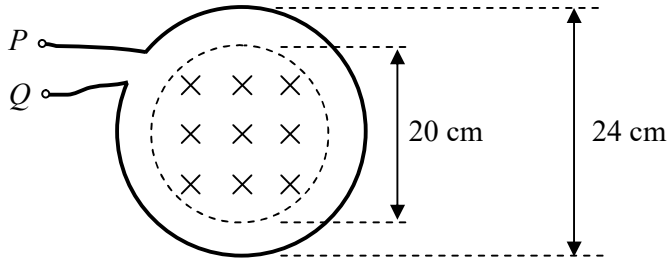
.....

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

9. In the figure below, a uniform magnetic field is confined to a circular area of diameter 20 cm. A circular loop of diameter 24 cm is placed so that it is perpendicular to the magnetic field. Now the magnetic field is set to decrease at a constant rate of 0.02 T s^{-1}.



(a) Suggest a practical way to obtain a uniform magnetic field vanishing at a constant rate. (2 marks)

.....

.....

.....

.....

(b) To measure the e.m.f. induced in the coil, which end (*P* or *Q*) of the loop should be connected to the positive terminal of the voltmeter? (1 mark)

.....

*(c) Estimate the magnitude of the e.m.f. induced in the coil. (2 marks)

.....

.....

.....

.....

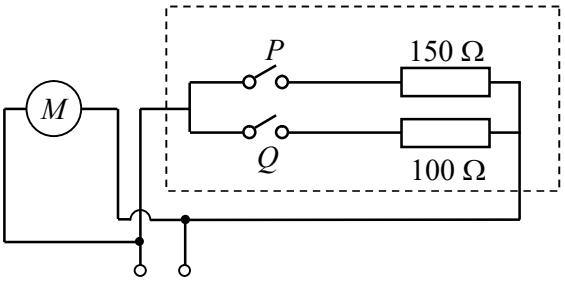
(d) Suggest a way to obtain a larger induced e.m.f. from the same vanishing magnetic field. (1 mark)

.....

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

10. The circuit diagram of a hair dryer is shown below. The heating element consists of two resistors of different resistance. The air, which is blown by the motor *M*, passes through the heating element and is heated up before leaving the hair dryer.



a.c. 220 V, 50 Hz

(a) By changing the states of *P* and *Q*, the equivalent resistance of the heating element R_{eq} can be set to three *non-zero* values. In the following table, write down the values of R_{eq} according to the different temperature settings of the hair dryer. (2 marks)

Temperature setting	**Low**	**Moderate**	**High**
R_{eq} / Ω			

(b) The hair dryer is now working at the higher temperature. The total power output of the hair dryer is 1.8 kW.

(i) Estimate the resistance of the motor. (2 marks)

.....

.....

.....

.....

*(ii) Find the *peak value* of the alternating current in the power supply. (3 marks)

.....

.....

.....

.....

.....

(iii) If fuses of rating 5 A, 10 A, 15 A and 20 A are available, which one is the most suitable for the hair dryer? (1 mark)

.....

*11. You are given two C-cores, some long conducting wires, an a.c. power supply and a voltmeter. Describe an experiment to investigate how a simple transformer would step up or down the voltage from a power supply according to the number of turns of coils.

(5 marks)

C-cores

long wires

a.c. power supply

voltmeter

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

END OF PAPER

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.