Class	Index Number	Name

PEI HWA SECONDARY SCHOOL

PRELIMINARY EXAMINATIONS 2022

Secondary Four Express

PHYSICS

6091/02

Paper 2 Theory

31 August 2022

1 h 45 min

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST
Do not open this booklet until you are told to do so.

1. Write your name, class and index number CLEARLY in the spaces above.
2. There are altogether 2 sections in this paper: Sections A and B.
3. **Section A: Structured Questions**
   Answer **ALL** questions in the spaces provided.
4. **Section B: Free Response Questions**
   Answer **ALL** questions in the spaces provided.
   Question **12** has a choice of parts to answer.
5. Candidates are to show all necessary workings in a clear and orderly manner.

Section		Mark
Paper 1		/40
Paper 2	A	/50
	B	/30
TOTAL		/120

This question paper consists of <u>21</u> printed pages, inclusive of this cover page.

SECTION A Structured Questions (50 marks)

Answer all the questions in the spaces provided.

1 Fig. 1.1 shows the velocity-time graph of the motion of a non-elastic ball.

The entire journey of the ball is a short distance. Air resistance is very small.

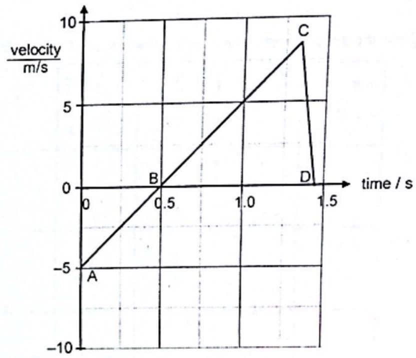


Fig. 1.1

(a) From A to D, Fig 1.1 shows the ball

- coming to a stop after being in contact with the ground
- moving downwards with constant acceleration
- moving upwards with constant acceleration

but not in this order.

Use each phrase once only to describe the motion of the ball between point A and point D.

A to B: ....

B to C: ....

C to D: .... [2]

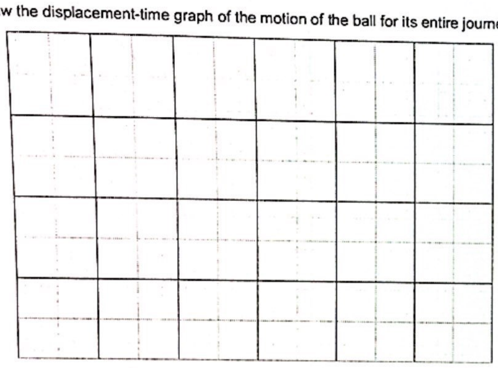
(b) Calculate the total displacement of the ball.

displacement = ... [1]

(c) Calculate the total distance of the ball.

distance = ... [1]

(d) Draw the displacement-time graph of the motion of the ball for its entire journey. [2]



2 Fig. 2.1 shows a pendulum that has been displaced from its rest position. The pendulum is released from point A and it moves to point B. The length of the string from its pivot to the center of gravity of the pendulum bob is 1.5 m.

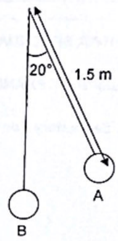


Fig. 2.1

(a) Ignoring air resistance, calculate the maximum speed that the pendulum bob will reach.

speed = ... [4]

(b) Describe the motion of the pendulum bob from point A to point B.

.... [1]

(c) The pendulum is now displaced slightly to its side and released.

Given that the period T of a pendulum can be given by

$$T = 2\pi\sqrt{\frac{L}{g}}$$

where L is the length of the string and g is the acceleration due to gravity,

calculate the time taken for the pendulum bob to reach its maximum speed on the 15th time.

time = ... [2]

3 Fig. 3.1 shows the top view of an object that spins horizontally in one plane. The object is made up of beams of uniform material and thickness, breadth 1 cm and unequal lengths. Different horizontal forces are exerted at various points of the object.

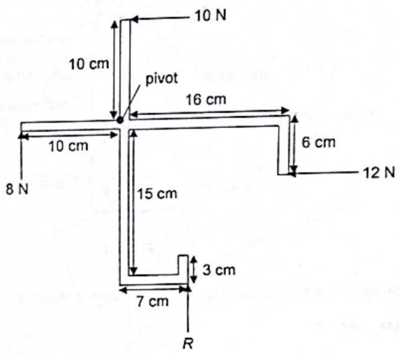


Fig. 3.1

(a) Explain what is meant by the *principle of moments*.

....

.... [1]

(b) The object in Fig. 3.1 is in equilibrium.

Calculate force R.

R = ... [3]

(c) The object is adjusted such that Fig. 3.1 shows the **side view** of the object.

When the object is released, suggest what is observed. Explain your answer.

....

....

.... [2]

4 Fig. 4.1 shows a vacuum flask that contains hot liquid.

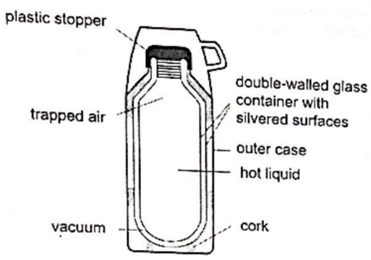


Fig. 4.1

Suggest and explain the purpose of the following features:

(a) vacuum,

....

....

.... [2]

(b) plastic stopper,

....

....

.... [2]

(c) silvered surfaces.

....

.... [1]

5 A space telescope can detect X-rays with wavelengths between 0.01 nm to 10 nm.

(a) State another use for X-rays.

.... [1]

(b) Calculate the lowest frequency of X-rays that can be detected by the CXO space telescope in vacuum.

frequency = ... [2]

(c) Data collected by the space telescope is sent back to Earth via microwaves. Fig. 5.1 shows the time taken for the microwaves to be transmitted back to Earth.

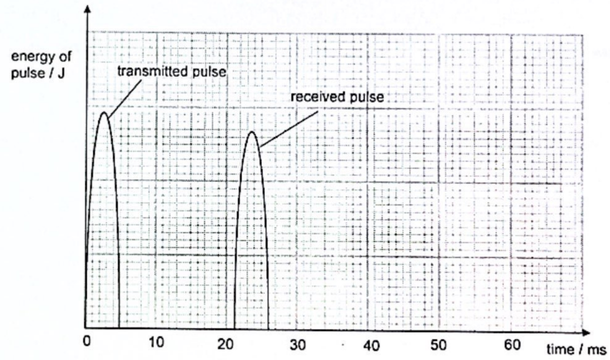


Fig. 5.1

(i) Express the unit of energy of pulse in base units.

unit of energy pulse = ... [1]

(ii) Determine the orbit height of the space telescope above Earth.

height = ... [2]

6 Fig. 6.1 shows a paper cone that has been glued to a magnet. Near the magnet, a soft iron core is placed inside a solenoid that has been connected to an a.c. power supply.

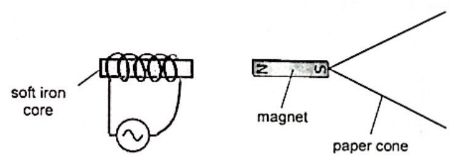


Fig. 6.1

(a) Explain how a sound can be produced by the paper cone when the a.c. power supply is switched on.

....

....

....

.... [3]

(b) Explain why the core is made from soft iron, instead of steel.

....

.... [1]

(c) If there are more coils around the soft iron core, suggest how the sound changes. Explain your answer.

....

....

.... [2]

(d) If the period of the a.c. power supply is now half its original period, suggest how the sound changes. Explain your answer.

....

....

.... [1]

7 Fig. 7.1 shows a crate travelling down a slope at an incline θ at a constant speed.

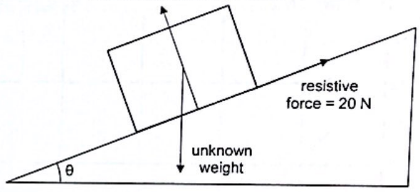


Fig. 7.1

In the space below, using a suitable scale, draw a vector diagram to determine the weight of the crate and the incline θ of the slope.

Hint: The incline θ of the slope is equal to the angle between normal reaction force and weight in the vector diagram.

weight = ... N

incline θ = ... [4]

8 Fig. 8.1 shows a circuit with a fixed resistor and a common thermistor.

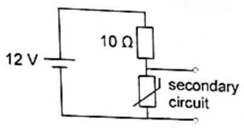


Fig. 8.1

(a) Fig 8.2 shows how the resistance of the thermistor varies as temperature changes.

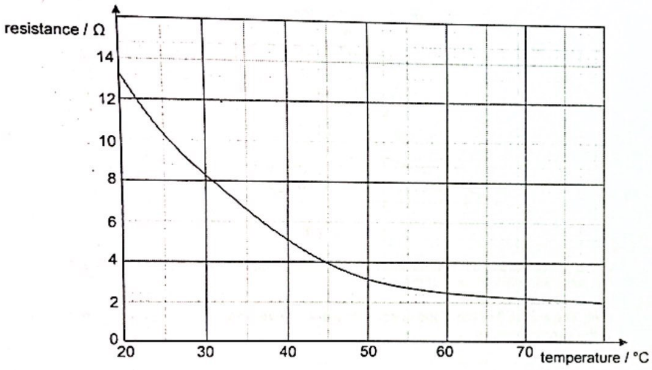


Fig. 8.2

A component is connected to the secondary circuit in Fig. 8.1.

Given that the minimum output voltage for the component is 6.2 V, determine the cut-off temperature of the component.

trigger temperature = ... [3]

(b) A syringe containing air with a movable piston is subjected to increasing temperature.

Suggest what will be observed. Explain your answer.

....

....

....

.... [3]

9 Fig. 9.1 shows the structure of a simple a.c. generator connected to a light bulb.

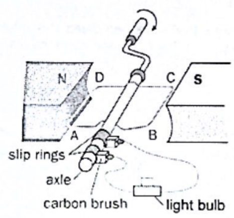


Fig. 9.1

When the coil is rotated, the light bulb lights up.

(a) State the purpose of the slip rings.

....

.... [1]

(b) Explain why the light bulb lights up.

....

....

.... [2]

<u>SECTION B Free Response Questions (30 marks)</u>

Answer all the questions in the spaces provided. Answer only one of the two alternatives in Question 13.

10 Fig. 10.1 shows a beaker with of an unknown liquid.

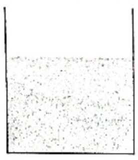


Fig. 10.1

Fig. 10.2 shows the temperature-time graph for the unknown liquid when the beaker was placed near a cooling source.

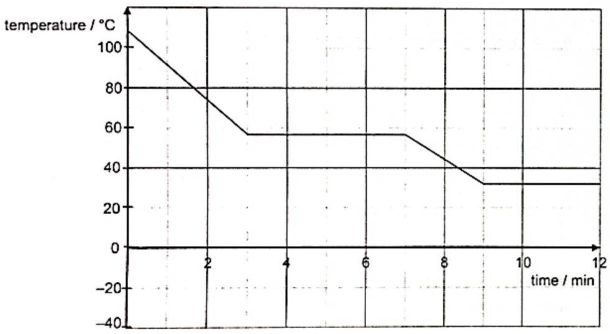


Fig. 10.2

Fig. 10.3 shows additional information that may be useful in answering the questions below.

rate of cooling	9000 J / min
depth of liquid	10.0 cm
atmospheric pressure	1.01×10^5 Pa
mass of liquid	700 g
internal radius of beaker	5.0 cm

Fig. 10.3

(a) Calculate the density of the liquid.

Take the volume of the cylinder to be $\pi r^2 h$.

density = ... [2]

(b) Calculate the pressure at the bottom of the beaker at the start of the experiment.

pressure = ... [2]

(c) Calculate the latent heat of fusion of the liquid.

latent heat of fusion = ... [2]

(d) Calculate the specific heat capacity of the unknown liquid.

specific heat capacity = ... [1]

(e) State if the calculated latent heat of fusion is likely to be higher or lower than the actual latent heat of fusion. Explain your answer.

....

....

.... [2]

(f) Suggest a reason why the temperature of the solid remains constant at 32°C.

.... [1]

11 Fig 11.1 shows the **top view** of an experimental set-up placed on a flat, frictionless surface.

A positively charged metal plate is held in place.

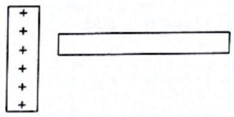


Fig. 11.1

(a) A light, uncharged aluminium rod is placed on the surface near the positively charged metal plate and released so that it is freely moving.

(i) Explain what is meant by *electric field*.

....

.... [1]

(ii) Suggest what will be observed. Explain your answer.

....

....

....

....

....

....

.... [3]

(b) The experimental set-up is modified as shown in Fig. 11.2 by adding permanent magnets, Y and Z. The permanent magnets apply an external magnetic field across the rod.

The top view of the experimental set-up is shown. An external magnetic field is applied across the rod.

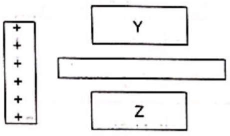


Fig. 11.2

(i) A light, uncharged aluminium rod is placed near the positively charged metal plate and released immediately.

In addition to what was observed in **(a)(ii)**, it also momentarily levitated above the surface before resting on the table.

Explain why this was observed.

....

....

....

....

....

.... [3]

(ii) Suggest which pole, Y or Z, is the North pole. Explain your answer.

....

....

....

.... [3]

12 EITHER

(a) Fig. 12.1 shows a small toy at the bottom of the pool. The diagram is not drawn to scale.

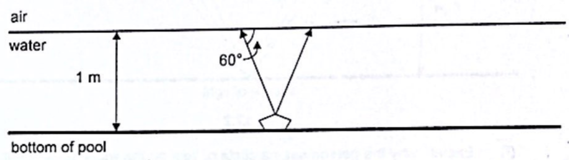


Fig. 12.1

Two rays from the toy are incident on the surface of the water.

(i) Complete Fig. 12.1 to show the two rays in air. [1]

(ii) Use the rays you have drawn in Fig. 12.1 to explain why the toy appears to have a different depth to its real depth.

....

....

.... [2]

(iii) Given that $n = \frac{r}{a}$, where n is the refractive index, real depth r = 1 m and apparent depth a = 0.75 m, calculate the angle of refraction of the light ray at the water-air boundary.

angle = ... [2]

(b) Fig. 12.2 shows a spotlight placed at the bottom of the same pool as in Fig. 12.1.

A person viewing the spotlight from above the water will realise that only a circle of light can be seen on the water surface.

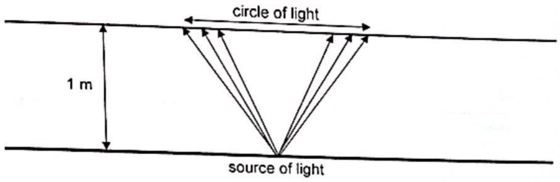


Fig. 12.2

(i) Explain why the person sees a circle of light on the water surface but not be able to see beyond that.

....

....

.... [2]

(ii) Calculate the area of the circle of light that can be seen.

area = ... [3]

12 OR

Fig. 12.3 shows an image formed by a converging lens with a focal length of 2 cm.

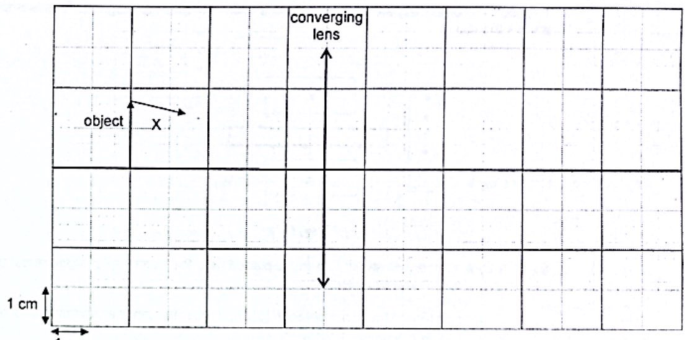


Fig. 12.3

(a) On Fig. 12.3,

(i) draw two rays from the top of the object to locate the image. [2]

(ii) complete ray X. [1]

(b) State an application of the ray diagram in Fig. 12.3.

.... [1]

(c) The bottom of the lens is covered.

Describe what will be observed.

.... [1]

(d) Describe the changes to the image when the object is moved from its original position to a distance of 1 cm away from the lens.

....

....

....

....

....

.... [4]

(e) Suggest a modification to the experimental set-up that will result in a bigger image.

.... [1]

_____ END OF PAPER 2 _____