Saint Ignatius' College
RIVERVIEW

St Ignatius College Riverview - Faculty of Science

2024 Examination

PHYSICS

General Instructions

- Reading Time - 5 Minutes
- Working Time - 2 Hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A data sheet, formulae sheet, and Periodic Table are provided at the back of this paper

Total marks: 70

Section I - 15 marks (pages 2 - 9)

- Attempt Questions 1-15
- Allow about 30 minutes for this section

Section II - 55 marks (pages 10 - 27)

- Attempt Questions 16 - 25
- Allow about 1 Hour and 30 minutes for this section

2024 Higher School Certificate Trial Examination

Student Number

Physics
Section I Question Booklet

15 marks
Attempt Questions 1 - 15
Allow about 30 Minutes for this section

Instructions

- Write your student number at the top of this page
- Show all relevant working in questions involving calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which questions you are answering.

Please turn over

Question 1

Which of the following includes *two vector* and *two scalar* quantities?

(A) Velocity, speed, acceleration, time

(B) Distance, displacement, speed, time

(C) Acceleration, velocity, displacement, speed

(D) Time, distance, velocity, speed

Question 2

In 1985, Marita Koch set the world record for the women's 400 m run with a time of 47.60 seconds.

What was Koch's *average speed* during the race?

(A) 0.120 m s^{-1}

(B) 8.40 m s^{-1}

(C) 30.2 m s^{-1}

(D) 1.90 x 10^{4} m s^{-1}

Question 3

A car travelling along a straight section of road at 20 km/h accelerates uniformly to 60 km/h over a period of 8 seconds.

The value of the car's *acceleration* during the 8 seconds would be:

(A) 1.4 ms^{-2}

(B) 5.0 ms^{-2}

(C) 9.8 ms^{-2}

(D) 144 ms^{-2}

Question 4

Two cars are travelling East along a straight road. Car A is travelling at 40 km/h and car B is travelling at 60 km/h.

The *velocity* of **car A with respect to car B** is:

(A) 20 km/h East

(B) 20 km/h West

(C) 40 km/h West

(D) 100 km/h East

Question 5

An object with a mass of 87 kg has a constant net force of 26 N applied to it.

What is the **magnitude** of the object's *acceleration*?

(A) 0.3 m s^{-2}

(B) 3.3 m s^{-2}

(C) 26 m s^{-2}

(D) 87 m s^{-2}

Question 6

Which row of the table shows the *appropriate* **units** for acceleration and gravitational potential energy?

	Acceleration	*Gravitational potential energy*
(A)	m s^{-1}	J
(B)	m s^{-2}	J
(C)	m s^{-1}	m s^{-2}
(D)	m s^{-2}	m s^{-1}

Question 7

The Earth has a mass of 6.0×10^{24} kg.

The Moon has a mass of 7.3×10^{22} kg.

Which of the following statements *correctly* **describes** the interaction between the Earth and the Moon?

(A) The Earth pulls on the Moon with a force that is greater that the force that the Moon pulls on the Earth.

(B) The Moon pulls of the Earth with a force that is greater that the force that the Earth pulls on the Moon.

(C) The Earth pulls on the Moon with a force of the same magnitude as the force that the Moon pulls on the Earth.

(D) The Earth experiences a greater acceleration that the Moon because the Moon has a smaller mass.

Question 8

How *long* would it take for a 2500 W microwave oven to use 9 M J of energy?

(A) 1 hour

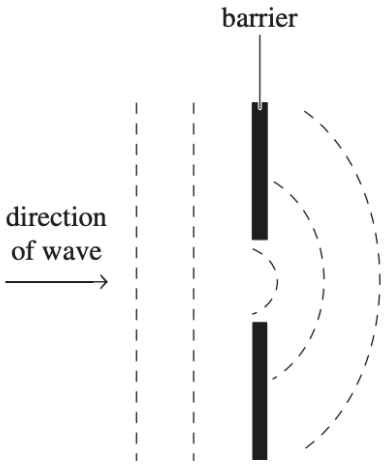
(B) 3.6 hours

(C) 278 hours

(D) 3600 hours

Question 9

Consider the diagram below.



Which of the following *wave behaviours* does the diagram illustrate?

(A) Diffraction

(B) Refraction

(C) Reflection

(D) Superposition

Question 10

Which of the following *wave behaviours* enables lenses to create **enlarged images**?

(A) Diffraction

(B) Refraction

(C) Reflection

(D) Superposition

Question 11

Which row of the table shows the media combination that would result in a *critical angle* of 35.15°?

	n_1	n_2
(A)	2.42	1.76
(B)	1.76	2.42
(C)	1.14	1.98
(D)	1.98	1.14

Question 12

Which row of the table shows the combination of natural frequency and driving frequency that would result in *resonance*?

	Natural frequency (Hz)	*Driving frequency (Hz)*
(A)	30	20
(B)	10	40
(C)	20	20
(D)	60	30

Question 13

240 V of potential difference is applied across a 12 Ω piece of wire. The wire has a length of 20 cm.

How many *electrons* would pass a particular point in the wire every 5.0 seconds?

(A) 1.6×10^{-17}

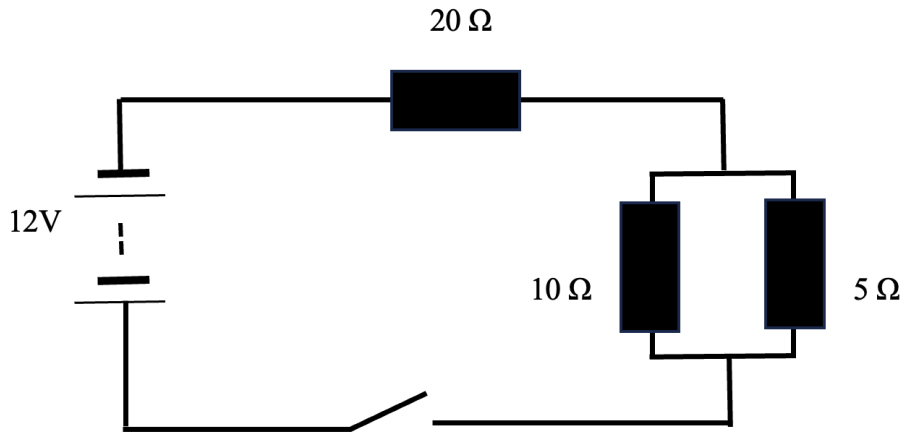
(B) 100

(C) 1.2×10^{20}

(D) 6.2×10^{20}

Question 14

The following circuit is set up:



Which of the following statements would be **true** when the switch is closed?

(A) The current through the 10 Ω resistor is half the current through the 20 Ω resistor.

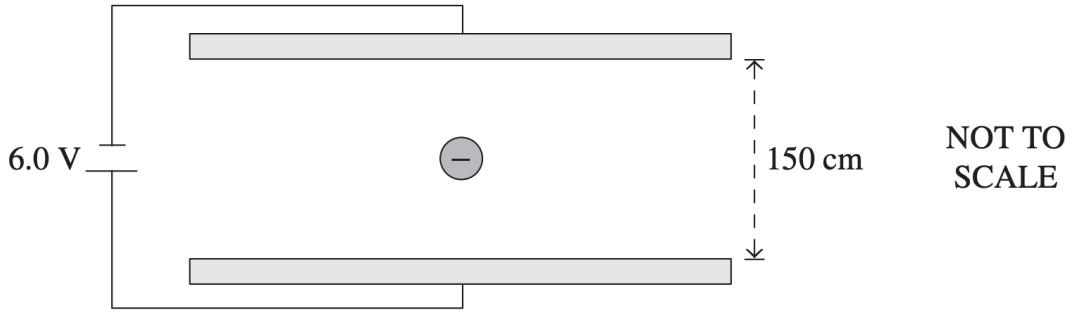
(B) The current through the 5 Ω resistor is twice the current through the 10 Ω resistor.

(C) The current through the 5 Ω resistor is greater than the current through the 20 Ω resistor.

(D) The current through the 10 Ω resistor is greater than the current through the 5 Ω resistor.

Question 15

An electron is positioned between two parallel charged plates as shown in the diagram.



What is the magnitude of the *force* acting on the electron?

(A) 6.4×10^{-19} N

(B) 1.3×10^{-18} N

(C) 25 N

(D) 900 N

End of Section I

2024 Higher School Certificate Trial Examination

Student Number

Physics
Section II Answer Booklet

55 marks
Attempt Questions 16 - 27
Allow about 1 Hour and 30 Minutes for this section

Instructions

- Write your student number at the top of this page
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of the response.
- Show all relevant working in questions involving calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which questions you are answering.

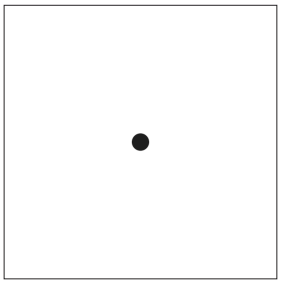
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Question 16 (2 marks)

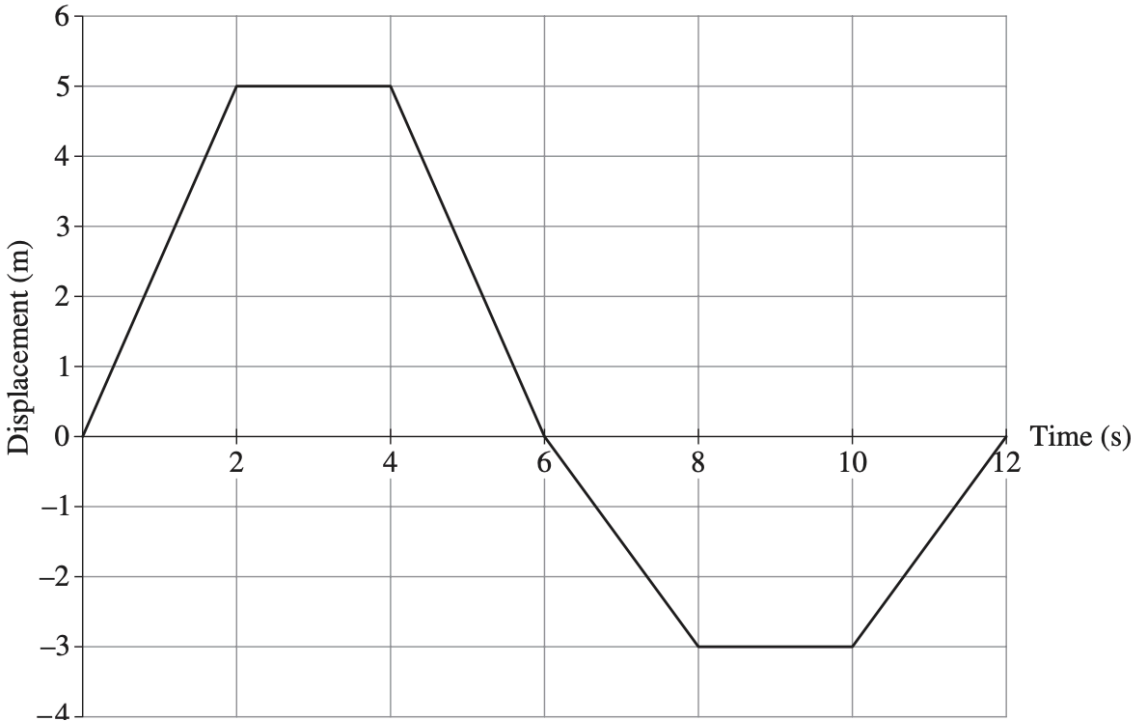
A box is accelerating down towards the ground. Air resistance is present. 2 marks

Complete the free-body diagram to show the *forces* acting on the box. Include labels in your answer.



Question 17 (5 marks)

The displacement-time graph shows the linear motion of a person walking.



a) **State** the persons *displacement* from their starting position after six seconds. 1 mark

b) **Calculate** the persons *average speed* for the entire journey. Give your answer correct to two decimal places. 2 marks

Question 17 is continued on page 15

Question 17 (continued)

c) **Propose** a reason for the *negative displacement* values shown in the graph. 2 marks

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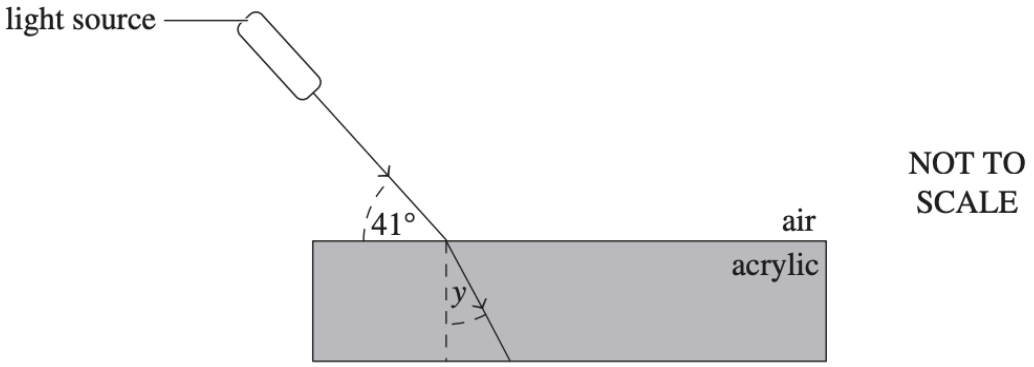
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Question 18 (6 marks)

Using a monochromatic light source, a student passes light through the air and into a piece of acrylic at an angle of 41° to the interface, as shown in the diagram.



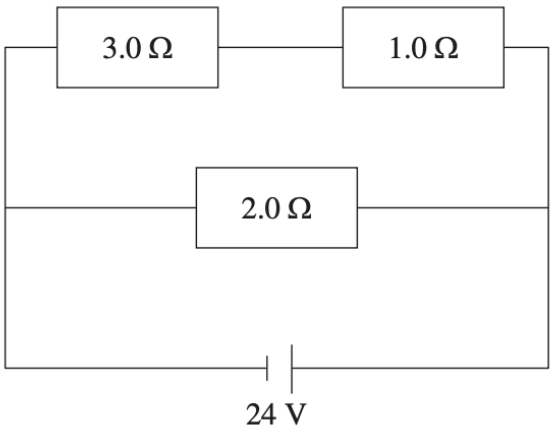
(Air has a refractive index of 1.00 and acrylic has a refractive index of 1.47).

a) How does the *speed of the light* change as it enters and propogates through the acrylic? Use the diagram to **justify** your answer. 3 marks

b) **Calculate** the angle of refraction, *y*. 3 marks

Question 19 (9 marks)

An electric circuit is shown.



a) **Calculate** the *total resistance* in the circuit. 2 marks

b) **Calculate** how much *energy* is used by the 3.0 Ω resistor every second. 3 marks

Question 19 is continued on page 18

Question 19 (continued)

c) **Explain** why *current* is conserved throughout this circuit. **Justify** your answer with reference to relevant laws. 4 marks

Question 20 (3 marks)

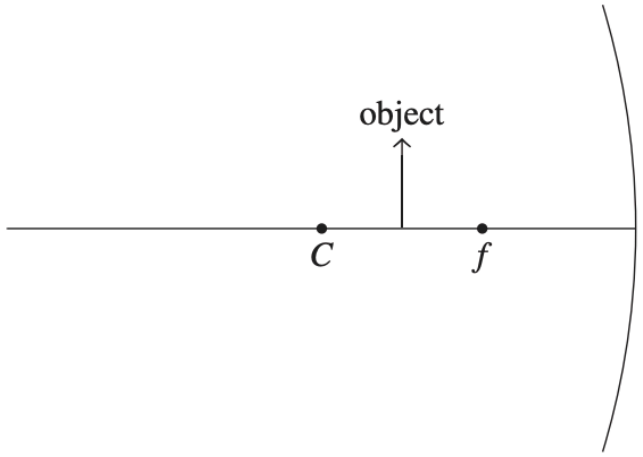
A stationary observer sees an aeroplane flying directly towards them at a constant speed of 221 m s^{-1}. 3 marks

The observer hears a sound coming from the aeroplane that has a frequency of 1200 Hz as it slides towards them.

Calculate the *frequency* of the sound heard by the observer as the aeroplane flies away from them.

Question 21 (4 marks)

An object is placed between the principal focus, *f*, and centre of curvature, *C*, of a concave mirror, as shown in the diagram.

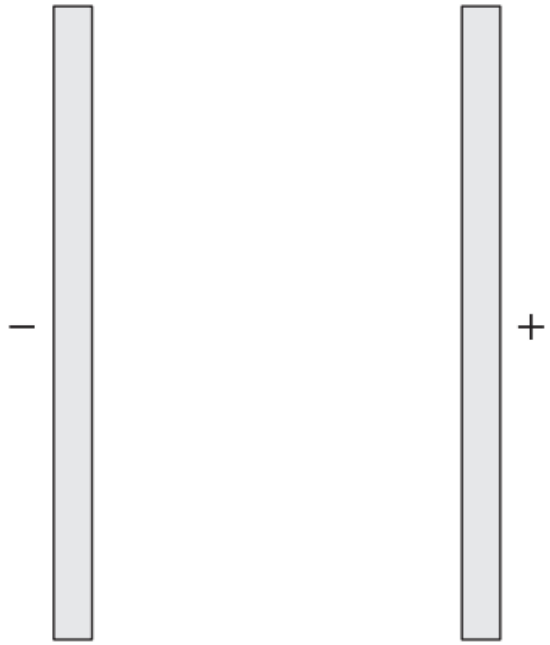


a) On the diagram, **draw** *rays* to show the location of the image produced. 2 marks

b) **Identify** the nature of the *image*. 2 marks

Question 22 (2 marks)

Two charged, parallel plates are pictured below. 2 marks



Draw *electric field lines* to complete the diagram.

Question 23 (4 marks)

A 200 g toy car is travelling at a constant speed of 8.0 m s^{-1}. A constant net force of 12 N is then applied to the toy car in its direction of travel for 0.50 seconds. 4 marks

Calculate the *change* in the toy car's kinetic energy.

Question 24 (7 marks)

A moving 1.60×10^4 kg object collides with a stationary 1.70×10^4 kg object at a speed of 26.0 m s^{-1}. After the collision, the objects move together in the same direction at 12.6 m s^{-1}.

a) **Show** that momentum is *conserved*. 3 marks

b) **Determine** if the collision is *elastic* or *inelastic*. **Justify** your answer with suitable calculations. 4 marks

Question 25 (4 marks)

An aircraft is travelling at a speed of 320 km h^{-1} south, with a crosswind blowing 55.0 km h^{-1} east. 4 marks

Determine the *velocity* of the aircraft relative to the ground. Use a labelled *vector diagram* to **support** your answer.

Question 26 (2 marks)

The diagram below represents a wire carrying a current flowing to the right. 2 marks

On the diagram, draw the magnetic field associated with the wire.

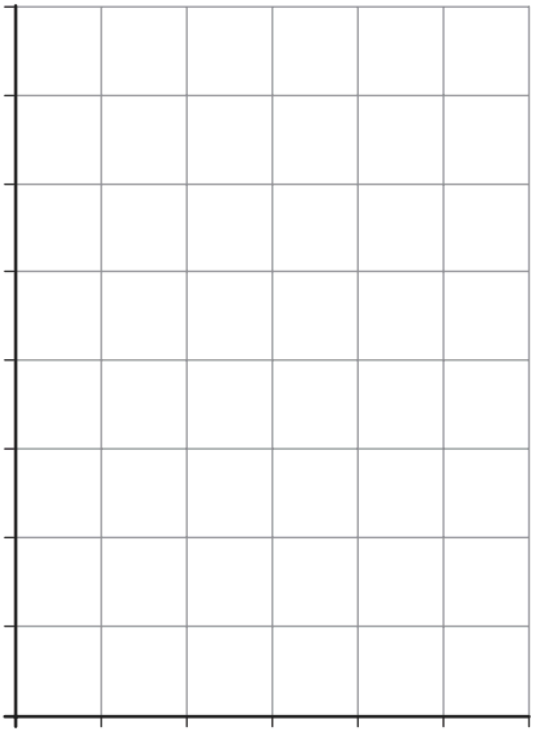


Question 27 (7 marks)

A student conducts an experiment to measure the electrostatic force between two identical, charged objects at various distances. Data obtained from the experiment is shown in the table.

Data point	*Distance (cm)*	*Electrostatic force (N)*
1	3	39.95
2	4	22.47
3	5	14.38
4	6	9.99

a) Plot the data points on the axes provided. Include a trendline. 4 marks



Question 27 is continued on page 27

Question 27

b) Show that the magnitude of the charge on each object is 2 μC. 3 marks

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End of Test

Section II extra writing space.

If you use this space, clearly indicate which question you are answering.

Section II extra writing space.

If you use this space, clearly indicate which question you are answering.

Student Number

PHYSICS – MULTIPLE-CHOICE ANSWER SHEET

ATTEMPT ALL QUESTIONS

Question	**1**	A ⬭	B ⬭	C ⬭	D ⬭
	2	A ⬭	B ⬭	C ⬭	D ⬭
	3	A ⬭	B ⬭	C ⬭	D ⬭
	4	A ⬭	B ⬭	C ⬭	D ⬭
	5	A ⬭	B ⬭	C ⬭	D ⬭
	6	A ⬭	B ⬭	C ⬭	D ⬭
	7	A ⬭	B ⬭	C ⬭	D ⬭
	8	A ⬭	B ⬭	C ⬭	D ⬭
	9	A ⬭	B ⬭	C ⬭	D ⬭
	10	A ⬭	B ⬭	C ⬭	D ⬭
	11	A ⬭	B ⬭	C ⬭	D ⬭
	12	A ⬭	B ⬭	C ⬭	D ⬭
	13	A ⬭	B ⬭	C ⬭	D ⬭
	14	A ⬭	B ⬭	C ⬭	D ⬭
	15	A ⬭	B ⬭	C ⬭	D ⬭