Neap

Final Examination 2022

NSW Year 11 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 and formulae sheet are provided at the back of this paper

Total Marks: 75

SECTION I – 15 marks (pages 2–6)

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

SECTION II – 60 marks (pages 7–21)

- Attempt Questions 16– 31
- Allow about 1 hour and 30 minutes for this section

SECTION I

15 marks
Attempt Questions 1–15
Allow about 30 minutes for this section

Use the multiple-choice answer sheet for Questions 1–15.

1 In 2009, Usain Bolt set the world record for the men's 100 m sprint with a time of 9.58 seconds. What was Bolt's average speed during the race?

A. 0.0958 m s^{-1}
B. 10.4 m s^{-1}
C. 20.8 m s^{-1}
D. 958 m s^{-1}

2 A net force of 13 N was applied to a trolley that had a mass of 5 kg.
What was the trolley's acceleration?

A. 2.6 m s^{-2}
B. 5.2 m s^{-2}
C. 52 m s^{-2}
D. 65 m s^{-2}

3 Which row of the table shows two properties of a sound wave?

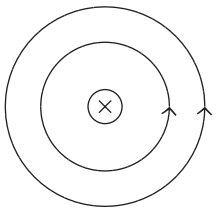
	Property 1	*Property 2*
A.	transverse	mechanical
B.	transverse	electromagnetic
C.	longitudinal	mechanical
D.	longitudinal	electromagnetic

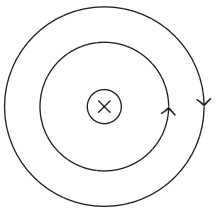
4 A small, charged object experiences a force of 0.1 N when exposed to an electric field of strength 1.0 N C^{-1}.

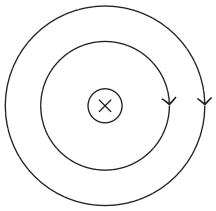
What is the charge of the object?

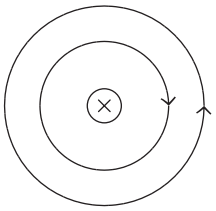
A. 0.1 C
B. 1.0 C
C. 10 C
D. 100 C

5 Which of the following diagrams shows the direction of a magnetic field around a conducting wire that has the current directed into the page?

A. 

B. 

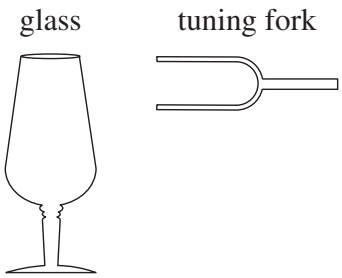
C. 

D. 

6 A man yells 'Cooee!' at a distance of 3.0 km from a flat cliff face.
How long would it take for the man to hear the echo that reflects off the cliff face?

A. 3.10 s
B. 8.82 s
C. 17.6 s
D. 20.1 s

7 A glass and tuning fork are shown.



When the tuning fork is struck and brought very close to the top of the glass, a loud sound is heard.
Which of the following wave behaviours is responsible for this effect?

A. diffraction
B. resonance
C. dispersion
D. refraction

8 A battery in an electric circuit has a voltage of 10 V between its terminals.

What is the electrical potential energy of a single electron in this circuit?

A. 10 J

B. 10 V

C. 1.602×10^{-18} J

D. 1.602×10^{-18} J C^{-1}

9 At a shooting range, a gun is fired and the bullet bounces off the top of a boulder. As the bullet hit the boulder, it exerted a force on the boulder, though the boulder did not move. At the same time, the boulder exerted a force on the bullet, resulting in the bullet slowing down and changing direction.

Which statement correctly describes this interaction?

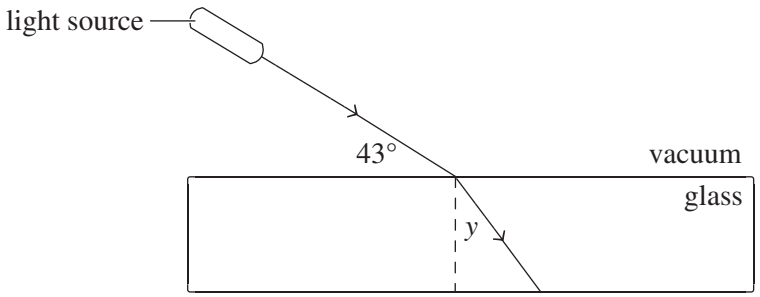
A. The force of the bullet on the boulder is greater than the force of the boulder on the bullet, resulting in the bullet slowing down and changing direction.

B. The force of the bullet on the boulder is less than the force of the boulder on the bullet, resulting in the boulder not moving.

C. The force of the bullet on the boulder is greater than the force of the boulder on the bullet, though the boulder has much more inertia and, therefore, does not move.

D. The force of the bullet on the boulder is equal to the force of the boulder on the bullet, and their mass difference accounts for their subsequent motion.

10 Using a monochromatic light source, a student passed light through a vacuum and into a piece of glass. The vacuum had a refractive index of 1.00 and the glass had a refractive index of 1.60. The student recorded the information as shown in the diagram.



According to this information, what is the angle of refraction (y)?

A. 25°

B. 27°

C. 43°

D. 47°

11 *A* and *B* are two charged spheres. Initially, the spheres are at a distance of *r* metres apart. Each sphere has a charge of *q* coulombs. There is a repulsive force of *F* newtons between them.

The distance between the two spheres is then increased to 2*r*. The charge on sphere *A* changes to 0.6*q* coulombs, and the charge on sphere *B* remains the same.

What is the new magnitude of the repulsive force between the spheres?

A. $0.09F$ newtons

B. $0.15F$ newtons

C. $0.30F$ newtons

D. $1.00F$ newtons

12 How much energy would need to be transferred to 140 L of water to raise its temperature from 20°C to 65°C?

A. 2.6×10^4 J

B. 1.9×10^5 J

C. 1.2×10^7 J

D. 2.6×10^7 J

13 A feather falls from a bird that is perched on a ledge 10 m above the ground. Due to air resistance, the feather takes 3.2 seconds to reach the ground.

If the feather were dropped from rest in a vacuum instead, how much further would the feather need to fall to reach the ground in the same amount of time?

A. 0 m

B. 40 m

C. 50 m

D. 60 m

14 A yellow motorbike and a red motorbike are approaching the same intersection at different velocities. The yellow motorbike is travelling at a velocity of 16 m s^{-1} heading north. The red motorbike is travelling at a velocity of 19 m s^{-1} heading east.

What is the velocity of the yellow motorbike relative to the red motorbike?

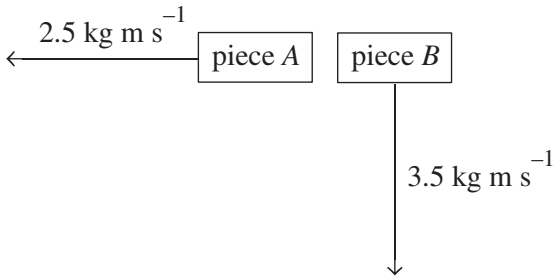
A. 35 m s^{-1} N40°E

B. 25 m s^{-1} N50°E

C. 35 m s^{-1} N40°W

D. 25 m s^{-1} N50°W

15 A stationary explosive with a mass of 5.5 kg is detonated and separates into three individual pieces, *A*, *B* and *C*. The momentum of piece *A* is 2.5 kg m s^{-1} west and the momentum of piece *B* is 3.5 kg m s^{-1} south, as shown in the diagram.



What is the magnitude and direction of the momentum of piece *C*?

A. 2.5 kg m s^{-1} N54°E

B. 4.3 kg m s^{-1} N36°E

C. 5.5 kg m s^{-1} N54°E

D. 6.0 kg m s^{-1} N36°E

NSW Year 11 Physics

Section II Answer Booklet

60 marks
Attempt Questions 16–31
Allow about 1 hour and 30 minutes for this section

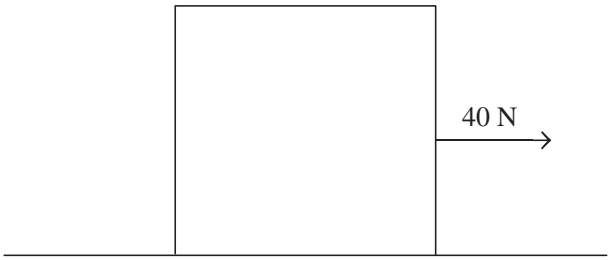
Instructions

- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of 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 question you are answering.

Please turn over

Question 16 (2 marks)

A box, initially at rest, is pushed across a horizontal, frictionless surface with a constant force of 40 N for 10 seconds, as shown in the diagram. During this time, the box accelerates at a rate of 2.0 m s^{-2}. **2**



How much power is exerted on the box?

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Question 17 (2 marks)

Two charged parallel plates are set up by a student with a supply voltage of 12 V. The measured electric field strength between the plates is a constant 40 V m^{-1}. **2**

Calculate the distance between the two plates.

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Question 18 (2 marks)

A positively charged particle is shown below. **2**

On the diagram, draw the electric field lines associated with the particle to show the shape and direction of the electric field.

Question 19 (4 marks)

The Bédoin to Mont Ventoux bicycle route in France is one of the most difficult bicycle routes in the world. Bédoin has an elevation of 283 m above sea level and the top of Mont Ventoux has an elevation of 1912 m above sea level.

The combined mass of a cyclist and their bicycle is 86.0 kg. They start riding at Bédoin and end at the top of Mont Ventoux.

(a) What is the cyclist's gain in gravitational potential energy? **2**

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(b) After reaching the end of the route, the cyclist turns around and begins to return from the top of Mont Ventoux. From a stationary start, the cyclist freewheels down the mountain (they do not pedal or brake). A spectator is located on the route at an elevation of 1876 m above sea level. **2**

What is the cyclist's speed when they pass the spectator? Ignore friction and any other resistive forces.

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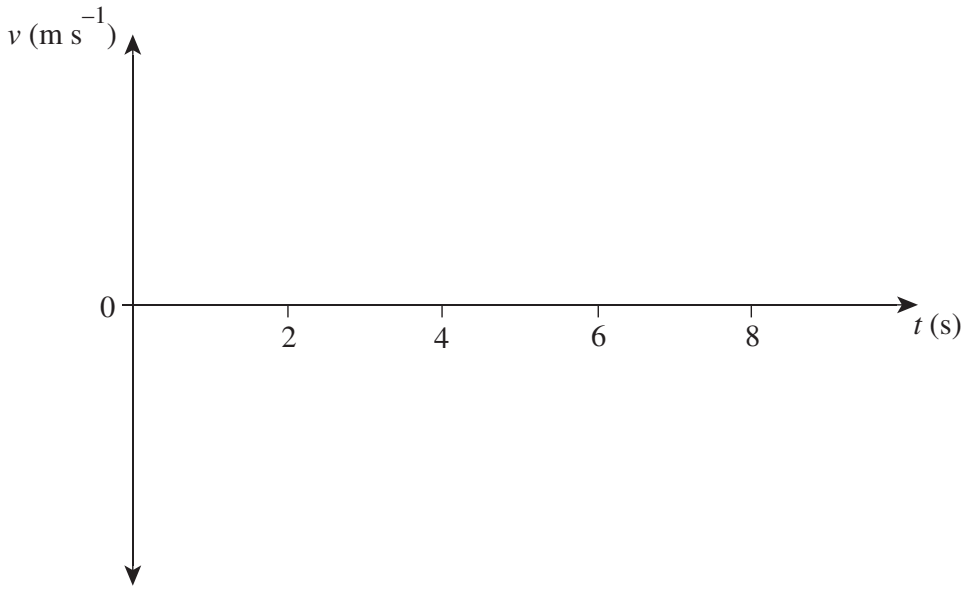
Question 20 (2 marks)

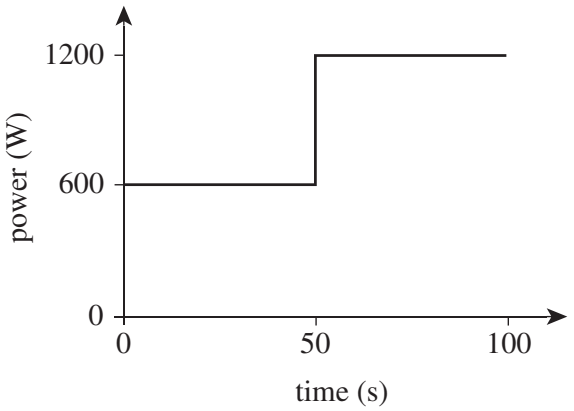
A basketball is thrown directly up into the air from the ground with an initial velocity at $t = 0$ s. The ball returns to the ground at $t = 4$ s. **2**

On the axes below, plot the basketball's velocity for the duration of its journey. Take the upwards direction as positive and ignore air resistance.



Question 21 (4 marks)

An electrical device has a supply voltage of 120 V. The power used by this device over 100 seconds is shown in the graph.



(a) Using the graph, determine the amount of energy used by the device over the period of 100 seconds. **2**

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(b) What is the average current drawn by the device during the period of 100 seconds? **2**

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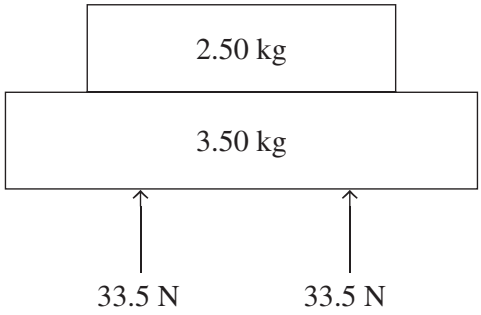
Question 22 (4 marks)

Simon is delivering two packages to a client. He stacks the lighter package on top of the heavier package. He then lifts the packages by applying a 33.5 N vertical force from each of his hands to the bottom of the heavier package as shown.



(a) What is the magnitude of the acceleration of the packages? **2**

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(b) The magnitude of the force that the 3.50 kg package applies to the 2.50 kg package is greater when the packages are accelerating than when they are at rest. **2**

Explain why.

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Question 23 (3 marks)

A student is swimming in a pool and shines a laser from underwater towards the air above.
The refractive index for air is 1.00 and the refractive index for water is 1.33.

(a) Calculate the speed of the laser beam through the water. **1**

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(b) Calculate the angle of incidence required for the laser beam to refract parallel to the air and water interface. **2**

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Question 24 (5 marks)

A speaker is set up at the front of the stage for a rock concert. Point *X* is at a distance of 2 metres from the speaker. At point *X*, the sound intensity is measured to be 1.8×10^{-2} W m^{-2}.

(a) How much further away from point *X* would a sound intensity of 2.0×10^{-3} W m^{-2} be measured? **3**

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(b) It can be assumed that the speaker is a source of spherically spreading sound waves. The surface area of a sphere is calculated using $4\pi r^2$. **2**

What is the power output of the speaker?

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Question 25 (3 marks)

A child slides down a plastic slide at a playground and becomes electrically charged. **3**

Explain why the child becomes electrically charged.

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Question 26 (4 marks)

Compare the images that are formed by convex mirrors and concave lenses. **4**

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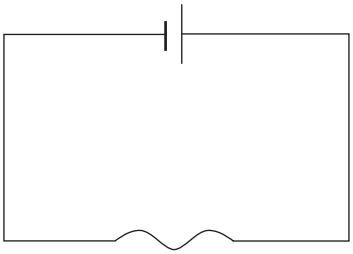
Question 27 (5 marks)

Louise has a piece of resistance wire, which is ohmic. She wants to investigate how its resistance varies with length. She sets up a circuit as shown. Louise also has access to a voltmeter, an ammeter and a ruler. **5**



resistance wire

Describe how Louise would obtain the data that she requires for this investigation.

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Question 28 (4 marks)

A ferry is attempting to cross a river. The current of water is moving downstream at a constant rate of 3.0 m s^{-1}. The ferry can move at 4.5 m s^{-1} relative to the water in the river, as measured by an observer on the ferry. **4**

Propose a way that the ferry can cross the river to reach a point directly across from its starting position.

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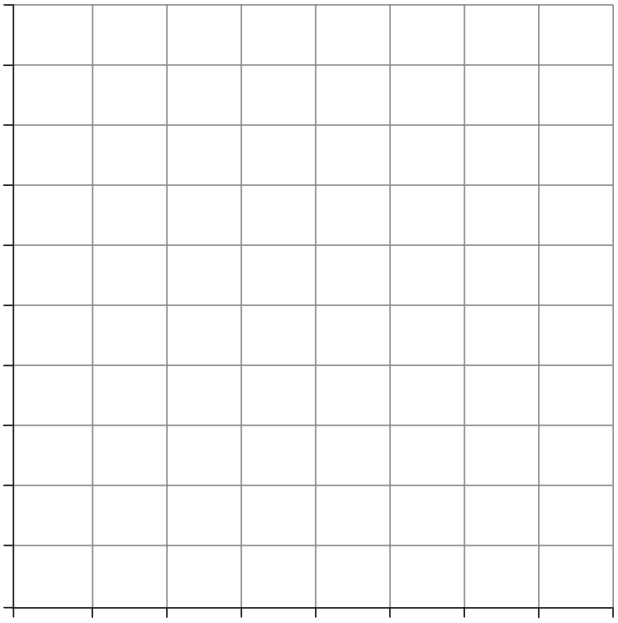
Question 29 (6 marks)

A student performs an experiment to measure the strength of the magnetic field produced by a current-carrying wire at particular distances away from it. Data from the experiment is shown in the table.

Data point	*Distance (cm)*	*Magnetic field strength ($\times 10^{-6}$ T)*
1	5	8.0
2	10	4.0
3	20	2.0
4	35	1.1

(a) Graph the data on the axes provided. **4**



(b) Determine the mathematical relationship between magnetic field strength and distance. **2**

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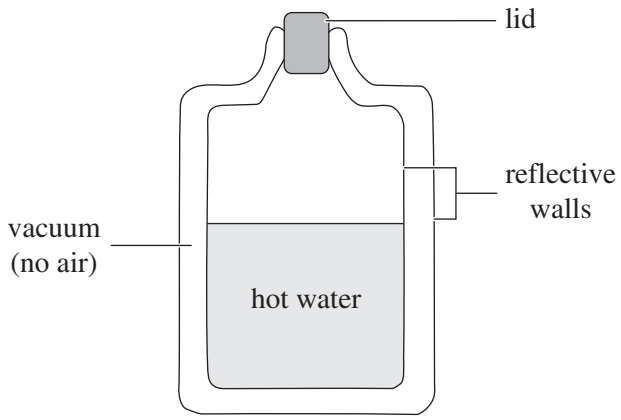
Question 30 (6 marks)

Heat transfer can occur via three processes: conduction, convection and radiation. **6**

Vacuum flasks are insulating storage containers. They have vacuum space between their internal and external walls, which are made of a reflective material, as shown in the diagram. These features significantly reduce the rate at which heat is transferred between the inside and outside of the flask.



With reference to the THREE heat transfer processes, explain why the structure of a vacuum flask significantly reduces the rate at which heat is transferred between the hot water inside the flask and the external environment.

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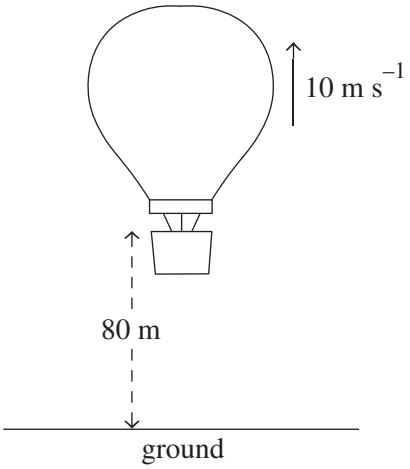
Question 31 (4 marks)

A hot-air balloon is travelling at a constant upwards velocity of 10 m s^{-1}. The operator of the balloon decides to time how long it takes for a coin to hit the ground when she drops it from a height of 80 m. **4**



Ignoring air resistance, calculate how long it would take for the coin to hit the ground.

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End of paper

Section II extra writing space

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

DATA SHEET

Charge on electron, q_e	-1.602×10^{-19} C
Mass of electron, m_e	9.109×10^{-31} kg
Mass of neutron, m_n	1.675×10^{-27} kg
Mass of proton, m_p	1.673×10^{-27} kg
Speed of sound in air	340 m s^{-1}
Earth's gravitational acceleration, g	9.8 m s^{-2}
Speed of light, c	3.00×10^{8} m s^{-1}
Electric permittivity constant, ε_0	8.854×10^{-12} A^2 s^4 kg^{-1} m^{-3}
Magnetic permeability constant, μ_0	$4\pi \times 10^{-7}$ N A^{-2}
Density of water, ρ	1.00×10^{3} kg m^{-3}
Specific heat capacity of water	4.18×10^{3} J kg^{-1} K^{-1}

FORMULAE SHEET

Motion, forces and gravity

$$s = ut + \frac{1}{2}at^2$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$\vec{F}_{\text{net}} = m\vec{a}$$

$$\Delta U = mg\Delta h$$

$$W = F_{||}s = Fs\cos\theta$$

$$P = \frac{\Delta E}{\Delta t}$$

$$K = \frac{1}{2}mv^2$$

$$\sum \frac{1}{2}mv^2_{\text{before}} = \sum \frac{1}{2}mv^2_{\text{after}}$$

$$P = F_{||}v = Fv\cos\theta$$

$$\Delta\vec{p} = \vec{F}_{\text{net}}\Delta t$$

$$\sum m\vec{v}_{\text{before}} = \sum m\vec{v}_{\text{after}}$$

Waves and thermodynamics

$$v = f\lambda$$

$$f_{\text{beat}} = |f_2 - f_1|$$

$$f = \frac{1}{T}$$

$$f' = f\frac{(v_{\text{wave}} + v_{\text{observer}})}{(v_{\text{wave}} - v_{\text{source}})}$$

$$n_x = \frac{c}{v_x}$$

$$n_1\sin\theta_1 = n_2\sin\theta_2$$

$$Q = mc\Delta T$$

$$\sin\theta_c = \frac{n_2}{n_1}$$

$$\frac{Q}{t} = \frac{kA\Delta T}{d}$$

$$I_1r_1^2 = I_2r_2^2$$

Electricity and magnetism

$$E = \frac{V}{d}$$

$$\vec{F} = q\vec{E}$$

$$V = \frac{\Delta U}{q}$$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2}$$

$$W = qV$$

$$I = \frac{q}{t}$$

$$W = qEd$$

$$V = IR$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$P = VI$$

$$B = \frac{\mu_0 NI}{L}$$

Final Examination 2022

NSW Year 11 Physics

DIRECTIONS:

Write your name in the space provided.
Write your student number in the boxes provided below. Then, in the columns of digits below each box, fill in the oval which has the same number as you have written in the box. Fill in **one** oval only in each column.
Read each question and its suggested answers. Select the alternative A, B, C, or D that best answers the question. Fill in the response oval completely, using blue or black pen. Mark only **one oval** per question.

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and draw an arrow as follows.

correct ↓

A ⊗ B ⊗ C ○ D ○

STUDENT NAME: _____

STUDENT NUMBER:

1	1	1	1	1		1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5		5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
0	0	0	0	0	0	0	0	0

SECTION I
MULTIPLE-CHOICE ANSWER SHEET

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 ○

STUDENTS SHOULD NOW CONTINUE WITH SECTION II