Neap

Final Examination 2021

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 2–7)

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

Section II – 60 marks (pages 9–22)

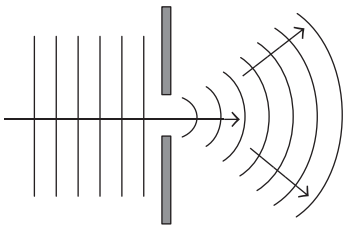
- Attempt Questions 16–29
- Allow about 1 hour and 30 minutes for this section

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 The diagram represents a phenomenon.



What is the correct name for the phenomenon shown in the diagram?

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

2 Steve is making a model of an electric circuit. He models the electrons in the circuit using marbles. He models the wire in the circuit using a track, inclined downwards, that the marbles can roll down. He models the battery using an elevator that can lift or lower marbles from their current height.

Which of the following best describes how the elevator should be used to model a battery?

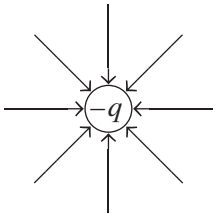
A. The elevator should lift marbles from its negative terminal to its positive terminal.
B. The elevator should lift marbles from its positive terminal to its negative terminal.
C. The elevator should lower marbles from its negative terminal to its positive terminal.
D. The elevator should lower marbles from its positive terminal to its negative terminal.

3 An object is placed in front of a concave mirror at a point beyond the centre of curvature.

The image created will be

A. diminished and inverted.
B. magnified and inverted.
C. diminished and upright.
D. magnified and upright.

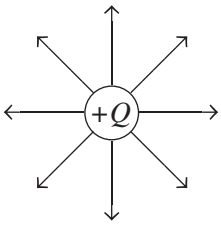
4 The diagram shows a point charge of magnitude q.



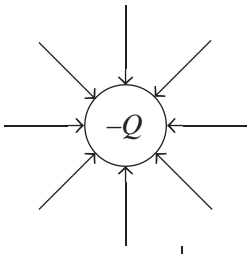
Four students were shown the diagram. They were asked to draw a point charge with a greater magnitude of charge than the point charge shown in the diagram.

Which of the following diagrams correctly represents this?

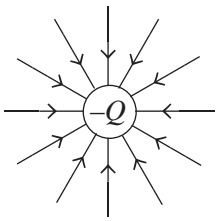
A.



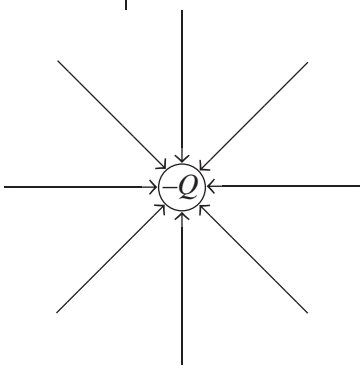
B.



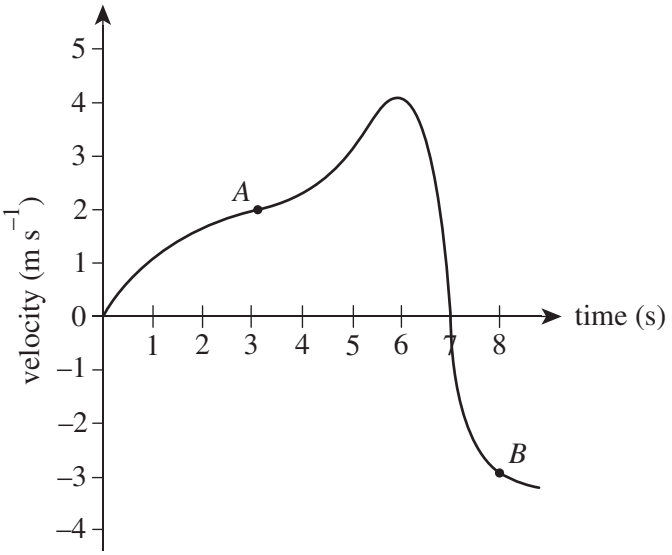
C.



D.



5 The velocity–time graph for an object is shown.



What is the average acceleration of the object between points *A* and *B*?

A. –5 m s^{-2}

B. –1 m s^{-2}

C. 1 m s^{-2}

D. 5 m s^{-2}

6 A billiard ball collides elastically with the edge of a frictionless billiards table at a constant speed and bounces off at the same speed.

Which of the following quantities will NOT be the same before and after the collision?

A. the ball's kinetic energy

B. the ball's mass

C. the ball's momentum

D. the ball's acceleration

7 An electron experiences a force of 4×10^{-15} N when placed between two charged parallel plates that are 1 mm apart.

What is the potential difference between the plates?

A. 1.602×10^{-22} V

B. 4.39×10^{12} V

C. 0.67 V

D. 25.0 V

8 A wave machine is designed to create waves of a fixed wavelength and frequency in a pool. Initially, the wavelength of each wave is a. The settings of the machine are altered so that the period of each wave is doubled and the velocity is halved.

What is the new wavelength of each wave?

A. $\frac{1}{4}a$

B. $\frac{1}{2}a$

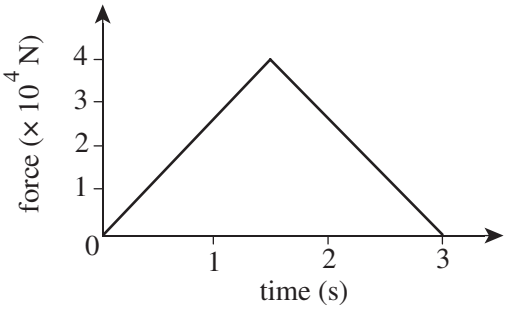
C. a

D. $2a$

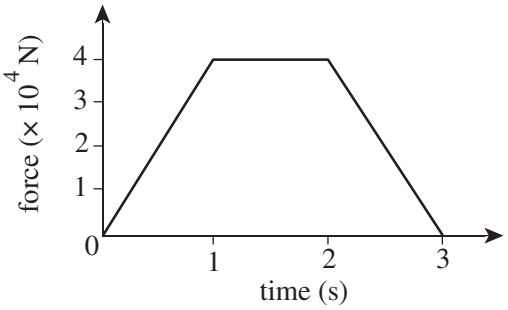
9 During a crash test, a car of mass 4000 kg was driven into a brick wall at 72 km h^{-1}. The car came to a complete stop immediately after the collision. The test took 3 seconds.

Which of the following graphs shows the force experienced by the car during the collision?

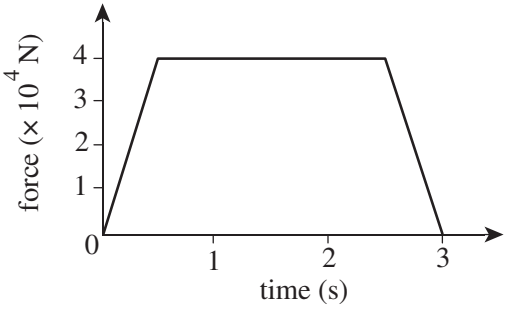
A.



B.



C.



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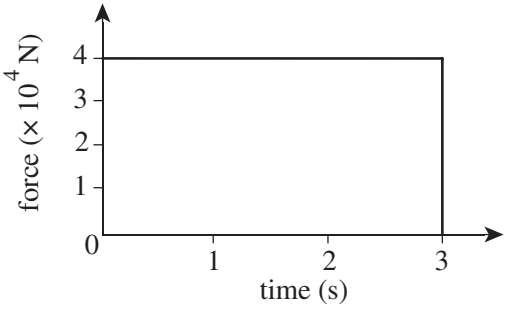


10 What are the SI units for watts?

A. kg m^2 s^{-3}

B. kg m s^{-2}

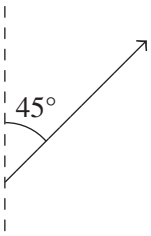
C. kg m^2 s^{-2}

D. kg m s^{-3}

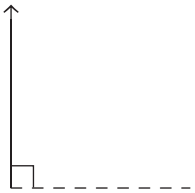
11 Aaron starts walking to the east. He suddenly changes direction and begins running at a greater speed to the northeast.

Which of the following vectors could represent Aaron's change in velocity?

A.



B.



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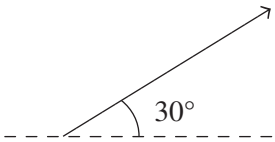

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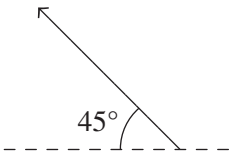

12 Gary applies a range of voltages to an incandescent light bulb and measures the resulting current using an ammeter. He plots his results on a graph with voltage on the *y*-axis, and observes that he cannot draw a linear line of best fit.

Which of the following best classifies the type of data Gary is analysing and gives an appropriate conclusion he could draw from it?

	Type of data involved	*Conclusion*
A.	primary, qualitative data	The light bulb is an ohmic resistor.
B.	primary, quantitative data	The light bulb is a non-ohmic resistor.
C.	secondary, quantitative data	The light bulb is an ohmic resistor.
D.	secondary, qualitative data	The light bulb is a non-ohmic resistor.

13 A 10 g ball is thrown directly downwards from a high bridge with an initial kinetic energy of 0.2 J.

Assuming air resistance is negligible, how long will the ball take to fall 20 m?

A. 0.47 s

B. 1.48 s

C. 1.61 s

D. 2.77 s

14 Which of the following is NOT an action–reaction force pair?

A. the force a hammer exerts on a nail and the force the nail exerts on the hammer

B. the normal force and the force of gravity acting on an object on the Earth's surface

C. the gravitational forces that attract the Earth and the Moon to one another

D. the repulsive forces that repel two like charges

15 A guitar string is played. The velocity of the standing wave produced in the second harmonic is 10 m s^{-1} and the frequency is 6 Hz.

If the velocity of the standing wave remains constant, what is the frequency of the fifth harmonic?

A. 1.67 Hz

B. 6 Hz

C. 15 Hz

D. 22 Hz

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NSW Year 11 Physics

Section II Answer Booklet

60 marks
Attempt Questions 16–29
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 body has two forces acting on it. The first force has a magnitude of 2 N and acts to the north. The second force has a magnitude of 1 N and acts to the east. A third force is then introduced to keep the body in equilibrium. **2**

What is the magnitude and direction of the third force?

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Question 17 (2 marks)

A duck was flying at 3 m s^{-1} to the east. The duck then changed direction and flew at 5 m s^{-1} to the west. **2**

What was the magnitude and direction of the duck's change in velocity?

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Question 18 (3 marks)

Bella and Tom conducted an experiment determining how the perceived volume of sound changes as you move away from the source. They used the following method. **3**

1. Bella and Tom stand beside each other at one end of a football field.
2. Bella walks 5 m away from Tom.
3. Bella yells as loud as she can and Tom measures the volume of her voice to the nearest decibel with a sound-level meter.
4. Bella walks a further 5 m away from Tom.
5. Steps 3 and 4 are repeated until Bella reaches the opposite end of the football field.
6. Bella and Tom then plot the volume of Bella's voice against her distance from Tom to determine the relationship between the two quantities.

Explain TWO changes that could be made to the experimental design to increase its validity.

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Question 19 (4 marks)

(a) State Newton's First Law of Motion. **1**

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(b) When Melvin kicks a football, it initially has a speed of 10 m s^{-1}. It slows down and eventually comes to a stop after 5 seconds. **3**

Explain why this occurs with reference to TWO of Newton's Laws of Motion.

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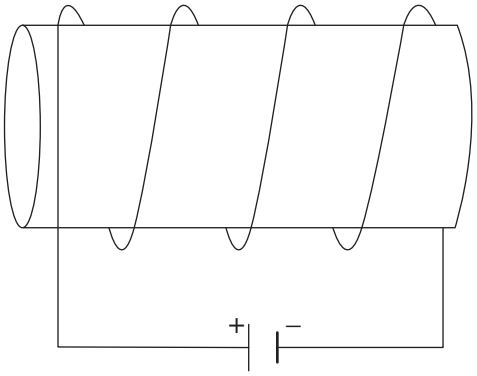
Question 20 (3 marks)

A solenoid is a type of electromagnet that consists of wire coils wrapped around a core.

(a) On the diagram, draw the magnetic field that occurs when the solenoid is connected to a battery. Include at least THREE field lines. **1**



(b) Identify THREE ways that the magnetic field strength of the solenoid could be increased and explain why with reference to the relevant formula. **2**

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Question 21 (5 marks)

Bodies *A* and *B*, each of mass 200 g, collide with one another on a smooth surface. They both come to a stop and stick together, forming body *C*.

(a) What was the initial speed of body *B* if the velocity of body *A* was 3 m s^{-1}? **1**

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(b) Was this collision elastic or inelastic? Justify your answer. **2**

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(c) Body *C* is now launched vertically into the air, which transfers 5 J of kinetic energy. **2**
What is the speed of body *C* the instant before it hits the ground?

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Question 22 (3 marks)

A telecommunications company wants to install fibre-optic internet cables in a town in New South Wales. The cables are covered by a special shielding with a refractive index of 1.52. To optimise transmission, incoming light hits the edge of the internet cables at the critical angle of incidence, 70°. **3**

Calculate the transmission speed of light in the cable.

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Question 23 (7 marks)

Freya is in a boat on the western bank of a north–south oriented river with uniform width. She wants to cross the river to reach the eastern bank. The width of the river is 60 m and its current is 4 m s^{-1} to the south. Starting from rest on the western bank, Freya's boat accelerates at 1.2 m s^{-2} to the east.

(a) Calculate the time it will take Freya to reach the eastern bank if she continues to cross the river with no changes to acceleration or direction. **2**

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(b) A dangerous rocky area on the eastern bank begins 42 m south of Freya's initial position. **2**

If Freya continues to cross the river with no changes to acceleration or direction, will she hit the rocks?

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(c) Henry is observing the river from the eastern bank. He has an instrument that gives the instantaneous velocity of Freya's boat from his perspective. The speedometer on Freya's boat also gives a reading for velocity. **3**

Which instrument will show a greater magnitude for velocity? Explain your answer.

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Question 24 (5 marks)

While studying, a student is annoyed by loud music coming from their neighbour's house across the street. From inside their room, the student observes that they can only hear the low pitches of the music.

(a) Explain this observation. **2**

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Note F has a wavelength of 2 m.

(b) Calculate the frequency of note F. **1**

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(c) The student gets up to ask their neighbours to turn the music off. Note F increases in frequency to 171 Hz while the student moves towards the source of the music. **2**

Calculate the student's velocity.

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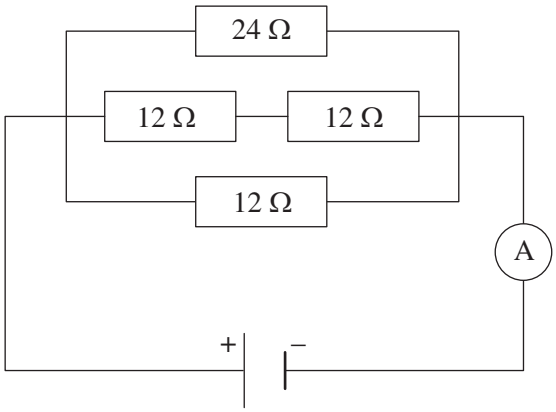
Question 25 (7 marks)

A large spotlight is made up of four smaller light bulbs, which can be modelled as ohmic resistors. The spotlight is powered by a 12 V battery, as represented in the circuit.



(a) Calculate the reading on the ammeter. **3**

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(b) How much energy will the spotlight consume over one hour? **2**

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(c) Explain how the spotlight's intensity will change as an observer moves away from it. **2**

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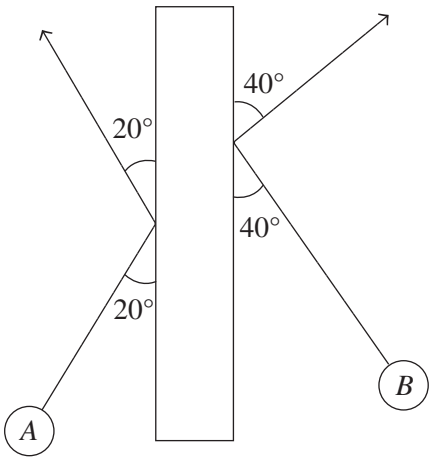
Question 26 (5 marks)

A block of ice of mass 50 g is placed on a metal sheet of mass 1 kg. Another block of ice of mass 20 g is placed on a polystyrene sheet of mass 1 kg. The temperature of the sheet of metal and the sheet of polystyrene is initially 50 °C. **5**

Explain and compare the thermodynamic changes that occur in both systems over time.

Question 27 (4 marks)

Two balls, *A* and *B*, are rolled towards a wall as shown. **4**



Initially, ball *A* travels at a constant speed of 12 m s^{-1} and ball *B* travels at a constant speed of 15 m s^{-1}.

What is the velocity of ball *A* relative to ball *B* after colliding with the wall? Include a diagram in your response.

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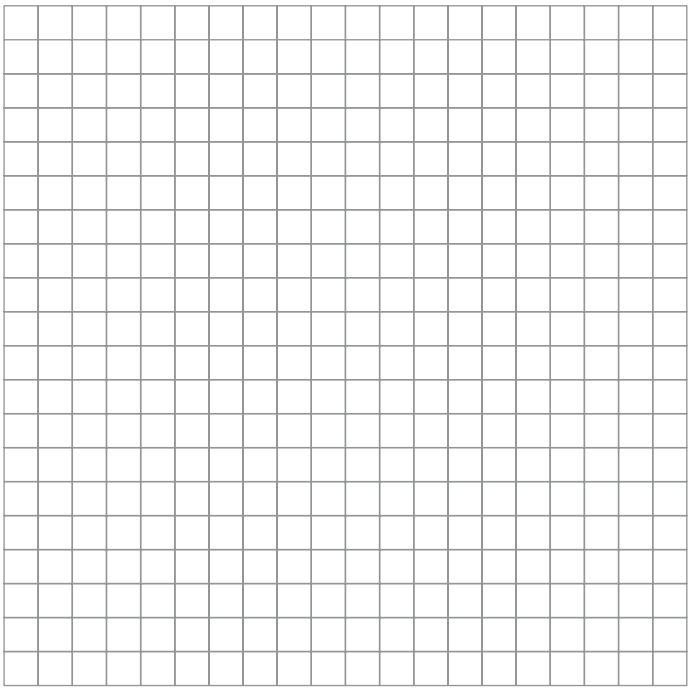
Question 28 (6 marks)

A student conducted an investigation into the force between charged particles. Two charged particles, q_1 and q_2, were placed a fixed distance of 1 m away from each other. The charge of q_2 was then varied, and the force between the particles was measured.

The results are given in the table.

Charge of q_2 (μC)	*Force (N)*
–5	4.5
–3	2.7
–1	0.6
2	–2.1
4	–3.6

(a) Plot the results on the grid below, including a line of best fit. **4**



Question 28 continues on page 21

Question 28 (continued)

(b) Using the graph in part (a), calculate the value of q_1 and explain the changes that occur in the force between the two particles. **2**

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End of Question 28

Question 29 (4 marks)

A block of mass m lies at rest on a surface inclined at θ degrees, where it experiences a maximum frictional force. The surface has a coefficient of static friction, μ. **4**

Draw a free-body diagram to show that the coefficient of static friction can be expressed as $\mu = \tan(\theta)$. Support your answer with calculations.

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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 2021

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