VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2021

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER | | | | | | | | | | Letter |

PHYSICS
Written examination

Wednesday 26 May 2021

Reading time: 10.00 am to 10.15 am (15 minutes)
Writing time: 10.15 am to 12.45 pm (2 hours 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	20	20	20
B	18	18	110
			Total 130

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, pre-written notes (one folded A3 sheet or two A4 sheets bound together by tape) and one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied
- Question and answer book of 33 pages
- Formula sheet
- Answer sheet for multiple-choice questions

Instructions
- Write your student number in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.
- You may keep the formula sheet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

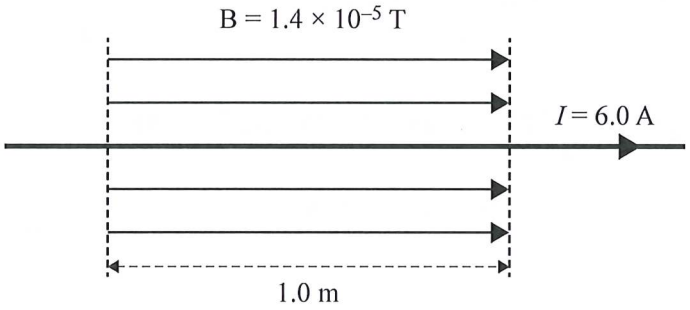
SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
Take the value of g to be 9.8 m s^{-2}.

Question 1

A wire carrying a current, I, of 6.0 A passes through a magnetic field, B, of strength 1.4×10^{-5} T, as shown below. The magnetic field is exactly 1.0 m wide.



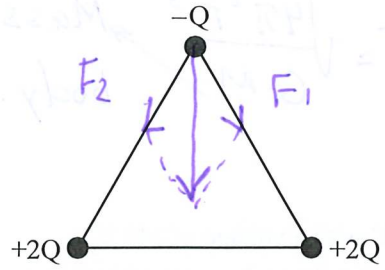
The magnitude of the force on the wire is closest to

A. 0 N
B. 2.3×10^{-6} N
C. 8.4×10^{-5} N
D. 4.3×10^{5} N

$\theta = 0°$ $F = BIL\sin\theta = 0$

Question 2

Three charges, –Q, +2Q and +2Q, are placed at the vertices of an equilateral triangle, as shown below.



Which one of the following arrows best represents the direction of the net force on the charge –Q?

A.

B.

C.

D.

Question 3

A 45 g golf ball, initially at rest, is hit by a golf club. The contact time between the club and the ball is 0.50 ms. The magnitude of the final velocity of the ball is 41 m s^{-1}.

Which one of the following is closest to the average force experienced by the golf ball?

A. 0.18 kN
B. 0.37 kN
C. 1.8 kN
D. 3.7 kN

$Ft = \Delta p$

$F = \frac{\Delta p}{t} = \frac{45 \times 10^{-3} \times 41}{0.5 \times 10^{-3}}$

Question 4

A person has a mass of 60.0 kg.

Which one of the following is closest to the weight of this person on Earth's surface?

A. 60.0 kg
B. 60.0 N
C. 588 kg
D. 588 N

mg

Question 5

When a spacecraft orbits Earth, its orbital period is **not** a function of the

A. mass of Earth.
B. mass of the spacecraft.
C. velocity of the spacecraft.
D. height of the spacecraft above Earth.

$T = \sqrt{\frac{4\pi^2 r^3}{GM}}$ → Mass of central body.

Question 6

The mains voltage in a particular part of Australia is AC with a voltage of 240 V_{RMS}.
Which one of the following is closest to the peak-to-peak voltage, V_{p-p}, for this mains voltage?

A. 170 V
B. 340 V
C. 480 V
D. 680 V

$V_{p-p} = 2\sqrt{2} V_{RMS}$

Question 7

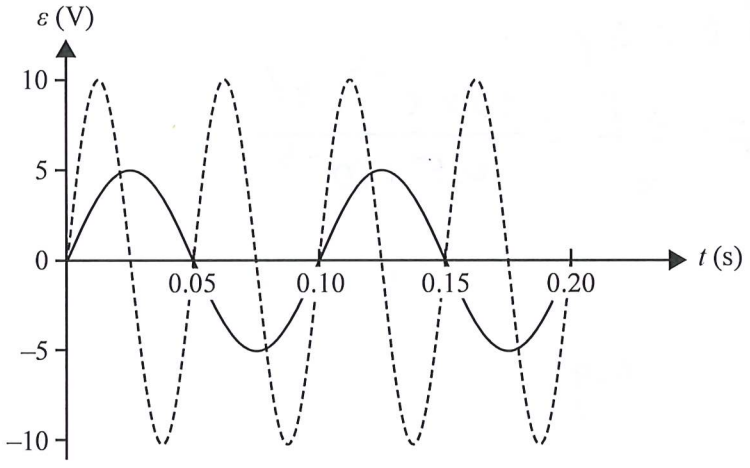
Electrical power stations are often situated far from the cities that require the power that they generate.
Which one of the following best describes the reason for the high-voltage transmission of electrical energy?

A. Transformers can be used to increase the voltage in the cities.
B. High voltages reduce the energy losses in the transmission lines.
C. High voltages provide the large currents needed for efficient transmission.
D. High voltages can reduce the overall total resistance in the transmission lines.

$P_{Loss} = I^2 R$
$V \uparrow I \downarrow$

Question 8

In the diagram below, the solid line represents the graph of output EMF, ε, versus time produced by an AC generator. A single change is made to the AC generator and its operation, and the new graph of output EMF, ε, versus time is shown as a dashed line.



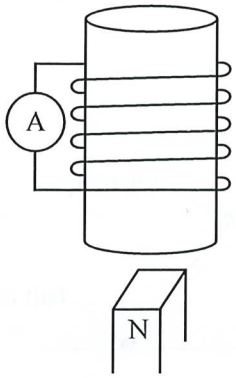
Which one of the following best describes the change made to the AC generator?

A. The area of the coil was doubled.
B. The speed of rotation was halved.
C. The speed of rotation was doubled.
D. The number of turns of the wire in the coil was doubled.

$T \downarrow \varepsilon \uparrow$

Question 9

The diagram below shows a bar magnet moving upward into a coil.



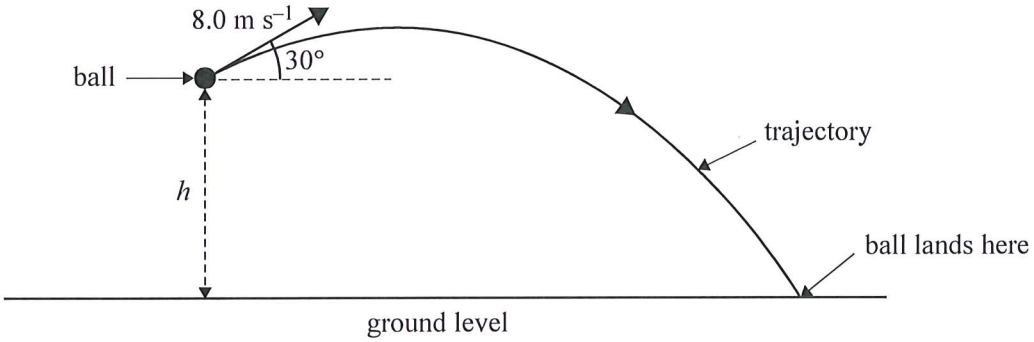
Which of the following correctly identifies the direction of the induced current, as viewed from the **top** of the coil, and the direction of the magnetic field produced by the induced current inside the coil?

	Current direction	Magnetic field direction
A.	clockwise	↓
B.	clockwise	↑
C.	anticlockwise	↑
D.	anticlockwise	↓

B is up and ↑, so induced B ↓, RHGR ↻

Use the following information to answer Questions 10 and 11.

Melissa launches a ball from height h above the ground at a speed of 8.0 m s^{-1} and at an angle of 30° above the horizontal. The time of the ball's flight is 1.0 s. The diagram below shows the trajectory of the ball.



Question 10

Ignoring air resistance, which one of the following is closest to the horizontal distance that the ball landed from Melissa?

A. 4.6 m
B. 5.0 m
C. 6.9 m
D. 8.0 m

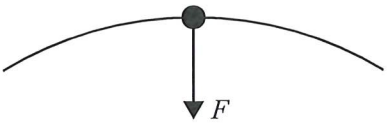
$x = 8\cos(30°) \times 1$

Question 11

Which one of the following diagrams best shows the direction of the resultant force, F, on the ball at the position of maximum height in the real situation where air resistance is **not** ignored?

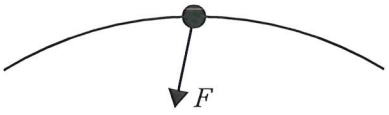
A.

B.



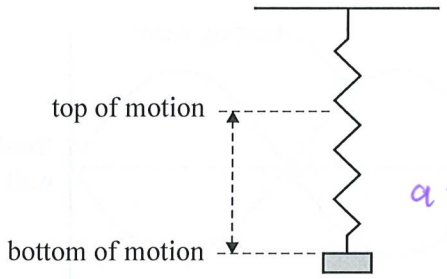
C.

D.



Question 12

A mass at the end of an ideal spring is oscillating freely up and down.



Which one of the following best describes the motion of this oscillating mass?

A. Its speed is a minimum only at the top of the motion.

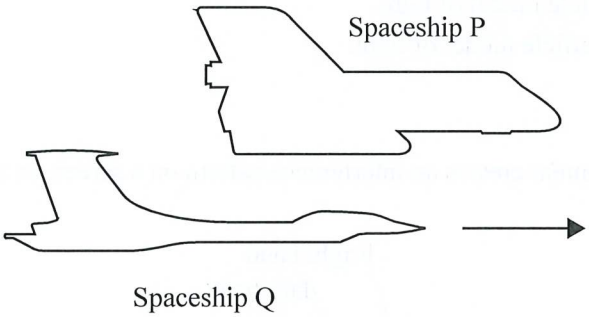
B. Its speed is a maximum when its acceleration is a maximum.

C. Its acceleration has a minimum value at both the top and the bottom of the motion.

D. Its acceleration has a maximum value upward when the mass is stationary at the bottom.

Question 13

Joanna is an observer in Spaceship P and is watching Spaceship Q fly past at a relative speed of $0.943c$ ($\gamma = 3.00$). She observes a stationary clock measuring a time interval of 75.0 s between two events in Spaceship Q. This is a proper time interval.



Which one of the following is closest to the time interval observed between the two events in Spaceship P's frame of reference?

A. 15.0 s

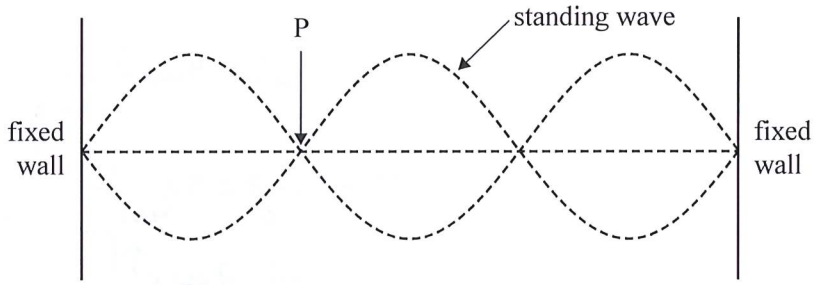
B. 25.0 s

C. 125 s

D. 225 s

Question 14

The diagram below represents a standing wave.



The point P on the standing wave is

A. a node resulting from destructive interference.
B. a node resulting from constructive interference.
C. an antinode resulting from destructive interference.
D. an antinode resulting from constructive interference.

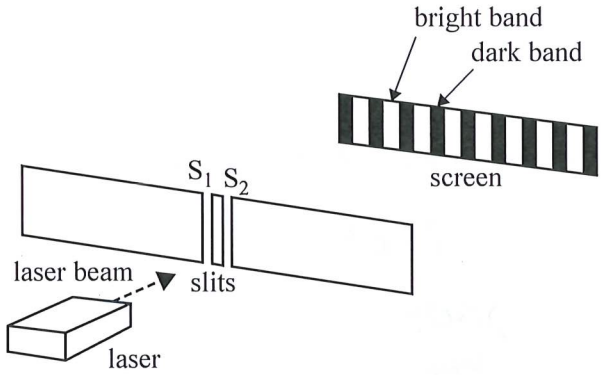
Question 15

The polarisation of light supports

A. the wave model of light.
B. the particle model of light.
C. both the wave model and the particle model of light.
D. neither the wave model nor the particle model of light.

Question 16

A red laser used in a double-slit experiment creates an interference pattern on a screen, as shown below.



The red laser is replaced with a green laser.

Which one of the following best explains what happens to the spacing between adjacent bright bands when the green laser is used?

$x = \frac{\lambda L}{w}$ $\lambda \downarrow$ so $x \downarrow$

A. The spacing increases.
B. The spacing decreases.
C. The spacing stays the same.
D. The spacing cannot be determined from the information given.

Question 17

Protons of mass 1.67×10^{-27} kg are accelerated to a speed of 2.0×10^{3} m s^{-1}.

The best estimate of the de Broglie wavelength of these protons is

A. 1.2×10^{-10} m

B. 2.0×10^{-10} m

C. 1.2×10^{-7} m

D. 2.0×10^{-7} m

$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 2 \times 10^{3}}$

Question 18

Experiments on the photoelectric effect involve shining light onto a metal surface. Measurements are made of the number of emitted electrons and their maximum kinetic energy from the metal surface. This is done for different frequencies and intensities of light.

Which one of the following statements would **not** be one of the experimental findings?

A. The ability to eject electrons from this metal depended only on the frequency of light.

B. The stopping potential for the photoelectrons was independent of the light intensity.

C. The maximum kinetic energy of the photoelectrons depended only on the light intensity.

D. At frequencies below the threshold frequency, no electrons were ejected from this metal no matter how high the light intensity was.

Question 19

In an experimental investigation, an independent variable is one that is

A. independent of the investigator's control.

B. a value selected by the investigator.

C. fixed throughout the experiment.

D. the key variable to be measured.

Question 20

A nucleus in an excited energy state emits a gamma ray of energy 3.6×10^{-13} J as it decays to its ground state. The initial mass of the excited nucleus is M_i.

The final mass of the nucleus after decay is closest to

A. $M_i - 4 \times 10^{-30}$ kg

B. $M_i - 8 \times 10^{-30}$ kg

C. M_i kg

D. $M_i + 4 \times 10^{-30}$ kg

$E = mc^2$

$\Delta M = \frac{3.6 \times 10^{-13}}{(3 \times 10^{8})^2}$

$M = M_i - \Delta M$

END OF SECTION A
TURN OVER