CRANBROOK SCHOOL

**YEAR 12 TRIAL HSC EXAMINATION**

**2 UNIT HSC COURSE**
**2012**

# Physics

## General Instructions

- Reading time – 5 minutes
- Working time – 2.5 hours
- Board-approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- A Data Sheet and Formulae Sheets are provided at the back of this paper
- Write your Student Number at the top of the pages indicated

**Total marks - 85**

**This examination has two parts, Part A and Part B**

Part A – 20 marks
- Attempt Questions 1 - 20

Part B – 65 marks
- Attempt Questions 21-32

***THERE ARE FOUR BOOKLETS AND ONE MULTIPLE CHOICE ANSWER SHEET IN THIS EXAMINATION***

**NO EXTRA PAPER/BOOKLETS ARE REQUIRED IN ADDITION TO THE WRITTEN EXAMINATION BOOKLETS**

**The content and format of this paper do not necessarily reflect the content and format of the HSC examination paper.**

**Student Number** | | | | | | | | |

# CRANBROOK SCHOOL

**2012 YEAR 12 TRIAL HSC EXAMINATION**

# PHYSICS

## 2 UNIT HSC COURSE

**DIRECTIONS TO CANDIDATES:**

- **Write your Student Number at the top right hand corner of this page.**
- **You may detach this answer sheet from the rest of the booklet**

**PART A Multiple Choice**

Select the alternative A, B, C or D that best answers the question. Fill in the response space.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 11. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 2. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 12. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 3. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 13. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 4. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 14. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 5. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 15. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 6. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 16. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 7. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 17. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 8. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 18. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 9. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 19. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 10. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 20. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |

## Part A – 20 marks
## Booklet 1
## Attempt Questions 1 – 20

Use the multiple choice answer sheet.
Select the alternative A, B, C or D that best answers the question. Fill in the response space.

**1** The escape velocity from a planet is $8.0 \times 10^3$ m $s^{-1}$. Which of the lists shown below contains factors which would <u>all</u> affect the value of the escape velocity?

(A) planet's radius, planet's mass, the value of G (the universal gravitational constant)
(B) planet's radius, direction of launch, planet's rotation
(C) the value of G (the universal gravitational constant), mass of launched object, planet's mass
(D) mass of launched object, planet's radius, direction of launch

**2** Which of the following statements best describes how a satellite is kept in place once it is in its orbit around the Earth?

(A) The rotation of the Earth helps to maintain the satellite's momentum.
(B) The rocket thrusters on the satellite keep it moving in a circle.
(C) Gravity provides all the force necessary to maintain the satellite's orbital motion.
(D) Earth's orbit around the Sun provides enough motion for the satellite to keep in orbit.

**3** Particle accelerators are used to increase the speed of very small particles to close to the speed of light. The particles are then smashed into each other. What is the purpose of using a particle accelerator?

(A) to allow the particles to attain very great kinetic energy.
(B) to try to give the particles a speed greater than the speed of light.
(C) to decrease the length of the particles.
(D) to decrease the mass of the particles.

Next page

**4** A physics student was attempting to compare low-Earth orbits and geostationary orbits of artificial satellites by constructing a table.

Which combination gives the most correct comparison?

| | *Low-Earth orbit* | *Geostationary orbit* |
|---|---|---|
| (A) | Fast speeds and high altitude | Slow speeds and low altitude |
| (B) | Fast speed and small period | Slow speed and small period |
| (C) | High altitude and 24-hour period | Low altitude and one-hour period |
| (D) | Low altitude and fast speed | High altitude and slow speed |

**5** In a nuclear reaction, $1.20 \times 10^{17}$ J of energy is released. The nuclear fuel used had an initial mass of 2.75 kg.

What is the final mass of the remaining fuel is closest to?

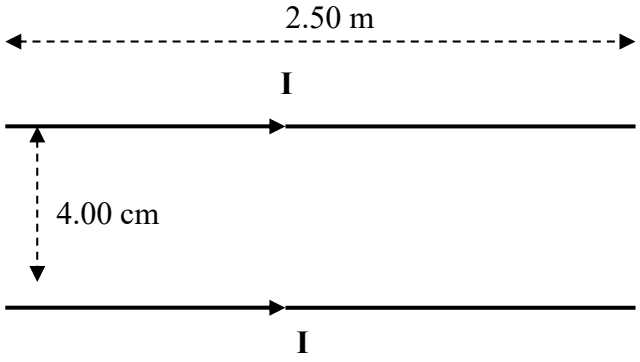
(A) 1.42 kg
(B) 2.75 kg
(C) 0.01 kg
(D) 1.33 kg

**6** Which of the following options below is an example of a scientific model used to explain natural phenomena?

(A) theory of relativity
(B) existence of the aether
(C) wave equation
(D) potential energy of orbiting satellites

Next page

**7** Two parallel conductors have direct current, I, flowing in them, as shown below.




A force of $5.00 \times 10^{-3}$ N exists between the two conductors.
The conductors are parallel for a distance of 2.50 m and they are 4.00 **cm** apart.
What is the value of I and the direction of the force?

(A) 400 A, away from each other
(B) 200 A, away from each other
(C) 40.0 A, towards each other
(D) 20.0 A, towards each other

**8** The trailers on some large trucks use eddy current braking. An aluminium disc attached to the wheel rotates between the poles of an electromagnet. To brake, the electromagnet is energised by current from the truck's battery. The retarding force slows the truck down.

Which of the statements below best describes what happens to the kinetic energy removed from the truck as it slows down?

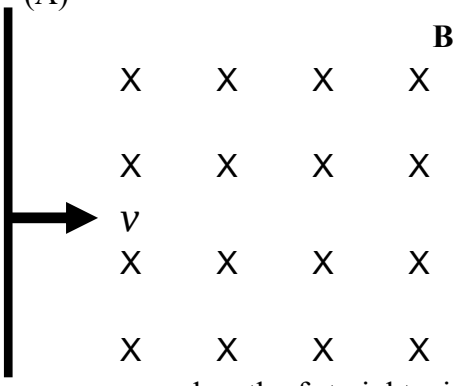
(A) Currents are induced in the electromagnet, which transfers the energy to the battery.
(B) Eddy currents are induced in the core of the electromagnet opposing the motion of the disc. The electromagnet heats up, radiating the energy away.
(C) Eddy currents are induced in the aluminium opposing the motion of the disc. The eddy currents cause the disc to heat up, radiating the energy away.
(D) The eddy currents in the disc attract it to the electromagnet and the friction removes the kinetic energy.

**9** What is a reason that a back EMF is desirable in a DC motor ?

(A) It reduces the voltage needed to run a motor.
(B) It limits the speed of a motor preventing it from rotating too fast.
(C) It increases the resistance of the coils in the motor.
(D) It helps a motor begin to rotate when started.

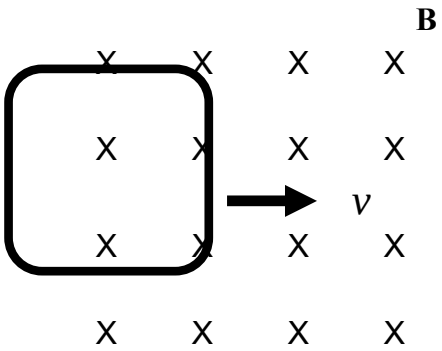
**10** In which of the following cases is a current being induced in the moving conductor at the instant shown?

(A)



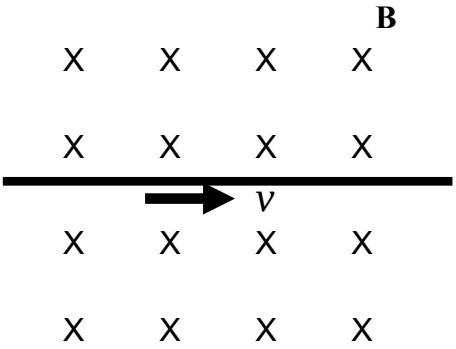

length of straight wire

(B)



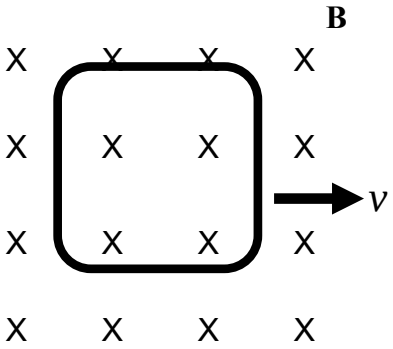

loop of wire

(C)




length of straight wire

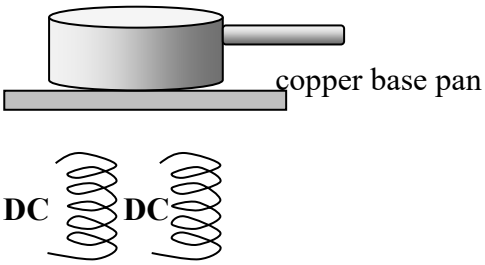
(D)



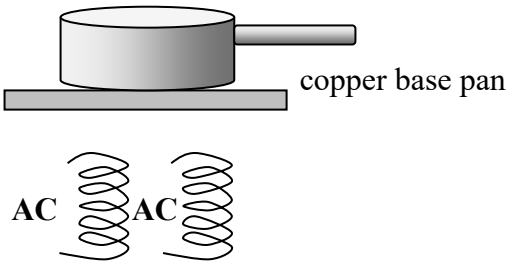

loop of wire

**11** In which of the following induction cooktop arrangements would heat be generated most effectively?

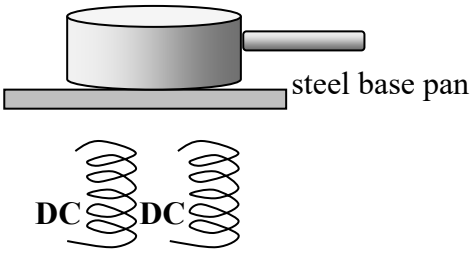
(A)



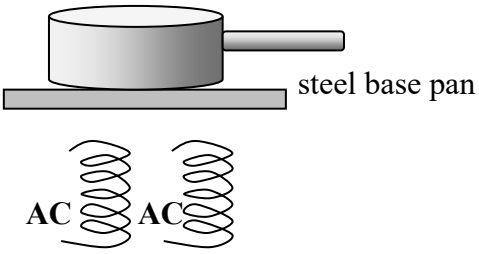

(B)




(C)

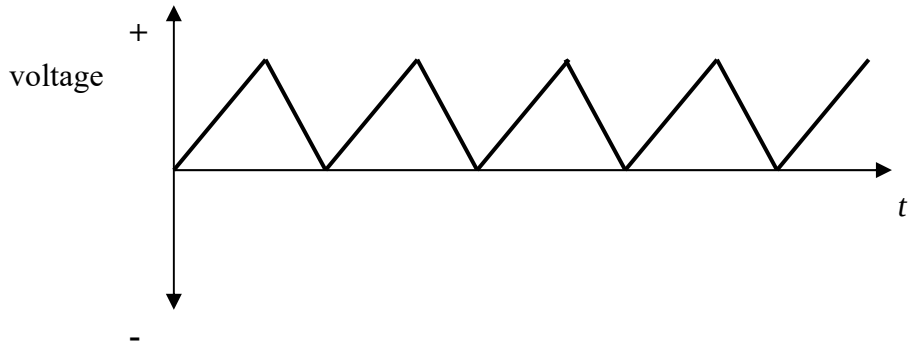



(D)

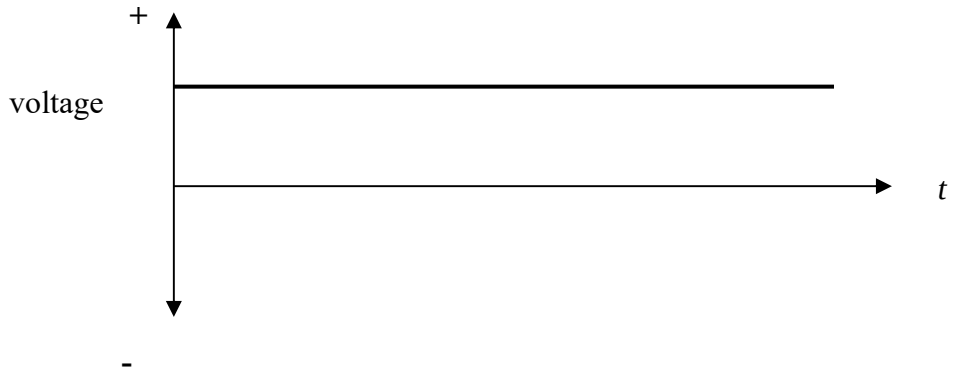


**12** Which voltage output was produced by a generator having a device that connects the brushes to the rotor coils that looks like the device shown here?

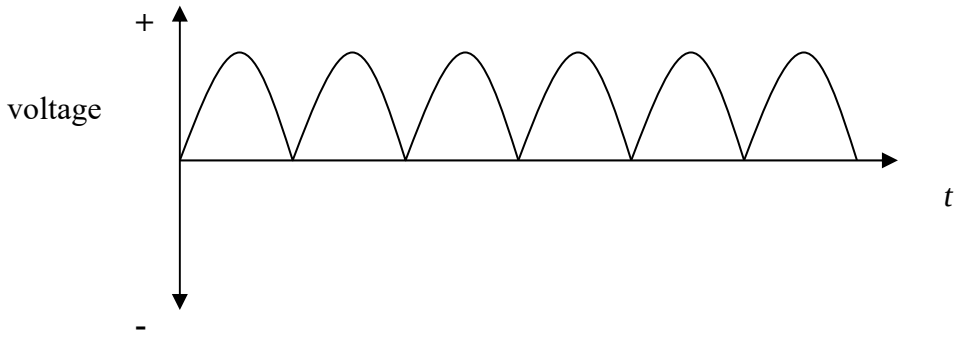
(A)



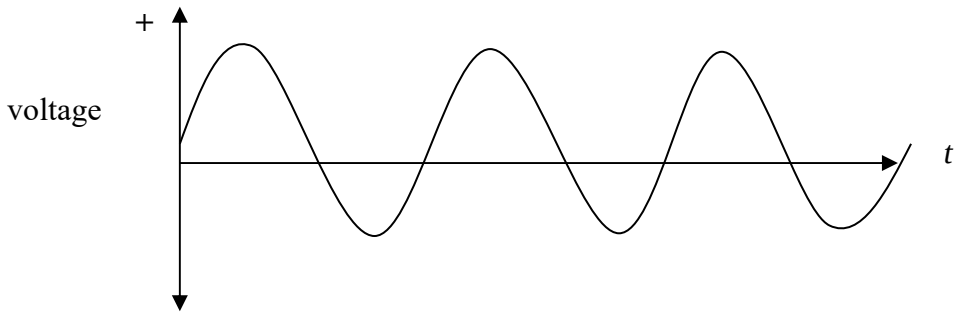

(B)



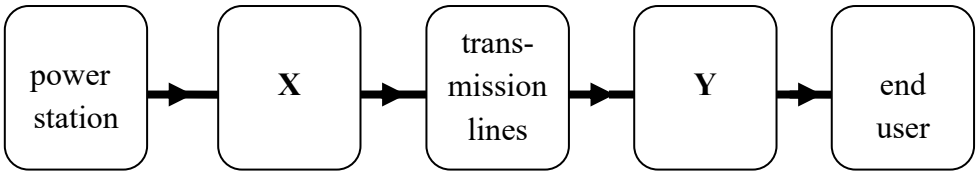

(C)




(D)



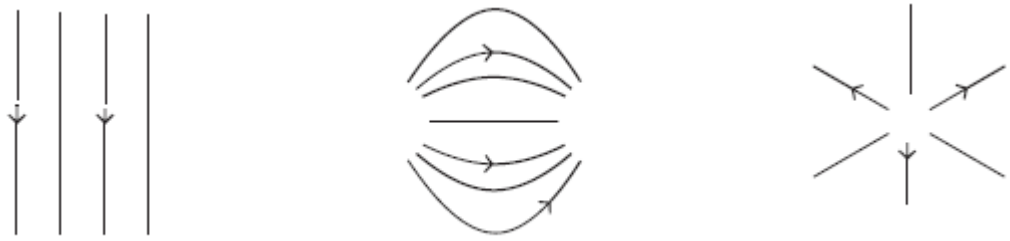
**13** This question refers to the simplified flow chart below representing the steps involved in the generation and transmission of electricity to the final user.




What is the process occurring at "**X**"?

(A) Converting the electricity to alternating current.
(B) Increasing the power of the electricity.
(C) Decreasing the frequency of the electricity.
(D) Increasing the voltage of the electricity.

**14** Which answer correctly identifies the origin of the following electric fields?



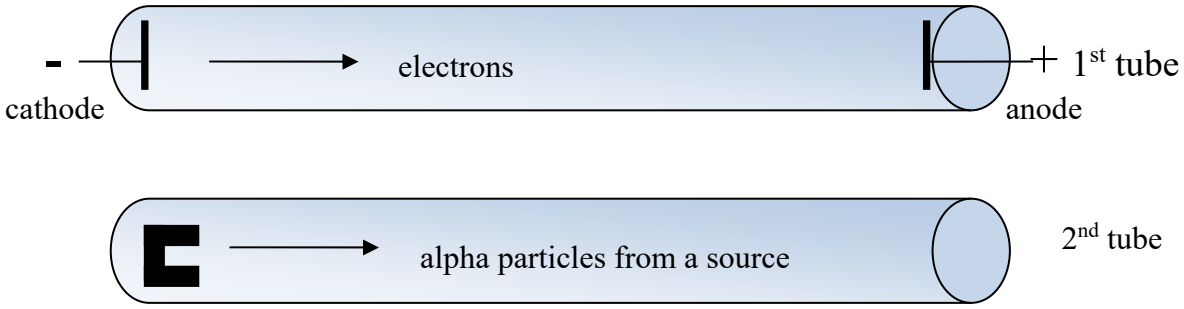
| | | | |
|---|---|---|---|
| (A) | point charge | + and – charge | charged parallel plates |
| (B) | + and – charge | point charge | charged parallel plates |
| (C) | point charge | charged parallel plates | + and – charge |
| (D) | charged parallel plates | + and – charge | point charge |

**15** A variety of patterns are seen when a current is passed through low-pressure gas discharge tubes.

Which one of the factors below plays the most <u>significant</u> part in forming these patterns?

(A) The material of which the electrodes are composed.
(B) The identity of the gas in the tube.
(C) The voltage applied to the tube.
(D) The gas pressure in the tube.

**16** A stream of electrons is being fired through a long, narrow vacuum glass tube, with 25 mC of charge passing through the tube per second. A second glass vacuum tube is placed **underneath** this tube with alpha particles moving through the tube, as shown.




alpha particles are **positively** charged

Neglect the effects of gravity.

In which direction would the path the alpha particles be expected to curve?

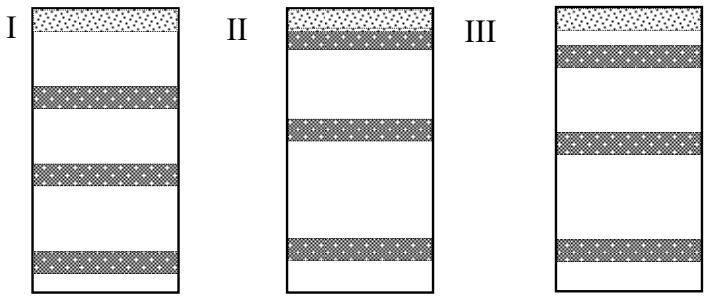
(A) down the page
(B) into the page
(C) out of the page
(D) no effect

**17** Early investigations into the nature of cathode rays were inconclusive. Whether the cathode rays were waves or particles was disputed. What was the reason for this dispute?

(A) Observations of their speed.
(B) The fact that they could travel through a vacuum.
(C) They could not be deflected by an electric field.
(D) They cast shadows of such shapes as a cross.

Next page

**18** These diagrams represent the band-theory structures for three distinct types of solid.




Of the following groups of solids, which would be most correctly represented by these diagrams, in the order given above?

(A) Magnesium; plastic; iron

(B) Calcium; sulfur; graphite

(C) Glass; copper; germanium

(D) Quartz; doped silicon; undoped silicon

**19** Which statement best describes a reliable investigation?

(A) The method allows for a fair test.

(B) The method allows the results to be repeatable.

(C) The method allows for the results to be accurate.

(D) The hypothesis will be supported.

**20** Which one of the following reasons may describe the UV catastrophe?

(A) The frequency of the emitted radiation was decreasing as the temperature was increased.

(B) The intensity of the emitted radiation dropped suddenly at high frequencies.

(C) Less energy was emitted as the temperature was increased over the whole range of frequencies detected.

(D) The maximum intensity occurred at longer wavelengths as the temperature was increased.

**Part B starts in Booklet 2**

**Student Number** | | | | | | | | |

**Part B – 65 marks**

**Booklet 2**

**Attempt Questions 21 - 32**

Answer the questions in the spaces provided

Show all relevant working in questions involving calculations.

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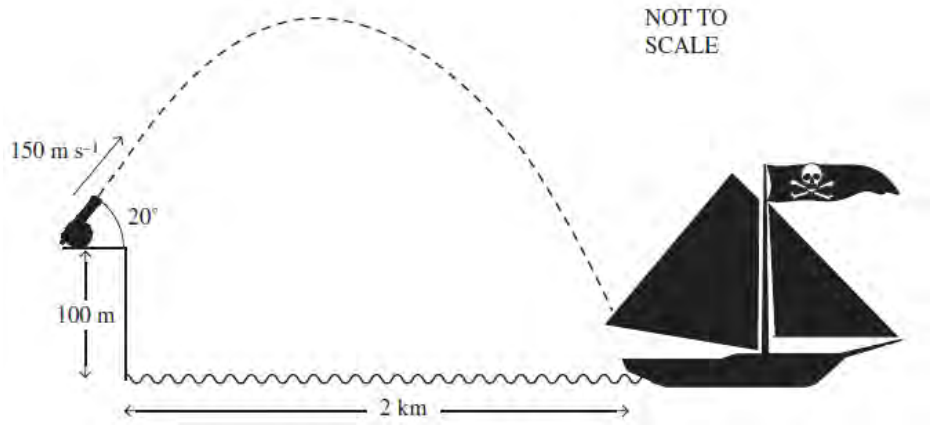
**Marks**

**Question 21** (7 marks)

A pirate ship was sailing 2 km from the coast. A cannon on a 100 metre-high cliff fired a cannon ball at an angle of 20° to the horizontal, at a speed of 150 m/s.




*Cannon ball ahoy!!*

(a) Determine the vertical and horizontal components of the initial velocity. **1**

(b) Calculate the time taken for the cannon ball to reach the maximum height **above the water**. **2**

continued next page

**Marks**

Question 21 continued

(c) Determine by what distance the cannon ball misses the pirate ship. **2**

(d) Describe <u>two</u> possible **variables** that can be adjusted for the cannon so that a cannon ball is able to strike the ship at 2 km away. **2**

Next page

**Marks**

**Question 22** (6 marks)

A rocket launches a satellite into orbit 350 km above Earth's surface. The radius of the Earth is 6400 km

(a) The weight of the satellite at launch is 14.0 **kilo** newtons. What is the weight of the satellite while it is in orbit? **3**

(b) Account for the change in the weight of the satellite. **1**

(c) The **apparent** weight of the satellite in its orbit is not equal to the weight of the satellite you determined in part (a). What is the apparent weight of the satellite and explain this value. **2**

Next page

**Marks**

**Question 23** (3 marks)

Evaluate the Michelson-Morley attempt to measure the relative velocity of the Earth through the aether. **3**

**Question 24** (3 marks)

Some of Einstein's predictions based on relativity were made many years before evidence was available to support them.

(a) Identify **one** of Einstein's predictions. **1**

(b) Identify the current experimental evidence supporting this prediction. **2**

**Marks**

**Question 25** (5 marks)

Astronauts aboard the spaceship Platypus are travelling at 0.90 c to visit a planet which is exactly 10.0 light years away, as measured from the Earth.

(a) To an observer on Earth watching the Platypus through a telescope, how long will this one-way trip take? **1**

(b) How much time will have elapsed **onboard** the Platypus by the time they reach the planet? **2**

(c) Explain <u>one</u> aspect of the situation described in this question that does not conform to the Special Theory of Relativity. **2**

**Next booklet**

**Student Number** | | | | | | | | |

**Part B (continued) Booklet 3**

**Marks**

**Question 26** (6 marks)

In your course you performed an investigation to demonstrate the production of an alternating current.

(a) Describe an experiment you did to produce alternating current, with particular reference to how you verified that alternating current was actually produced. **3**

(b) Describe three advantages of using AC generators for large-scale electrical power production. **3**

**Marks**

**Question 27** (8 marks)

(a) Explain how rotating a coil within a magnetic field can cause an *emf* to be induced within the wires of the coil while an external magnetic field remains stationary and constant. **2**

(b) Identify *two* changes that could be made to the coil that would increase the induced *emf* as it was being rotated in the external magnetic field and **what** do these two changes affect to produce an increased *emf*. **2**

(c) Explain why a soft iron core is used in DC motors and discuss what problem the soft iron causes and how the effects of this problem are reduced. **4**

**Marks**

**Question 28** (7 marks)

The two diagrams, P and Q, below show a situation in which a rectangular loop of wire is in a uniform magnetic field (directed perpendicularly into the plane of the paper) of strength 2**B** (Diagram P) and then the strength of the magnetic field is halved to a uniform magnetic field strength of **B** (Diagram Q).

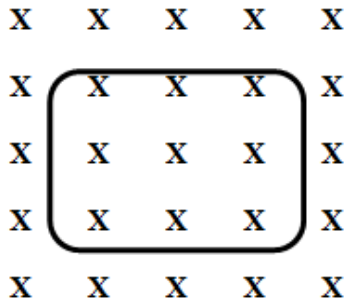


*Diagram P*
magnetic field strength, 2**B**

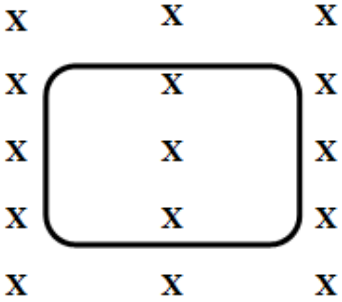


*Diagram Q*
magnetic field strength, **B**

(a) Using the appropriate principle, **state** and **explain** the direction of the induced current in the loop of the wire during this change in the magnetic field strength. **3**

(b) The change in magnetic field to induce an *emf* and current is used in an important device in electricity distribution. Name this device and state its purpose in electricity distribution. **2**

continued next page

**Marks**

Question 28 continued

(c) State **two** differences that are used to produce a change in magnetic field in the device you mentioned in part (b) compared to the way the magnetic field is changed in part (a). **2**

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**Next booklet**

**Student Number** | | | | | | | | |

**Part B (continued) Booklet 4**

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**Marks**

**Question 29** (4 marks)

Using silicon as an example of a semiconductor, describe how it carries a current and how doping affects the process of electrical conduction. **4**

**Question 30** (9 marks)

Only in the last few years have cathode ray tube televisions been superseded by flat screen technology. Three electron guns are used in colour televisions to fire electrons at the screen of the cathode ray tube.

(a) Outline the role of the electrodes in the electron guns. **2**

continued next page

**Marks**

Question 30 continued

(b) Find the magnitude of the force on an electron that has a speed of $6.5 \times 10^3$ m $s^{-1}$, moving from **left to right** in the cathode ray tube when a magnetic field of intensity $4.0 \times 10^{-2}$ T is perpendicular to the direction **(into the plane of the paper)** of the velocity of the electron. **2**

(c) Determine the **magnitude**, **direction** and **orientation with respect to the magnetic field** of the electric field that needs to be imposed so that the electron does not experience a net force. **3**

(d) The arrangement of an electric field and a magnetic field on a stream of electrons was used in a celebrated experiment to determine the charge to mass ratio of the electron by J.J. Thomson. Explain briefly why Thomson did not determine the charge on the electron and what was a conclusion that could be drawn from the value of charge to mass ratio that was obtained. **2**

Next page

**Marks**

**Question 31** (4 marks)

In 1900 Max Planck made a revolutionary suggestion that changed the course of Physics.

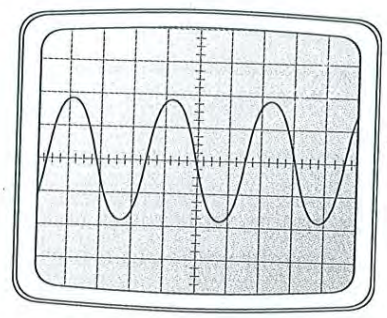
Outline Planck's hypothesis that allowed him to successfully predict the black body radiation curve and explain why he needed to introduce this hypothesis. **4**

Question 32 next page

**Marks**

**Question 32** (3 marks)

Two sets of plates deflect an electron beam in a cathode ray oscilloscope to produce a trace on the screen as shown.



Explain in detail how the deflection plates produce this pattern.

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End of Examination