

2010

Trial HSC Examination

HSC Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your student number at the top of each page where relevant
- A data sheet, formulae sheets and Periodic Table are provided

Total marks – 100

This examination has TWO SECTIONS, Section 1 and section 2

SECTION I – Total marks 85

This section has two parts **Part A and Part B**

Part A – 20 marks

Attempt Questions 1–20

- Allow about 40 minutes for this part

Part B – 65 marks

Longer Answer Question

- Attempt Questions 21–33 Allow about 1 hour 45 minutes for this part

SECTION II – Total marks 15

Option Question

- Allow about 35 minutes for this part
- USE THE SEPARATE OPTION BOOKLET FOR YOUR ANSWERS

Section I

Part A – 20 marks

Attempt Questions 1–20

Allow about 40 minutes for this part

Use the multiple-choice answer sheet provided for Questions 1–20.

1. What is the weight of an 80kg astronaut when placed in a gravitational field of 0.5g, where g is the Earth's gravitational acceleration? Take $g = 10 \text{ ms}^{-2}$.
- A 40kg
 - B 80kg
 - C 400N
 - D 800N

2. Which statement correctly describes the period of a satellite in low Earth orbit?
- A A satellite in low Earth orbit has a period less than that of a geostationary orbit.
 - B A satellite in low Earth orbit has a period equal to that of a geostationary orbit.
 - C A satellite in low Earth orbit has a period greater than that of a geostationary orbit.
 - D A satellite in low Earth orbit has a period greater than or equal to that of a geostationary orbit.

3. A satellite is placed in a circular orbit around the Earth.

If the orbital radius of the satellite increases, what effect will this have on its kinetic and gravitational potential energy?

	KINETIC ENERGY	GRAVITATIONAL POTENTIAL ENERGY
A	Decrease	Decrease
B	Increase	Increase
C	Increase	Decrease
D	Decrease	Increase

4. For the Michelson-Morley experiment which of the following statements is *incorrect*?
- A The outcome of the experiment was that no motion of the Earth relative to the ether was detectable.
 - B The half-silvered mirror was used to split the light beam to allow interference patterns to be observed.
 - C The experiment attempted to measure the velocity of the Earth relative to the ether.
 - D the speed of light is dependent on the motion of the observer through the ether.

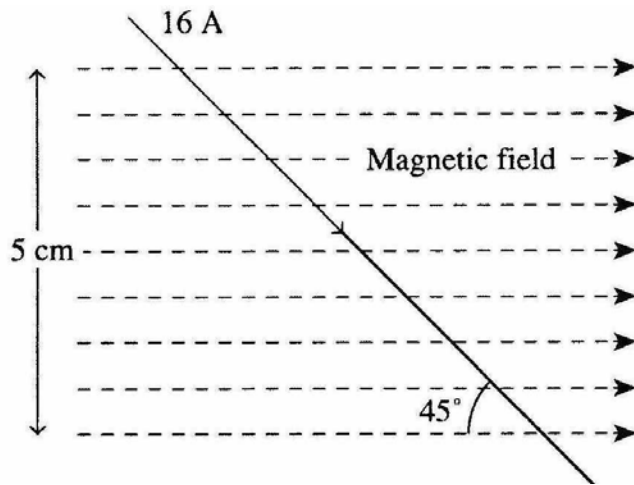
5. The current flowing in a DC motor reduces as the motor's speed increases. How can the change in current be accounted for?
- A The wires increase in resistance as the coil spins, leading to a reduction in current.
 - B The back emf reduces the effective resistance leading to a reduction in the current in the circuit.
 - C The back emf increases effective the resistance leading to a reduction in the current in the circuit.
 - D A governor is used to reduce the current in the circuit as the motor spins more rapidly to reduce the chance of the motor burning out.

6. A flat metal pendulum disc is set swinging between the poles of a horseshoe magnet, so that the plane of the disc is perpendicular to the magnetic field.

Which statement best explains why the disc slows down?

- A A back emf is set up in the disc.
 - B The magnetic field experiences a force in the opposite direction.
 - C Eddy currents in the disc cause a braking effect
 - D Relative motion of the conductor in the magnetic field accelerates the disc.
7. Which of the following explains why the resistance in metals increases as they are heated?
- A Expansion of the metal
 - B Increased lattice vibration
 - C Pairing of electrons
 - D The effect of impurities
8. What is the ratio of the number of coils in the primary to the number of coils in the secondary for a step up transformer?
- A Less than one.
 - B Less than or equal to one.
 - C Equal to one.
 - D Greater than one.

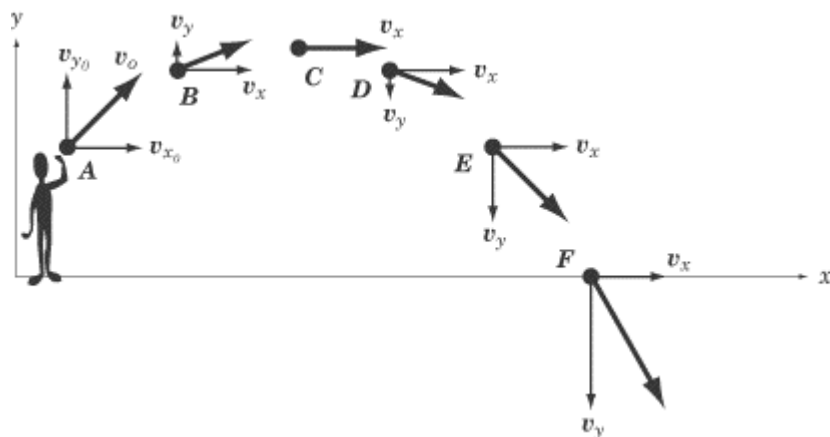
9. The diagram below represents a conductor carrying a current in a magnetic field.



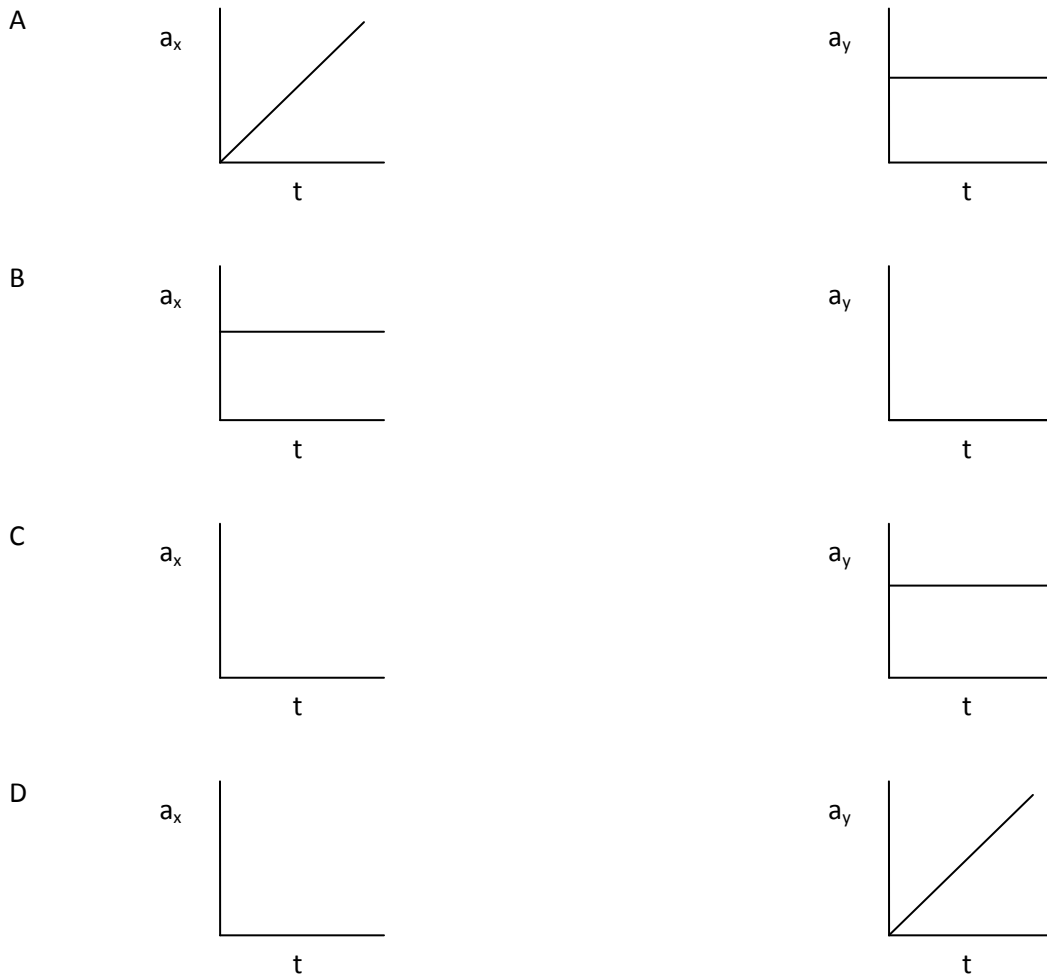
When the current through the conductor is 16 A, the force on the conductor is 0.5 N.
What is the magnetic flux density of the magnetic field?

- A 0.88 T
- B 0.62 T
- C 0.40 T
- D $6.25 \times 10^3 \text{ T}$

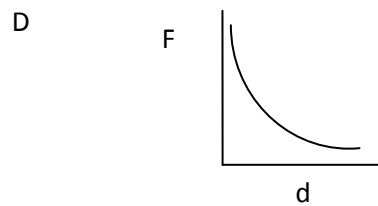
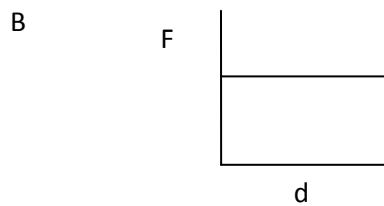
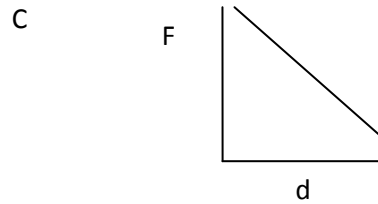
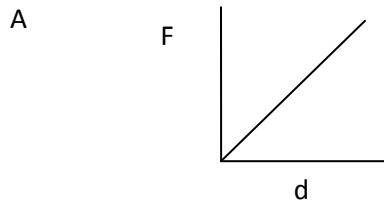
10. The diagram below shows the path of a projectile under the influence of the Earth's gravitational field.



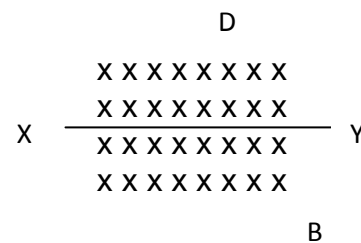
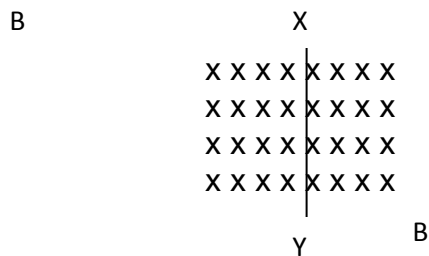
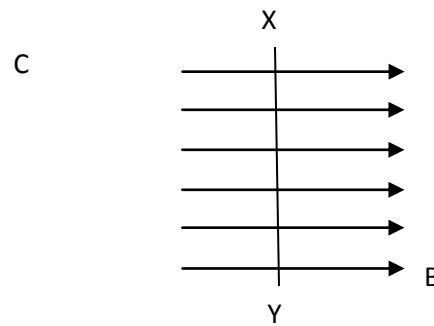
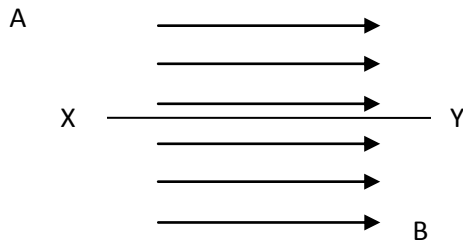
Which combination of graphs best depicts the projectile's vertical and horizontal acceleration for the motion with respect to time?



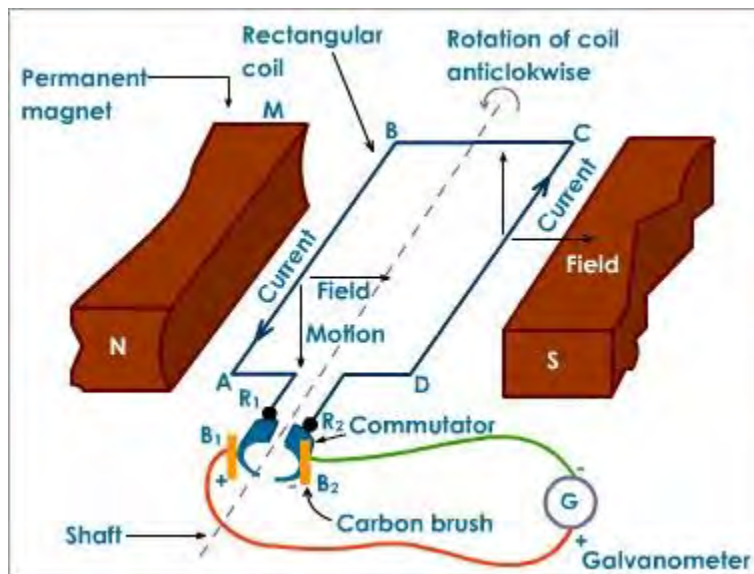
11. Which graph best depicts the variation of gravitational force F , with distance d , from the centre of the Earth?



12. In which situation will the current carrying wire marked XY **NOT** experience a force?



13. The diagram below represents an electrical generator



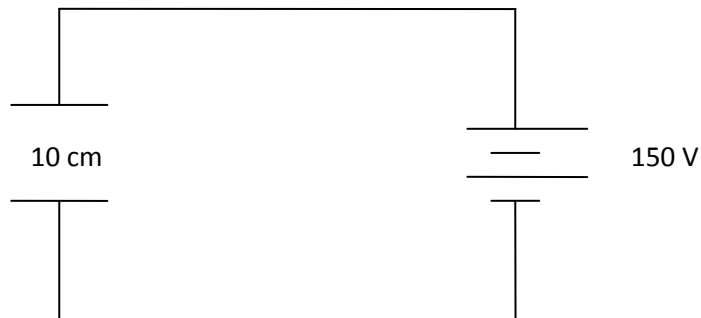
What type of current would be produced by the generator?

- A DC of constant magnitude
- B DC of varying magnitude
- C AC
- D None

14. What is the energy of a photon of blue light with a wavelength of 430 nm?

- A $6.63 \times 10^{-34} \times 10^{-9} \text{ J}$
- B $6.63 \times 10^{-34} \times 3 \times 10^8 \text{ J}$
- C $6.63 \times 10^{-34} \times 430 \text{ J}$
- D $6.63 \times 10^{-34} \times 7 \times 10^{14} \text{ J}$

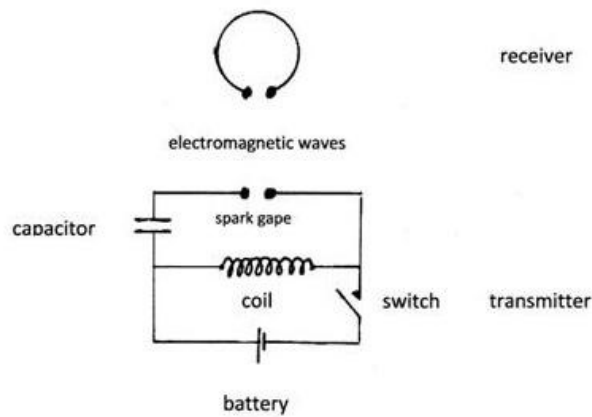
15. The diagram below shows two parallel plates.



What is the magnitude of the electric field between the plates?

- A $150 / 1.0 \text{ V / m}$
 - B $150 / (1.0 \times 10^{-2}) \text{ V / m}$
 - C $150 \times 10^{-1} \text{ V / m}$
 - D $150 \times 1.0 \text{ V / m}$
16. Which of the following does not produce electromagnetic radiation?
- A Turning on a light switch
 - B Creating a spark with two wires
 - C An electron 'orbiting' a nucleus
 - D Electrons hitting a metal target
17. What type of semi conductor material would be produced by doping a semi conductor material with small amounts of a Group V element?
- A An n-type semi conductor with an excess of electrons.
 - B An n-type semi conductor with an excess of holes.
 - C A p-type semi conductor with an excess of electrons.
 - D A p-type semi conductor with an excess of holes.

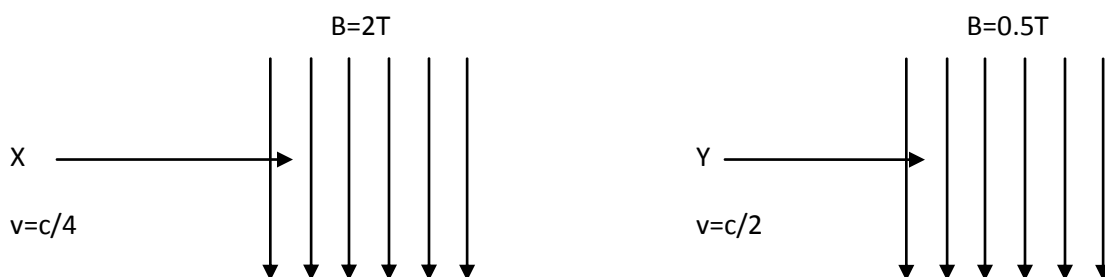
18. Heinrich Hertz used a set-up similar to the one shown below to investigate the production and detection of electromagnetic radiation.



A glass sheet was placed between the transmitter and receiver.

Which of the following observations is consistent with the photoelectric effect that Hertz produced?

- A Radio waves were blocked when the glass sheet was in place.
 - B Ultraviolet waves were blocked when the glass sheet was in place.
 - C The maximum spark length was longer when the glass sheet was in place
 - D The maximum spark length was shorter when the glass sheet was in place.
19. Two electrons, X and Y, travelling at the same speed enter a magnetic field as shown in the diagram.



What is the ratio of the force on electron X to the force on electron Y?

- A 1 : 1/2
- B 1 : 1
- C 1 : 3/2
- D 1 : 2

20. The diagram shows the side view of a simple cathode ray tube.

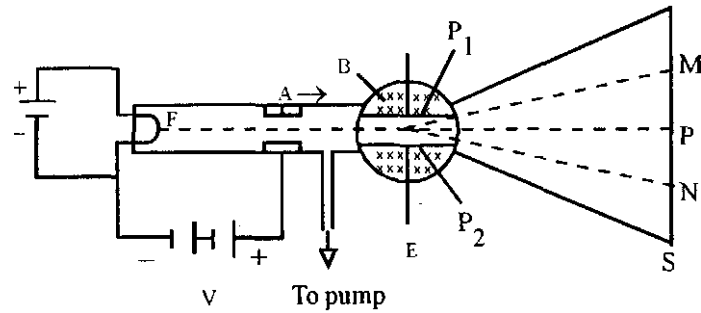


Fig. 9.2 J.J. Thomson's Experiment

What is the function of the electrically charged plates labelled P₁ and P₂?

- A To produce cathode rays.
- B To stop cathode rays striking the screen.
- C To deflect the cathode rays vertically.
- D To deflect the cathode rays horizontally.

Physics

OUTCOME	MARK
Knowledge and Understanding	/83
Planning & Conducting Investigations Q 26 & 32	/8
Problem Solving Q 21a, 23b & 31b	/9
TOTAL	/100

PART A: Answer the multiple choice questions HERE.
Circle the letter of the BEST alternative.

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

Candidate Number: _____

Section I

Part B

Total marks 65

Attempt all questions 21 to

Marks

Allow about 1 hour and forty five minutes for this part

21. A satellite with a mass of 200 kg maintains its orbit at an altitude of 300 km above the Earth's surface. The Earth has a radius of 6.38×10^6 m and a mass of 5.97×10^{24} kg.

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(a) Determine the gravitational potential energy of the satellite at this altitude.

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(b) Would you expect the gravitational force on this satellite in orbit to be different from its value on the surface of the Earth prior to launch. Explain any variation.

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22. Outline the contribution to space exploration of one of the 19th or 20th Century Scientists you have studied

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23. (a) Describe the important contribution that Galileo's analysis of projectile motion made to our current understanding of this type of motion. 2

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- (b) A projectile is fired at an angle of 30° to the horizontal from a tower 20m high. The projectile takes 10s to hit the ground. Calculate the initial speed of the projectile. 4

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24. The mathematical term $1 - (v^2/c^2)$ is fundamental to our understanding of Einstein's theory of special relativity.

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(a) State *qualitatively* how the value of this mathematical term varies as the velocity (v) increases.

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(b) Outline how this mathematical term accounts for:

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- length contraction
- time dilation

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25. Draw in the space below, a labelled diagram of a simple DC electric motor

(a) Label all components

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(b) With reference to the components you identified in your diagram, explain how your motor would work

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26. (a) Describe an experiment that would allow you to demonstrate the principle of an AC induction motor. **3**

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- (b) Give one major advantage and one disadvantage of induction motors. **2**

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27. Magnetic flux is an important concept in physics. 4
(a) Describe the concept of magnetic flux and show how it relates to the magnetic flux density, B

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- (b) Use the concept of magnetic flux to explain the production of back emf in motors. 2

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28. This question refers to the electrical resistivity of different materials at room temperature

Material	Approximate resistivity (ohms/centimetre)
Diamond	10^{14}
Glass	10^{10}
Pure silicon	10^5
Doped Silicon	10^3
Pure germanium	10^2
Doped Germanium	10^0
Copper	10^{-6}

Both silicon and germanium are semiconductor materials.

- (a) Distinguish between pure silicon and doped silicon

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- (b) By referring to the table, explain how doping a semiconductor can change its electrical properties

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29. Assess Einstein's contribution to quantum theory and its relation to the photoelectric effect. 4

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30. Outline how the Braggs were able to determine the internal structure of a crystal. What did this type of investigation tell us about the structure of metals? 5

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31. (a) Outline Thomson's experiment to measure the charge/mass ratio of an electron. 3

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(b) An electron is accelerated to a speed of $1.5 \times 10^4 \text{ ms}^{-1}$ inside a cathode ray tube. The electron enters a region of crossed magnetic field of 0.1 T and electric fields as shown in the diagram below. Calculate the potential difference across the parallel plates, P1 and P2, required to allow the electron to pass undeflected through the electric and magnetic fields. The distance between the plates is 1 cm. 3

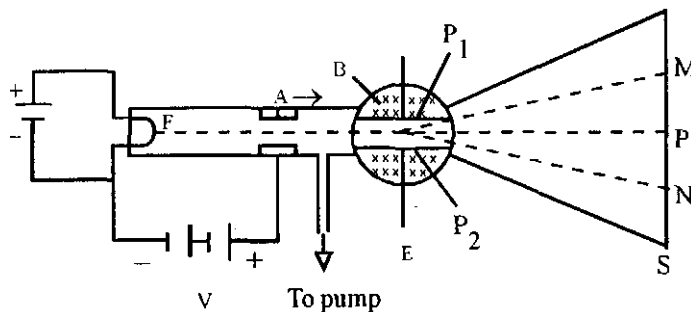


Fig. 9.2 J.J. Thomson's Experiment

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32. Describe a first-hand investigation to demonstrate the effect on a generated electric current when the relative motion between the magnet and the coil is varied.

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In your description include:

- a labelled sketch of the experimental set-up.
- how you varied the relative motion of the magnet and the coil

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33. Discuss the impact of the development of transformers on society.

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Section II

Total marks 15

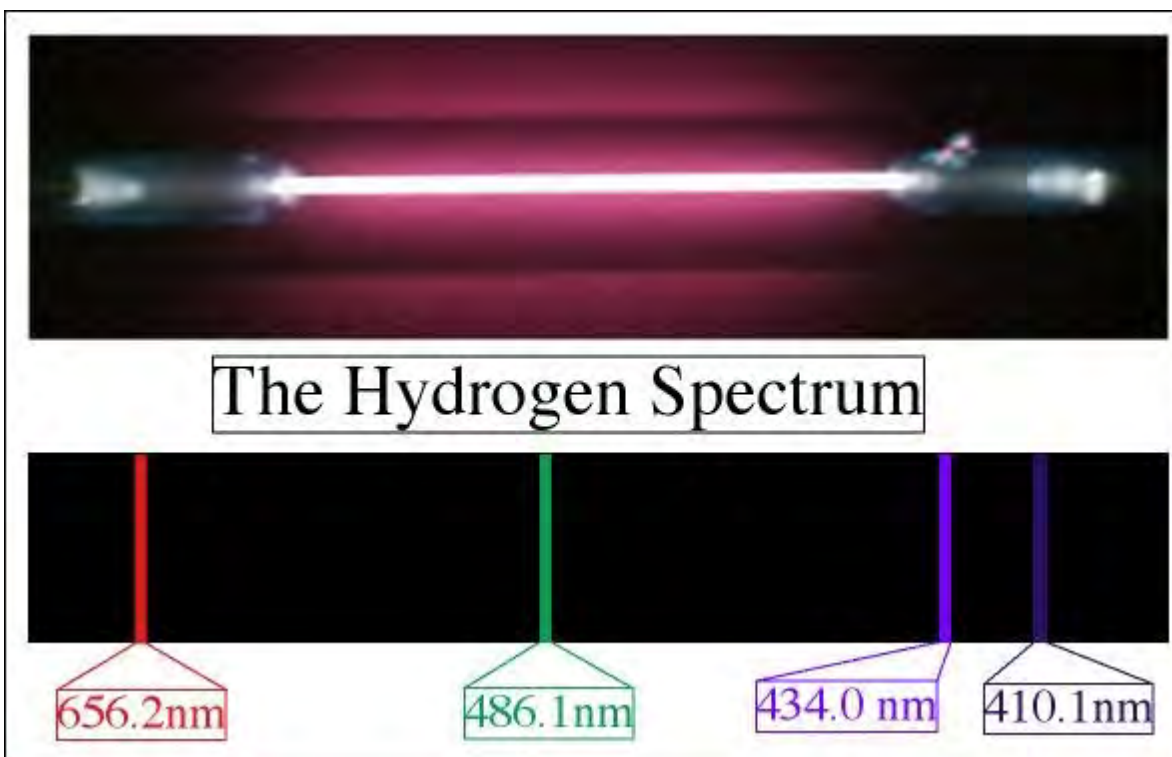
Allow about 35 minutes for this part

Answer the question in the booklet provided.

34. From Quanta to Quarks

(a) Below is given the emission spectrum for hydrogen gas. Calculate the frequency of the shortest wavelength of the Balmer series.

3



(b) Describe how Bohr's postulates helped explain the mathematical model (Rydberg Equation) that accounted for the lines in the spectrum shown above.

3

(c) Assess the contributions made by Heisenberg and Pauli to the development of the atomic theory.

2

(d) (i) Find the velocity of an electron emitted by a cathode ray tube with a wavelength of 4.85×10^{-10} m.

3

(ii) De Broglie, in 1924, referred to "matter waves". Outline his contribution to our current understanding of matter and waves.

2

(iii) Outline Davisson and Germer's experiment and explain why it was an important breakthrough.

2

Physics

OUTCOME	MARK
Knowledge and Understanding	/83
Planning & Conducting Investigations Q 26 & 32	/8
Problem Solving Q 21a, 23b & 31b	/9
TOTAL	/100

PART A: Answer the multiple choice questions HERE.
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8	A B C D	18	A B C D
9	A B C D	19	A B C D
10	A B C D	20	A B C D