Centre Number

Student Number

SCEGGS Darlinghurst

2007

HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Physics

This is a TRIAL PAPER only and does not necessarily reflect the content or format of the Higher School Certificate Examination for this subject.

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
- A data sheet, formulae sheets and Periodic Table are provided at the back of this paper
- Write your Centre Number and Student Number at the top of this page and page 8.

Total marks – 100

Section I Pages 2–21

75 marks
This section has two parts, Part A and Part B

Part A – 15 marks
- Attempt Questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks
- Attempt Questions 16–31
- Allow about 1 hour and 45 minutes for this part

Section II Page 22

25 marks
- Attempt Questions 32
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 15 marks
Attempt Questions 1–15
Allow about 30 minutes for this part

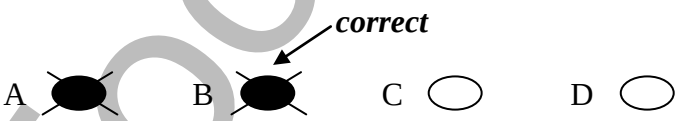
Use the multiple-choice answer sheet.

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

Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

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

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



1 An experiment was repeated several times in an attempt to measure Earth's gravitational acceleration at the surface of the Earth. The results are shown in the table below:

Trial number	Result (ms^{-2})
1	8.80
2	8.82
3	8.79
4	8.81
5	8.78

It would be true to say that this experiment was:

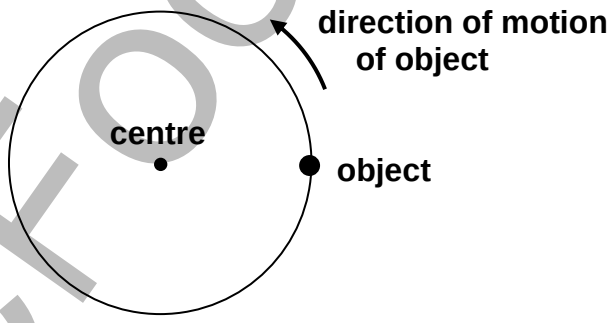
(A) accurate and reliable.

(B) accurate but not reliable.

(C) not accurate but reliable.

(D) not accurate and not reliable.

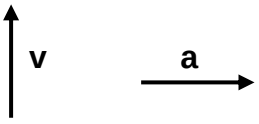
2 An object is travelling around in a circular track at a constant speed of 15 ms^{-1}, as shown in the diagram below.



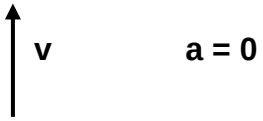
Which vectors best represent the velocity and acceleration of the object at the position shown?

(A)

(B)



(C)



(D)

3 In which of the following situations would you expect the *smallest* escape velocity?

(A) Launching from a 10km high mountain on Earth.

(B) Launching from a planet with half the radius of Earth, but with the same mass.

(C) Launching from a planet with twice the radius of Earth, but with the same mass.

(D) Launching from the bottom of a deep vertical mine shaft.

4 Which of the following could be considered an inertial frame of reference?

(A) A satellite orbiting Earth.

(B) An aircraft accelerating in a straight line.

(C) A spaceship drifting between stars.

(D) A boat bobbing up and down in waves.

5 Any type of AC generator does NOT have:

(A) an armature.

(B) a rotor.

(C) slip rings.

(D) a split-ring commutator.

6 In comparing step-up to step-down transformers, it is true to say that:

(A) the ratio $\frac{n_p}{n_s}$ for step down transformers is always less than in step-up transformers.

(B) the ratio $\frac{n_p}{n_s}$ for step-up transformers is always less than in step-down transformers.

(C) step-up transformers are more efficient than step-down transformers.

(D) step-up transformers are always larger than step-down transformers.

7 Electrical energy is transformed into many different types of useful energy in the home.

Of the transformations listed, which would be most unlikely to be found in the home?

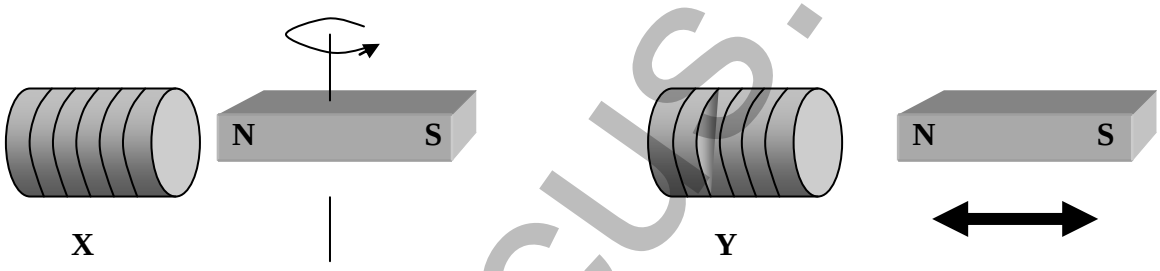
(A) electrical → sound

(B) electrical → chemical

(C) electrical → electromagnetic

(D) electrical → nuclear

8 A bar magnet placed at one end of a solenoid "**X**" was spun on an axle drilled through its mid-point, as shown. An identical bar magnet was also moved backwards and forwards close to the end of an identical solenoid, "**Y**". The second bar magnet completed one back and forth motion to every one rotation of the other magnet.



When the EMF in the coils of the solenoids was displayed on a CRO, it was found that:

(A) the graphs of the EMFs had the same general shapes.

(B) the graph of solenoid **X** had twice the frequency of the graph for solenoid **Y**.

(C) the graph for solenoid **X** was much smoother than the graph for solenoid **Y**.

(D) the graphs were a sine wave shape for solenoid **X** and a square wave shape for solenoid **Y**.

9 The main advantage of AC induction motors over other motors such as the universal motor is that AC induction motors:

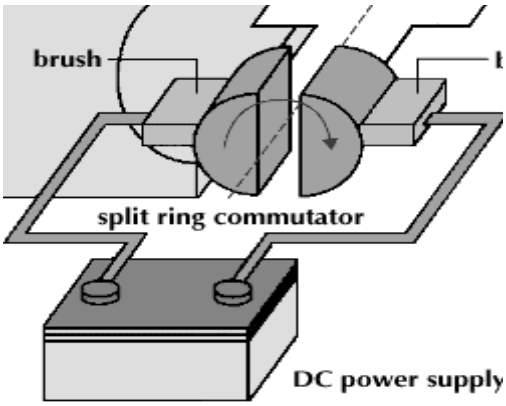
(A) can produce more torque.

(B) can be made much smaller.

(C) do not have brushes that wear out.

(D) can rotate faster.

10 In this diagram of part of a DC motor, the function of the brush is to:



(A) ensure the power supply connects to the commutator ring, even when it is turning.

(B) reverse the direction of the current through the coil.

(C) provide a braking force on the commutator.

(D) ensure that the power supply does not get short-circuited.

11 A circular loop of wire is held horizontally. It is then rotated about a north-south oriented horizontal axis.

The EMF generated would be greatest in which of the following scenarios:

(A) at the equator.

(B) at the south pole.

(C) at the equator, but with an east-west orientation for the axis.

(D) at the equator, but rotated about a vertical axis.

12 The results of Thomson's charge to mass ratio experiments for cathode ray particles showed that they had:

(A) very little mass but moved very quickly.

(B) a charge of one electron.

(C) a small charge to mass ratio.

(D) a large charge to mass ratio.

13 The energy E of photons is graphed against their frequency, *f*. The gradient of the graph produced:

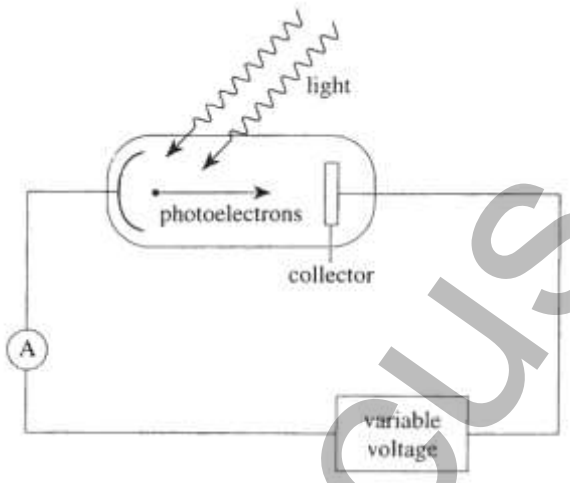
(A) gives the mass of the photons.

(B) is known as Planck's constant.

(C) varies so cannot be measured.

(D) gives the speed of the photons.

14 A beam of light is shone onto a cathode as shown in the diagram below.



Which of the following will increase the number of photoelectrons?

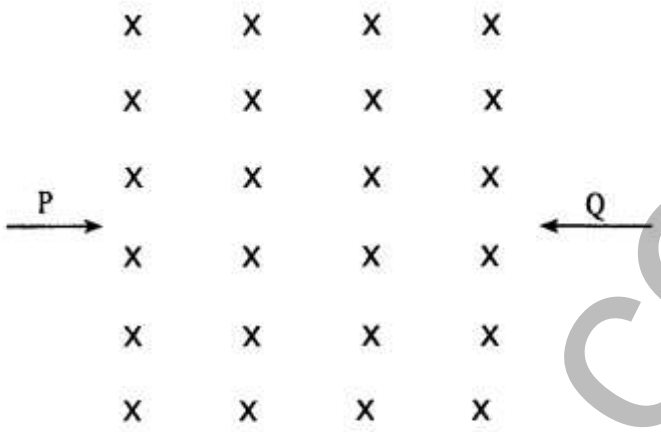
(A) increasing the intensity of the light

(B) decreasing the intensity of the light

(C) increasing the frequency of the light

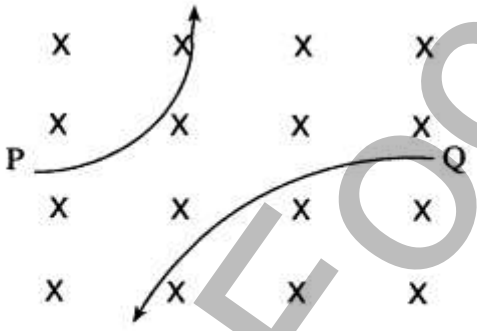
(D) decreasing the frequency of the light

15 Two positively charged particles, P and Q, of equal mass and speed enter a uniform magnetic field directed into the page as shown in the diagram below. Particle Q has **twice** the magnitude of charge as P.

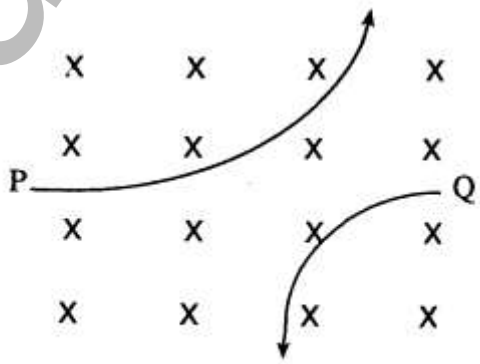


Which diagram correctly represents the subsequent paths of both particles?

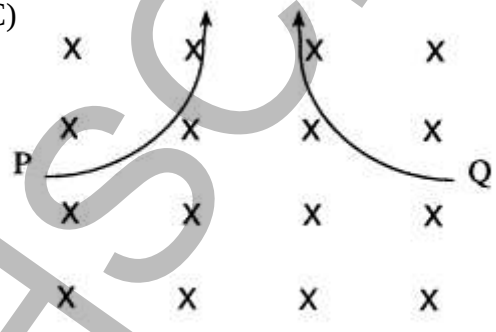
(A)



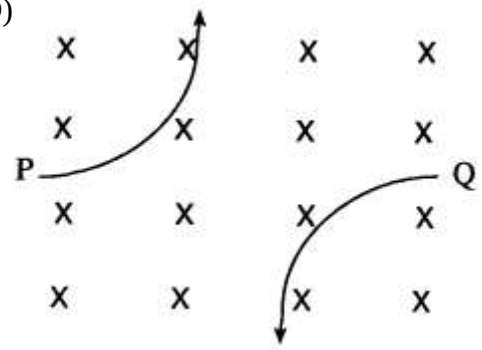
(B)



(C)



(D)



Centre Number

Section I (continued)

Student Number

Part B – 60 marks
Attempt Questions 16–31
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Marks

Question 16 (5 marks)

A 200 kg satellite is orbiting the Earth of radius 6400 km with an altitude of 800 km.

(a) Calculate the gravitational force between the satellite and Earth. **3**

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(b) Determine the orbital speed of this satellite. **2**

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Marks

Question 17 (3 marks)

Explain why launch facilities for putting satellites into Earth orbit are usually located close to the equator. **3**

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Question 18 (4 marks)

Old standards for length used a metal rod kept safely so that it could be compared. **4**

Since 1983, however, the definition of the metre has been:

"*The metre is the length of the path travelled by light in a vacuum during a time interval of 1/299 792 458 of a second*.".

With reference to the principle of relativity, discuss the need for this change to the definition of length.

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Question 19 (4 marks)

A projectile is launched at 52 ms^{-1} at an angle of 35° above the horizontal.

(a) Calculate the range of the projectile 4.0 s after its launch. **1**

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(b) Calculate the speed of the projectile at this time. **3**

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Question 20 (2 marks)

The Michelson-Morley experiments failed to prove the existence of the aether, despite many further attempts with modified designs by other scientists. **2**

Outline why Michelson and Morley believed that if the aether existed, it could be detected using their apparatus.

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Marks

Question 21 (4 marks)

(a) Quantitatively compare the mass of an electron at rest with an electron moving with a velocity of 0.98c. **2**

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(b) What significance does this result have for particle accelerators, which can accelerate particles to speeds approaching 0.9999c? **2**

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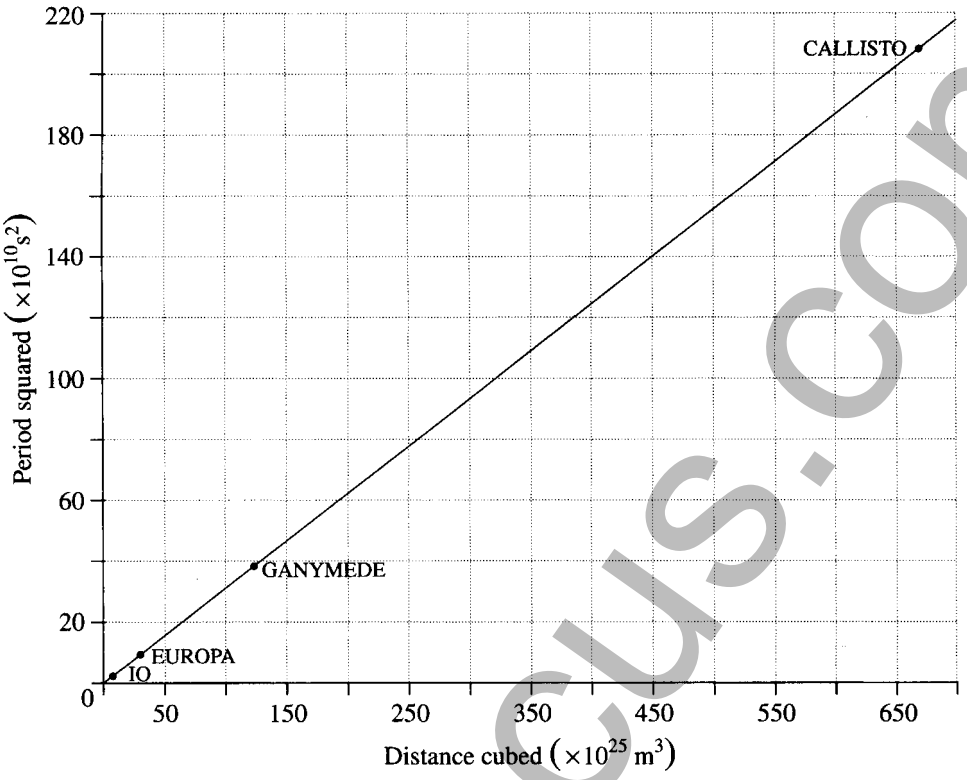
Marks

Question 22 (4 marks)

The graph below shows the relationship between the period and distance from the centre of Jupiter of four of its moons.



(a) Calculate the gradient of the graph. **2**

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(b) Hence, or otherwise, determine the mass of Jupiter. **2**

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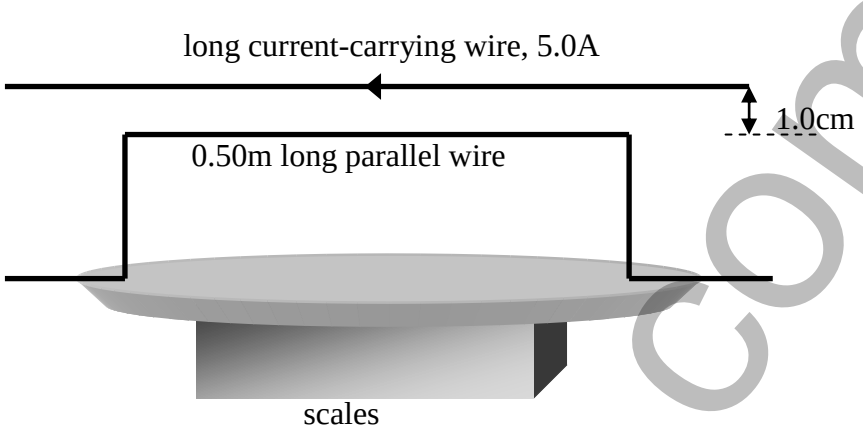
Marks

Question 23 (3 marks)

In an experiment to indirectly measure the current through a conductor, the following apparatus was constructed. **3**



The conductors are parallel for 0.500m, and are separated by 1.0cm. A current of 5.0A is flowing through the top conductor. When a current flows through the conductor which is resting on the scales, the scales measurement *increases* by 3.50×10^{-4}N.

Calculate the magnitude and direction of the current flowing through the conductor resting on the scales.

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Marks

Question 24 (3 marks)

Describe how the motor effect is used in the production of sound in loudspeakers. **3**

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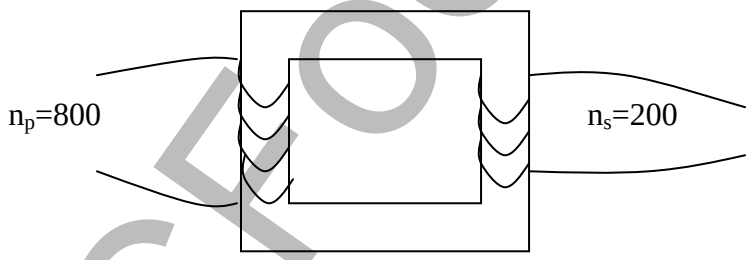
Question 25 (2 marks)

An ideal transformer (assume it is 100% efficient), is designed with a primary voltage of 2.0×10^5 V. Its input power is 20.0MW. **2**

A diagram of this ideal transformer is shown below.



Determine the secondary current in this ideal transformer.

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Marks

Question 26 (3 marks)

Eddy currents are used in a number of applications, including induction cooktops and electromagnetic braking. **3**

With reference to Lenz's Law, explain how eddy currents produced in a conducting disk can cause a braking effect.

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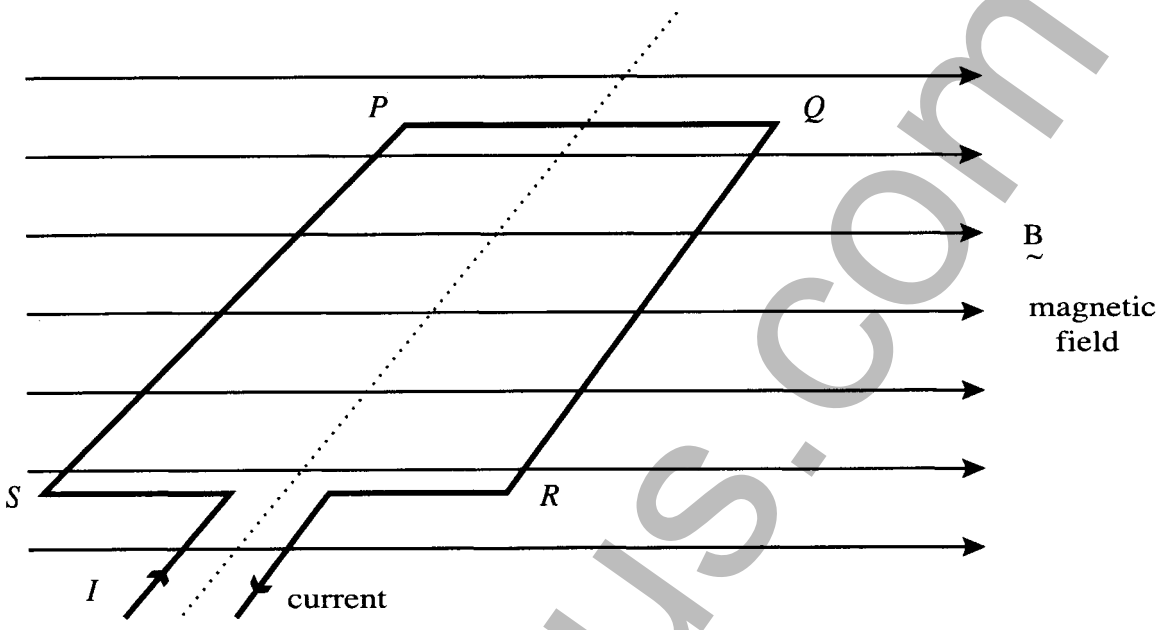
Marks

Question 27 (4 marks)

The diagram below shows a rectangular loop of wire placed parallel to a uniform magnetic field of strength 4.0×10^{-3} T. Side SP has length 5.0×10^{-2} m and side PQ has length 4.0×10^{-2} m.



When a current of 25 A flows through the loop it starts to rotate about the dotted line.

The rotation can be prevented by hanging a small mass at the centre of one of the longer sides of the loop.

(a) On which side should the mass be placed to prevent the rotation of the loop? **1**

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(b) Determine the minimum mass that would prevent the rotation of the loop. **3**

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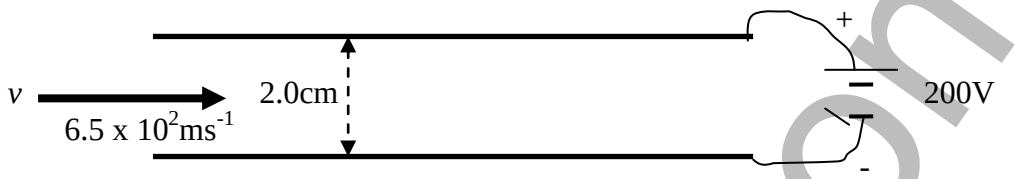
Marks

Question 28 (5 marks)

Cathode rays are directed into a region containing a uniform electric field, **E**, as shown below. They are moving with a speed of $6.5 \times 10^2 ms^{-1}$.



(a) Calculate the magnitude of the electric field **E** between the two charged plates. **2**

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(b) Hence find the magnitude and direction of the magnetic field that must be produced between the two charged plates so that the cathode ray particles will pass through undeflected. **3**

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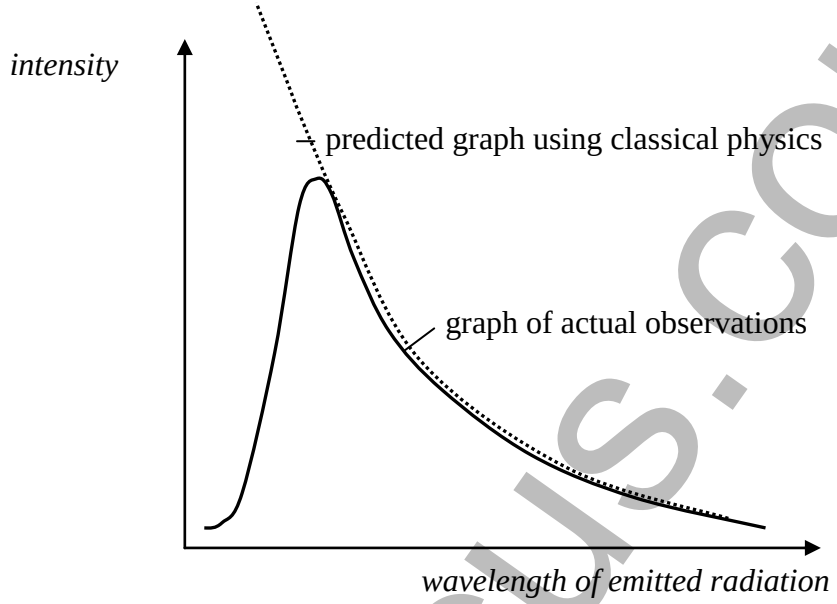
Marks

Question 29 (4 marks)

Einstein's explanation for the way in which energy is emitted from black bodies did not fit into the thinking of classical physics. **4**

Consider the graph of intensity versus wavelength of emitted radiation for a black body.



Describe how Einstein's contribution to quantum theory assisted physicists to overcome the shortcomings in the classical theory in relation to the above graph.

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Marks

Question 30 (2 marks)

Outline the first-hand investigation that you conducted to demonstrate the production and reception of radio waves. **2**

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Question 31 (8 marks)

Assess the impact on society and the environment of technologies that have been developed as a result of Faraday's discovery of electromagnetic induction. **8**

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Question 31 continues on page 20

Question 31 (continued)

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Physics

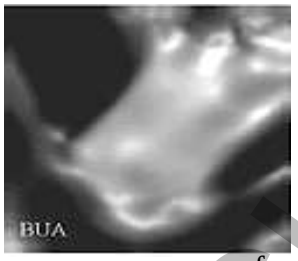
Section II

25 marks
Attempt Questions 32
Allow about 45 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.
Show all relevant working in questions involving calculations.

Question 32 Medical Physics (25 marks)

(a) (i) The image below is that of a heel bone scan taken using ultrasound. **2**



source: www.cnrs.fr

Describe how this image could be used to determine bone density.

(ii) Identify the property of bone that makes it possible to obtain an ultrasound image while still surrounded by other tissue. **1**

(iii) Describe the differences between A scans and B scans and the particular situation in which each would be used. **3**

(b) (i) Explain the role of total internal reflection in the functioning of an endoscope. **2**

(ii) Discuss the use of different types of bundles of fibres in relation to their particular use in endoscopes. **4**

(c) Explain how the magnetic field produced by nuclear particles can be used as a diagnostic tool in medical applications. **7**

(d) (i) Radioactive isotopes are used to obtain scans of organs. Outline the properties of such radioactive isotopes that make them suitable for their intended purpose. **2**

(ii) Compare images produced by bone scan and by X-ray. **4**

End of paper

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