2003

Higher School Certificate

Trial Examination

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Board approved calculators may be used
- Write using black or blue pen
- Draw diagrams using pencil
- A Data Sheet, Formulae Sheets and Periodic Table are provided separately with this exam paper
- Write your student number and/or name at the top of every page

Total marks - 100

Section I (Pages 2 – 18)
75 marks
This section has two parts, Part A and Part B

Part A
Total marks (15)
Attempt questions 1-15
Allow about 30 minutes for this part

Part B
Total marks (60)
Attempt questions 16-27
Allow about 1 hour 45 minutes for this part

Section II (Pages 19 – 27)
25 marks
Attempt ONE question from Questions 28-32
Allow about 45 minutes for this section

This paper MUST NOT be removed from the examination room

STUDENT NUMBER/NAME: .....

1. An astronaut in a full body suit on the surface of the planet, Earth, experiences a downward force of 1225 N.

The same astronaut lands on the planet Cheese. The average acceleration due to gravity of Cheese was determined to be 7.35 m s^{-2}. What is the force experienced by the astronaut in full body suit on the planet Cheese?

(A) 1225 newtons.
(B) 1100 newtons.
(C) 919 newtons.
(D) 735 newtons.

2. A cube shaped space probe with sides of 100 m flies past a space station. An observer on the space station measures the width of the probe as 85 m. What does this observer measure the height of the probe as?

(A) 85 m.
(B) Between 85 and 100 m.
(C) 100 m.
(D) Unable to be determined on this data.

3. What quantity of mass needs to be converted into energy to produce 1.20×10^{16} joules?

(A) 4.00×10^{7} kilograms.
(B) 1.33×10^{-1} kilograms.
(C) 1.33×10^{-4} kilograms.
(D) 1.3×10^{-4} kilograms.

9. In a certain electric motor, wires that carry a current of 5 A are perpendicular to a magnetic field of 0.8 T. What is the force on each centimetre of these wires?

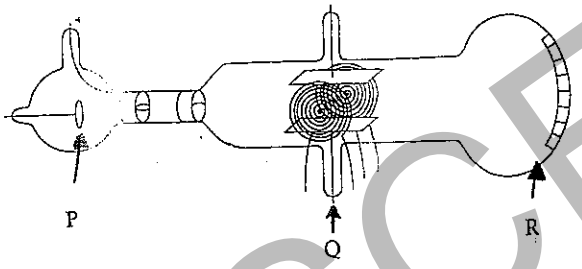
(A) 0.004 N
(B) 0.04 N
(C) 0.4 N
(D) 4 N

10 *Magnetic flux* and *magnetic field strength* can be described using the concept of "field lines".

What is the best description of *magnetic flux* and *magnetic field strength*?

	Magnetic flux	Magnetic field strength
(A)	Number of field lines divided by area	Total number of lines of force
(B)	Number of field lines multiplied by area	Total number of lines of force
(C)	Total number of lines of force	Number of field lines multiplied by area
(D)	Total number of lines of force	Number of field lines divided by area

11. Which of the following describes the function of part of the cathode ray oscilloscope?



(A) Part P is the electron gun that controls the deflection of the beam.
(B) Part Q produces two varying magnetic fields at right angles, controlling the deflection, up and down and side to side, of the beam
(C) Part P contains the cathode and several other electrodes that focus the electron beam.
(D) Part R is a fluorescent screen that transmits electrons.

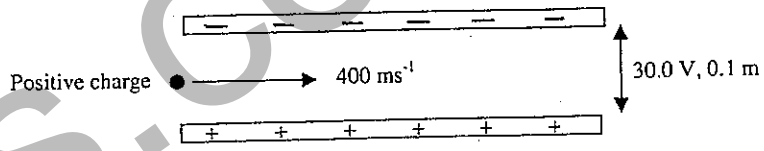
12. Which of the following changes is most likely to increase the resistance of particular wire?

(A) reducing the temperature of the wire
(B) increasing the diameter of the wire
(C) adding impurities to the metal that makes up the wire
(D) reducing the length of the wire

13. Which property of cathode rays is a property of particles only?

(A) They can be reflected.
(B) They travel in straight lines.
(C) They are deflected by an electric field.
(D) They are emitted from the anode.

14. Two parallel plates are separated by 0.1 m and a potential difference of 30.0 V is applied between the plates. The top plate is negative. A magnetic field is also applied to the area between the plates. A positively charged particle enters the area between the plates with a speed of 400 ms^{-1}.



What magnetic field is required so that the charge experiences zero force?

(A) 0.75 T out of the page.
(B) 0.75 T into the page.
(C) 0.0075 T into the page.
(D) 0.0075 T out of the page.

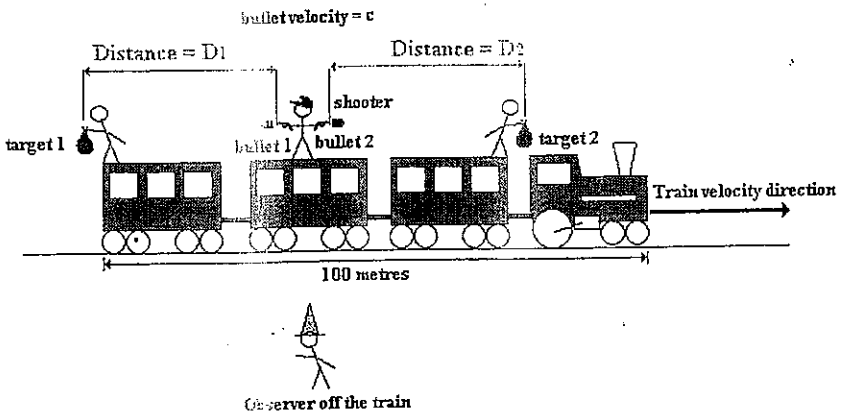
15. According to the particle theory of light, which of the following statements is correct?

(A) Photons contain light energy and have no wave nature.
(B) Light and other electromagnetic waves have both a particle and a wave nature.
(C) The energy of a photon is inversely proportional to its frequency.
(D) Electromagnetic waves have a wave nature but light does not have a wave nature.

STUDENT NUMBER/NAME: .....

Question 18 (5 marks)

The diagram below shows a shooter holding two "laser pulse pistols" at a distance D_1 from target 1 and D_2 from target 2. Distance D_1 is equal to distance D_2. All targets and the shooter are on a train moving to the right at a velocity "v".
An observer off the train is watching the events on the train.
The overall length of the train is 100 metres.



(a) Describe the principle of simultaneity. 1

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(b) The shooter fires a laser pulse, that can be seen by all, at each target at the same instant of time. Compare the observations made by the "shooter" to those made by the "observer off the train" in relation to the targets being struck by the laser pulses. 2

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(c) In a *different* situation, the train is accelerated to a velocity of "0.995c". Calculate the length of the train as would be determined by the "observer off the train". 2

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STUDENT NUMBER/NAME: .....

Question 19 (5 marks)

Outline an experiment you have done to determine the value of the acceleration due to gravity. Your answer should:

- indicate the equipment used;
- how your measured results were analysed to find a value for the acceleration;
- how you ensured that your results were reliable.

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Question 22 (5 marks)

The text and photo below is an advertisement for induction cooktops.

"When using an induction cooktop, 90% of every dollar you spend on energy goes right where you want it - in the pan! Gas delivers only 55% to the pan and traditional electric about 65%. Induction cooking is obviously much safer than gas or other electric surfaces."

a) What type of current is used to allow the induction cooktops to function? **1**

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b) The advertisement implies that these cooktops are more efficient and much safer than the more conventional gas and electric cooktops. Qualitatively justify these claims. **2**

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c) Explain how induction is used in these cooktops. **2**

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Question 23 (4 marks)

The main components of a modern electrical transmission system are:

- Generators
- Transformers
- Transmission lines
- Supporting poles & pylons

For EACH of TWO (2) of these components, describe a structural feature that enables the device to perform its intended purpose efficiently and explain how it increases efficiency. **4**

Component 1: .....

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Component 2: .....

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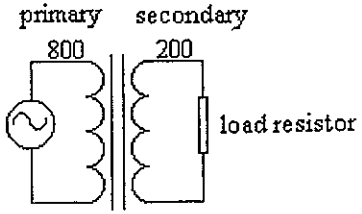
Question 24 (2 marks)

A transformer has 800 turns in the primary coil and 200 turns in the secondary coil, as shown in the diagram below:



(a) Assuming 100% efficiency, calculate the output voltage when the input voltage is 240V. **1**

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(b) Name the part in the diagram with the symbol, ~. **1**

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STUDENT NUMBER/NAME: .....

Question 27 (5 marks)

Discuss the aether, including reasons for its proposal and any significant contributions to resolve whether it existed. 5

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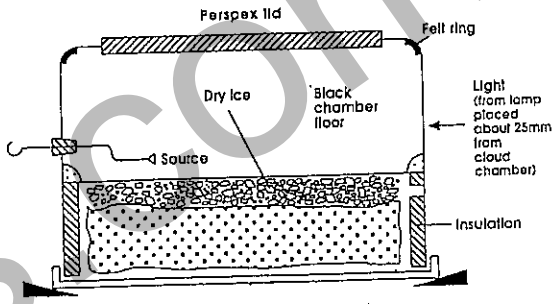
STUDENT NUMBER/NAME: .....

Marks

Question 31 — From Quanta to Quarks (25 marks)

(a) (i) Define the term "transmutation". 1

(ii) The diagram shows a Wilson Cloud chamber.



Describe and compare typical observations when alpha and beta sources are inserted into the chamber. 3

(iii) Explain how the path of the alpha particles is made visible. 2

(b) (i) Calculate the wavelength of an electron moving at 1.5×10^8 ms^{-1} in a cathode ray tube. 1

(ii) Define diffraction and account for the pattern of maxima and minima often resulting from wave diffraction. (No mathematical analysis required.) 2

(iii) Assess the contribution made by Pauli to the development of atomic theory. 3

(c) (i) Compare the hydrogen spectrum observed through a laboratory spectroscope with the light emitted by the hydrogen source (as observed without an instrument). 2

(ii) Discuss the Rutherford model of the atom, describing an observation explained by the model and a problem with this model. 4

(d) Assess the significance to society of the discovery of fission referring to the Manhattan project and ONE other use of fission. 7

End of Question 31

STUDENT NUMBER/NAME: .....

Question 27 (5 marks)

Discuss the aether, including reasons for its proposal and any significant contributions to resolve whether it existed.

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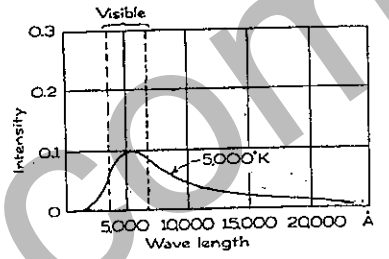
STUDENT NUMBER/NAME: .....

Question 30 – Astrophysics (25 marks)

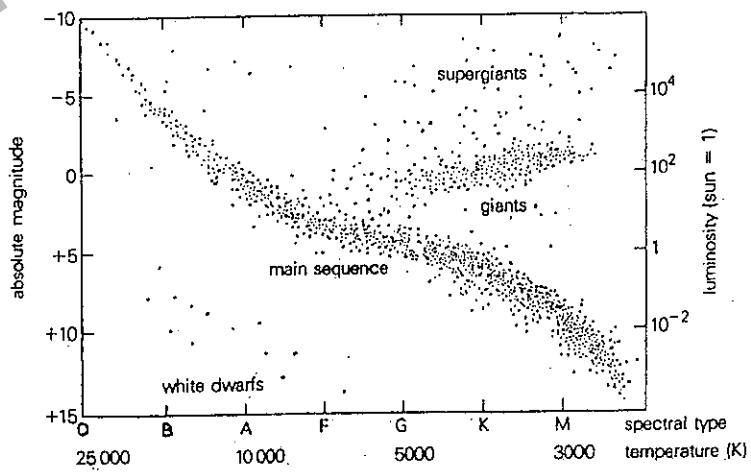
Marks

(a) (i) The graph below shows the intensity distribution of different wavelengths emitted by a hot body at 5000 K.



Describe the differences that a graph of intensity distribution of different wavelengths for a hot object at 6000 K would have. **1**

(ii) The graph is an Hertzsprung-Russell diagram for various groups of stars.



Archernar is a main sequence star belonging to spectral class B5 with an apparent magnitude of 0.60. Use spectroscopic parallax to determine its approximate distance in parsecs and its parallax angle. **3**

(b) Describe an investigation to compare the sensitivity of different lenses or mirrors and explain how resolution and sensitivity are related. **4**

Question 30 continues on page 24

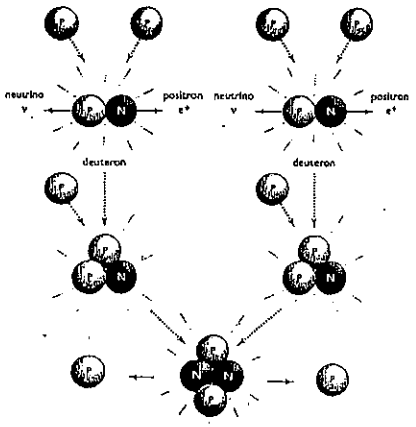
STUDENT NUMBER/NAME: .....

Marks

Question 30 (continued)

(c) (i) Describe ONE advantage of photoelectric technologies over photographic methods for photometry. **1**

(ii) The diagram shows an energy producing reaction occurring in stars.

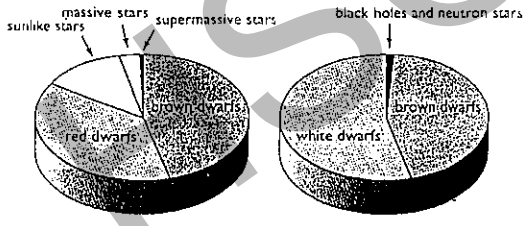


State when this particular reaction is most common in stars. **1**

(iii) Describe how the features of stellar spectra are used to classify stars. **3**

(d) Outline the methods used to detect binary stars and explain their importance in determining stellar masses. **6**

(e) The diagram shows a comparison made by an astronomer of initial and predicted final stellar distributions.



Initial Stellar Distribution Final Stellar Distribution

Do you agree with this prediction? Justify your answer using your understanding of the processes involved in stellar formation, the key stages of a star's life cycle and star death. **6**

End of Question 30