Student Number: _____

St George Girls High School

Trial Higher School Certificate Examination

2004

Physics

Total Marks 100

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 and a Periodic Table are provided at the back of this paper

Section I
Marks (75)
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 – 30
- Allow about 1 hour and 45 minutes for this part

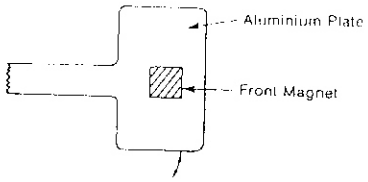
Section II
Question 31
Marks (25)
Astrophysics
Allow about 45 minutes for this section

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

Section I

Part A (15 marks)

1



Many "beam" balances have an aluminium plate attached to the other end of the swinging beam. This is set to swing between two fixed magnets. In this way the balance settles down quickly to a stationary position so that a reading can be obtained. This is possible because:

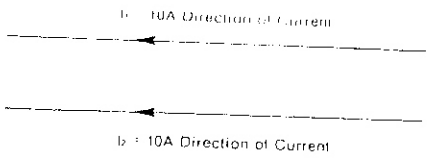
A. the aluminium plate is attracted to one or the other of the magnets
B. an electrostatic charge builds up on the aluminium plate
C. an induced current in the aluminium plate results in a force which opposes the motion of the plate
D. the electrons in the aluminium plate are attracted to the north pole of the magnets

2. This question refers to the following diagram.

A wire PQ is moved steadily at right angles to a uniform magnetic field directed vertically downwards. The number of electrons at P:

A. is greater than at Q
B. is less than at Q
C. is equal to that at Q
D. varies sinusoidally

Question 3 and 4 refer to the diagram below.



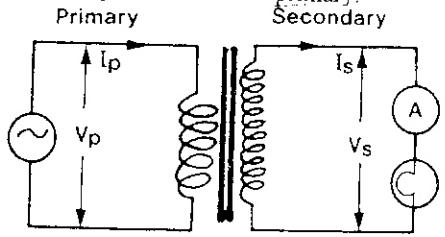
3. The diagram shows two long, parallel current-carrying conductors. If both conductors have a current of 10 amps flowing through them in the same direction, they will:

   A. attract each other
   B. repel each other
   C. repel then attract each other
   D. have no effect on each other

4. If the current in each wire is doubled and the distance is trebled the new force would be:

   A. 2F/9
   B. 4F/9
   C. 2F/3
   D. 4F/3

5. The diagram shows an ideal transformer i.e. 100% efficient. The transformer has more turns of wire in the secondary coil than in the primary.



The voltage across the primary and secondary coils are Vp and Vs respectively. The current across the primary and secondary coils are Ip and Is respectively.

It is true to say:

A. Ip<Is and Vp<Vs
B. Ip<Is and Vp>Vs
C. Ip>Is and Vp<Vs
D. Ip>Is and Vp>Vs

6. Which of the following properties of cathode rays is incorrect? Cathode rays:

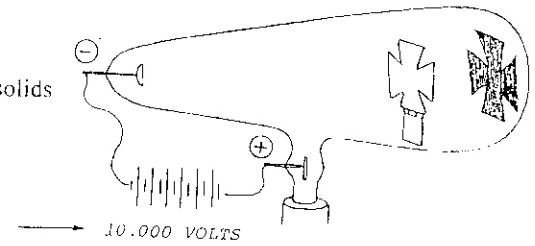
   A. emanate from the cathode of a discharge tube
   B. have a q/m ratio less than that of the hydrogen ion
   C. cause glass to fluoresce
   D. carry energy and momentum

7. In an n-type doped semiconductor:

   A. electrons are majority carriers and holes are minority carriers
   B. electrons are minority carriers and holes are majority carriers
   C. current flows more easily one way than the other
   D. a trivalent impurity atom is used for doping

8. The drawing illustrates the equipment used in the Maltese Cross experiment. This experiment reveals Cathode rays:

   A. are charged
   B. are reflected by metals
   C. cannot travel through all solids
   D. travel in straight lines



9. Electrons are ejected from the surface of a given metal when it receives electro-magnetic radiation of:

   A. all frequencies
   B. one frequency only
   C. all frequencies above the threshold frequency
   D. all frequencies below the threshold frequency

10. As temperature decreases:

    A. the resistivity of metals increases
    B. the resistivity of semiconductors increases
    C. all substances become superconductors
    D. the resistivity of semiconductors decreases

11. The negative sign in front of the equation for the gravitational potential energy is due to:

A. bad mathematics
B. the zero of potential energy being at infinity
C. the zero of potential energy being at the Earth's surface
D. the zero of potential energy being at the radius of a geostationary orbit

12. The formula for the escape velocity is derived by equating a rocket's kinetic energy to the magnitude of its gravitational potential energy at the Earth's surface. Neglecting air resistance this velocity represents:

A. the greatest speed a rocket can travel at in Earth's atmosphere
B. the minimum velocity for a rocket to reach a geostationary orbit
C. the minimum velocity for a rocket to reach low Earth orbit
D. the velocity at the Earth's surface which will allow a rocket to reach infinity

13. Two simultaneous events seen by an observer in one frame of reference can only be simultaneous to an observer in another frame of reference if these two observers are:

A. twins.
B. moving at the same speed but in opposite directions.
C. moving with the same velocity relative to the events' rest frame but are different distances from the events.
D. moving with different velocities relative to the events' rest frame but are equal distances from the events.

14. In order to take advantage of the Earth's motion through the universe, rocket's are preferentially launched:

A. In an easterly direction and in the direction of the Earth's revolution around the sun.
B. In a westerly direction and in the direction of the Earth's revolution around the sun.
C. In an easterly direction and in the opposite direction to the Earth's revolution around the sun.
D. In a westerly direction and in the opposite direction to the Earth's revolution around the sun.

15. The gravitational force acting on a 200 gram apple at a distance of 10,000 km from the centre of the Earth is closest to:

A. 8.0×10^{-1} N.
B. 8.0×10^{2} N.
C. 8.0×10^{3} N.
D. 8.0×10^{8} N.

Section I : Part B (60 marks)

Allow 1 hour and 45 minutes for this part.
Answer the questions in the space provided.
Show all relevant working in questions involving calculations.

16. Conventional TV displays and oscilloscopes have 3 features in common. Describe the role each feature has in the operation of the device. (3 Marks)

17. Describe how Hertz came to the conclusion that the waves generated in his experiment were electromagnetic. (3 Marks)

18. A particular metal has a work function of 9×10^{-19} J. It is irradiated with UV radiation with a wavelength 180nm.
Explain the effect on the electrons in the metal. (3 Marks)

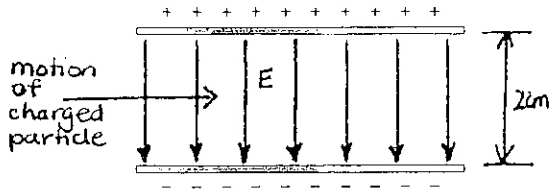
19. Using band structures and relative electrical resistance, compare conductors and semiconductors. (3 Marks)

20. Discuss the effects of the application of superconductors on transmission of electricity through power grids. (4 Marks)

21. A positively charged particle travelling at 10% of the speed of light enters the region between a pair of oppositely charged parallel plates.

The plates are separated by 2cm and a potential difference of 5000V exists across them.

A magnetic field is directed perpendicular and between the plates so that the charge continues to travel in a straight line.



Determine the:
a) Strength of the electric field. (1 Mark)
b) Size and direction of the magnetic field. (2 Marks)

22. Discuss the use of transformers in electrical appliances in the home. (4 Marks)

23. A square coil consisting of 200 turns wound in a single plane, of area 2×10^{-3} m^2 lies parallel to a uniform magnetic field of 100 mT. It takes 0.05 seconds to rotate the coil so that the coil lies perpendicular to the magnetic field lines.

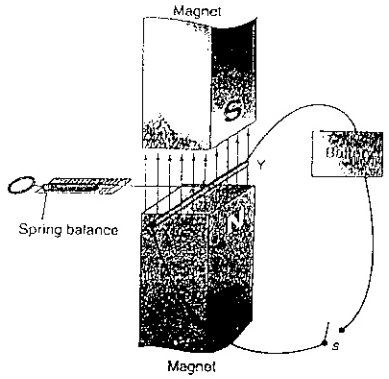
a) Calculate the emf which is generated. (1 Mark)

b) On the axes shown below, sketch how the induced emf varies with time over one rotation. Label the points where the plane of the coil is parallel to the magnetic field lines. (1 Mark)

c) Sketch on the same axes and clearly label, the resulting waveform for the induced emf if the coil were rotated twice as fast. Show one rotation. (2 Marks)

24. When a simple motor supplied by a battery is slowed down due to an increased load, the current drawn by the motor increases. Explain this observation. (2 Marks)

25. In an experiment shown below a 20cm length of cooper rod XY is held in a magnetic field. The rod is connected to battery. When the switch is closed the rod experiences a force which is recorded by the spring balance.



As the current was changed the force was measured. The results are shown below.

I(A)	F(N)
0.5	0.04
1.0	0.08
1.5	0.12
2.0	0.16
2.5	0.20
3.0	0.24

a) Draw a graph of Force (N) versus Current (A). (2 Marks)

b) Determine the size of the magnetic field strength. (2 Marks)

26. Assess the use of generators to efficiently provide large scale power production. (6 Marks)

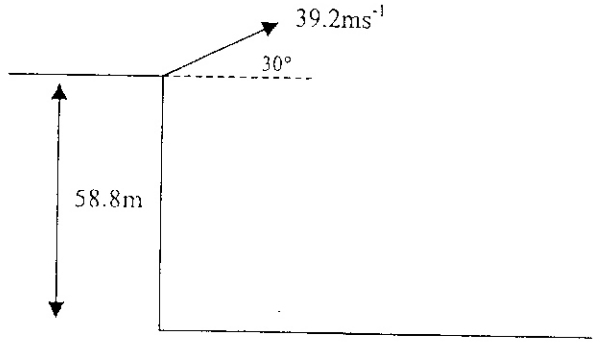
27. Discuss the principle of relativity. (6 Marks)

28. An 800 kg satellite is in a geostationary orbit.

a) State the period of this satellite. (1 Mark)

b) Determine the orbital radius of this satellite. (2 Marks)

29. A projectile is launched from the top of a 58.8 m high cliff with an initial velocity of 39.2 ms^{-1} at an angle of 30^0 to the horizontal. The situation is drawn below. (6 Marks)



a) Determine the time for the projectile to reach the ground level with the base of the cliff.

b) Hence, or otherwise, determine the horizontal distance of the landing point from the base of the cliff.

c) Determine the velocity of the projectile just before it hits the ground.

30. Analysis of the re-entry angles and speeds of all the NASA Space Shuttle missions has indicated that in all cases optimal re-entry speeds and angles were exceeded.

Describe the effect this would have on the space shuttle and its occupants. (3 Marks)

31. A muon is travelling at 0.99c in a circular particle accelerator of radius 1000 metre. Calculate the circumference of the accelerator in the muon's reference frame. (2 Marks)