Cheltenham Girls High School

Physics

2 unit

HSC
Trial Exam
2001

Time allowed: 3 hours

Student Number: _____

This task is worth 35% of the total HSC Course assessment.

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 Aheet, Formulae Sheets and
Perlodic Table are provided at the back of
this paper.
Wtire your student name on the top of every
page.

Section I – Pages 2-13
Total marks (75)
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 16-30
Allow about 1 hour and 45 minutes for this part.

Section II – Page 14
Total marks (25)
Attempt all parts of this question.
Allow about 45 minutes for this section.

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

Use the multiple-choice answer sheet provided

1. The reason why the acceleration due to gravity on Mars is different to that on Earth is

   (a)   Mars has a different atmosphere.
   (b)   Mars has a different mass and radius.
   (c)   Mars is further from the Sun than the Earth.
   (d)   Mars has a different period of rotation.

2. A satellite was placed in orbit around the Earth in the 1980s to 'spy' on Russian military facilities. The satellite passed over Russia three times a day. This satellite

   (a)   Moved in a low orbit from pole to pole.
   (b)   Moved in a high orbit from pole to pole.
   (c)   Moved in a low orbit parallel to the equator.
   (d)   Moved in a high orbit parallel to the equator.

3. The reason why satellites gradually decrease their altitude above the Earth is because

   (a)   The atmosphere slows the satellite down.
   (b)   Of collisions with meteorites.
   (c)   Their power source gradually fails.
   (d)   They interact with the van Allen Radiation Belts.

4. The aether

   (a)   Is necessary for the transmission of light in space.
   (b)   Does not exist.
   (c)   Was discovered by Michelson-Morley.
   (d)   Is everywhere around the Earth.

5. According to relativity theory, for an object moving close to the speed of light relative to an observer

   (a)   length contraction and time dilation would be apparent.
   (b)   length contraction and mass decrease would be apparent.
   (c)   time would stand still.
   (d)   there would be relativity of simultaneity.

(a) a conductor moves in a magnetic field.
(b) a conductor moves parallel to a magnetic field.
(c) a conductor moves at right angles to a magnetic field.
(d) all of the above.

7. A step-down transformer

(a) increases the voltage in the secondary circuit
(b) increases the power in the secondary circuit.
(c) increases the current in the secondary circuit.
(d) increases the resistance in the secondary circuit.

8. Which of the following combinations correctly describes the component necessary for the working of an AC generator and a DC generator?

	AC Generator	DC Generator
(a)	Split-ring commutator	Split-ring commutator
(b)	Slip-ring commutator	Slip-ring commutator
(c)	Split-ring commutator	Slip-ring commutator
(d)	Slip-ring commutator	Split-ring commutator

9. You are designing a transformer with an input voltage of 11 kV AC and an output of 240 V. The number of turns in the primary coil is 5000. The number of turns that you would have to provide in the secondary coil is

(a) 5000
(b) 1100
(c) 110
(d) 11

10. Eddy currents

(a) Have been utilised in switching devices and in electromagnetic braking.
(b) Occur only in iron and steel.
(c) Are an example of Faraday's Law.
(d) Are necessary to produce electromagnetic interference in transmission devices.

11. An electron moves through a magnetic field parallel to the field. It is travelling at 100 ms^{-1}. The magnetic field strength is 0.01 T. The magnitude of the force acting on the electron is closest to

(a) O
(b) 1 N
(c) 100 N
(d) 1.6×10^{-19} N

Temperature (K)

From the graph we can conclude that

(a)   Mercury is a superconductor of electricity above 4.20 degrees Kelvin.
(b)   Mercury is a superconductor of electricity below 4.20 degrees Kelvin.
(c)   The conductivity of mercury drops to zero below 4.20 degrees Kelvin.
(d)   The electrical resistance of mercury can only be extrapolated from the graph below 4,20 degrees Kelvin.

13. The table below shows the threshold frequencies for five different metallic elements.

Metal	Threshold Frequency $x10^{14}$ Hz
Aluminium	9.9
Magnesium	8.7
Zinc	7.4
Sodium	5.5
Caesium	4.4

From which of these metals will electrons be emitted if each is lit by light of frequency 7.2×10^{14} Hz.

(a)   Aluminium, Magnesium and Zinc.
(b)   Caesium and Sodium
(c)   All of the metallic elements
(d)   None of the metallic elements

14. The drift velocity of electrons in a conductor is related to the

(a) Density of electrons.
(b) Cross-sectional area of the conductor
(c) The electronic charge
(d) All of the above

4

15. The scientist responsible for expanding our understanding of crystal structure is

   (a)   Einstein
   (b)   Bragg
   (c)   Planck
   (d)   Heisenberg

Part B
Total marks (60)
Attempt Questions 16-30
Allow about 1 hour and 45 minutes for this part

Write your answers on this sheet

16. A 100 kg man has a weight of 1 160 N on the planet Krypton. Calculate the acceleration of gravity on Krypton.

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17. a) Describe Galileo's analysis of projectile motion.

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b) The diagram below is a record of a stroboscopic photograph of the motion of a projectile fired from a horizontal surface. The time interval between images is 0.5 seconds. Take the acceleration due to gravity (g) as 10 ms^{-1}.
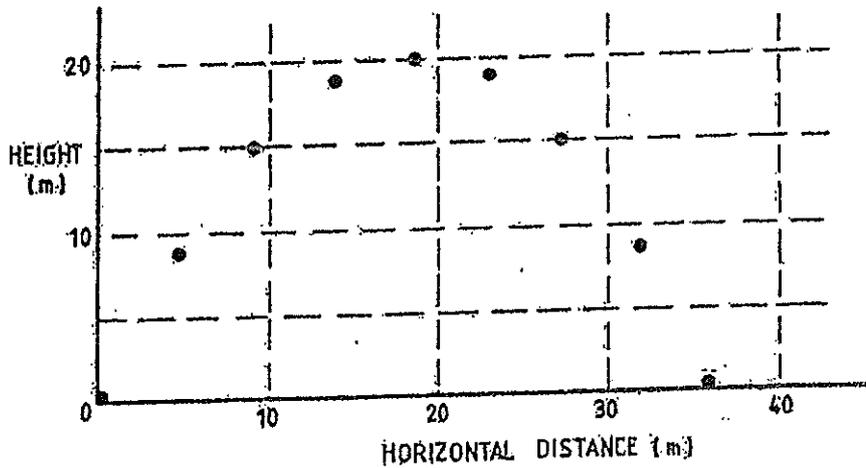
When the horizontal distance travelled by the projectile is 18m, the vertical component of its velocity is zero.

(i) What is the range of the projectile?

1

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(ii) What is the time of flight of the projectile?

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(iv) What was the vertical component of its initial velocity?   **2**

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18. Describe how the slingshot effect is provided by planets to increase the speed of space probes.   **2**

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19. Describe two difficulties associated with effective and reliable communications between satellites
     and Earth.   **3**

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20. Describe an investigation that you carried out in class, which demonstrates the changes in the motion
     of a satellite as it approaches the parent body. Relate this to the motion of a real satellite.   **3**

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21. A spaceship of length 20m flies at 0.9 C past an observer on the Earth.

(a) What is the apparent length of the spaceship from the observer on Earth? 1

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(b) At what speed would a radio transmission from the Earth pass the spacecraft? Explain your
answer. 2

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22. Below is a diagram of a simple electric motor.
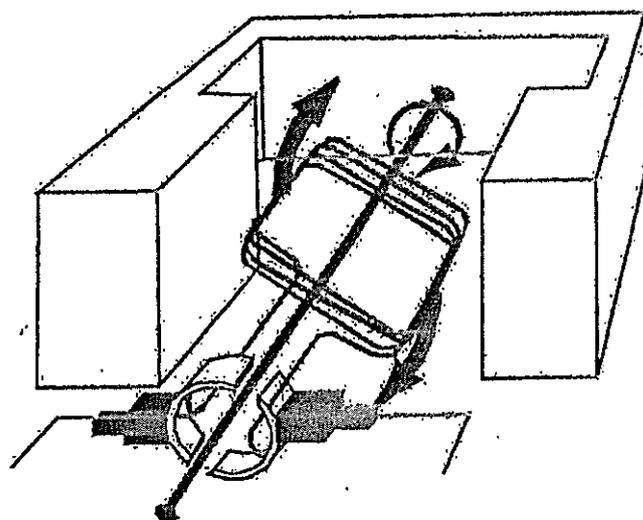
(a) Is the motor an AC or a DC motor? Explain. 1

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(b) What modification would need to be made to this motor to make it operate using the other type
of current? 1

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23. (a) Describe a simple experiment to show the generation of an induced current.   2

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(b) How can you predict the direction of an induced current?   1

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24. Explain why induction motors have certain advantages over other types of electric motors.   1

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25. (a) State why electricity transmission across NSW is AC as opposed to DC.   1

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(b) Why do some electrical appliances in the home that are connected to the mains domestic power
supply use a transformer?   1

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26. During your studies, you used discharge tubes containing a Maltese Cross, a wheel and a fluorescent
display screen. Briefly discuss which property of electrons each of these discharge tubes
demonstrates.   3

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(c) List three factors that determine the size of the **force** acting on the wire in the coil.　　3

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(c) (i) What is torque?　　1

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(ii) For this motor, describe the magnitude of the torque as the coil rotates through 90^0, starting from a horizontal position.　　2

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(d) Compare the structure and function of an electric motor to that of a electric generator.　　2

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(d) Briefly analyse the effects of the development of AC and DC generators on society and the environment.　　4

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27. Cathode ray tubes are used in television sets. Briefly describe the role of three major components of these cathode ray tubes.

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28. Describe the production of electromagnetic waves in antennas.

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29. A scientist is investigating the effects if different types of radiation on the surface of a piece of sodium metal. The apparatus is set up as shown below.
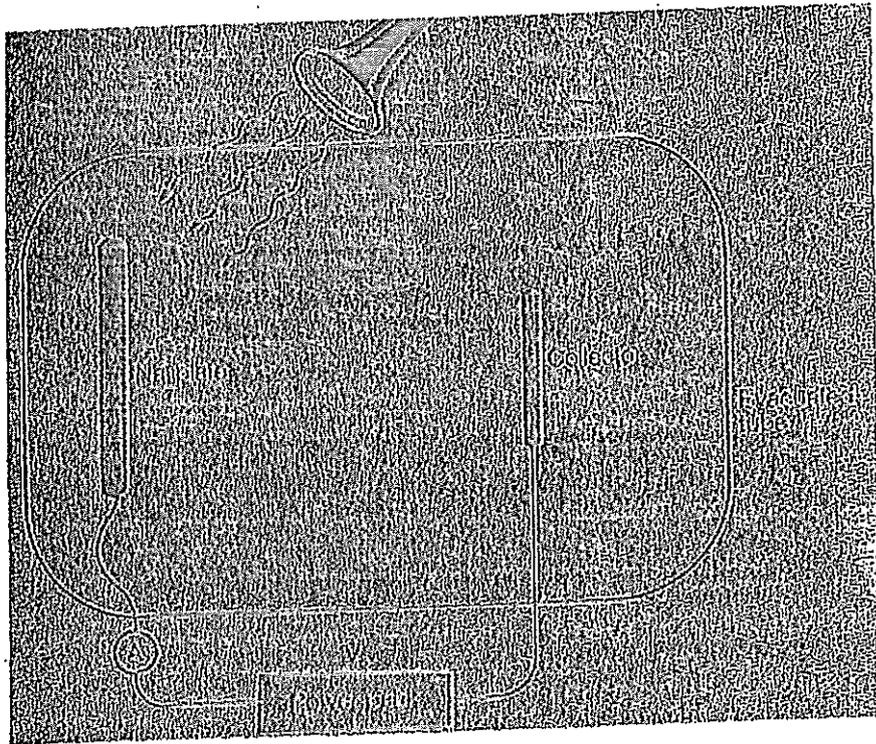

The two variables under investigation are the frequency of radiation and the kinetic energy of the photoelectrons. Results for the experiment are listed on the next page.

Frequency of incident light ($\times 10^{14}$ Hz)	KE of photoelectrons $\times 10^{19}$ J
5.4	0.72
6.8	1.62
7.3	1.84
8.1	2.54
9.4	3.44
11.9	4.66

a) Record these results on a KE_{max} versus frequency graph.   3
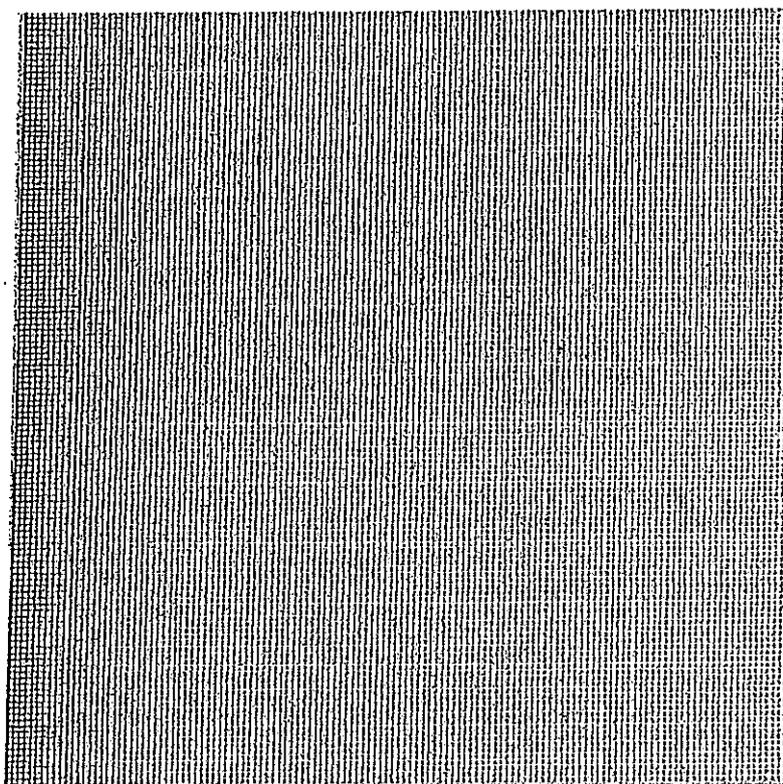
b) Determine the threshold frequency of the sodium metal.   1

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c) Determine the value of Planck's constant from your graph.   1

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d) On your graph, draw a line that represents a different metal with a higher work function. Clearly label this line.   2

30. Superconducting materials have been discovered and possible uses for these new materials are being explored.

a) What are the causes of resistance to the flow of electrons in metals at room temperature?   2

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b) What are superconductors?   1

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c) Discuss the advantages of using superconductors in motors and the transmission of electricity in power grids over long distances.   3

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- Write your answers on the loose paper provided.
- Write your Student Number on that paper.
- This section is worth 25%
- Allow about 45 minutes for this question
- Attempt all parts of this question.
- Show all relevant working in questions involving calculations.

Question 31: Quanta to Quarks

a) Describe the structure of the Rutherford model of the atom. **2**

b) Discuss the significance of the hydrogen emission spectra in the development of Bohr's model of the atom. **2**

c) State Bohr's postulates. **3**

d) List four difficulties with the Rutherford/Bohr model of the atom. **4**

e) Calculate the wavelength of the photon emitted by an electron moving from stationary state 4 in the Balmer Series. **3**

f) Explain the stability of electron orbits in the Bohr atom using De Broglie's hypothesis. **2**

g) Calculate the velocity of an electron if it has a De Broglie wavelength of 2×10^{-10}m. **2**

h) State the contributions made by (i) Heisenberg and (ii) Pauli to the development of atomic theory. **2**

i) Compare and contrast the workings of a light microscope and an electron microscope with reference to (i) resolution (ii) lenses and (iii) the nature of the radiation that produces the image. **5**

End of paper.