2005
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 at the back of this paper
- Write your student number and/or name at the top of every page

Section I (Pages 3 – 15)
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 16–28
Allow about 1 hour 45 minutes for this part

Section II (Pages 16 – 21)
Total marks (25)
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: .....

Section I

Total marks (75)

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

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
1				
2				
3				
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10				
11				
12				
13				
14				
15				

STUDENT NUMBER/NAME: .....

1. Mars has a gravitational acceleration equal to 0.38 that of Earth. How much would a 5 kg object weigh on Mars?

   (A) 1.9 N
   (B) 3.7 N
   (C) 6.4 N
   (D) 18.6 N

2. Which alternative correctly identifies the variables which influence the period of the orbit of a satellite?

   (A) the mass of the satellite, the mass of the planet, the altitude of the orbit
   (B) the mass of the satellite, the mass of the planet, the radius of the orbit
   (C) the velocity of the satellite, the mass of the planet, the radius of the orbit
   (D) the mass of the planet, the radius of the orbit

3. Which of the following statements was a valid conclusion which might be drawn from the Michelson-Morley experiment?

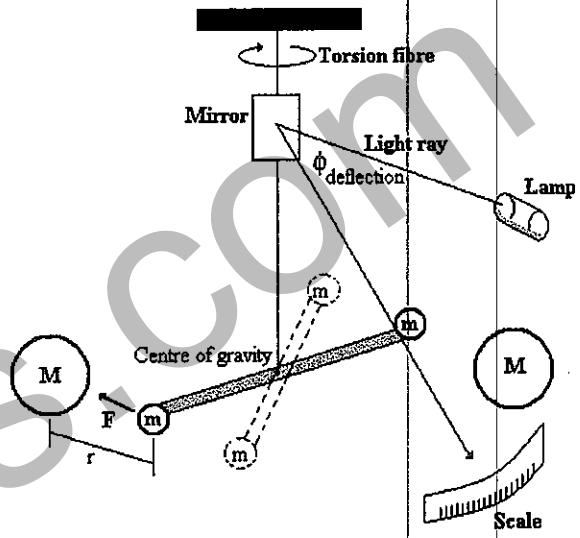
   (A) The aether does not exist
   (B) There is an aether, but the equipment was not sensitive enough to detect it
   (C) They achieved a null result
   (D) No conclusion is possible

4. An object in an orbiting spacecraft appears "weightless". Which choice correctly identifies the net force acting on the object?

   (A) zero net force
   (B) gravitational force
   (C) inertial force forwards
   (D) centrifugal force

STUDENT NUMBER/NAME: .....

5. In 1783 Henry Cavendish, working on one of Isaac Newton's principles, proposed to measure the value of "G" by using the apparatus shown below:



The equation most suited for this experiment is:

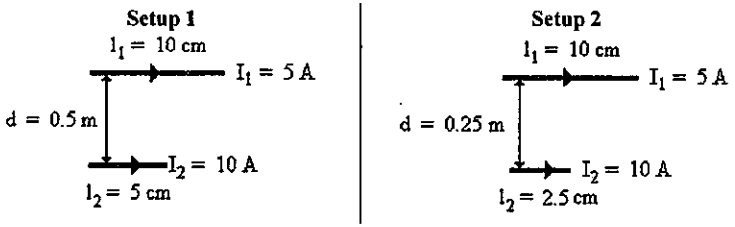
(A) $F = \frac{GMm}{d^2}$

(B) $v = \sqrt{\frac{Gm}{r}}$

(C) $\frac{r^3}{T^2} = \frac{Gm}{4\pi^2}$

(D) $F = mG$

6. The diagram below shows two different sets of parallel current-carrying wires. Note that the diagrams are not drawn to scale.

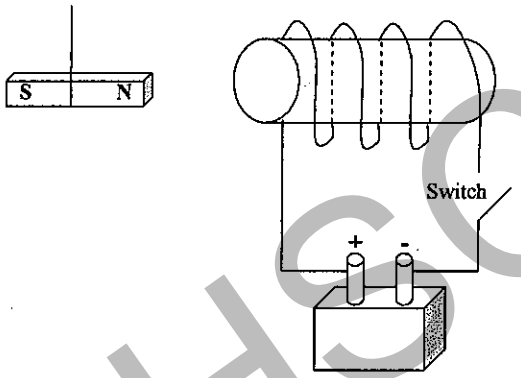


The direction of current is left to right in both wires for each setup. Setup 1 experiences a force, F_1, between the wires. Setup 2 experiences a force, F_2, between the wires.

The ratio of $\frac{F_1}{F_2}$ is:

(A) 1
(B) 2
(C) 3
(D) 4

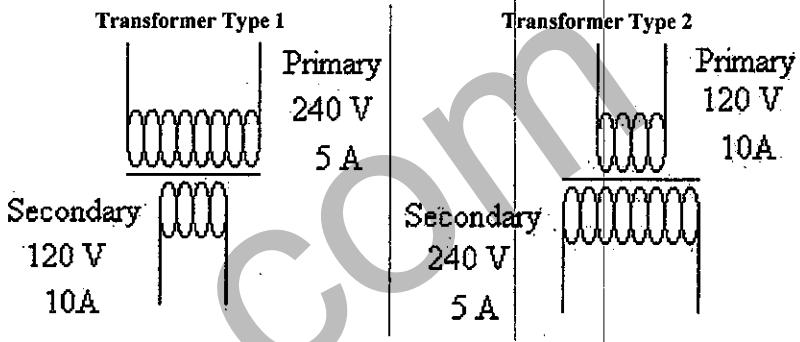
7. A bar magnet is held suspended at rest, near a fixed coil as shown below.



What will happen to the bar magnet when the switch is closed?

(A) It will move to the right.
(B) It will move to the left.
(C) It will remain stationary.
(D) It will rotate clockwise.

8. The transformers below are both rated 1.2 kVA to show the current changes with different voltages.



The advantage of Transformer Type 1 over Transformer Type 2 is:

(A) thicker wires may be used for the primary windings
(B) thinner wires may be used for the primary windings
(C) power is constant
(D) power is variable

9. What is the name of a scientist who discovered that an electric current can be generated by a moving magnet?

(A) Lenz
(B) Ohm
(C) Faraday
(D) Ampere

10. High voltages are used in distributing electricity over large distances. Which set of values in the following table summarises the effect on power loss and current if the voltage is doubled?

	Power Loss	Current
(A)	Half	Half
(B)	¼	Half
(C)	¼	Double
(D)	Half	Double

11. An electron moving at $4.0x10^3 ms^{-1}$ enters the electric field between two metal plates separated by 10cm with a potential difference of 50V across the plates.
What is the force on the electron?

(A) $2.4x10^{-16}$ N
(B) $2.4x10^{-18}$ N
(C) $8.0 x10^{-17}$ N
(D) $8.0 x10^{-19}$ N

12. Which property of cathode rays is demonstrated in a discharge tube with a maltese cross?

(A) wave nature
(B) momentum
(C) negative charge
(D) straight line propagation

13. A photon has a wavelength of 6.5×10^{-7} m. What is the energy of the photon?

(A) $9.1x10^{-11}$ J
(B) $3.1x10^{-19}$ J
(C) $1.4x10^{-32}$ J
(D) $4.3x10^{-41}$ J

14. Thomson's famous experiment aimed to measure various characteristics of cathode rays. Assuming that the electrons produced always have the same unknown velocity, which alternative correctly lists the dependent and independent variables in his experiment?

Variables:

E – electric field	B – magnetic field
r – radius of circular path	m – mass of electron
v – velocity of electron	q – charge of electron

	Independent variables	Dependent variables
(A)	r, m, v, q	E, B
(B)	E, B	r, m, v, q
(C)	B	r, E
(D)	B, E, r	q, m

15. Which of the following does not apply to both vacuum photocells and solar cells?

(A) Contains semiconductor devices
(B) Releases electrons
(C) Uses light as an energy source
(D) Is an energy converter

Section I – continued

Part B

Total marks (60)
Attempt questions 16 – 26
Allow about 1 hour 45 minutes for this part

Answer the questions in the spaces provided

Show all relevant working in questions involving calculations.

Question 16 (5 marks) **Marks**

Outline an experiment you have done to study the motion of a projectile. Your answer should indicate the equipment used and how your measured results were analysed. **5**

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Question 17 (5 marks) **Marks**

Three planets orbiting a distant star have the following properties:

	Planet X	Planet Y	Planet Z
Diameter	4000 km	6000 km	16000 km
Mass	2×10^{23} kg	8×10^{23} kg	1.2×10^{24} kg
Orbital period	200 days	300 days	800 days
Rotational period	200 days	36 hours	42 hours

(a) Predict which planet would have the greatest gravitational acceleration at its surface. Justify your answer. **3**

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(b) Planet Y is orbiting 3.0×10^6 km from the star. How far is planet Z from the star? **2**

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Question 18 (6 marks)

Einstein's Theory of Special Relativity made predictions about time, length and mass measurements for objects travelling at speeds approaching the speed of light.

(a) Discuss the experimental evidence for one of these predictions. **3**

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(b) Calculate the mass of a proton when it is travelling at 75% the speed of light. **3**

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Question 19 (4 marks) **Marks**

A ball is projected from ground level at an angle of 40° to the horizontal. The ball reaches a maximum height of 33 m above the ground which is horizontal.

(a) Calculate the velocity at which the ball was launched. **2**

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(b) What was the time of flight of the ball? **2**

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Question 20 (4 marks)

Compare and contrast a D.C. generator with an A.C. generator. **4**

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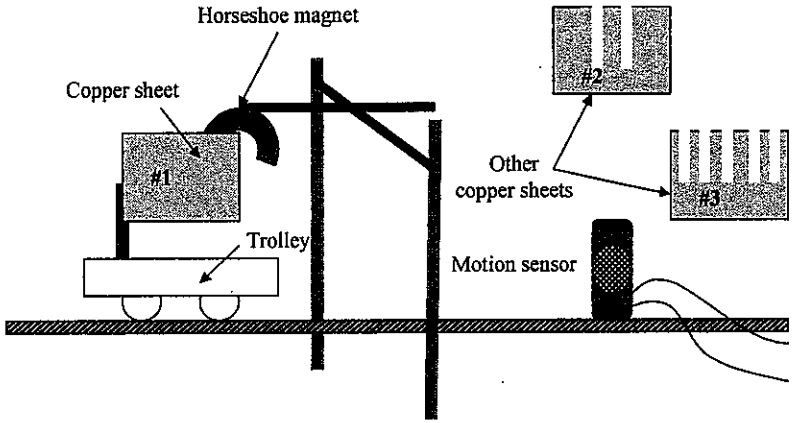
Question 21 (6 marks)

In an experiment into eddy currents, some physics students used the following apparatus



They used the motion sensor to record the velocity of the trolley before, during and after it passed through the horseshoe magnet. A table of the results obtained for sheet #1 is shown on the next page.

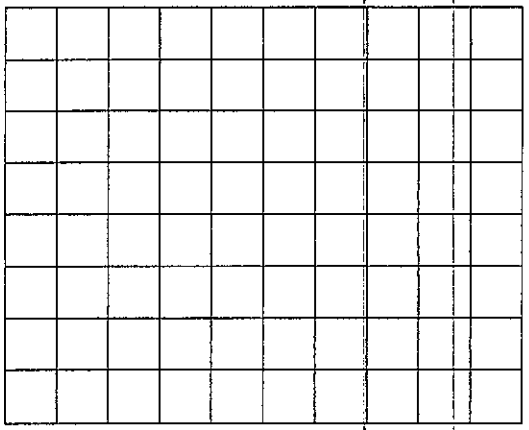
Question 21 continues on page 12

Question 21 (continued) **Marks**

Time (s)	Velocity of Trolley ($m\ s^{-1}$)
0.00	1.30
0.05	1.30
0.10	1.30
0.15	1.20
0.20	1.10
0.25	1.00
0.30	0.90
0.35	0.90
0.40	0.90
0.45	0.90

a) On the grid provided below, draw a graph of the results for sheet #1. **3**

b) Sheets #2 and #3 were then mounted separately, in turn, on the trolley which was given the same initial velocity. On the same grid, draw two different graph lines to represent the likely trends in the results that would be obtained when using each of sheets #2 and #3. Explain your reasoning. **3**



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Question 22 (4 marks) **Marks**

State one law of electromagnetic induction, and describe an experiment to illustrate the law. **4**

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Question 23 (4 marks)

(a) Draw the electric field between oppositely charged parallel metal plates. **2**

(b) Describe the path of a charged particle moving in a magnetic field perpendicular to its velocity. Justify your answer. **2**

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Question 24 (4 marks) **Marks**

Discuss Einstein and Planck's differing views about whether science research is removed from social and political forces. **4**

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Question 25 (5 marks)

Construct a table to compare metals, insulators and semiconductors in terms of the following properties: **5**

- band structure and electron movement between bands
- relative electrical resistance
- relative number of electrons free to drift from atom to atom.

STUDENT NUMBER/NAME: .....

Question 26 (4 marks) **Marks**

Discuss the possible application of superconductors and the effects of these applications on computers and electricity generation. **4**

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Question 27 (3 marks)

Q6. Cathode rays were first investigated over 150 years ago. Experiments, since that time have indicated that cathode rays have the following properties:

- ** travel in straight lines
- ** rays are charged particles
- ** the charge on the rays is negative
- ** the rays are able to transfer energy and do work

(a) For any TWO of these properties, describe how they can be demonstrated in the laboratory using discharge tubes **2**

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(c) Justify ONE of the demonstrations you described in (a). **1**

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Question 31 – From Quanta to Quarks (25 marks) **Marks**

(a) (i) Use de Broglie's hypothesis to explain the stability of the electron orbits in the Bohr atom. **2**

(ii) Calculate the wavelength of an electron moving with a velocity of $4.5 \times 10^5 ms^{-1}$. **1**

(iii) Describe the confirmation of de Broglie's proposal by Davisson and Germer. **3**

(b) Planck's contribution to the study of black body radiation resulted in one of the biggest advances ever seen in physics.
Discuss how his contribution enabled physicists to better explain two phenomena already observed. **4**

(c) Calculate the mass defect (in kilograms) of an atom of oxygen, $^{17}O_8$ of mass 16.999 131u. **2**

(d) (i) Name two isotopes, one used in agriculture and one used in medicine, and describe their use. **4**

(ii) Describe two properties of neutrons and how these properties make neutron scattering such an important research tool. **4**

(e) It has been stated that if the Coulomb electrostatic force between protons did not exist, the number of elements occurring naturally in the universe would not be limited to 92. Discuss the forces inside the nucleus of an atom and justify the above statement. **5**