ALEXANDER ROAD HIGH SCHOOL

GRADE 12

TRIAL EXAMINATIONS

7 SEPTEMBER 2010

PHYSICAL SCIENCES: PHYSICS (P1)

MARKS: 150

TIME: 3 hours

This paper consists of:

- Question Paper
- Data Sheets
- Section A : Answer Sheet

INSTRUCTIONS AND INFORMATION

1. Write your name in the spaces on the answer sheet for Section A.
2. Answer ALL questions.
3. This paper consists of TWO sections:

   SECTION A (25)

   SECTION B (125)
4. Answer Section A on the answer sheet provided. Answer Section B in the Answer Book or on the folio paper provided.
5. Non-programmable calculators may be used.
6. Appropriate mathematical instruments may be used.
7. Number the questions correctly according to the numbering system used in this question paper.
8. Data sheets are attached for your use.
9. Give brief motivations, discussions, et cetera where required.

SECTION A

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write down only the term/word next to the question number (1.1 - 1.5) on the ANSWER SHEET.

1.1 The physical quantity that is equivalent to the rate of change of momentum. (1)

1.2 A collision during which kinetic energy changes. (1)

1.3 The imaginary line that joins points in phase on a wave. (1)

1.4 The phenomenon whereby a current is induced in a coil that is rotated in a magnetic field. (1)

1.5 Electromagnetic radiation with the lowest frequency. (1)

[5]

QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (2.1 – 2.10) on the ANSWER SHEET.

2.1 A boy sits in a train travelling east at 80 $km \cdot h^{-1}$. A bird flies directly overhead, at 10 $km \cdot h^{-1}$ west.

Which ONE of the following is the description of how the bird is moving relative to the boy in the train?

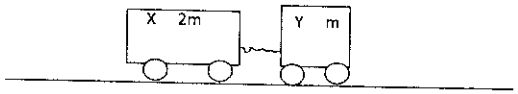
	Magnitude of velocity of bird ($km \cdot h^{-1}$)	Direction of velocity of bird
A	70	East
B	70	West
C	90	West
D	90	East

(2)

2.2 An object moves at a constant velocity ***v*** and has kinetic energy ***K***. If the velocity of the object is changed to ***3v***, the kinetic energy will be...

A. $\frac{1}{9}K$ B. $\frac{1}{3}K$ C. $3K$ D. $9K$ (2)

2.3 A compressed spring between two trolleys X, mass **2m**, and Y, mass **m**, resting on a frictionless surface, is released.



If the magnitude of the impulse on Y is 8 $N \cdot s$, then the magnitude of the impulse on X, in $N \cdot s$, is

A. 16 B. 8 C. 4 D. 2 (2)

2.4 Two identical conducting spheres P and Q carry charges of +6,4 x 10^{-19}C and -6,4 x 10^{-19}C respectively. The spheres are allowed to touch. During contact, sphere P

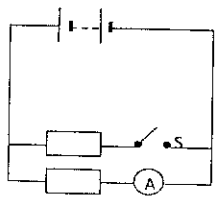
A. gains 4 electrons

B. gains 2 electrons

C. loses 2 electrons

D. loses 4 electrons (2)

2.5 Two identical resistors are connected in parallel as shown. The resistance of the battery and the connecting wires can be ignored.



When switch S is closed, the reading on ammeter A will

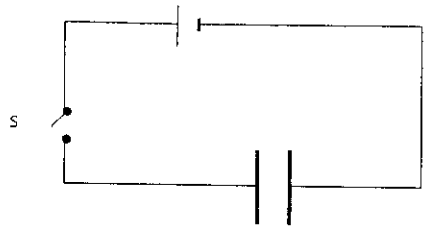
A. remain unchanged

B. be doubled

C. be halved

D. become zero (2)

2.6 A capacitor is connected to a battery in a circuit as shown.



Which ONE of the following correctly describes the change in current (I) in the circuit and potential difference (V) across the capacitor when the switch S is closed?

	I	V
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	Increases	increases

(2)

2.7 Diffraction through a narrow slit is less for blue light than for red light because

A. blue light travels more slowly than red light

B. blue light has a lower intensity than red light

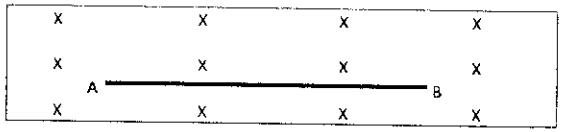
C. blue light has a lower frequency than red light

D. blue light has a shorter wavelength than red light. (2)

2.8 A material with a photoelectric work function $W_0 = hf_0$, is illuminated with light of frequency $f = 3f_0$. The maximum kinetic energy of the photoelectron is

A. $4hf_0$ B. $3hf_0$ C. $2hf_0$ D. hf_0 (2)

2.9 The diagram shows a current-carrying conductor AB which crosses a magnetic field which runs INTO the plane of the page.



Which of the following combinations is TRUE for the direction of the current flow and the direction of the force on the conductor?

	Direction of current flow	Direction of force on conductor
A	From A to B	Out of the plane of the page
B	From A to B	Towards the bottom of the page
C	From B to A	Towards the top of the page
D	From B to A	Towards the bottom of the page

(2)

2.10 Electrical energy is transmitted on the national grid using alternating current (AC). This is because

A. the transformers only operate on AC.

B. AC produces a better heating and lighting effect than direct current (DC).

C. AC voltages do not vary as much as DC voltages.

D. there is too great a power loss if DC is transmitted through the national grid. (2)

[2 x 10 =20]

TOTAL SECTION A: [25]

SECTION B

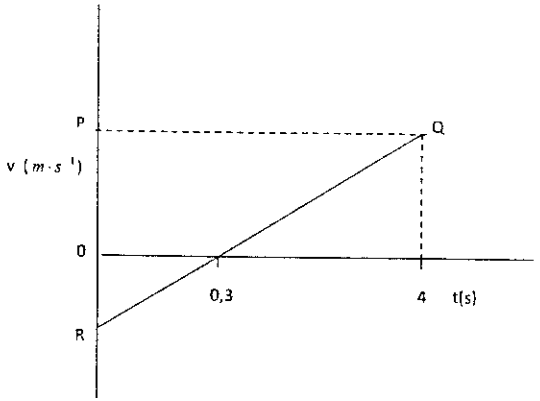
INSTRUCTIONS AND INFORMATION

1. Answer this section in the Answer Book or on the folio paper provided.
2. Formulae and substitutions must be shown in ALL calculations.
3. Round off your answers to TWO decimal places.

QUESTION 3

A lift at a construction site is used to hoist material to a group of workers at the top of a building. The lift is ascending vertically upwards at a constant velocity of 2,94 $m \cdot s^{-1}$ when a hammer falls off the lift platform. The hammer reaches the ground 4s later.

The velocity-time graph below represents the vertical motion of the hammer from the moment it falls from the platform.



Do NOT use formal equations of motion in the following questions. Where applicable, show how you obtained your answer using graphical methods.

3.1 What is the velocity of the hammer at point R? (2)

3.2 The gradient of the graph is 9,8. With which physical quantity, relating to motion, does this value correspond? (1)

3.3 Which part of the hammer's motion is represented at time t = 0,3 s on the graph? (2)

3.4 Calculate, using graphical methods, the hammer's velocity when it reaches the ground. (4)

3.5 Calculate, using graphical methods, the height reached by the lift at the time the hammer

fell off. (4)
[13]

QUESTION 4

Collisions between vehicles are a frequent occurrence on our roads.

In a certain collision Car A, of mass 1400 kg, travelling to the right at 25 $m \cdot s^{-1}$, drives into the rear of Car B, mass 1600 kg, also travelling to the right, but at 20 $m \cdot s^{-1}$.

After the collision, Car A continues to move to the right, but at a lower velocity of 21 $m \cdot s^{-1}$.

4.1 State the Law of Conservation of Linear Momentum. (2)

4.2 Calculate the velocity of Car B immediately after the collision. (6)

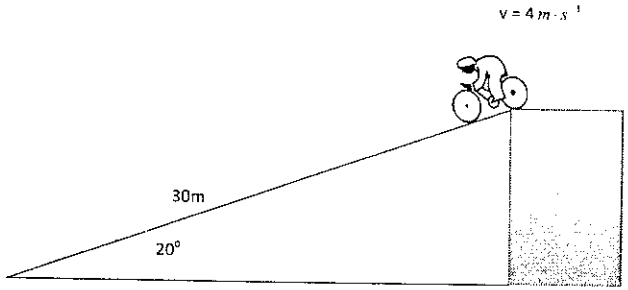
4.3 If the contact time during the collision was collision was 1,2s , calculate the average force acting on car A during the impact. (5)

Modern cars are designed with airbags and crumple zones as safety features.

4.4 Discuss, with reference to relevant physical quantities, how the features mentioned above contribute to the safety of passengers during a collision. (3)
[16]

QUESTION 5

A young boy cycles down a rough incline 30m long. The incline makes an angle of 20° with the horizontal as shown, and the boy's velocity as he descends down the incline is 4 $m \cdot s^{-1}$.



The total mass of the boy and his bicycle is 70kg. There is a constant frictional force of 50N opposing the cyclist's motion.

5.1 Calculate the magnitude of the net force , parallel to the incline, experienced by the cyclist. (5)

5.2 Calculate the magnitude of the cyclist's velocity at the bottom of the 30m incline. (6)
[11]

QUESTION 6

A man, sitting on a bench at a bus-stop, hears a police vehicle approaching with its siren on. He observes that the pitch of the sound he hears changes as the vehicle moves towards him and then away from him.

6.1 What is the name given to the phenomenon responsible for the observation made? (1)

6.2 Explain, using diagrams, how the frequency appears to changes as the police vehicle moves

6.2.1 towards the man and

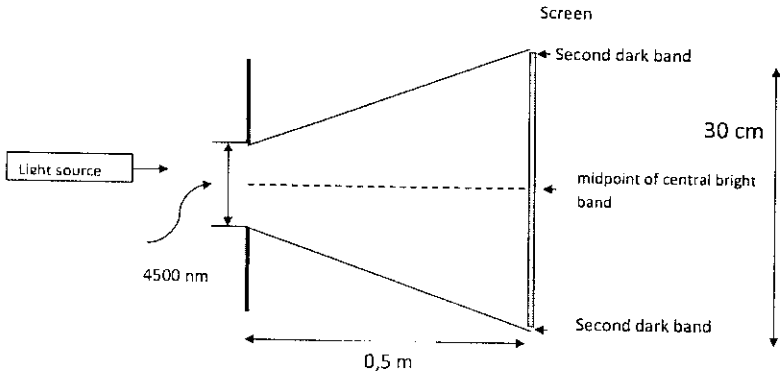
6.2.2 away from the man. (6)

6.3 If the speed of sound is air is accepted as 340 $m \cdot s^{-1}$, calculate the apparent frequency of the sound waves as the vehicle moves towards the man at a constant speed of 25 $m \cdot s^{-1}$, emitting sound waves at a frequency of 400Hz. (4)
[11]

QUESTION 7

A light source emits red light that passes through a single slit. A student observes a diffraction pattern on a screen placed 0,5m away from the slit.

7.1 The source emits monochromatic light. What is meant by the term 'monochromatic'? (1)



The diagram shows the following information:

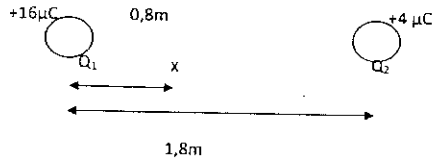
- *The width of the slit is 4500 nm*
- *The distance between the slit and the screen in 0,5m*
- *The distance between the two dark bands shown (second order bands) is 30cm.*

7.2 Use the information supplied to calculate the wavelength of red light. (5)

7.3 The student wants to increase the distance between the central bright band and the dark bands. What change to the arrangement of equipment can be made to achieve this, if the same light source is used? (1)
[7]

QUESTION 8

Two point charges Q_1 and Q_2 are placed a distance of 1,8m apart. The charge on Q_1 is +16μC and that on Q_2 is +4 μC.



X is a point situated 0,8m to the right of charge Q_1.

8.1 Define the term 'electric field' for a point in space. (2)

8.2 Calculate the net electric field at point X. (6)

8.3 Calculate the force that would be experienced by an electron placed at point X between the two point charges. (4)
[12]

QUESTION 9

A parallel-plate capacitor consists of two metal plates, each 25mm by 25mm, separated by a distance of 0,5mm. This capacitor is rated 200V.

9.1 Calculate the capacitance of the capacitor described above. (4)

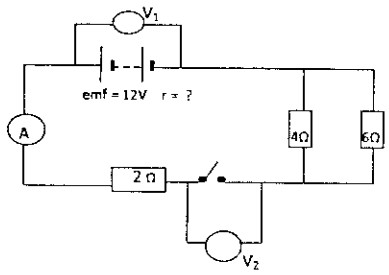
9.2 Calculate the maximum amount of charge that can be stored by this capacitor. (3)

A dielectric, mica, is inserted between the plates in order to increase the capacitance of this capacitor.

9.3 Explain why the capacitance increases when a dielectric is inserted. (5)
[12]

QUESTION 10

In the circuit shown, the battery has an emf of 12V and an unknown internal resistance, r.
Voltmeter V_1 is connected across the battery and V_2 across the open switch S.
The resistance of the connecting wires and the ammeter may be ignored.



Switch S is OPEN:

10.1 What is the reading on voltmeter V_1? (1)

10.2 What is the reading on voltmeter V_2? (1)

Switch S is now closed. The reading on voltmeter V_1 drops to 8,8V.

10.3 What is the reading on voltmeter V_2? (1)

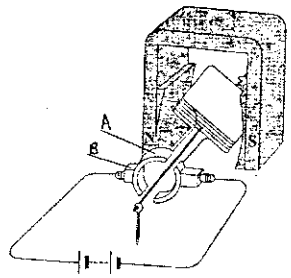
10.4 Calculate the reading on the ammeter A. (7)

10.5 Calculate the internal resistance *r* of the battery. (4)

[14]

QUESTION 11

The diagram below represents a DC motor



11.1 Give the energy conversion that occurs in a DC motor. (1)

11.2 Name the parts of the motor labelled
11.2.1 A and 11.2.2 B. (2)

11.3 What is the function of the part labelled A? (2)

11.4 Give TWO ways in which the efficiency of the DC motor may be increased. (2)

11.5 In practice, many appliances, such as electric drills, use alternating current (AC) as the input current. What change in design is required in an AC motor? (2)
[9]

QUESTION 12

In South Africa , the main supply is alternating current potential at 230V (rms) and 50Hz.

12.1 Give TWO advantages associated with the use of alternating current at powerstations and in transmission. (2)

You have a heater, marked 1 800W. A substation supplies 230V at your wall socket.

12.2 Calculate the maximum value of the voltage supplied to the heater. (3)

12.3 This maximum value for voltage can also be negative. Draw a graph of voltage vs time to illustrate one complete cycle of AC current as supplied to your heater. Indicate relevant voltage and time values. (4)
[9]

QUESTION 13

A photo-electric cell has a metal cathode as part of its design. The work function of the metal cathode is $1,8 \times 10^{-19}$J.

13.1 Define the term 'threshold frequency'. (2)

13.2 Calculate the threshold frequency of this metal. (3)

13.3 Light of wavelength 500nm shines on the cathode. Prove by calculation that electrons will be ejected from the cathode. (4)

13.4 **The following changes are made:** For each change state whether the **number of photo-electrons** will INCREASE, DECREASE or STAY THE SAME.

13.4.1 the frequency of the incident light is increased;

13.4.2 the intensity of the incident light increases . (2)
[11]

TOTAL SECTION B: 125
GRAND TOTAL: 150