SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

OCTOBER / NOVEMBER
OKTOBER / NOVEMBER

2004

FUNCTIONAL PHYSICAL SCIENCE

FUNKSIONELE NATUUR- EN SKEIKUNDE

(First Paper: Physics)
(Eerste Vraestel: Fiska)

SG **305-2/1**

12 pages
12 bladsye

305 2 1 SG

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

FUNKSIONELE NATUUR- EN SKEIKUNDE SG
(Eerste Vraestel: Fisika)

TYD: 2 uur

PUNTE: 150

BENODIGHEDE:

- 'n Goedgekeurde (nie-programmeerbare, wetenskaplike) sakrekenaar. Kandidate moet hulle eie sakrekenaars verskaf.

INSTRUKSIES:

- Skryf jou eksamennommer in die spasies wat voor op die antwoordboek daarvoor voorsien word.
- Beantwoord ALLE vrae.
- Beantwoord Vraag 1 op die **antwoordblad** aan die **binnekant** van die **omslag** van jou **antwoordboek**. Trek 'n kruisie (**X**) oor die letter **A**, **B**, **C** of **D** om aan te dui watter letter jy kies.
- Beantwoord alle ander vrae in die antwoordboek. Indien jy 'n antwoord moet oordoen, moet dit op 'n nuwe bladsy gedoen word. Nommer alle antwoorde duidelik.
- Begin elke vraag op 'n nuwe bladsy.
- 'n Inligtingsblad word aan die einde van hierdie vraestel voorsien. Dit bevat formules en konstantes. Die inligting wat voorsien word, mag jou in die beantwoording van die vrae van hulp wees.
- Rofwerk mag agter in jou antwoordboek op die blanko bladsye gedoen word.

GAUTENG DEPARTMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

FUNCTIONAL PHYSICAL SCIENCE SG
(First Paper: Physics)

TIME: 2 hours

MARKS: 150

REQUIREMENTS:

- An approved (non-programmable, scientific) calculator. Candidates should supply their own calculators.

INSTRUCTIONS:

- Write your examination number in the spaces provided for this purpose on the front of your answer book.
- Answer ALL questions.
- Answer Question 1 on the **answer sheet** on the **inside cover** of your **answer book**. Make a cross (**X**) over the letter **A**, **B**, **C** or **D**, to indicate the letter you have chosen.
- Answer all other questions in the answer book. If you need to redo an answer, redo it on a new page. Number all answers correctly.
- Start each question on a new page.
- An information sheet is provided at the end of this question paper. It contains formulae and constants. The information provided may be useful in answering the questions.
- Rough work may be done on the blank pages at the back of your answer book.

VRAAG 1
MEERVOUDIGE KEUSEVRAE

Elke vraag is van vier moontlike antwoorde (A, B, C en D) voorsien. Kies die letter wat na jou mening die korrekte antwoord verteenwoordig en dui dit aan deur 'n kruisie (**X**) oor die oorstemmende letter op die **antwoordblad** aan die **binnekant van die omslag** van jou **antwoordboek** te maak. Indien daar meer as een kruisie in enige antwoord voorkom, sal GEEN PUNTE toegeken word nie.

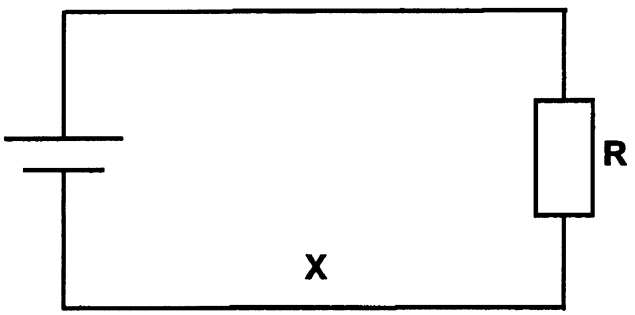
VOORBEELD:

By watter temperatuur smelt suiwer ys?

A. -4°C
B. 0°C
C. O K
D. 4°C

ANTWOORD: | A | **X** B | C | D |

1.1 Die rigting van die magneetveld by punt **X** in die skets is _____.



A. na regs
B. na links
C. loodreg, in die bladsy in
D. loodreg, uit die bladsy uit

1.2 Waarom kan watergolwe nooit longitudinale golwe wees nie?

A. Waterdeeltjies beweeg net loodreg met die golfrigting.
B. Water is nie saampersbaar nie.
C. Dit sal die polarisasie van water moontlik maak.
D. Water is 'n digter golfmedium as lug.

QUESTION 1
MULTIPLE-CHOICE QUESTIONS

Each question has four possible answers (A, B, C and D). Choose the letter which in your opinion represents the correct answer and make a cross (**X**) over the corresponding letter on the **answer sheet** on the **inside cover** of your **answer book**. If more than one cross appears in an answer, NO MARKS will be awarded.

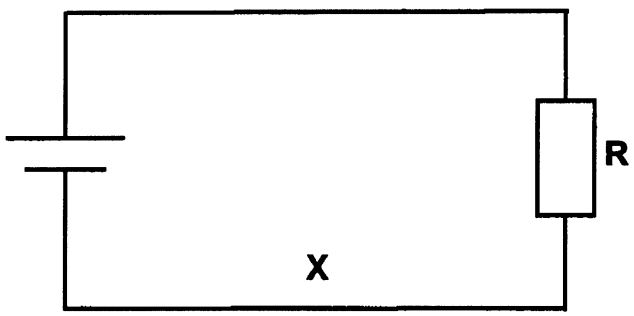
EXAMPLE:

At what temperature does pure ice melt?

A. -4°C
B. 0°C
C. O K
D. 4°C

ANSWER: A | ~~B~~ | C | D

1.1 The direction of the magnetic field at point **X** is _____.

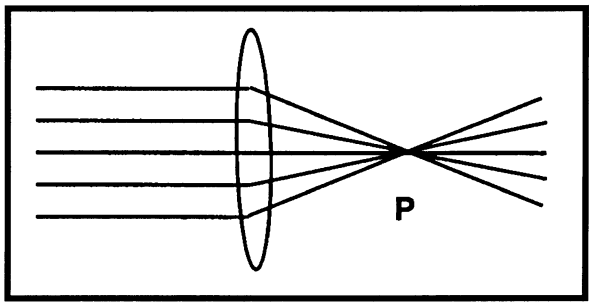


A. to the right
B. to the left
C. perpendicular, into the paper
D. perpendicular, out of the paper

1.2 Why can water waves never be longitudinal waves?

A. Water particles only move perpendicular to the direction of the wave.
B. Water isn't compressible.
C. They would enable water to be polarised.
D. Water is a denser wave medium than air.

1.3 Die rigting verandering van die lig wat deur die lens geskyn word, is as gevolg van _____ .



A. weerkaatsing
B. breking
C. diffraksie
D. dispersie

1.4 Die apparaat wat ingesluit word om 'n selfoonbattery te laai is _____.

A. 'n verlagingstransformator.
B. 'n wisselstroomdinamo.
C. 'n verhogingstransformator.
D. 'n gelykstroommotor.

1.5 Die ooreenkoms tussen 'n transistor en 'n transformator is dat beide kan optree as _____.

A. elektroniese skakelaars
B. potensiaalversterkers
C. stroomversterkers
D. ladingstoorders

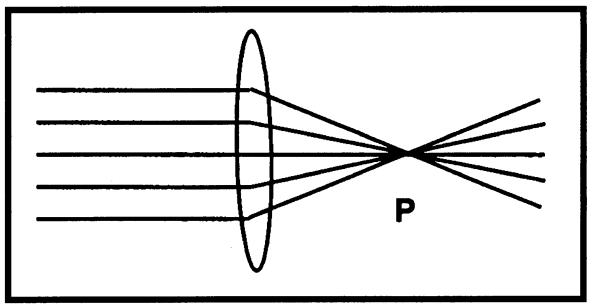
1.6 In 'n diodebuis word gelaaide deeltjies deur _____ vrygestel.

A. interferensie
B. die ionisasie van 'n gas
C. die foto-elektriese effek
D. termioniese emissie

1.7 'n Onbekende metaal/element kan fisies geïdentifiseer word deur die vlamkleur se _____.

A. frekwensie
B. kontinue spektrum
C. ionisasie-energie
D. lynspektra

1.3 The change of direction of the light rays after passing through the lens is a result of



A. reflection
B. refraction
C. diffraction
D. dispersion

1.4 The apparatus that is normally included to charge a cellphone battery is _____.

A. a step-down transformer
B. an alternating current dynamo
C. a step-up transformer
D. a direct current motor

1.5 The similarity between a transistor and a transformer is that both can act as _____.

A. electronic switches
B. potential amplifiers
C. current amplifiers
D. charge storers

1.6 In a diode tube charged particles are liberated by _____.

A. interference
B. ionization of gas
C. the photo-electric effect
D. thermionic emission

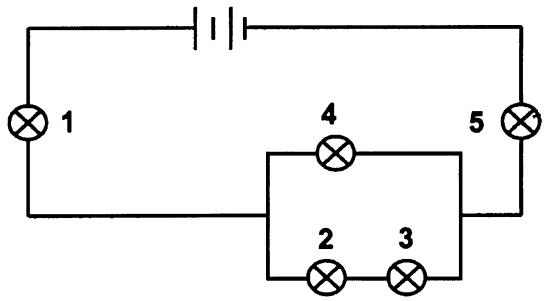
1.7 An unknown metal / element can be identified physically through its flame colour's _____.

A. frequency
B. continuous spectrum
C. ionization energy
D. line spectra

1.8 Lenna verbind 'n stuk draad aan 'n battery. Sy plaas die draad in 'n sterk magnetiese veld. Wanneer is die krag wat deur die geleier in die magneetveld ervaar word 'n maksimum? Indien die stroomrigting _____.

A. parallel aan die rigting van die magneetveld is
B. in dieselfde rigting as die magneetveld is
C. loodreg met die rigting van die magneetveld is
D. in die teenoorgestelde rigting van die magneetveld is

1.9 Al die gloeilampies in die stroombaan hieronder is identies. Watter gloeilampie(s) gloei (brand) die helderste?



A. 1
B. 1 en 5
C. 4
D. 2 en 3

1.10 Eiwad plaas 'n sagte ysterkern in 'n stroomdraende spoel. Dit veroorsaak dat die omliggende magneetveld van die spoel _____.

A. onveranderd bly
B. se rigting omkeer
C. versterk word
D. verswak word

1.11 Rednaz bestraal 'n sekere metaal met verskeie stralings. Hy bevind dat slegs een van die stralings foto-elektrone vrystel. Watter een van die volgende is die waarskynlikste straling?

A. Groen lig
B. Infrarooi lig
C. Rooi lig
D. Geel lig

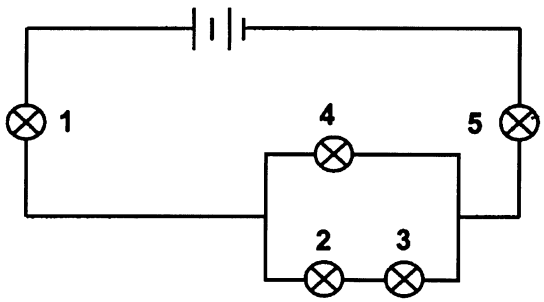
1.12 Twee polaroid-skywe word naby mekaar voor 'n ultraviolet lamp geplaas sodat geen ultravioletlig deurgelaat word nie. Dit bewys dat ultravioletlig _____.

A. in reguit lyne kan beweeg
B. partikeleienskappe besit
C. golfeienskappe besit
D. 'n transversale golf is

1.8 Lenna connects a piece of wire to a battery. She places the wire in a strong magnetic field. When is the force experienced by the conductor in the magnetic field a maximum? When the direction of the current _____.

A. is parallel to the direction of the magnetic field
B. has the same direction as the magnetic field
C. is perpendicular to the direction of the magnetic field
D. is in the opposite direction to that of the magnetic field

1.9 All the bulbs in the circuit below are identical. Which bulb(s) glow(s) the brightest?



A. 1
B. 1 and 5
C. 4
D. 2 and 3

1.10 Eiwad places a soft-iron core in a coil in which there is current. This causes the magnetic field surrounding the coil to _____.

A. remain constant
B. reverse its direction
C. increase
D. decrease

1.11 Rednaz irradiates a certain metal with various radiations. It is found that only one of the radiations liberates photo electrons. Which one of the following is the most likely radiation?

A. Green light
B. Infra-red light
C. Red light
D. Yellow light

1.12 Two polaroid discs are placed close together in front of an ultraviolet lamp so that no ultraviolet light passes through them. This proves that ultraviolet light _____.

A. can travel in straight lines
B. has particle properties
C. has wave properties
D. is a transverse wave

1.13 Watter van die volgende verskynsels kan by klankgolwe voorkom?

A. Slegs interferensie
B. Slegs interferensie en diffraksie
C. Interferensie, breking en polarisasie
D. Interferensie, breking en diffraksie

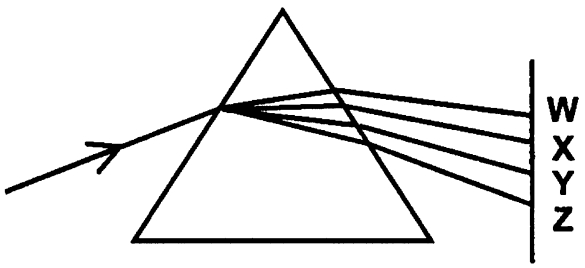
1.14 Die volgende is 'n paar elektromagnetiese golwe met hulle ooreenstemmende golflengtes:

Uitstraling	Golflengte
X-Strale	$2X10^{-10}m$
Ultraviolet	$3X10^{-7}m$
Sigbare lig	$5X10^{-6}m$
Infrarooi	$4X10^{-5}m$

Watter een van die bostaande vorme van uitstraling het die **minste** energie?

A. X-Strale
B. Ultraviolet
C. Sigbare lig
D. Infrarooi

1.15 Nebur skyn wit lig deur 'n glas prisma.



W, **X**, **Y** en **Z** verwys na kleure op die sigbare spektrum. Die violetlig is by _____.

A. W
B. X
C. Y
D. Z

3x15=**[45]**

1.13 Which of the following phenomena can occur with sound waves?

A. Interference only
B. Interference and diffraction only
C. Interference, refraction and polarisation
D. Interference, refraction and diffraction

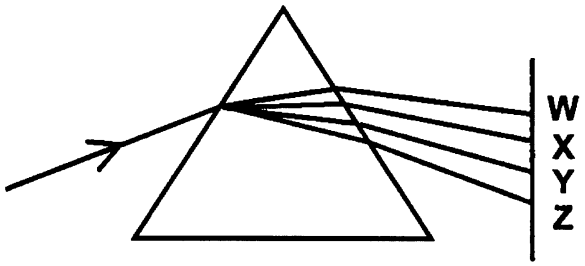
1.14 The following are some electromagnetic waves with their corresponding wavelengths:

Radiation	Wavelength
X-rays	$2X10^{-10}m$
Ultraviolet	$3X10^{-7}m$
Visible light	$5X10^{-6}m$
Infra-red	$4X10^{-5}m$

Which one of the above forms of radiation has the **least** energy?

A. X-rays
B. Ultraviolet
C. Visible light
D. Infra-red

1.15 Nebur shines white light through a glass prism.



W, **X**, **Y** and **Z** refer to colours in the visible spectrum. The violet light is at _____.

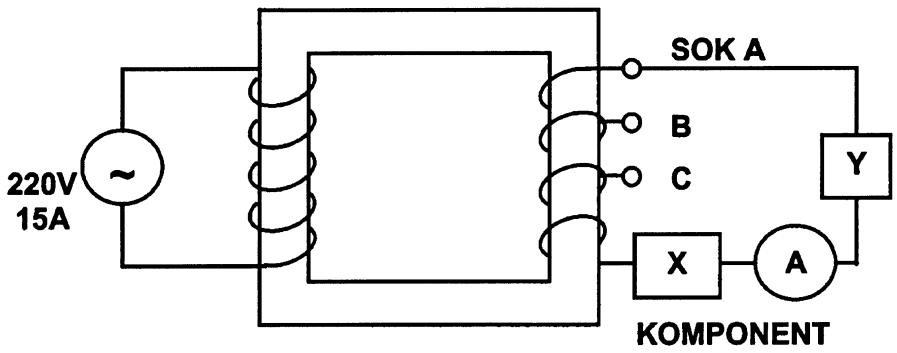
A. W
B. X
C. Y
D. Z

3x15=**[45]**

Beantwoord die volgende vrae in jou antwoordboek. Toon al die nodige berekeninge, asook die formules en berekeninge wat gebruik is in die beantwoording van die vrae.

VRAAG 2
TRANSFORMATORS

'n Elektriese sweismasjien **Y** is deur 'n tegnikus ontwerp en ontwikkel om teen 'n potensiaalverskil van 12 V tot 90 V te funksioneer. Die werkswinkel waarin hy sy projek doen, is van 220 V voorsien. Hy koppel die apparaat **Y** aan 'n transformator met 360 windings op sy sekondêre spoel, soos in die skets voorgestel word.



2.1 Bereken die aantal windings op die primêre spoel indien die tegnikus die sweismasjien op sok **A** teen 'n potensiaalverskil van 90 V gebruik. (5)

2.2 Watter tipe transformator gebruik die tegnikus nou? Die tegnikus koppel die apparaat **Y** in sok **C**, sodat dit as 'n 12 V-motorbatterylaaier kan funksioneer. (1)

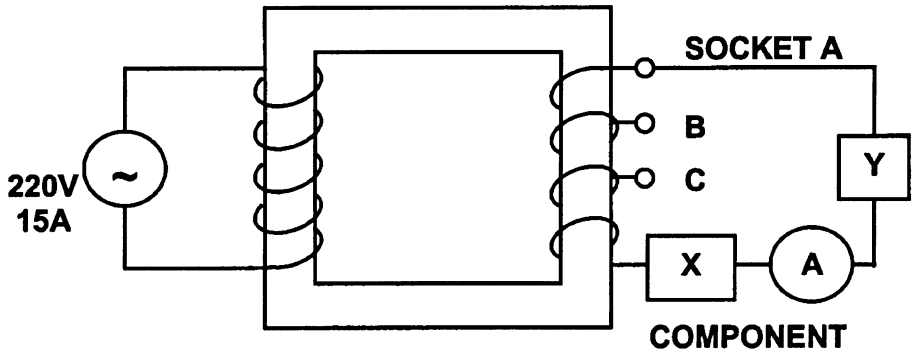
2.3 Bereken die stroomsterkte van die batterylaaier wat in sok **C** aan die sekondêre spoel van hierdie transformator gekoppel is indien die stroomsterkte voorsien 0,3A is. (5)

2.4 Watter komponent **X** moet in die sekondêre stroombaan gekoppel word om die stroom geskik te maak om 'n motorbattery te laai? Verduidelik waarom. (4)
[15]

Answer the following questions in your answer book. Show all the necessary equations and calculations you have used in answering the questions.

QUESTION 2
TRANSFORMERS

An electrical welding machine **Y** is designed and developed by a technician to function at a potential difference of 12 V to 90 V. The workshop where he does his project is supplied with 220 V. He connects the apparatus **Y** to a transformer with 360 turns on its secondary coil as shown in the sketch.



2.1 Calculate the number of turns on the primary coil if the technician connects the welding machine to socket **A** functioning at a potential difference of 90 V. (5)

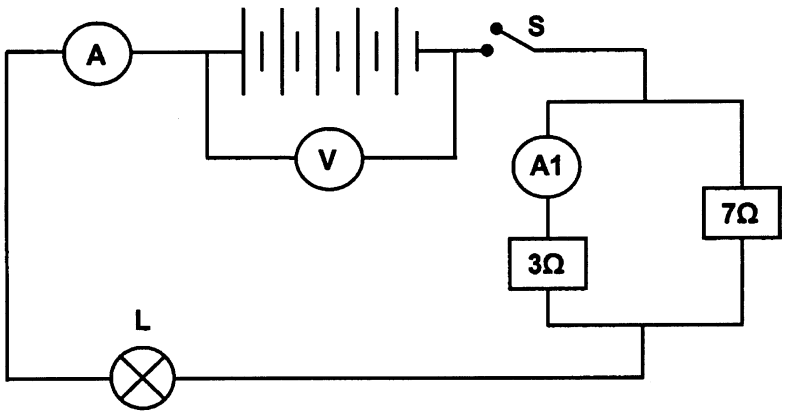
2.2 To function like a 12V charger of a motor battery the technician connects apparatus **Y** to socket **C**. Which type of transformer is the technician using now? (1)

2.3 Calculate the current of the battery charger connected to socket **C** in the secondary coil of this transformer if the current drawn from the supply is 0,3 A. (5)

2.4 Which component **X** should be connected to the secondary circuit to make the current appropriate to charge a motor battery? Explain why. (4)
[15]

VRAAG 3
OHM SE WET

In die stroombaan hieronder, bestaan die battery uit vyf seriegeskakelde selle. Die emk van elke sel is 1,5 V. Die interne weerstand van die battery is weglaatbaar klein. **L** is 'n gloeilamp met 'n weerstand 0,9 Ω.



3.1 Wat is die lesing op die voltmeter **V** en die ammeter **A** as die skakelaar oop is? (2)

3.2 Die skakelaar word nou gesluit. Bereken die totale weerstand in die stroombaan. (5)

3.3 Bereken die stroomsterkte deur die gloeilamp **L**. (4)

3.4 Bereken die lesing op ammeter **A1**. (7)

3.5 Wat sal met die helderheid van die gloeilamp **L** gebeur indien die 3 Ω weerstand uit die stroombaan verwyder word? (1)

3.6 Verduidelik jou antwoord in Vraag 3.5. (3)
[22]

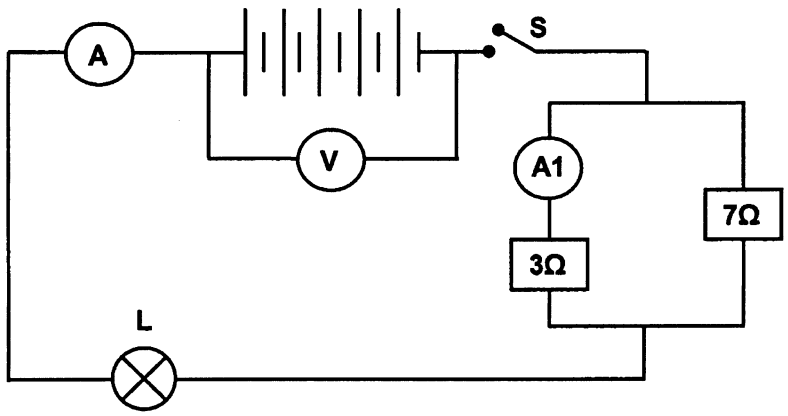
VRAAG 4
GOLWE

4.1 'n Wetenskapopvoeder veroorsaak golwe in 'n golftenk. 'n Golf word elke 0,6 s opgewek. Die lengte van een volledige golf is 50 mm. 'n Klein stukkie hout wat op die water dryf, beweeg op en af deur 'n totale afstand van 9 mm.

4.1.1 Is hierdie golwe transversaal? Verduidelik jou antwoord. (3)
4.1.2 Is hierdie golwe gepolariseerd? Verduidelik jou antwoord. (3)
4.1.3 Wat is die amplitude van hierdie golwe? (2)
4.1.4 Bereken die frekwensie van hierdie golwe. (3)
4.1.5 Bereken die snelheid van voortplanting van hierdie golwe. (4)

QUESTION 3
OHM'S LAW

In the circuit below the battery consists of five cells connected in series. The emf of each cell is 1,5 V. The internal resistance of the battery is negligible. **L** is a bulb with a resistance of 0,9 Ω.



3.1 What is the reading on the voltmeter **V** and the ammeter **A** if the switch is open? (2)

3.2 The switch is now closed. Calculate the total resistance in the circuit. (5)

3.3 Calculate the current through the lamp **L**. (4)

3.4 Calculate the reading on ammeter **A1**. (7)

3.5 What will happen to the brightness of lamp **L** if the 3 Ω resistor is removed from the circuit? (1)

3.6 Explain your answer to Question 3.5. (3)
[22]

QUESTION 4
WAVES

4.1 A science educator generates waves in a ripple tank. A wave is generated every 0,6 s. The length of one complete wave is 50 mm. A small piece of wood floating on the water moves up and down through a total distance of 9 mm.

4.1.1 Are these waves transverse? Explain your answer. (3)
4.1.2 Are these waves polarised? Explain your answer. (3)
4.1.3 What is the amplitude of these waves? (2)
4.1.4 Calculate the frequency of these waves. (3)
4.1.5 Calculate the velocity of propagation of these waves. (4)

4.2 Elektromagnetiese golwe ontstaan wanneer elektriese ladings versnel.

4.2.1 Watter eienskap van hierdie golwe bepaal die energie daarvan? (1)

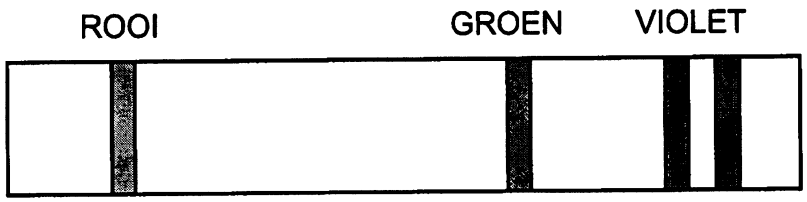
4.2.2 Noem TWEE soorte elektromagnetiese golwe wat 'n hoë deurdringingsvermoë het. (2)

4.2.3 Die periode van 'n sekere elektromagnetiese golf is $4X10^{-14}s$. Bereken die golflengte van hierdie golf in 'n vakuum. (6)

[24]

VRAAG 5
LIG, KLEUR EN SPEKTRA

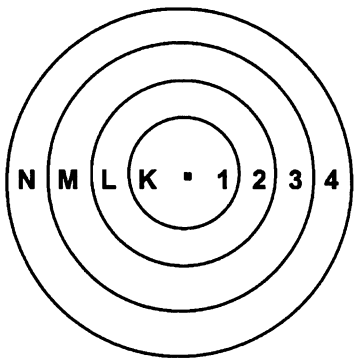
5.1 As lig wat deur 'n waterstofontladingsbuis vrygestel word, deur 'n spektroskoop bekyk word, word die volgende spektrum soos hieronder waargeneem:



5.1.1 Wat word hierdie soort spektrum genoem? (1)

5.1.2 Bereken die golflengte van violetlig met 'n frekwensie van $6,9X10^{14}Hz$. (4)

5.2 Die diagram toon die vier belangrikste energievlakke van die waterstofatoom.



5.2.1 Noem die belangrikste energievlak(ke) waarin die elektron van die waterstofatoom verkry (aangetref) sal word wanneer die atoom in die

(a) grondtoestand, en (1)

(b) opgewekte toestand is. (2)

5.2.2 Verwys na die energievlakmodel van die waterstofatoom soos in die diagram hierbo en verduidelik die oorsprong van die tipe spektrum wat in Vraag 5.1 uitgebeeld word. (3)

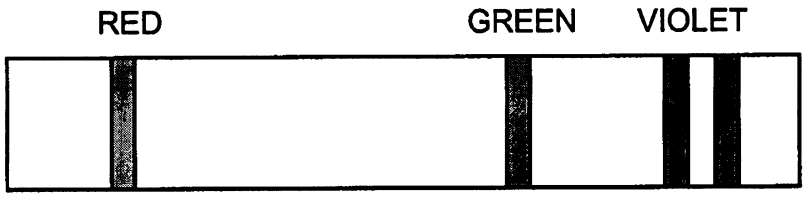
[11]

4.2 Electromagnetic waves originate when electric charges are accelerated.

4.2.1 Which characteristic of these waves determines the energy of the waves? (1)
4.2.2 Name TWO types of electromagnetic waves with high penetrative power. (2)
4.2.3 The period of a certain electromagnetic wave is $4X10^{-14}$s. Calculate the wavelength of this wave in a vacuum. (6)
[24]

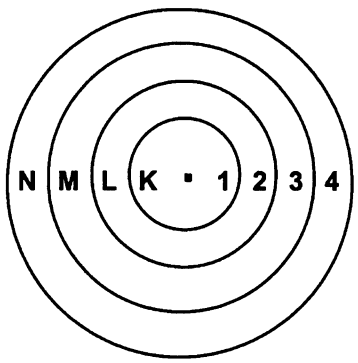
QUESTION 5
LIGHT, COLOUR AND SPECTRA

5.1 When light that is emitted by a hydrogen discharge tube is viewed through a spectroscope, the following spectrum as shown below is observed:



5.1.1 What is this type of spectrum called? (1)
5.1.2 Calculate the wavelength of violet light with a frequency of $6,9X10^{14}$Hz. (4)

5.2 The diagram shows the four principal energy levels of the hydrogen atom.



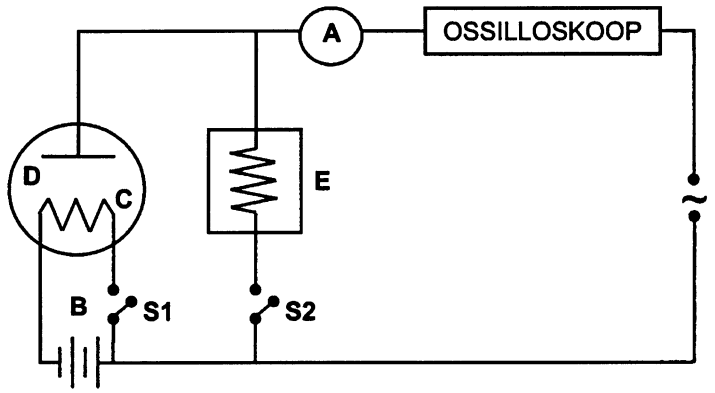
5.2.1 Name the principal energy level(s) in which the electron of the hydrogen atom will be found when the atom is in the

(a) ground state, and (1)
(b) excited state. (2)

5.2.2 Refer to the energy level model of the hydrogen atom as shown above and explain the origin of the type of spectrum illustrated in Question 5.1. (3)
[11]

VRAAG 6
ELEKTRONE IN DIE ATOOM

Die diagram hieronder toon 'n diode wat met 'n wisselstroombron (WS) geskakel word.



6.1 Verduidelik die doel van battery **B**. (2)

6.2 Skakelaar **S1** word gesluit (toegemaak).

6.2.1 Watter deeltjies word by gloeidraad **C** vrygestel? (1)
6.2.2 Wat word hierdie verskynsel genoem? (2)

6.3

6.3.1 Watter tipe diode word in hierdie diagram gebruik? Verklaar die funksie daarvan. (4)
6.3.2 Wat moet die polariteit van plaat **D** wees om stroom deur die diode te laat vloei? Verduidelik u antwoord. (3)

6.4 Skakelaar **S1** word oopgemaak en skakelaar **S2** gesluit (toegemaak).

6.4.1 Noem die tipe stroom wat nou deur die ammeter vloei. (2)
6.4.2 Teken die beeld wat op die skerm van die ossilloskoop getoon word. (2)

6.5 Skakelaar **S1** word gesluit en skakelaar **S2** word oopgemaak.

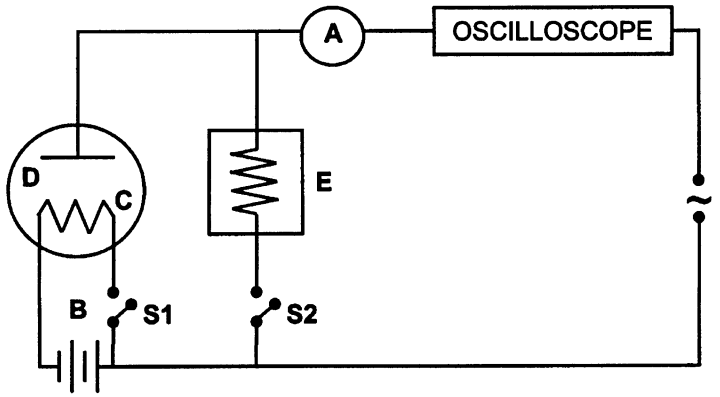
6.5.1 Noem die tipe stroom wat nou deur die ammeter vloei. (2)
6.5.2 Teken die beeld wat nou op die ossilloskoopskerm getoon word. (2)

6.6 'n Kapasitor vervang die weerstand in blok **E** van die diagram. Skakelaar **S1** en **S2** word albei gesluit.

6.6.1 Wat is die funksie van 'n kapasitor? (2)
6.6.2 Teken die beeld wat op die ossilloskoopskerm getoon sal word met die kapasitor ingeskakel. (2)
[24]

QUESTION 6
ELECTRONS IN THE ATOM

The diagram below shows a diode connected to a source of alternating current (AC).



6.1 Explain the purpose of battery **B**. (2)

6.2 Switch **S1** is closed.

6.2.1 What particles are liberated at filament **C**? (1)
6.2.2 What is the name of this phenomenon? (2)

6.3

6.3.1 What type of diode is used in the diagram? Explain its function. (4)
6.3.2 What must the polarity of plate **D** be, to allow current to flow through the diode? Explain your answer. (3)

6.4 Switch **S1** is opened and switch **S2** is closed.

6.4.1 Name the type of current which flows through the ammeter. (2)
6.4.2 Sketch the image displayed on the screen of the oscilloscope. (2)

6.5 Switch **S1** is closed and switch **S2** is opened.

6.5.1 Name the type of current which flows through the ammeter. (2)
6.5.2 Sketch the image displayed on the screen of the oscilloscope. (2)

6.6 A capacitor replaces the resistor in block **E** of the diagram. Switches **S1** and **S2** are both closed.

6.6.1 What is the function of a capacitor? (2)
6.6.2 Sketch the image displayed on the screen of the oscilloscope with the capacitor switched on. (2)

[24]

VRAAG 7
ELEKTRONIKA

7.1 Gee 'n ander naam vir die vastestoftriode. (2)

7.2 Skryf TWEE gebruike van 'n vastestoftriode neer. (2)

7.3 Teken die simbool vir 'n vastestoftriode en benoem die stroomdraende bene aan 'n vastestoftriode. (5)
[9]

TOTAAL: 150

QUESTION 7
ELECTRONICS

7.1 Give another name for the solid state triode. (2)

7.2 Name TWO uses of the solid state triode. (2)

7.3 Draw the symbol of a solid state triode and name the current-bearing legs on a solid state triode. (5)
[9]

TOTAL: 150

PHYSICS INFORMATION SHEET/ *FISIKA-INLIGTINGSBLAD*

EQUATIONS / *VERGELYKINGS*

WAVES / *GOLWE*	ELECTRICITY / *ELEKTRISITEIT*
$v = f\lambda$	$R = r_1 + r_2 + r_3$
$f = \frac{1}{T}$	$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$
	$V_p I_p = V_s I_s$
	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$

PHYSICS CONSTANTS / *FISIKA KONSTANTES*

Miscellaneous constants (Approximate values)
Diverse konstantes (Benaderde waardes)

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Speed of light *Spoed van lig*	c	$3,0 \times 10^8$ m.s^{-1}
Charge on electron *Lading op elektron*	e^-	$-1,6 \times 10^{-19}$ C

END / *EINDE*