basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NASIONALE
SENIOR SERTIFIKAAT

GRAAD 12

PHSC.1

FISIESE WETENSKAPPE: FISIKA (V1)

NOVEMBER 2016

PUNTE: 150

TYD: 3 uur

Hierdie vraestel bestaan uit 16 bladsye en 3 gegewensblaaie.

OGGENDSESSIE

INSTRUKSIES EN INLIGTING

1. Skryf jou sentrumnommer en eksamennommer in die toepaslike ruimtes op die ANTWOORDEBOEK.

2. Hierdie vraestel bestaan uit 10 vrae. Beantwoord AL die vrae in die ANTWOORDEBOEK.

3. Begin ELKE vraag op 'n NUWE bladsy in die ANTWOORDEBOEK.

4. Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.

5. Laat EEN reël oop tussen twee subvrae, byvoorbeeld tussen VRAAG 2.1 en VRAAG 2.2.

6. Jy mag 'n nieprogrammeerbare sakrekenaar gebruik.

7. Jy mag toepaslike wiskundige instrumente gebruik.

8. Jy word aangeraai om die aangehegte GEGEWENSBLAAIE te gebruik.

9. Toon ALLE formules en substitusies in ALLE berekeninge.

10. Rond jou finale numeriese antwoorde tot 'n minimum van TWEE desimale plekke af.

11. Gee kort (bondige) motiverings, besprekings ensovoorts waar nodig.

12. Skryf netjies en leesbaar.

VRAAG 1: MEERVOUDIGEKEUSE-VRAE

Verskeie opsies word as moontlike antwoorde op die volgende vrae gegee. Skryf die vraagnommer (1.1–1.10) neer, kies die antwoord en maak 'n kruisie (X) oor die letter (A–D) van jou keuse in die ANTWOORDEBOEK.

VOORBEELD:

1.11 | **A** | **B** | **C** | ~~**D**~~ |

1.1 Die geneigdheid van 'n voorwerp om in rus te bly of om sy uniforme beweging in 'n reguitlyn voort te sit, staan as ... bekend.

A traagheid

B versnelling

C Newton se Derde Wet

D Newton se Tweede Wet (2)

1.2 Die massa van 'n ruimtevaarder op Aarde is M. Op 'n hoogte gelyk aan twee maal die radius van die Aarde, sal die **massa** van die ruimtevaarder ... wees.

A $\frac{1}{4}$ M

B $\frac{1}{9}$ M

C M

D 2 M (2)

1.3 'n Voorwerp word vertikaal opwaarts van die grond af gegooi.

Watter EEN van die volgende is KORREK rakende die rigting van die versnelling van die voorwerp soos dit opwaarts en dan afwaarts beweeg? Ignoreer die effekte van lugweerstand.

	VOORWERP WAT OPWAARTS BEWEEG	VOORWERP WAT AFWAARTS BEWEEG
A	Afwaarts	Opwaarts
B	Opwaarts	Afwaarts
C	Afwaarts	Afwaarts
D	Opwaarts	Opwaarts

(2)

1.4 'n Persoon laat 'n glasbottel vanaf 'n sekere hoogte op 'n betonvloer val en die bottel breek. Die persoon laat val dan 'n tweede, identiese glasbottel vanaf dieselfde hoogte op 'n dik wolmat, maar die bottel breek nie.

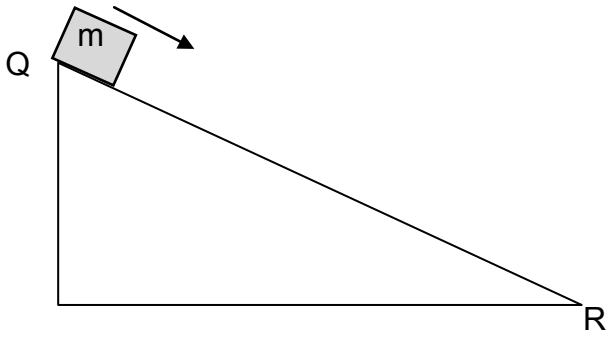
Watter EEN van die volgende is KORREK vir die tweede bottel in vergelyking met die eerste bottel vir dieselfde momentumverandering?

	GEMIDDELDE KRAG OP TWEEDE BOTTEL	**KONTAKTYD MET MAT**
A	Groter	Kleiner
B	Kleiner	Kleiner
C	Groter	Groter
D	Kleiner	Groter

(2)

1.5 'n Blok met massa m beweeg uit rus vanaf die bopunt van 'n wrywinglose skuinsvlak **QR**, soos hieronder getoon.

Die totale meganiese energie van die blok is E_Q by punt **Q** en E_R by punt **R**. Die blok se kinetiese energie by punt **Q** en **R** is onderskeidelik K_Q en K_R.

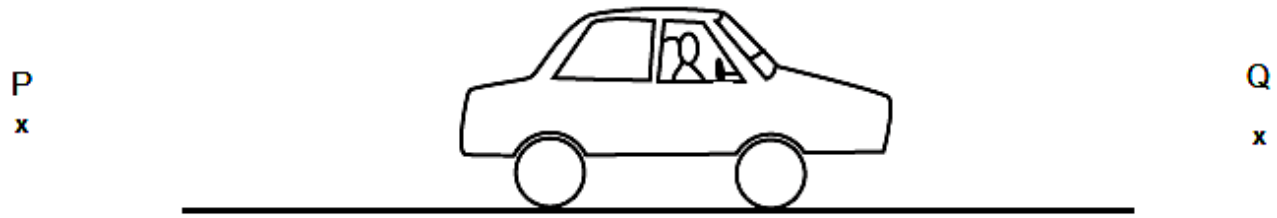


Watter EEN van die stellings oor die totale meganiese energie en die kinetiese energie van die blok by punt **Q** en **R** onderskeidelik is KORREK?

	TOTALE MEGANIESE ENERGIE E	**KINETIESE ENERGIE K**
A	$E_Q > E_R$	$K_Q = K_R$
B	$E_Q = E_R$	$K_Q < K_R$
C	$E_Q = E_R$	$K_Q = K_R$
D	$E_Q < E_R$	$K_Q > K_R$

(2)

1.6 Die diagram hieronder toon die posisies van twee stilstaande luisteraars, **P** en **Q**, relatief tot 'n motor wat teen 'n konstante snelheid na luisteraar **Q** beweeg. Die toeter van die motor stel klank vry. Luisteraars **P** en **Q** en die bestuurder hoor almal die klank van die toeter.

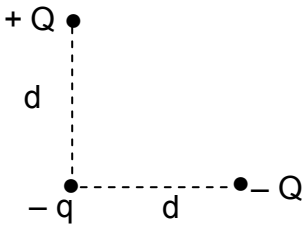


Watter EEN van die volgende is 'n KORREKTE beskrywing van die frekwensie van die klank wat **P** en **Q** hoor *in vergelyking met dit wat die bestuurder hoor*?

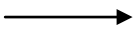
	FREKWENSIE VAN DIE KLANK WAT P HOOR	**FREKWENSIE VAN DIE KLANK WAT Q HOOR**
A	Laer	Hoër
B	Hoër	Hoër
C	Laer	Laer
D	Hoër	Laer

(2)

1.7 Twee ladings, + Q en – Q, word op 'n afstand d vanaf 'n negatiewe lading – q geplaas. Die ladings, + Q en – Q, word op lyne wat loodreg op mekaar is, gevind, soos in die diagram hieronder getoon.



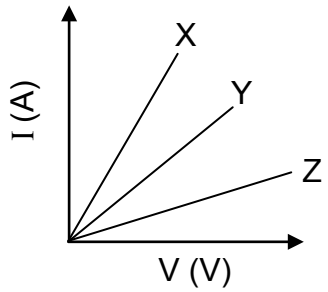
Watter EEN van die volgende pyltjies dui die rigting van die netto krag wat op lading - q inwerk as gevolg van die teenwoordigheid van lading + Q en – Q KORREK aan?

A	
B	
C	
D	

(2)

1.8 Leerders ondersoek die verwantskap tussen stroom (I) en potensiaalverskil (V) by 'n konstante temperatuur vir drie verskillende resistors, **X**, **Y** en **Z**.

Hulle verkry die grafieke hieronder.



Die weerstande van **X**, **Y** en **Z** is R_X, R_Y en R_Z onderskeidelik.

Watter EEN van die volgende gevolgtrekkings oor die weerstand van die resistors is KORREK?

A $R_z > R_Y > R_x$

B $R_X = R_Y = R_Z$

C $R_X > R_Y > R_Z$

D $R_X > R_Y$ en $R_Y < R_Z$ (2)

1.9 Watter EEN van die volgende veranderinge kan tot 'n toename in die emk van 'n WS-generator lei sonder om sy frekwensie te verander?

A Verlaag die weerstand van die spoel.

B Vergroot die oppervlakte van die spoel.

C Verhoog die weerstand van die spoel.

D Verlaag die rotasiespoed. (2)

1.10 Die golflengte van 'n monochromatiese ligbron **P** is twee keer dié van 'n monochromatiese ligbron **Q**. Die energie van 'n foton van ligbron **P** sal … van 'n foton van bron **Q** wees.

A 'n kwart van die energie

B die helfte van die energie

C gelyk aan die energie

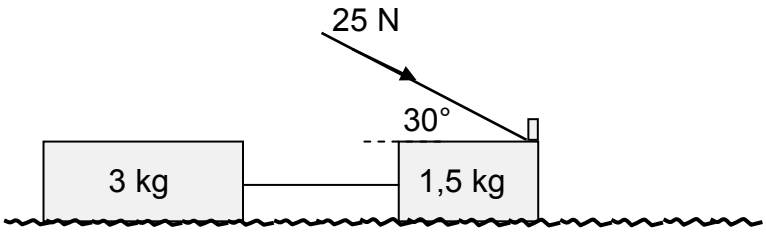
D twee keer die energie (2)

[20]

VRAAG 2 (Begin op 'n nuwe bladsy.)

'n Leerder bou 'n speelding wat hy kan stoot deur twee blokke met massa 1,5 kg en 3 kg onderskeidelik te gebruik. Die blokke word met 'n massalose, onrekbare toutjie verbind.

Die leerder pas dan 'n krag van 25 N teen 'n hoek van 30° op die 1,5 kg-blok toe deur middel van 'n ligte stewige staaf wat veroorsaak dat die speelding oor 'n plat, ruwe, horisontale oppervlak beweeg, soos in die diagram hieronder getoon.



Die kinetiese wrywingkoëffisiënt (μ_k) tussen die oppervlak en elke blok is 0,15.

2.1 Stel Newton se Tweede Bewegingswet in woorde. (2)

2.2 Bereken die grootte van die kinetiese wrywingskrag wat op die 3 kg-blok inwerk. (3)

2.3 Teken 'n benoemde vrye kragtediagram wat AL die kragte toon wat op die 1,5 kg-blok inwerk. (5)

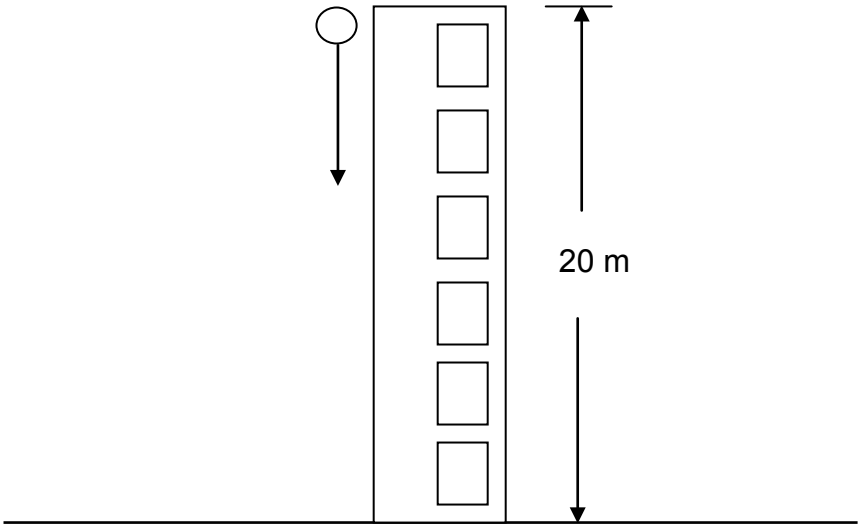
2.4 Bereken die grootte van die:

2.4.1 Kinetiese wrywingskrag wat op die 1,5 kg-blok inwerk (3)

2.4.2 Spanning in die toutjie wat die twee blokke verbind (5)
[18]

VRAAG 3 (Begin op 'n nuwe bladsy.)

'n Bal word vanaf die bokant van 'n 20 m hoë gebou laat val. Ignoreer die effek van lugweerstand.



3.1 Definieer die term *vryval*. (2)

3.2 Bereken die:

3.2.1 Spoed waarteen die bal die grond tref (4)

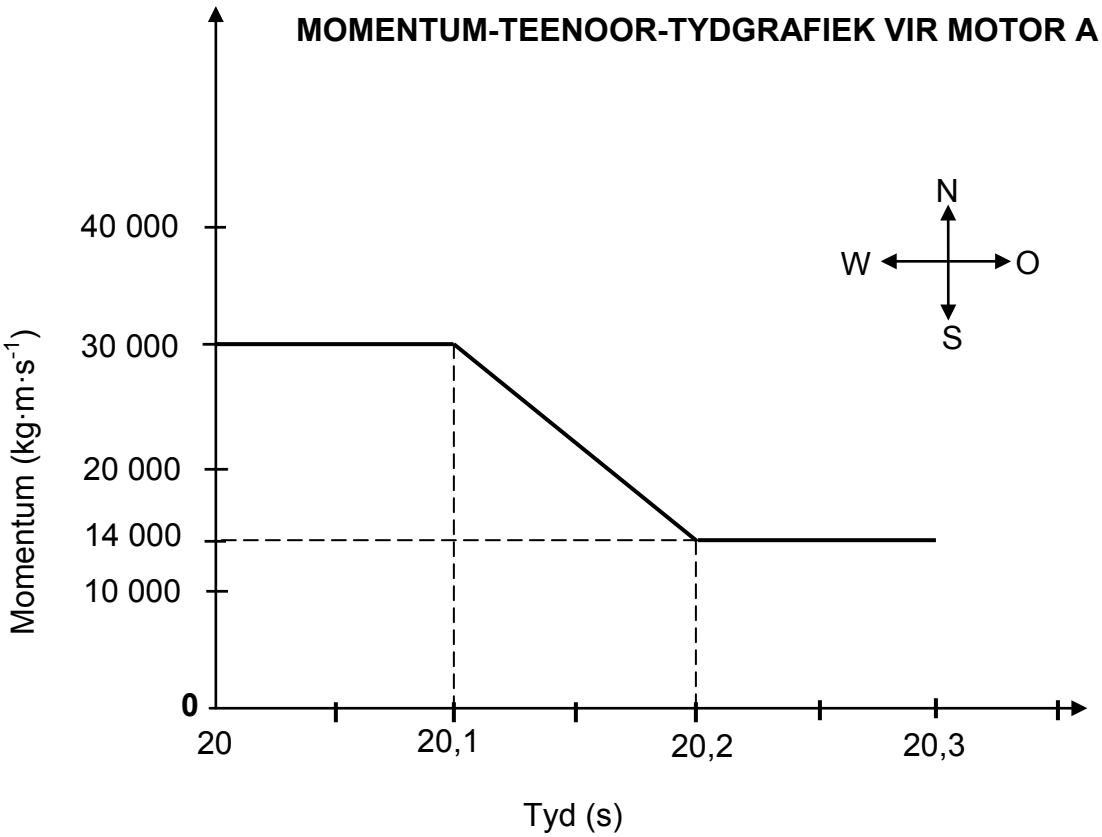
3.2.2 Tyd wat dit die bal neem om die grond te bereik (3)

3.3 Skets 'n snelheid-tyd-grafiek vir die beweging van die bal (geen waardes vereis nie). (2)
[11]

VRAAG 4 (Begin op 'n nuwe bladsy.)

Die grafiek hieronder toon hoe die momentum van motor **A** met verloop van tyd verander *net voor* en *net nadat* dit kop teen kop met motor **B** bots.

Motor **A** het 'n massa van 1 500 kg, terwyl die massa van motor **B** 900 kg is. Motor **B** het voor die botsing teen 'n konstante snelheid van 15 $m \cdot s^{-1}$ wes beweeg. Neem oos as positief en beskou die sisteem as geïsoleerd.



4.1 Wat verstaan jy onder die term *geïsoleerde sisteem* soos dit in fisika gebruik word? (1)

Gebruik die inligting in die grafiek om die volgende vrae te beantwoord.

4.2 Bereken die:

4.2.1 Grootte van die snelheid van motor **A** net voor die botsing (3)

4.2.2 Snelheid van motor **B** net na die botsing (5)

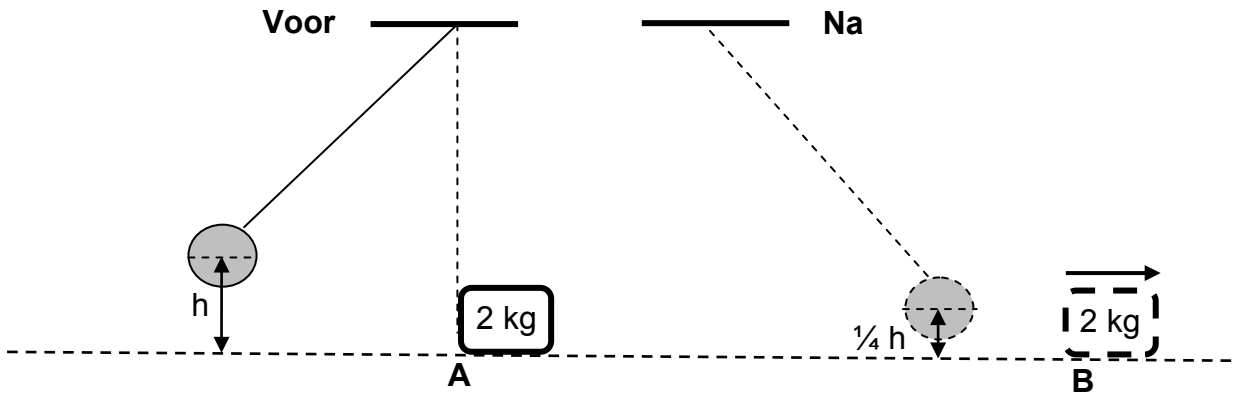
4.2.3 Grootte van die netto gemiddelde krag wat tydens die botsing op motor **A** inwerk (4)
[13]

VRAAG 5 (Begin op 'n nuwe bladsy.)

'n Pendulum met 'n skietlood met massa 5 kg word in rus op 'n hoogte van h meter bo die grond gehou. Wanneer dit losgelaat word, bots dit met 'n blok met massa 2 kg wat by punt **A** in rus is.

Die skietlood swaai verby **A** en kom vir 'n oomblik tot rus by 'n posisie ¼ h bo die grond.

Die diagramme hieronder is NIE volgens skaal geteken NIE.



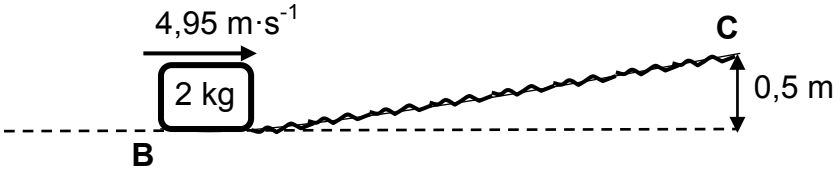
Onmiddellik na die botsing begin die 2 kg-blok teen 'n konstante spoed van 4,95 $m \cdot s^{-1}$ vanaf **A** na **B** beweeg.
Ignoreer wrywingseffekte en aanvaar dat geen verlies aan meganiese energie tydens die botsing voorkom nie.

5.1 Bereken die:

5.1.1 Kinetiese energie van die blok onmiddellik na die botsing (3)

5.1.2 Hoogte h (4)

Die blok beweeg van punt **B** met 'n snelheid van 4,95 $m \cdot s^{-1}$ teen 'n ruwe skuinsvlak op na punt **C**. Die spoed van die blok by punt **C** is 2 $m \cdot s^{-1}$. Punt **C** is 0,5 m bo die horisontaal, soos in die diagram hieronder getoon.
Tydens die beweging vanaf **B** na **C** werk 'n uniforme wrywingskrag op die blok in.



5.2 Stel die werk-energie-stelling in woorde. (2)

5.3 Gebruik energiebeginsels om die arbeid wat deur die wrywingskrag verrig word, te bereken wanneer die 2 kg-blok vanaf punt **B** na punt **C** beweeg. (4)
[13]

VRAAG 6 (Begin op 'n nuwe bladsy.)

6.1 'n Ambulans beweeg teen 'n konstante snelheid van 30 $m \cdot s^{-1}$ na 'n stilstaande luisteraar toe. Die sirene van die ambulans stel klankgolwe met 'n golflengte van 0,28 m vry. Neem die spoed van klank in lug as 340 $m \cdot s^{-1}$.

6.1.1 Stel die Doppler-effek in woorde. (2)

6.1.2 Bereken die frekwensie van die klankgolwe wat deur die sirene voortgebring word soos dit deur die bestuurder van die ambulans gehoor word. (3)

6.1.3 Bereken die frekwensie van die klankgolwe wat deur die sirene voortgebring word soos dit deur die luisteraar gehoor word. (5)

6.1.4 Hoe sal die antwoord op VRAAG 6.1.3 verander indien die spoed van die ambulans MINDER AS 30 $m \cdot s^{-1}$ is? Skryf slegs VERHOOG, VERLAAG of BLY DIESELFDE. (1)

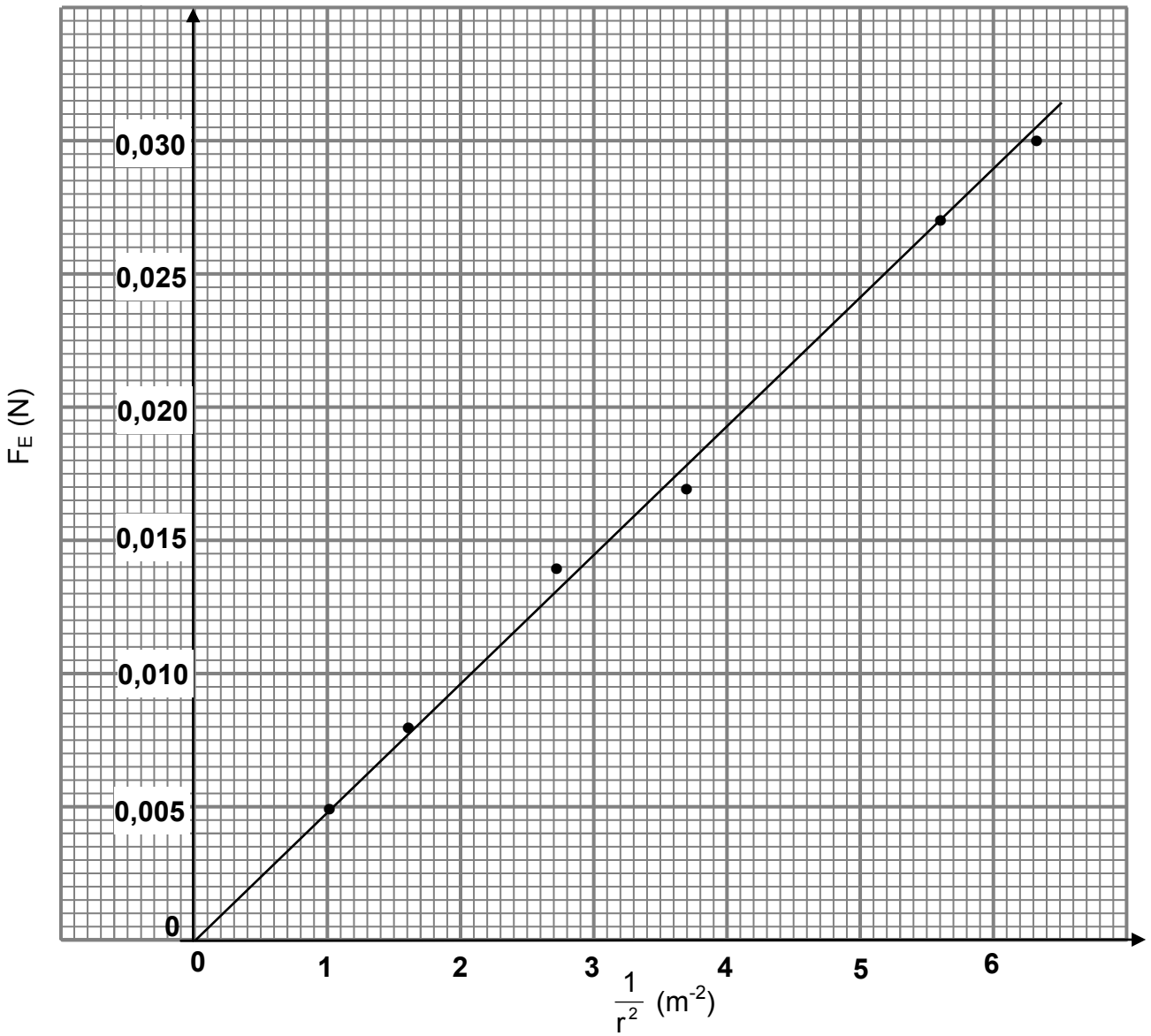
6.2 'n Waarneming van die spektrum van 'n afgeleë ster toon aan dat dit weg van die Aarde af beweeg.

Verduidelik, ten opsigte van die frekwensies van die spektraallyne, hoe dit moontlik is om tot die gevolgtrekking te kom dat die ster weg van die Aarde af beweeg. (2)
[13]

VRAAG 7 (Begin op 'n nuwe bladsy.)

7.1 In 'n eksperiment om die verwantskap tussen die elektrostatiese krag, F_E, en afstand, r, tussen twee **identiese**, positief gelaaide sfere te verifieer, is die grafiek hieronder verkry.

GRAFIEK VAN F_E TEENOOR $\frac{1}{r^2}$



7.1.1 Stel Coulomb se wet in woorde. (2)

7.1.2 Skryf die afhanklike veranderlike van die eksperiment neer. (1)

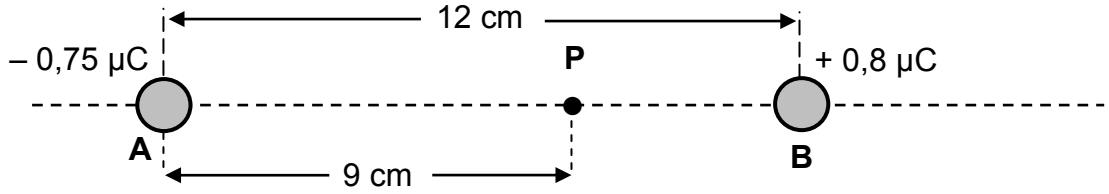
7.1.3 Watter verwantskap tussen die elektrostatiese krag F_E en die kwadraat van die afstand, r^2, tussen die gelaaide sfere kan uit die grafiek afgelei word? (1)

7.1.4 Gebruik die inligting in die grafiek om die lading op elke sfeer te bereken. (6)

7.2 'n Gelaaide sfeer, **A**, dra 'n lading van – 0,75 µC.

7.2.1 Teken 'n diagram wat die elektrieseveld-lyne rondom sfeer **A** toon. (2)

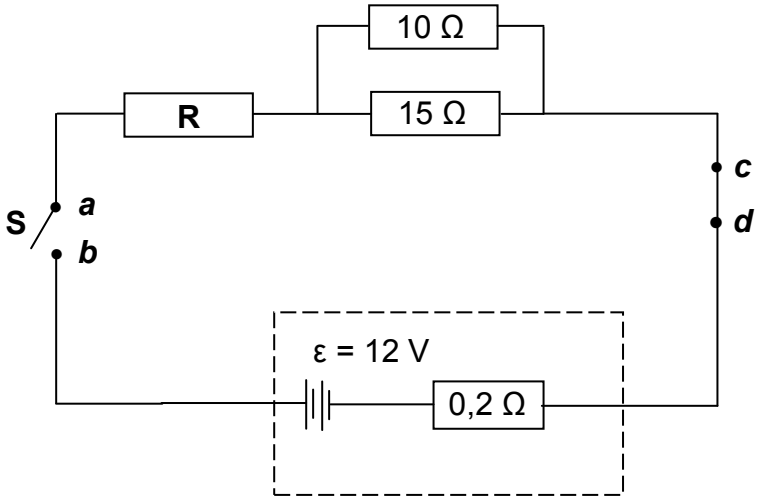
Sfeer **A** word 12 cm vanaf 'n ander gelaaide sfeer, **B**, in 'n reguitlyn in 'n vakuum geplaas, soos hieronder getoon. Sfeer **B** dra 'n lading van +0,8 µC. Punt **P** is 9 cm regs van sfeer **A** geleë.



7.2.2 Bereken die grootte van die netto elektriese veld by punt **P**. (5)
[17]

VRAAG 8 (Begin op 'n nuwe bladsy.)

8.1 In die stroombaan hieronder het die battery 'n emk (ε) van 12 V en 'n interne weerstand van 0,2 Ω. Die weerstande van die verbindingsdrade is weglaatbaar.



8.1.1 Definieer die term *emk van 'n battery.* (2)

8.1.2 Skakelaar **S** is oop. 'n Hoëweerstand-voltmeter is oor punt ***a*** *en* ***b*** geskakel.
Wat sal die lesing op die voltmeter wees? (1)

8.1.3 Skakelaar **S** word nou gesluit. Dieselfde voltmeter word nou oor punt ***c*** en ***d*** geskakel.
Wat sal die lesing op die voltmeter wees? (1)

Wanneer skakelaar **S** gesluit word, is die potensiaalverskil oor die terminale van die battery 11,7 V.

Bereken die:

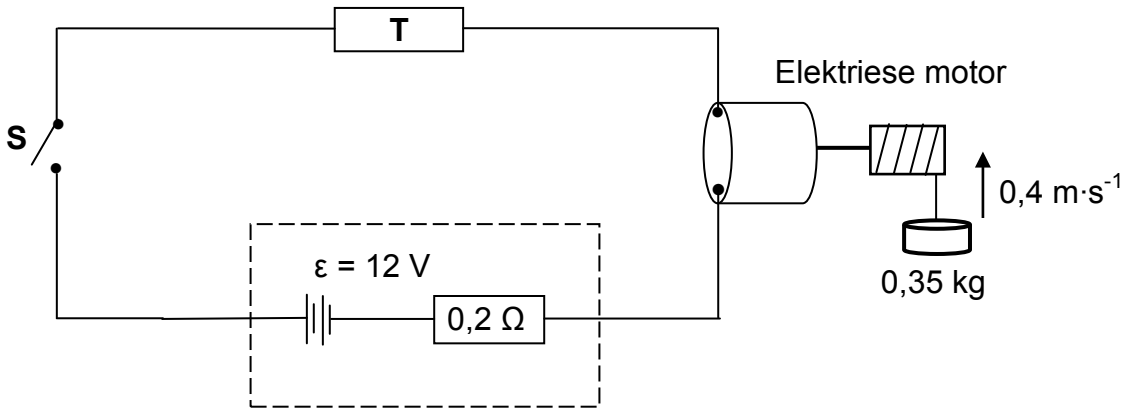
8.1.4 Stroom in die battery (3)

8.1.5 Effektiewe weerstand van die **parallelle** tak (2)

8.1.6 Weerstand van resistor **R** (4)

8.2 'n Battery met 'n emk van 12 V en 'n interne weerstand van 0,2 Ω word in serie geskakel met 'n baie klein elektriese motor en 'n resistor, **T**, met onbekende weerstand, soos in die stroombaan hieronder getoon.

Die motor is **X** watt, 3 volt gemerk, en funksioneer teen optimale toestande.



Wanneer skakelaar **S** gesluit is, hys die motor 'n massa van 0,35 kg vertikaal opwaarts teen 'n konstante snelheid van 0,4 $m \cdot s^{-1}$. Aanvaar dat daar geen energie-omskakeling na hitte en klank is nie.

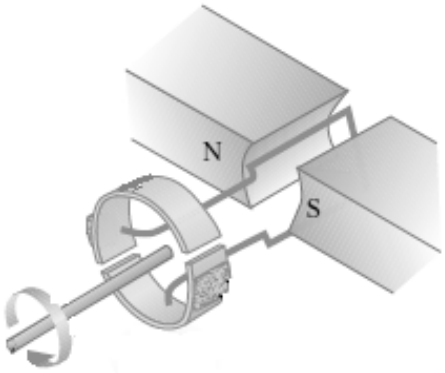
Bereken die waarde van:

8.2.1 **X** (3)

8.2.2 Die weerstand van resistor **T** (5)
[21]

VRAAG 9 (Begin op 'n nuwe bladsy.)

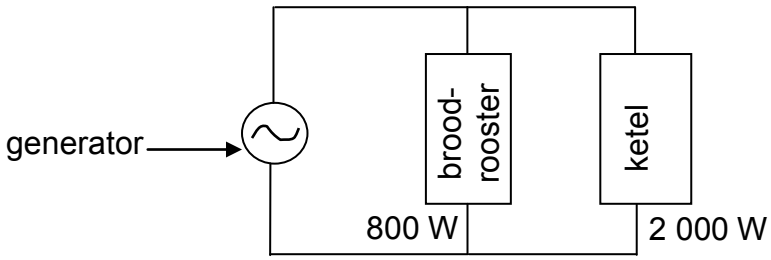
9.1 'n Generator word hieronder getoon. Neem aan dat die spoel in 'n vertikale posisie is.



9.1.1 Is die generator hierbo WS of GS? Gee 'n rede vir die antwoord. (2)

9.1.2 Skets 'n geïnduseerde-emk-teenoor-tyd-grafiek vir EEN volledige rotasie van die spoel. (Die spoel begin draai vanaf die vertikale posisie.) (2)

9.2 'n WS-generator werk teen 'n maksimum emk van 340 V. Dit word aan 'n broodrooster en 'n ketel gekoppel, soos in die diagram hieronder getoon.



Die broodrooster is 800 W gemerk, terwyl die ketel 2 000 W gemerk is. Beide werk onder optimale toestande.

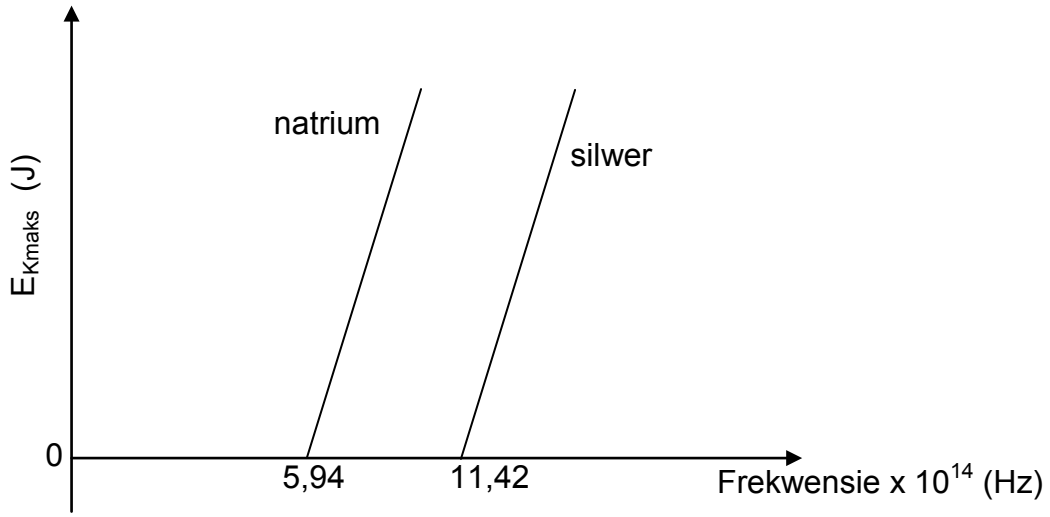
Bereken die:

9.2.1 wgk-stroom wat deur die broodrooster vloei (3)

9.2.2 Totale wgk-stroom wat deur die generator gelewer word (4)
[11]

VRAAG 10 (Begin op 'n nuwe bladsy.)

10.1 'n Leerder ondersoek die foto-elektriese effek vir twee verskillende metale, silwer en natrium, deur lig van verskillende frekwensies te gebruik. Die maksimum kinetiese energie van die vrygestelde foto-elektrone word teenoor die frekwensie van die lig vir elk van die metale geteken, soos getoon in die grafieke hieronder.



10.1.1 Definieer die term *drumpelfrekwensie*. (2)

10.1.2 Watter metaal, natrium of silwer, het die grootste arbeidsfunksie? Verduidelik die antwoord. (3)

10.1.3 Noem die fisiese konstante wat deur die helling van die grafieke verteenwoordig word. (1)

10.1.4 In watter metaal sal die vrygestelde foto-elektrone die grootste maksimum kinetiese energie hê indien lig met dieselfde frekwensie op elk van die metale geskyn word? (1)

10.2 In 'n ander foto-elektriese eksperiment word blou lig wat van 'n gloeilamp verkry is, op 'n metaalplaat geskyn en elektrone word vrygestel.

Die golflengte van die blou lig is 470×10^{-9} m, en die gloeilamp is 60 mW gemerk. Die gloeilamp is slegs 5% effektief.

10.2.1 Bereken die getal fotone wat per sekonde op die metaalplaat sal inval as aanvaar word dat al die lig vanaf die gloeilamp op die metaalplaat inval. (5)

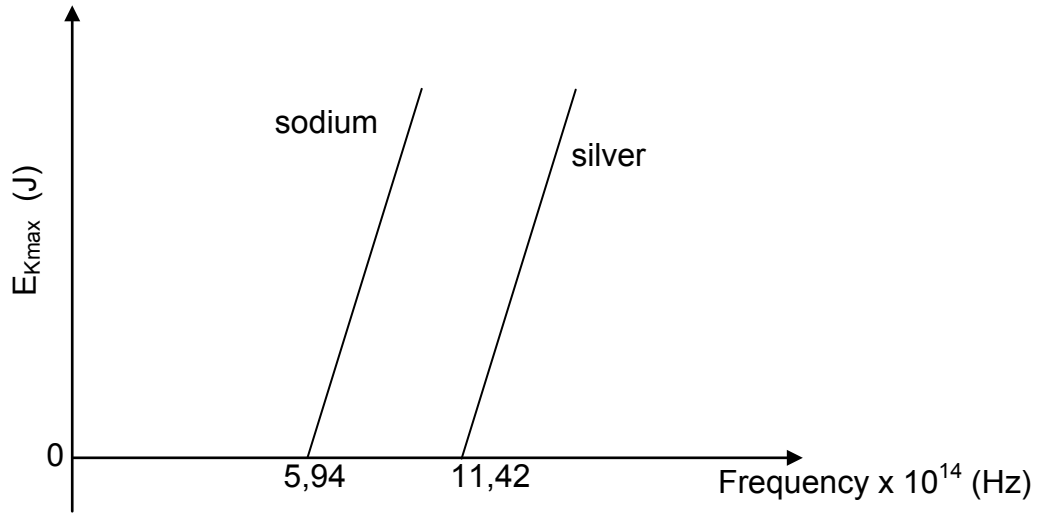
10.2.2 Skryf, **sonder enige verdere berekening**, die getal elektrone neer wat per sekonde vanaf die metaal vrygestel word. (1)

[13]

TOTAAL: 150

QUESTION 10 (Start on a new page.)

10.1 A learner is investigating the photoelectric effect for two different metals, silver and sodium, using light of different frequencies. The maximum kinetic energy of the emitted photoelectrons is plotted against the frequency of the light for each of the metals, as shown in the graphs below.



10.1.1 Define the term *threshold frequency*. (2)

10.1.2 Which metal, sodium or silver, has the larger work function? Explain the answer. (3)

10.1.3 Name the physical constant represented by the slopes of the graphs. (1)

10.1.4 If light of the same frequency is shone on each of the metals, in which metal will the ejected photoelectrons have a larger maximum kinetic energy? (1)

10.2 In a different photoelectric experiment blue light obtained from a light bulb is shone onto a metal plate and electrons are released.

The wavelength of the blue light is 470 x 10^{-9} m and the bulb is rated at 60 mW. The bulb is only 5% efficient.

10.2.1 Calculate the number of photons that will be incident on the metal plate per second, assuming all the light from the bulb is incident on the metal plate. (5)

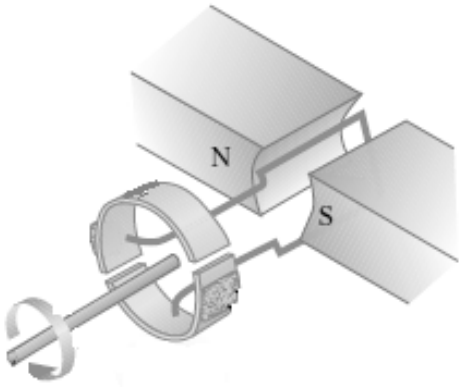
10.2.2 **Without any further calculation**, write down the number of electrons emitted per second from the metal. (1)

[13]

TOTAL: 150

QUESTION 9 (Start on a new page.)

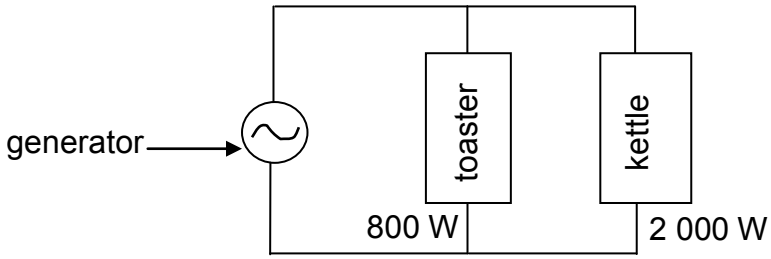
9.1 A generator is shown below. Assume that the coil is in a vertical position.



9.1.1 Is the generator above AC or DC? Give a reason for the answer. (2)

9.1.2 Sketch an induced emf versus time graph for ONE complete rotation of the coil. (The coil starts turning from the vertical position.) (2)

9.2 An AC generator is operating at a maximum emf of 340 V. It is connected across a toaster and a kettle, as shown in the diagram below.



The toaster is rated at 800 W, while the kettle is rated at 2 000 W. Both are working under optimal conditions.

Calculate the:

9.2.1 rms current passing through the toaster (3)

9.2.2 Total rms current delivered by the generator (4)
[11]

When switch **S** is closed, the potential difference across the terminals of the battery is 11,7 V.

Calculate the:

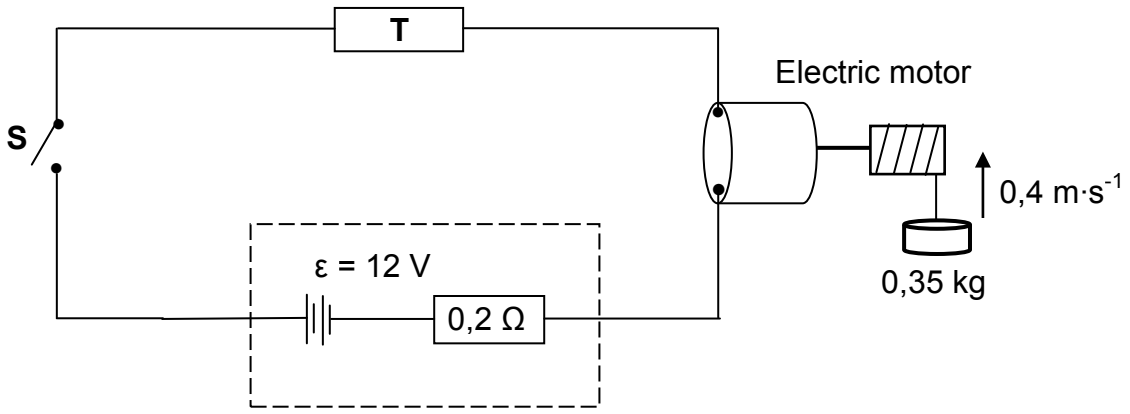
8.1.4 Current in the battery (3)

8.1.5 Effective resistance of the **parallel** branch (2)

8.1.6 Resistance of resistor **R** (4)

8.2 A battery with an emf of 12 V and an internal resistance of 0,2 Ω are connected in series to a very small electric motor and a resistor, **T**, of unknown resistance, as shown in the circuit below.

The motor is rated **X** watts, 3 volts, and operates at optimal conditions.



When switch **S** is closed, the motor lifts a 0,35 kg mass vertically upwards at a constant speed of 0,4 $m \cdot s^{-1}$. Assume that there is no energy conversion into heat and sound.

Calculate the value of:

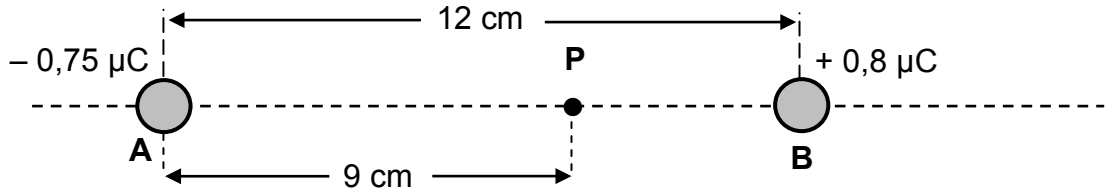
8.2.1 **X** (3)

8.2.2 The resistance of resistor **T** (5)
[21]

7.2 A charged sphere, **A**, carries a charge of – 0,75 µC.

7.2.1 Draw a diagram showing the electric field lines surrounding sphere **A**. (2)

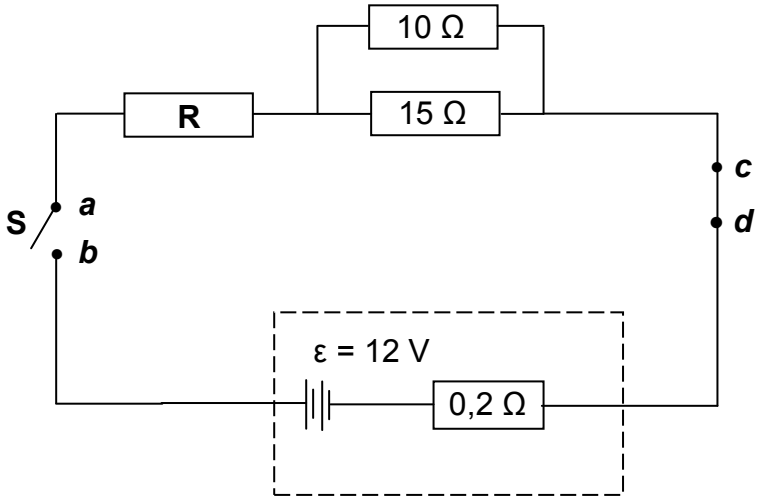
Sphere **A** is placed 12 cm away from another charged sphere, **B**, along a straight line in a vacuum, as shown below. Sphere **B** carries a charge of +0,8 µC. Point **P** is located 9 cm to the right of sphere **A**.



7.2.2 Calculate the magnitude of the net electric field at point **P**. (5)
[17]

QUESTION 8 (Start on a new page.)

8.1 In the circuit below the battery has an emf (ε) of 12 V and an internal resistance of 0,2 Ω. The resistances of the connecting wires are negligible.



8.1.1 Define the term *emf of a battery.* (2)

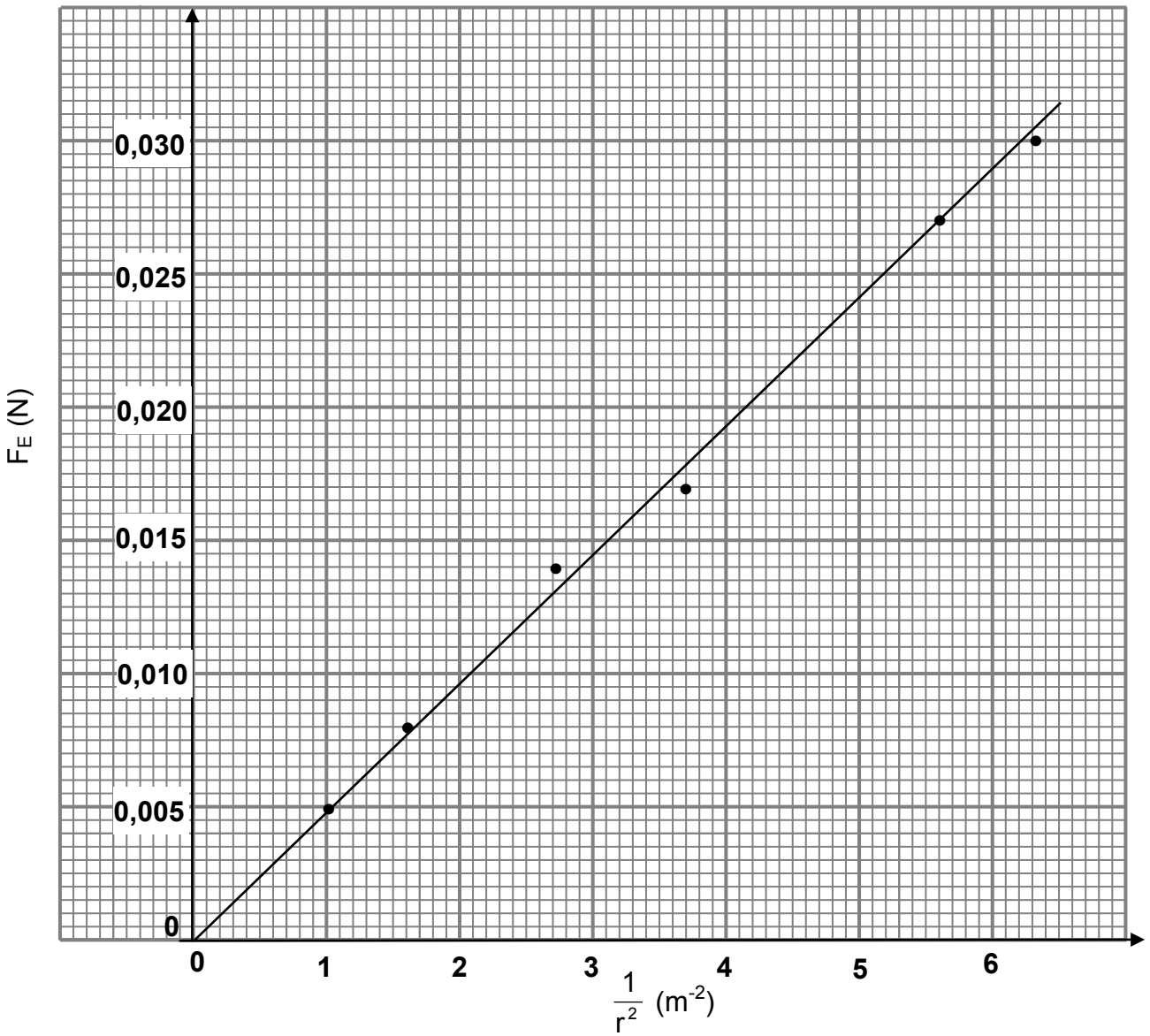
8.1.2 Switch **S** is open. A high-resistance voltmeter is connected across points ***a*** and ***b***.
What will the reading on the voltmeter be? (1)

8.1.3 Switch **S** is now closed. The same voltmeter is now connected across points ***c*** and ***d***.
What will the reading on the voltmeter be? (1)

QUESTION 7 (Start on a new page.)

7.1 In an experiment to verify the relationship between the electrostatic force, F_E, and distance, r, between two **identical**, positively charged spheres, the graph below was obtained.

GRAPH OF F_E VERSUS $\frac{1}{r^2}$



7.1.1 State Coulomb's law in words. (2)

7.1.2 Write down the dependent variable of the experiment. (1)

7.1.3 What relationship between the electrostatic force F_E and the square of the distance, r^2, between the charged spheres can be deduced from the graph? (1)

7.1.4 Use the information in the graph to calculate the charge on each sphere. (6)

QUESTION 6 (Start on a new page.)

6.1 An ambulance is moving towards a stationary listener at a constant speed of 30 $m \cdot s^{-1}$. The siren of the ambulance emits sound waves having a wavelength of 0,28 m. Take the speed of sound in air as 340 $m \cdot s^{-1}$.

6.1.1 State the Doppler effect in words. (2)

6.1.2 Calculate the frequency of the sound waves emitted by the siren as heard by the ambulance driver. (3)

6.1.3 Calculate the frequency of the sound waves emitted by the siren as heard by the listener. (5)

6.1.4 How would the answer to QUESTION 6.1.3 change if the speed of the ambulance were LESS THAN 30 $m \cdot s^{-1}$? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

6.2 An observation of the spectrum of a distant star shows that it is moving away from the Earth.

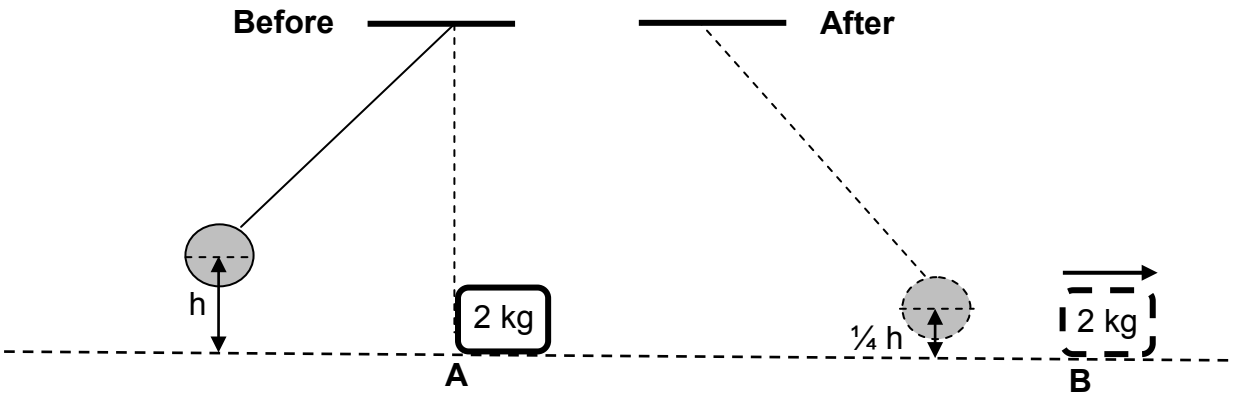
Explain, in terms of the frequencies of the spectral lines, how it is possible to conclude that the star is moving away from the Earth. (2)
[13]

QUESTION 5 (Start on a new page.)

A pendulum with a bob of mass 5 kg is held stationary at a height h metres above the ground. When released, it collides with a block of mass 2 kg which is stationary at point **A**.

The bob swings past **A** and comes to rest momentarily at a position ¼ h above the ground.

The diagrams below are NOT drawn to scale.



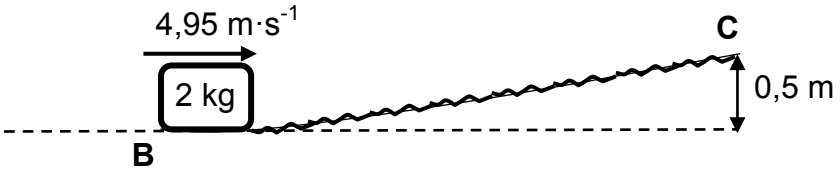
Immediately after the collision the 2 kg block begins to move from **A** to **B** at a constant speed of 4,95 $m \cdot s^{-1}$.
Ignore frictional effects and assume that no loss of mechanical energy occurs during the collision.

5.1 Calculate the:

5.1.1 Kinetic energy of the block immediately after the collision (3)

5.1.2 Height h (4)

The block moves from point **B** at a velocity of 4,95 $m \cdot s^{-1}$ up a rough inclined plane to point **C**. The speed of the block at point **C** is 2 $m \cdot s^{-1}$. Point **C** is 0,5 m above the horizontal, as shown in the diagram below.
During its motion from **B** to **C** a uniform frictional force acts on the block.



5.2 State the work-energy theorem in words. (2)

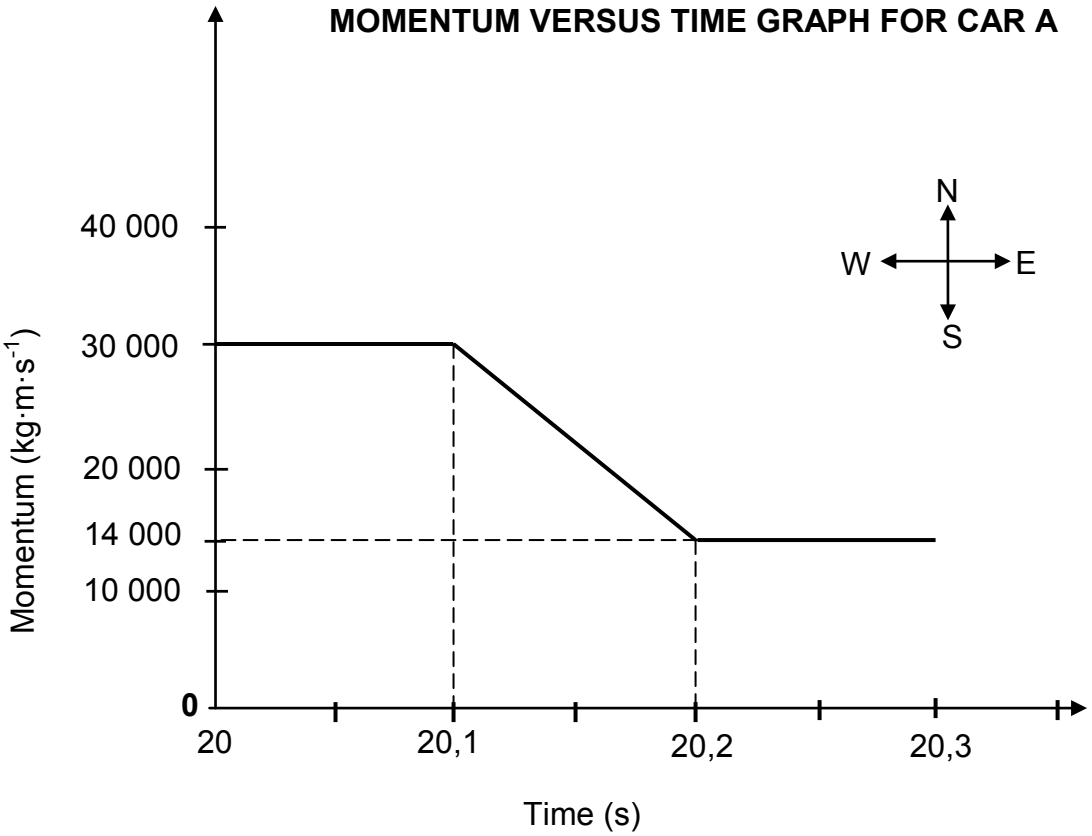
5.3 Use energy principles to calculate the work done by the frictional force when the 2 kg block moves from point **B** to point **C**. (4)

[13]

QUESTION 4 (Start on a new page.)

The graph below shows how the momentum of car **A** changes with time *just before* and *just after* a head-on collision with car **B**.

Car **A** has a mass of 1 500 kg, while the mass of car **B** is 900 kg.
Car **B** was travelling at a constant velocity of 15 $m \cdot s^{-1}$ west before the collision.
Take east as positive and consider the system as isolated.



4.1 What do you understand by the term *isolated system* as used in physics? (1)

Use the information in the graph to answer the following questions.

4.2 Calculate the:

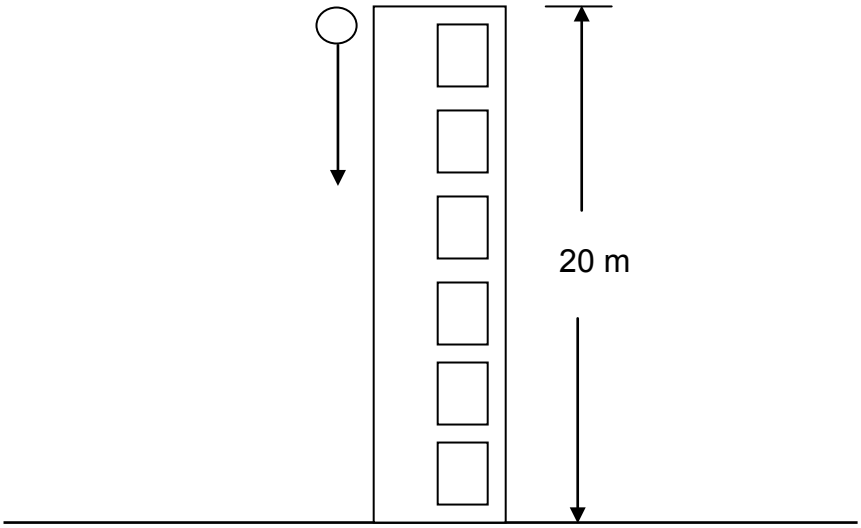
4.2.1 Magnitude of the velocity of car **A** just before the collision (3)

4.2.2 Velocity of car **B** just after the collision (5)

4.2.3 Magnitude of the net average force acting on car **A** during the collision (4)
[13]

QUESTION 3 (Start on a new page.)

A ball is dropped from the top of a building 20 m high. Ignore the effects of air resistance.



3.1 Define the term *free fall*. (2)

3.2 Calculate the:

3.2.1 Speed at which the ball hits the ground (4)

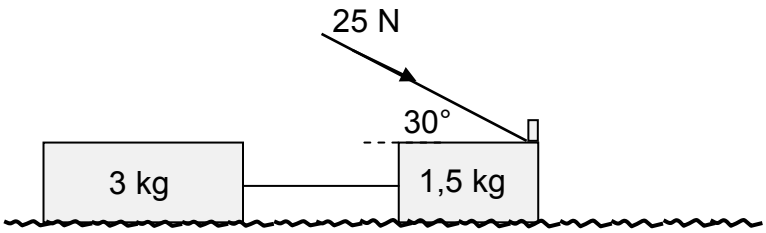
3.2.2 Time it takes the ball to reach the ground (3)

3.3 Sketch a velocity-time graph for the motion of the ball (no values required). (2)
[11]

QUESTION 2 (Start on a new page.)

A learner constructs a push toy using two blocks with masses 1,5 kg and 3 kg respectively. The blocks are connected by a massless, inextensible cord.

The learner then applies a force of 25 N at an angle of 30^o to the 1,5 kg block by means of a light rigid rod, causing the toy to move across a flat, rough, horizontal surface, as shown in the diagram below.



The coefficient of kinetic friction (μ_k) between the surface and each block is 0,15.

2.1 State Newton's Second Law of Motion in words. (2)

2.2 Calculate the magnitude of the kinetic frictional force acting on the 3 kg block. (3)

2.3 Draw a labelled free-body diagram showing ALL the forces acting on the 1,5 kg block. (5)

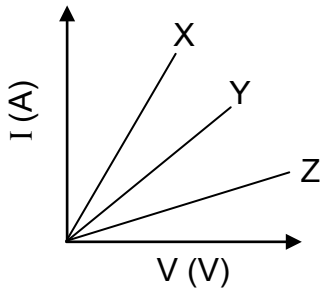
2.4 Calculate the magnitude of the:

2.4.1 Kinetic frictional force acting on the 1,5 kg block (3)

2.4.2 Tension in the cord connecting the two blocks (5)
[18]

1.8 Learners investigate the relationship between current (I) and potential difference (V) at a constant temperature for three different resistors, **X**, **Y** and **Z**.

They obtain the graphs shown below.



The resistances of **X**, **Y** and **Z** are R_X, R_Y and R_Z respectively.

Which ONE of the following conclusions regarding the resistances of the resistors is CORRECT?

A $R_z > R_Y > R_x$

B $R_X = R_Y = R_Z$

C $R_X > R_Y > R_Z$

D $R_X > R_Y$ and $R_Y < R_Z$ (2)

1.9 Which ONE of the following changes may lead to an increase in the emf of an AC generator without changing its frequency?

A Decrease the resistance of the coil.

B Increase the area of the coil.

C Increase the resistance of the coil.

D Decrease the speed of rotation. (2)

1.10 The wavelength of a monochromatic light source **P** is twice that of a monochromatic light source **Q**. The energy of a photon from source **P** will be … of a photon from source **Q**.

A a quarter of the energy

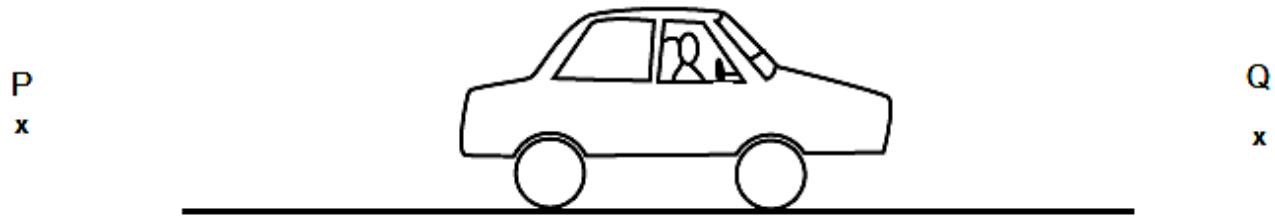
B half the energy

C equal to the energy

D twice the energy (2)

[20]

1.6 The diagram below shows the positions of two stationary listeners, **P** and **Q**, relative to a car moving at a constant velocity towards listener **Q**. The hooter on the car emits sound. Listeners **P** and **Q** and the driver all hear the sound of the hooter.

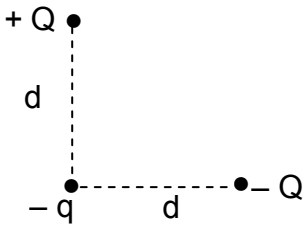


Which ONE of the following CORRECTLY describes the frequency of the sound heard by **P** and **Q**, *compared to that heard by the driver*?

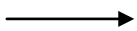
	FREQUENCY OF THE SOUND HEARD BY P	FREQUENCY OF THE SOUND HEARD BY Q
A	Lower	Higher
B	Higher	Higher
C	Lower	Lower
D	Higher	Lower

(2)

1.7 Two charges, + Q and – Q, are placed a distance d from a negative charge – q. The charges, + Q and – Q, are located along lines that are perpendicular to each other as shown in the diagram below.



Which ONE of the following arrows CORRECTLY shows the direction of the net force acting on charge – q due to the presence of charges + Q and – Q?

A	
B	
C	
D	

(2)

1.4 A person drops a glass bottle onto a concrete floor from a certain height and the bottle breaks. The person then drops a second, identical glass bottle from the same height onto a thick, woollen carpet, but the bottle does not break.

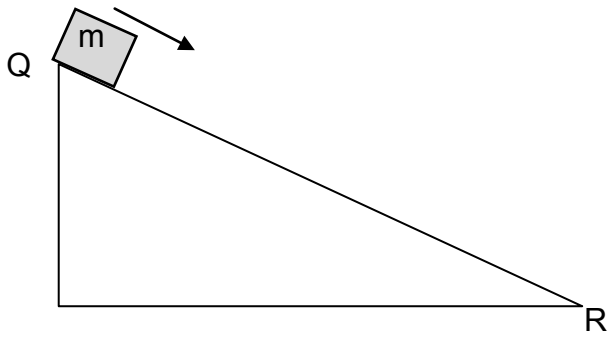
Which ONE of the following is CORRECT for the second bottle compared to the first bottle for the same momentum change?

	AVERAGE FORCE ON SECOND BOTTLE	**TIME OF CONTACT WITH CARPET**
A	Larger	Smaller
B	Smaller	Smaller
C	Larger	Larger
D	Smaller	Larger

(2)

1.5 A block of mass m is released from rest from the top of a frictionless inclined plane **QR**, as shown below.

The total mechanical energy of the block is E_Q at point **Q** and E_R at point **R**. The kinetic energy of the block at points **Q** and **R** is K_Q and K_R respectively.



Which ONE of the statements regarding the total mechanical energy and the kinetic energy of the block at points **Q** and **R** respectively is CORRECT?

	TOTAL MECHANICAL ENERGY E	**KINETIC ENERGY K**
A	$E_Q > E_R$	$K_Q = K_R$
B	$E_Q = E_R$	$K_Q < K_R$
C	$E_Q = E_R$	$K_Q = K_R$
D	$E_Q < E_R$	$K_Q > K_R$

(2)

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:

1.11 | A | B | C | ~~D~~ |

1.1 The tendency of an object to remain at rest or to continue in its uniform motion in a straight line is known as …

A inertia.

B acceleration.

C Newton's Third Law.

D Newton's Second Law. (2)

1.2 The mass of an astronaut on Earth is M. At a height equal to twice the radius of the Earth, the **mass** of the astronaut will be …

A $\frac{1}{4}$M

B $\frac{1}{9}$M

C M

D 2M (2)

1.3 An object is thrown vertically upwards from the ground.

Which ONE of the following is CORRECT regarding the direction of the acceleration of the object as it moves upwards and then downwards? Ignore the effects of air resistance.

	OBJECT MOVING UPWARDS	OBJECT MOVING DOWNWARDS
A	Downwards	Upwards
B	Upwards	Downwards
C	Downwards	Downwards
D	Upwards	Upwards

(2)

INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of 10 questions. Answer ALL the questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable calculator.

7. You may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your final numerical answers to a minimum of TWO decimal places.

11. Give brief motivations, discussions et cetera where required.

12. Write neatly and legibly.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHSC.1

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2016

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages and 3 data sheets.

MORNING SESSION