



Province of the  
**EASTERN CAPE**  
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo  
Provinsie van die Oos Kaap: Departement van Onderwys  
Porafensie Ya Kapa Botjhabela: Lefapha la Thuto

# **NATIONAL SENIOR CERTIFICATE**

**KEREITI 12**

**LOETSE 2024**

**FISIKALE SAENSESE P1  
(FIZIKS)**

**DIMARAKA: 150**

**NAKO: Dihora tse 3**

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Pampiri ena e na le maqephe a 21 ho kenyeletsa le didata shiti tse 3.

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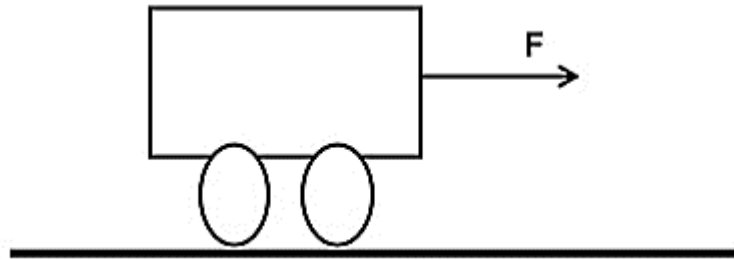
**DITAELO LE TLHAHISOLESERING**

1. Ngola ka botlalo LEBITSO le FANE tsa hao dibakeng tse tswanelehileng BUKENG YA HO ARABELA.
2. Pampiri ena e na le dipotso tse 11. Araba dipotso KAOFELA ka BUKENG YA HO ARABELA.
3. Qala POTSO ka NNGWE leqepheng le LETJHA BUKENG YA HO ARABELA.
4. Nomora dikarabo tsa hao fela jwalo ka ha dipotso di nomorilwe ho pamperi ya dipotso.
5. Siya mola O LE MONG dipakeng tsa dipotso, mohlala dipakeng tsa POTSO YA 2.1 le POTSO YA 2.2.
6. O ka sebedisa khaltjhuleitha e sa porokeremuwang.
7. O ka sebedisa dimathematical instrument tse tswanelehileng.
8. Bontsha KAOFELA difomulara le disubstitjhushene tsohle tsa moo o khaltjhuleitileng.
9. Atametsa dikarabo tsa hao TSA HO QETELA tsa dinomoro ho didesimale TSE PEDI.
10. Fana ka tshehetso, dimanollo jwalo jwalo moo ho hlokehang.
11. O eletswa ho sebedisa DITATA SHITI tse kgomareditsweng.
12. Ngola ka mongolo o hlakileng.

**POTSO YA 1: DIPOTSO TSA KGETHO**

Dikgetho tse fapaneng di fanwe e le dikarabo tse ka nepahalang dipotsong tse latelang. Kgetha karabo o ngole tlhaku fela (A–D) pela nomoro ya potso (1.1 ho ya ho 1.10) ka BUKENG YA HO ARABELA, mohlala, 11.1E.

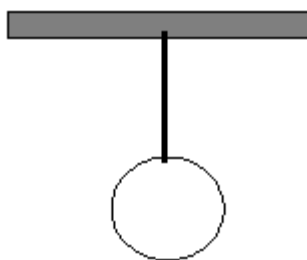
- 1.1 Terole e tsamaya sebakeng se tsitsitseng, ka fose e sa fetoheng,  $F$ , e apolauweng ho yona.



Ke efe ya difisikale kwathithi E LE NNGWE E TLA DULA e sa fetohle ha terole e tsamaya?

- A Momentamo
- B Akeselerashene
- C Kaenetike enoji
- D Kerafitheishenale potenshiale enoji (2)

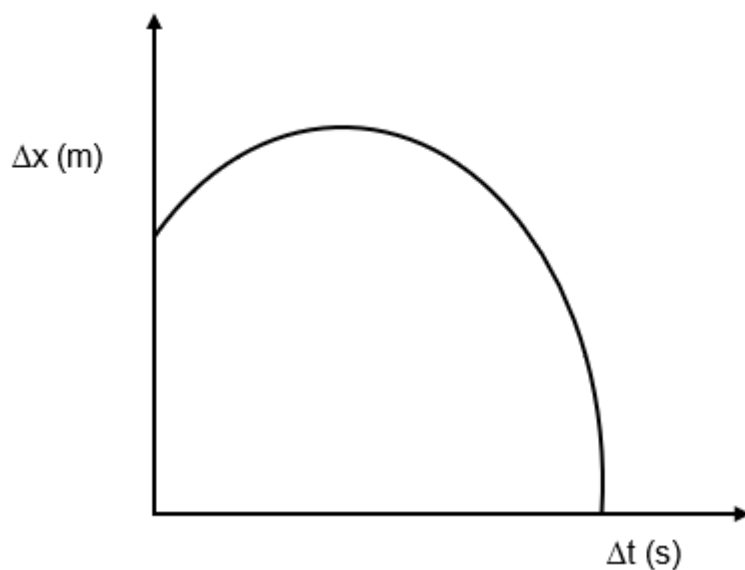
- 1.2 Sifiye se khomareditsweng thapong se leketlisitsweng ho tloha palong e otlohohileng e tsitsitseng, jwalo ka ha ho bontshitswe tayakeramong e ka tlase.



Reekeshene fose e ho kerafitheishenale fose e etswang ke lefatshe ho sifiye ke ...

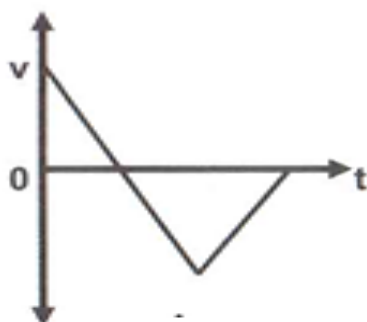
- A fose ya palo ho sifiye.
- B fose ya kgwele sifiyeng.
- C Fose ya sefiye lefatsheng.
- D Fose ya palo kgweleng. (2)

- 1.3 Position versus time, kerafo e ka tlase e bontsha motsamano wa ntho e tsamayang fetikale. Nka lefatshe e le zero reference.

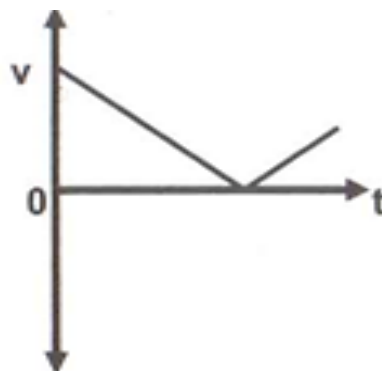


Ke efe E LE NNGWE ya tse latelang ho kerafo ya velocity-time e ka tlase e emetseng hantle motsamano wa ntho?

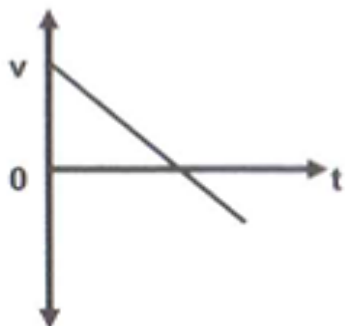
A



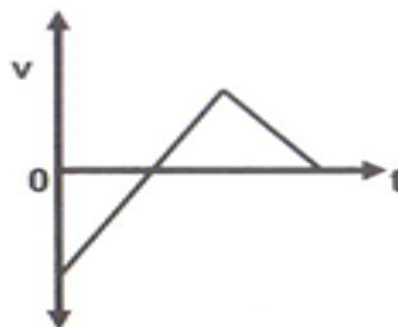
B



C

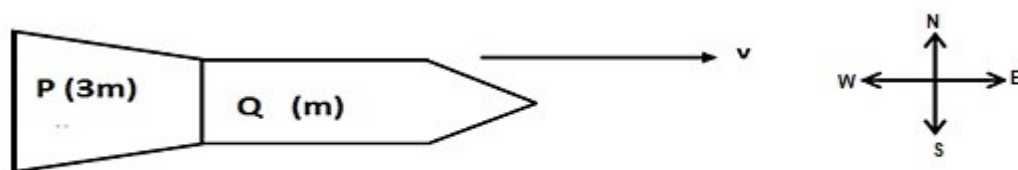


D



(2)

- 1.4 Spacecraft, se entsweng ka dimojule tse pedi **P** le **Q** tsa boima ba **3m** le **m** ka ho latellana, e tsamayang motsitseng ka felositi ya **v** ho ya botjhabela. Explosion e etsa hore dimojule di arohane.

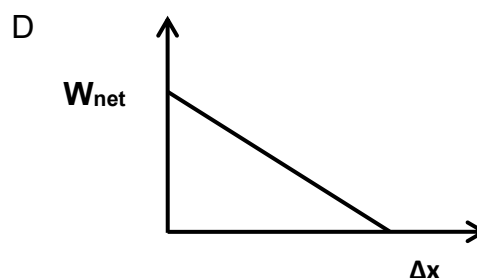
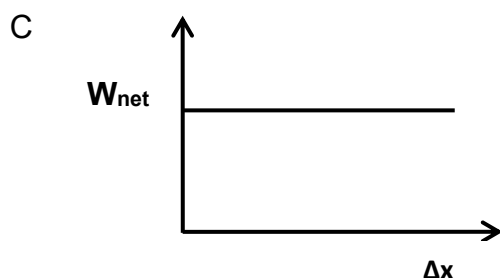
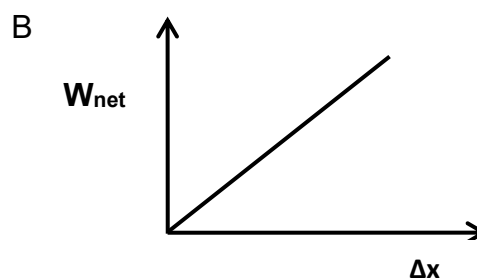
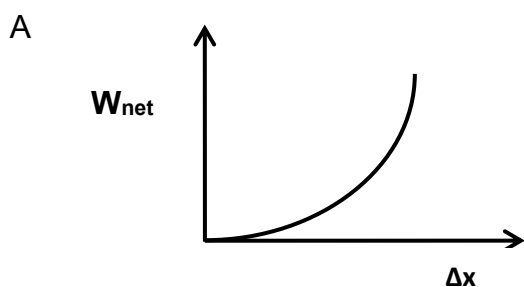


Mojule wa **Q** u tswela pele ka lehlakoreng la wona la mathomo hang kamora explosion ya felositi ya  $3v$ . E tla ba bokae **makenetjute le lehlakore** la felositi ya **P** hang kamora seqhomane?

	MAKENETJUTE YA FELOSITI YA <b>P</b>	LEHLAKORE LA <b>P</b> KAMORA SEQHOMANE
<b>A</b>	$\frac{1}{3}v$	Botjhabela
<b>B</b>	$v$	Bophirima
<b>C</b>	$v$	Botjhabela
<b>D</b>	$\frac{1}{3}v$	Bophirima

- 1.5 Koi e tsamaya ho tloha sethathong ka laene e setereiti tlasa kgahlamelo ya nete fose.

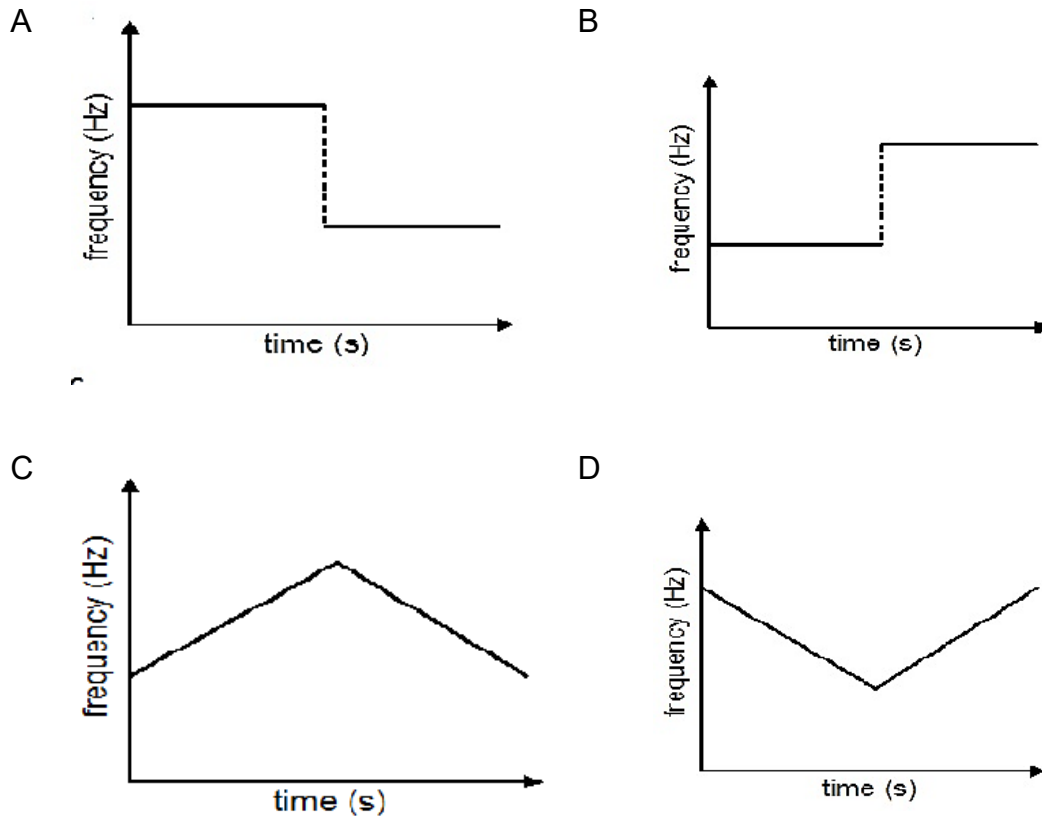
Ke efe **E LE NNGWE** ho dikerafo tse latelang e emetseng hantle net work done ( $W_{\text{net}}$ ) ya koi e amanang le displacement ( $\Delta x$ )?



(2)

- 1.6 Mohlodi wa modumo o atamela momamedli ya emeng moleng o otlolohileng ka felositi e sa fetoheng. O feta momamedi o tsamaya ho tloha ho momamedi ka moleng o otlolohileng ka felositi e e sa fetoheng.

Ke efe E NGWE ya dikerafo tse latelang e emetseng hantle phetoho e bonwang ya forekwensi kgahlanong le nako?



(2)

- 1.7 Tjhatjhe ya teko e nyane  $+q$  e beuwe hantle depakeng tsa ditjatjhe tse tswanang tse lekanang tse posetifo, **X** and **Y**, bobedi di na le tjhatjhe ya  $+Q$ , jwalo ka ha ho bontshitswe ka tlase.

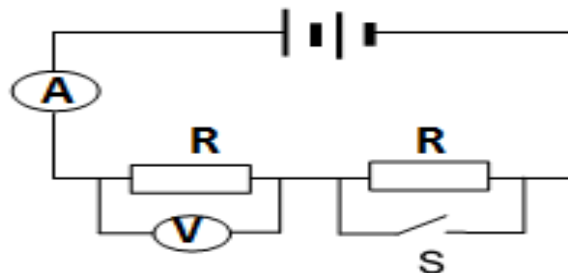


Tjhatjhe ya teko  $+q$  e tla ...

- A tsamaya ho ya tlase.
- B tsamaya ho ya ho **X**.
- C tsamaya ho ya ho **Y**.
- D dula e eme.

(2)

- 1.8 Resisetense ya kahare ya leshala teyakeramong ya sekete e ka tlase ha e na kgahlamelo.

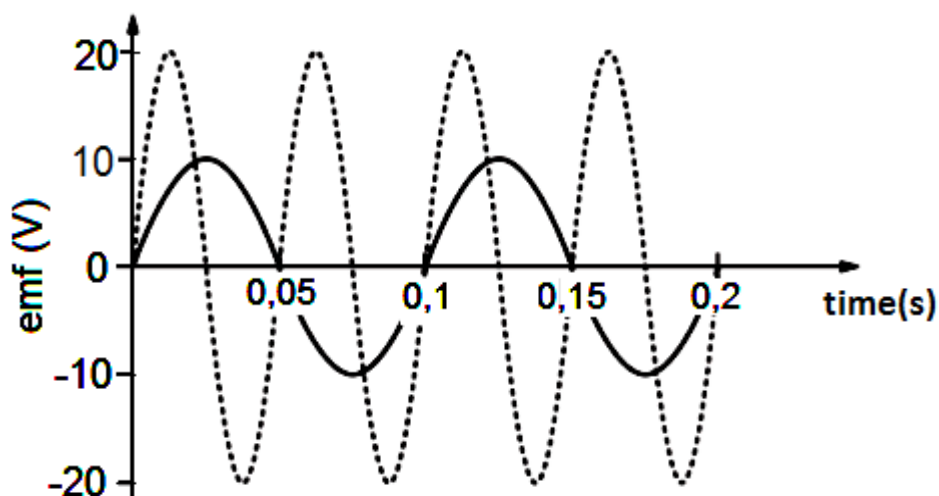


Ha switjhi **S** e kwalwa, ke efe ENNGWE ya tse latelang e emetseng hantle phetoho ya palo ya foletemitha le ammitha?

	PALO YA FOLETEMITHA	PALO YA AMMITHA
A	E a fokotseha	E a nyoloha
B	E a nyoloha	E a fokotseha
C	E a fokotseha	E a fokotseha
D	E a nyoloha	E a nyoloha

(2)

- 1.9 Kerafong e ka tlase, mola o feletseng u emetse Emf e etswang ke jenereita e simpole, ha e fetoha le nako. Mola o makgekakgeka u bontsha Emf ya jenereita e tswanang kamora hore phetoho e etswe.



Ke phetoho efe e entsweng ho hlahisa diphetho tsa mola wa kerafo e makgekakgeka?

- A Ke ha lebelo ho potapota le hafotswe.
- B Ke ha lebelo le ekeditswe habedi.
- C Split-ring commutator e kenyeleditswe.
- D Maborashe a kenyeleditswe. (2)

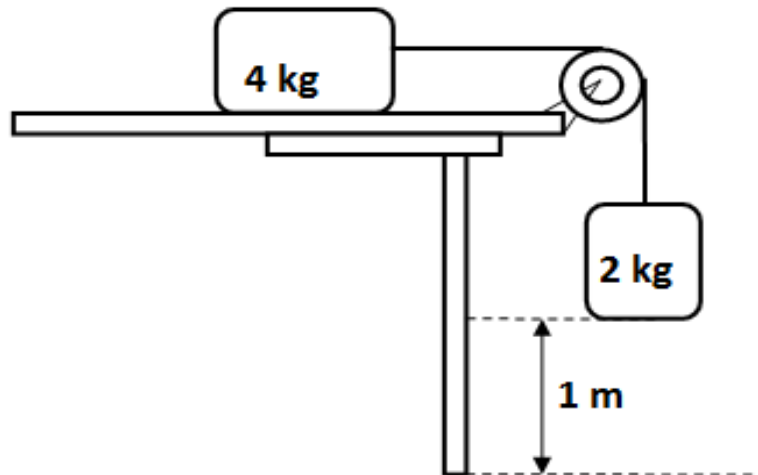
- 1.10 Ha ekesaethete eleketerone e tsamaya ho tloha ho eneji e hodimo ho ya ho eneji e tlase ka boemo e sepesifiki ...

- A Emishne laene ya emishene sepeketeramo e ya bonwa.
  - B Emishene laene abosoposhene sepeketeramo e ya bonwa.
  - C Abosoposhene laene ya emishene sepeketeramo e ya bonwa.
  - D abosoposhene laene ya abosoposhene e ya bonwa. (2)
- [20]**



**POTSO YA 2 (Qala leqepheng le letjha.)**

Boloko ba boima ba 4kg bo tswerwe tafoleng e motsitseng. Boloko bo hokahantswe le khwele e bobebe e sa saroloheng e fetang hodima phuli e se nang mahoashe ho boloko bo bong ba boima ba 2 kg. Boloko ba 2kg bo leketlile ho ya hodimo jwalo ka ha ho bontshitswe tayakeramong e ka tlase.



Boloko ba 4 kg jwale bo a tlohellwa, le sisitimi ya boima e tsamaya e ya le hlakoreng le letona. Koeffisente ya kaenetike forekesahene dipakeng tsa boloko ba 4 kg ke 0,25. Lesa kgahlamello ya forekishene ya moya.

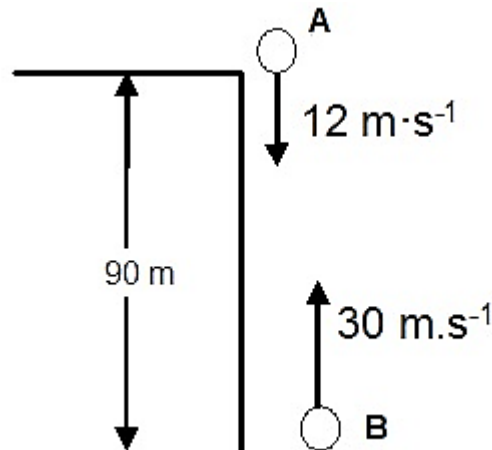
- 2.1 Hlalosa Newton's Second Law ka mantswa. (2)
- 2.2 Teroya foree boti e bontshang difose KAOFELA ho boloko ba 4 kg pele ho motsamao. (4)
- 2.3 Khaltjhuleitha makenetjute ya:
  - 2.3.1 Forikeshene fose e etsahalang bolokong ba 4 kg (3)
  - 2.3.2 Lebelo leo boima ba 2 kg bo otlang fatshe (7)
- 2.4 Hlalosa hore hobaneng motsamao wa boloko ba 2 kg BO KEKE ba lekanngwa ele ba 'foree fole' ya motsama. (2)

**[18]**

**POTSO YA 3 (Qala leqepheng le letjha. )**

Bolo ya **A** e betsetswa fatshe ho tloha mohawong, 90 m ho ya hodimo, ka felositi ya  $12 \text{ m}\cdot\text{s}^{-1}$ . Ka nako e tshwanang, bolo ya bobedi e tshwanang e betsetswa hodimo ka felositi ya  $30 \text{ m}\cdot\text{s}^{-1}$ . Bolo ya **A** le bolo ya **B** di fetana kamora 2,135 s.

Lesa kgahlamelo ya mahwashe a moya.



- 3.1 Fana ka lehlakore leo akasalerashene ya bolo ya **B** ha e ya hodimo. (1)
- 3.2 Khaltjuleitha felositi ya bolo ya **B** ka nakong eo e fetanang le bolo ya **A**. (3)
- 3.3 Khaltjuleitha sebaka se dipakeng tsa bolo ya **A** le ya **B** 2,5 s kamora hore dibolo di betswe. (5)
- 3.4 Seteng ya diakeses tse tswanang teroya seketjhe sa poseshene-nako ya dikerafo tsa motsamao wa bolo ya **A** le bolo ya **B**.
  - Bakeng sa bolo ya **A**, ho tloha nakong eo e betswang ho fihlela e fihla fatshe.
  - Bakeng sa bolo ya **B** ho tloha nakong, yeo e betswang ho fihlela e feta bolo ya **A**.
  - Bontsha ka ho hlaka nako eo dibolo tse pedi di fetanang.
  - Sebedisa fetshe e le zero position.
  - Leyibola dikerafo tsa **A** le **B**. (3)

**[12]**

**POTSO YA 4 (Qala leqepheng le letjha. )**

Koloi e nkang dithoto ya boima ba 5 000 kg, e tsamaya ka felositi ya  $15 \text{ m}\cdot\text{s}^{-1}$  ho ya lehlakoreng le letona ha di tjhaisana phatla-ntjhotjho le motokara wa boima ba 2 000 kg e tsamayang ka  $20 \text{ m}\cdot\text{s}^{-1}$  e lebile lehlakoreng le sele. Hang kamora hore di tjhaisane, motokara u tsamaya ka  $5 \text{ m}\cdot\text{s}^{-1}$  ho ya ho le letona.

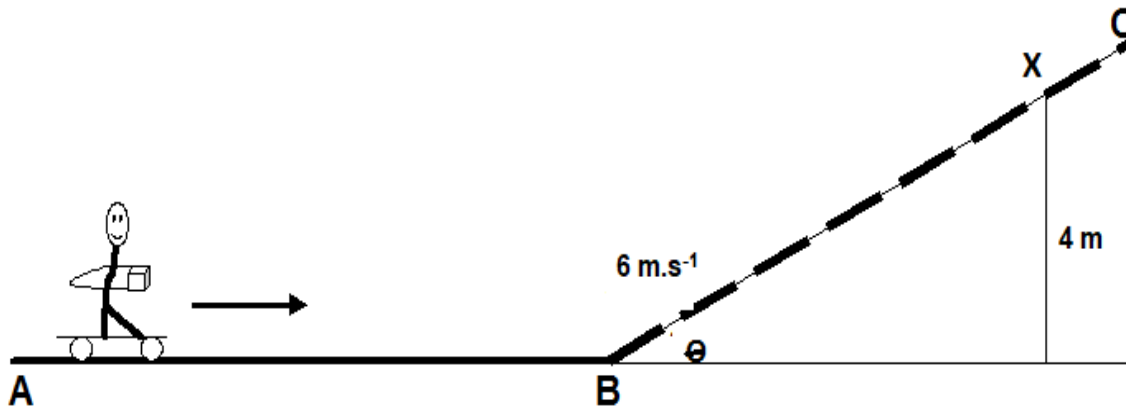


- 4.1 Ngola fatshe principle ya conservation ya linear momentamo ka mantswa. (2)
- 4.2 Khaltjhuleitha makenetjute ya felositi ya koloi e nkang dithoto hang kamora hore di tjhaisane. (4)
- 4.3 Haeba di thulana ka metsotswana e 0,4, khaltjhuleitha fose ya koloi e nkang dithoto ha e sututsa motokara ha di thulana. (4)

**[10]**

**POTSO YA 5 (Qala leqepheng le letjha. )**

Moshanyana o hodima roller-sekeite u tsamaya ka felositi e sa fetoheng a lebile botjhabela karolong e otlohlileng e se nang mahwashe **AB** tseleng a nkile morwalo. O qeta ka hore a eketse felositi eo a betsang morwalo ho tloha ho yena motsitseng.



5.1 Morwalo ho batlahala hore u betsetswe nqa e fe hore felositi ya moshanyana e eketsehe mme e fihlele hodimodimo? (1)

5.2 Fana ka lebitso mme o hlalose ka mantswe molao wa fisikise o sebedisitsweng. POTSONG YA 5.1. (3)

Moshanyana o fihla ntlheng ya **B** ka felositi ya  $6 \text{ m} \cdot \text{s}^{-1}$  mme o tswelapele ho tsamaya a nyolohela hodimo karolong e mahwashe **BC** tseleng mme a eme a phomola ha fihla ho **X**, 4 m ka hodima fatshe jwalo ka ha ho bontshitswe tayakeramong e ka tlase. Forekishenale fose ya 40 N e etsahala ho roller skates. Boima bo menahaneng ba moshanyana le roller skates ke 57 kg.

5.3 Khaltjhuleitha boleng ba  $\theta$  ya moepeng. (5)

5.4 Boima ba motokara o remote-controlled ke 4 kg ha e kgannelwa hodimo moepeng o etsang enkele ya  $30^\circ$  ho tloha motsitseng ka afaretje fose e yang pele ya 80 N jwalo ka ha ho bontshitswe tayakeramong e ka tlase. Motokara o hahamelwa ke fose e mahwashe esa fetoheng ya  $15 \text{ N}$ , ha e nyolohela moepeng. Lebelo la motokara ha e tloha tlase moepeng ke  $3 \text{ m} \cdot \text{s}^{-1}$ .



Sebedisa porinsipole ya eneji ho khaltjhuleitha lebelo la motokara ha u tsamaya 5 m moepeng.

(6)  
[15]

**POTSO YA 6 (Qala leqepheng le letjha. )**

Saerene ya teraka e emeng ya mollo e ntsha modumo wa diweifo tsa forekwensi ya 1 800 Hz. Motokara o tsamayang tseleng e tsitsitseng ka lebelo le sa fetoheng la  $30 \text{ m}\cdot\text{s}^{-1}$ , o feta teraka ya mollo mme o tswela pele ka lebelo le sa fetoheng.

6.1 Bolela Doppler efekete ka mantswa. (2)

6.2 Ana pitjhi ya saerine, e utluwang ke moqhobi wa motokara, e tla fetoha ha motokara o tsamaya ...

(Araba fela ka E A EKETSEHA, E A FOKOTSEHA kapa E DULA E TSWANA.)

6.2.1 O atamela enjene ya mollo? (1)

6.2.2 O tsamayela hole le teraka ya mollo? (1)

6.3 Khaltjuleitha forekwensi e utluwang ke mkganni wa motokara ha motokara o atamela ho teraka ya setimamollo. (Nka lebelo la modumo moyeng e le  $330 \text{ m}\cdot\text{s}^{-1}$ .) (5)

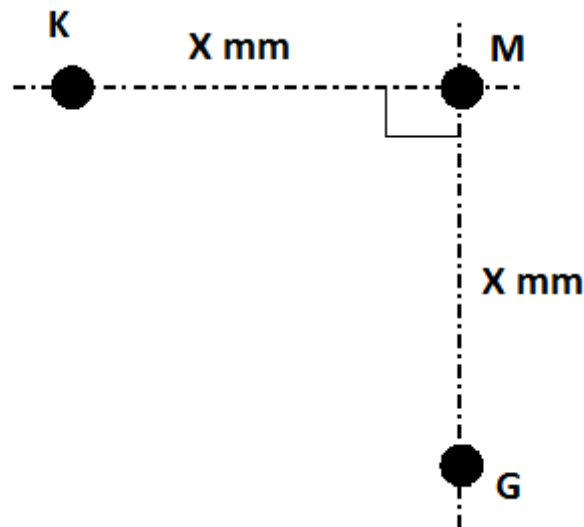
6.4 Seketjha kerafo ho bontsha forekwensi ya saerine ha e fetoha e le function of time ya moqhobi ha a atamela a bile a feta teraka ya setimamollo. (Ha ho manane a nang le boleng a hlokehang.) (3)

6.5 Fana ka lebitso la sesebediswa se sebediswang ho Doppler effect karolong ya meriana. (1)

**[13]**

**POTSO YA 7 (Qala leqepheng le letjha.)**

Disefiye tse tharo tse nyane, tse tshwanang tsa tshepe, **K**, **M** and **G** di beuwe sebakeng se senang moya e nngwe le e nngwe ya disefiye e nka tjhatjhe ya  $6 \text{ nC}$ . Disefiye di beuwe ka hore **K** le **G** di arohane ka **X mm** ho tloha ho **M** jwalo ka ha ho bontshitswe teyakeramong e ka tlase:



7.1 Bolela Coulomb's law ka mantswa. (2)

Makenetjute ya nete fose e etswang ke **M** ho **K** le **G** ke  $2,864 \times 10^{-6} \text{ N}$ .

7.2 Khaltjhuleitha sebaka , **X**, dipakeng tsa **G** le **M**. (8)  
[10]

**POTSO YA 8 (Qala leqepheng le letjha. )**

Ka tlase ke tjhathje e ikemetseng ya ntlha, **P**, ya makenetjute wa  $+200\text{ nC}$ .

8.1 Teroya eleteriki fillete e potapotileng tjhathje ya ntlha **P**.

(3)

Tjhathje ya bobedi, **Q**, le yona e nkile tjhathje ya  $+200\text{ nC}$ , e beuwe sebaka sa  $600\text{ mm}$  ho tloha ho tjhathje ya **P** jwalo ka ha ho bontshitswe teyakeramong e ka tlase:



**Y** ke ntlha e  $200\text{ mm}$  ho ya ho le letona la tjhathje ya ntlha **P**.

8.2 Hlalosa theme *electric field at a point*.

(2)

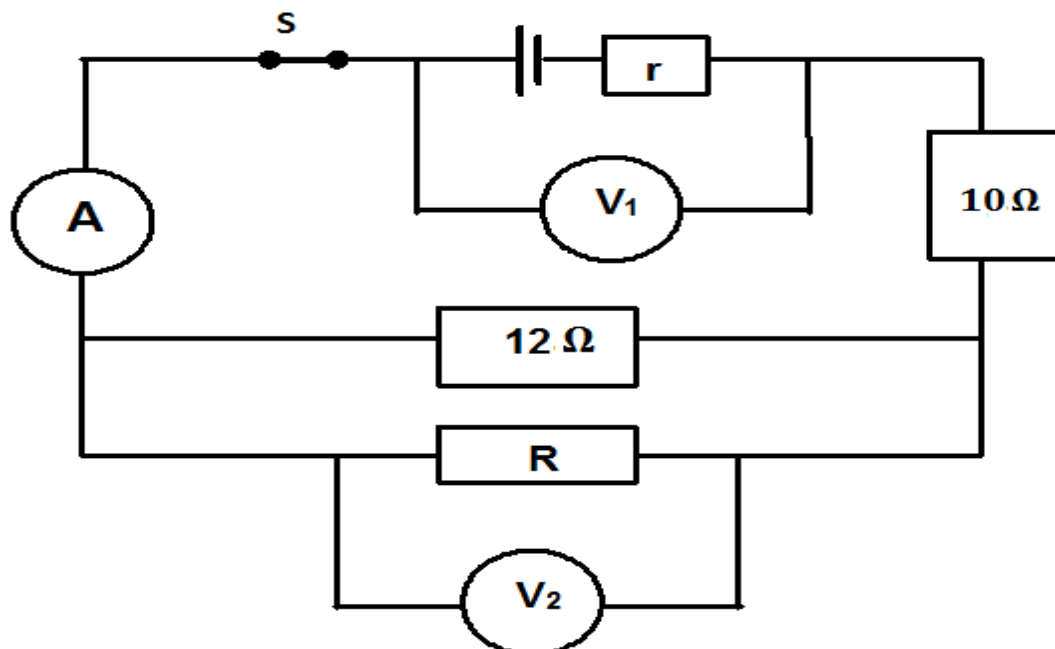
8.3 Khaltjuletha nete electric field at point ya **Y** ka lebaka la kgahlamelo ya **P** le **Q**.

(5)

**[10]**

**POTSO YA 9 (Qala leqepheng le letjha. )**

Leshala le teyakeramong ya sekete e ka tlase, lena le resisetense e kahare ya  $r$ . Ha switjhi **S** e kwetswe, palo ya foletemitha  $V_2$  ke 18 V ha ya resisetara **R** e ntsha 13,5 W.



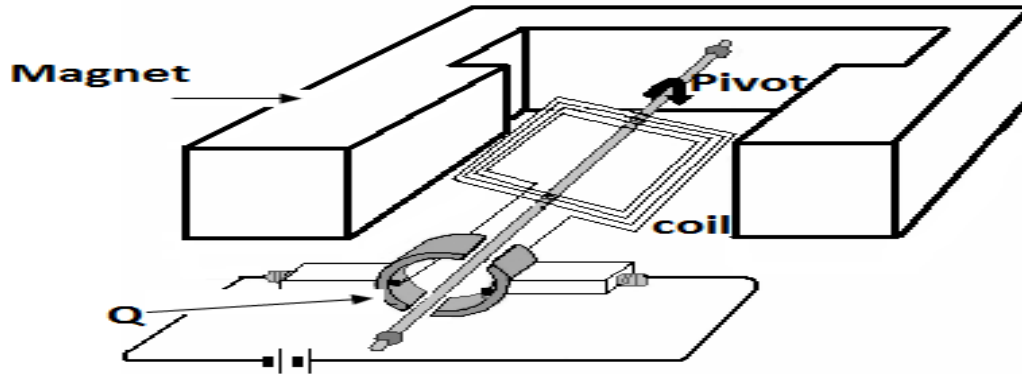
- 9.1 Hlalosa Ohm's Law ka mantswe. (2)
- 9.2 Khaltjuleitha resistense ya resisetara ya **R**. (3)
- 9.3 Khaltjuleitha palo ya ammitha **A**. (5)
- 9.4 Hlalosa, ka mantswe, se bolelwang ka theme *resisetense ya kahare* ya betiri. (2)
- 9.5 Khaltjuleitha potentheale diforens e fetang ho  $10\ \Omega$  resisetara. (3)
- 9.6 Ha switjhi **S** e butswe, palo ya foletemitha  $V_1$  e ne le 45,9. Khaltjuleitha internal resistance ya betiri. (5)
- 9.7 Na resisetense ya kahare e seketeng E YA EKETSEHA, E YA FOKOTSEHA, kapa EDULA E TSWANA ha resistera **R** e ntshitswe? (1)

**[21]**



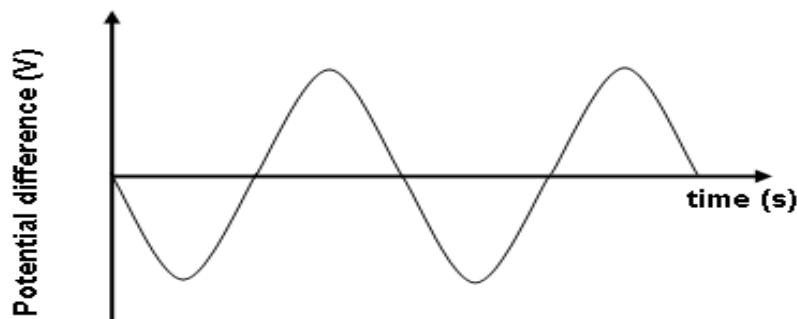
**POTSO YA 10 (Qala leqepheng le letjha. )**

Ithute seketje se fanweng ka tlase.



- 10.1 Ngola fatshe mosebetsi wa karolwana e leibutsweng **Q** seketjeng se ka hodimo. (1)

Tjhatjheng tse pedi ho etswa diphetoho ho seteraketja sa sesebediswa jwalo ka ha ho bontshitswe ka hodimo ho fana ka tse latelang output potenshiale diforensa.



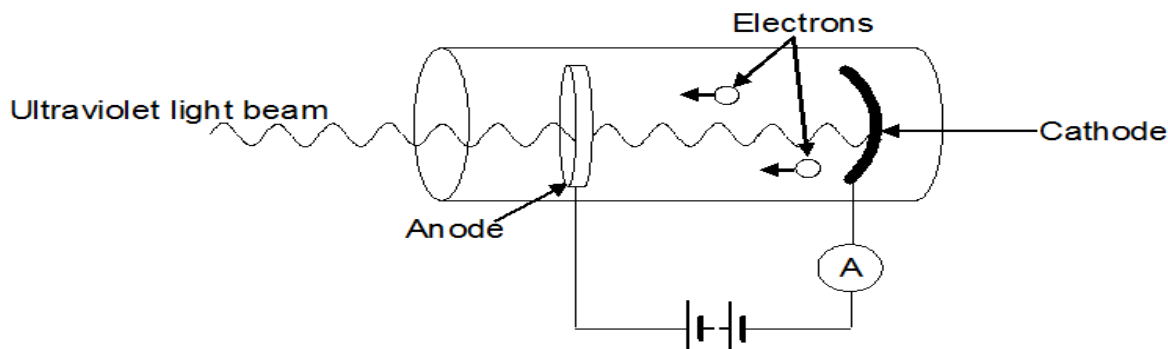
- 10.2 Ngola fatshe diphetoho TSE PEDI tse entsweng se sebedisweng. (2)

Ha 60 W laete balebo e hokahantswe ho sebediswa se setjha, peak current ya 0,54 A e phalla hoyo ho laete balebo.

- 10.3 Khaltjuleitha potenshiale diforensa ya DC e ntshang kganya e tswanang le ya laete balebo. (5)  
[8]

**POTSO YA 11 (Qala leqepheng le letjha. )**

Fotho-eleteriiki efekete e sebediswa dibakeng tse ngata. Fothosele, jwalo ka e ka tlase ke e nngwe e sebediswang ho Alamo ya disisitimi tsa ho thjwatla matlong, ke enngwe ya moo e sebediswang.



Waifolenfo e kholohadi ya monochromatic light e ka etsang hore dieleketerone tsa photoeleketerone tse kahodimo di tswa tsa fothosele, ke 229 nm. Ha motho a ferekanya bimi, hang ho fokotseha karente ho etsang hore switjhi e hlasimolohe e sebetse, e etse hore alamo e kwalehe.

- 11.1 Khaltjuleitha forekwensi ya monochromatic laete ya weifolenfo ya 229 nm. (3)
- 11.2 Fana ka saentifiki theme ya forekwensi e khaltjuleitweng ho POTSO YA 11.1 ka hodimo. (1)
- 11.3 Hlalosa *weke fankeshene* ka mantswe. (2)
- 11.4 Khatjuleitha forekwensi ya monochromatic laete e tlamehang ho sebediswa, ho ntsha photoelectrons tsa felositi ya  $1,57 \times 10^6 \text{ m.s}^{-1}$  ho tloha ho kathote e ka hodimo ya photocell. (4)
- 11.5 E be POTSO YA 11.4 e tla fetoha ha weifolenfo e kholohadi ya monochromatic light e hloka hla ho ntsha photoelectron e khutsufala ka 189 nm?

Ngola fatshe E YA NYOLOHA, E YA FOKOTSEHA, kapa E DULA E TSWANA.

Hlalosa karabo ya hao. (3)  
[13]

**MATSHWAO KAOFELA: 150**

## DATA YA FISIKALE SAENSESE KEREITE 12

## PAMPIRI YA 1 (FISIKISI)

## TAFOLE YA 1: FISIKALE KONSETENTE

LEBITSO	LETSWAO	BOLENG
Akeseleraishene ya kerafithi	$g$	$9,8 \text{ m}\cdot\text{s}^{-2}$
Yunefesale kerafitheishenale konsetente	$G$	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Lebelo la kganya moo ho senang moya	$c$	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck konsetente	$h$	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb konsetente	$k$	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Tjhatjhe ya eleketerone	$e$	$-1,6 \times 10^{-19} \text{ C}$
Boima ba eleketerone	$m_e$	$9,11 \times 10^{-31} \text{ kg}$
Boima ba lefatshe	$M$	$5,98 \times 10^{24} \text{ kg}$
Retiase ya lefatshe	$R_E$	$6,38 \times 10^6 \text{ m}$

## TAFOLE YA 2: DIFOMULARA

## MOTSAMAO

$v_f = v_i + a \Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ kapa $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t$ kapa $\Delta y = \left( \frac{v_i + v_f}{2} \right) \Delta t$

## FOSE

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$g = G \frac{M}{d^2}$

**WEKE, ENEJI LE MATLA**

$W = F \Delta x \cos \theta$	$U = mgh$ kapa $E_p = mgh$
$K = \frac{1}{2}mv^2$ kapa $E_k = \frac{1}{2}mv^2$	$W_{\text{nett}} = \Delta K$ kapa $W_{\text{nett}} = \Delta E_k$ $\Delta K = K_f - K_i$ kapa $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ kapa $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{ave}} = Fv$	

**DIWEIFO, MODUMO LE KGANYA**

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ kapa $E = h \frac{c}{\lambda}$
$E = W_0 + E_{k(\text{max})}$ moo $E = hf$ le $W_0 = hf_0$ and/le $E_{k(\text{max})} = \frac{1}{2}mv_{\text{max}}^2$ kapa $K_{(\text{max})} = \frac{1}{2}mv_{\text{max}}^2$	

**ELEKETOROSSETATIKISE**

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{q_e}$	

**DISEKETE TSA MOTLAKASE**

$R = \frac{V}{I}$	$\text{emf } (\mathcal{E}) = I(R + r)$
$R_s = R_1 + R_2 + R_3 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$Q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$  $P = I^2 R$ $P = \frac{V^2}{R}$

**KARENTE E FETOFETOHANG**

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$  $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$	$P_{\text{average}} = V_{\text{rms}} I_{\text{rms}}$  $P_{\text{average}} = I_{\text{rms}}^2 R$  $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R}$
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