



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

GREYIDI 12

SEPTEMBER 2024

**IFIZIKHALI SAYENSIZI P1
(IFIZIKS)**

AMANQAKU: 150

IXESHA: liyure ezi 3

Eli phepha linamaphepha ayi19, kuquka needatha shiti ezi 3.

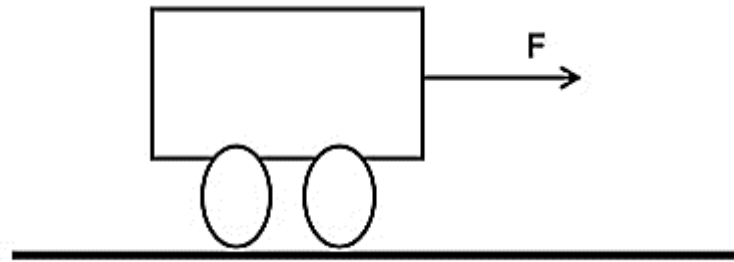
IMIYALELO NEENKCUKACHA

1. Bhala iGAMA neFANI yakho ngokupheleleyo kwizithuba ezilungele oko KWINCADI YAKHO YEEMPENDULO.
2. Eliphepha lemibuzo linemibuzo eyi 11. Phendula YONKE imibuzo kwiNCWADI YEEMPENDULO.
3. Qala umbuzo NGAMNYE kwiphepha ELITSHA KWINCWADI YEEMPENDULO.
4. Nambarisha iimpendulo zakho NGQO ngale Ndlela imibuzo yakho inambarishwe ngayo.
5. Shiya umgca OMNYE phakathi kweesabhukhweshini umz: UMBUZO 2.1 noMBUZO 2.2.
6. Uvumelekile ukusebenzisa ikhaltyhuleyitha engafakwanga lwazi.
7. Uvumelekile ukusebenzisa iimathematikhal instrumenti.
8. Bonakalisa ZONKE iifomyula nee SABSTITYUSHINI kuzo ZONKE iikhaltyhuleyishini.
9. Ipendulo yakho yokugqibela yezibalo yishiye kwiidesimali pleyisi EZIMBINI.
10. Imizobo AYENZIWANGA ngokomlinganiselo (sikeyili).
11. Xhasa okanye unike ingxoxwana, njalo-njalo kuloombuzo ifuna oko.
12. Uyacetyiswa ukuba uzisebenzise IIDATHA SHITHI ezincanyathiselwe ngasemva kweli phepha.
13. Bhala ngokucocekileyo nangokucacileyo.

UMBUZO 1: IMIBUZO YEEMALITIPULI TSHOYISI

lindlela ezahlukileyo zinikiwe njengeempendulo ezinokuchaneka kwimimibuzo elandelayo. Khetha impendulo ze ubhale kuphela unobumba (A–D) ecaleni kwenombolo yombuzo (1.1 ukuya ku1.10) kwiNCWADI YEEMPENDULO, umzekelo, 1.11 E.

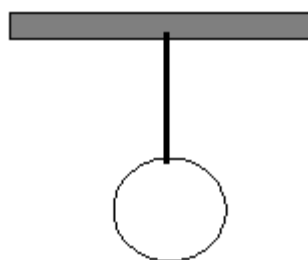
- 1.1 Itroli ihamba kwisafeyisi iflethi, ehorizontali xa ifosi engaguqukiyo, \mathbf{uF} , isetyenzisiwe kuyo.



Yeyiphi ENYE yeefizikhali khwantithi ezilandelayo EZOHLALA injalo xa itroli ihamba?

- A Imomentam
- B Iakhselereyishini
- C Ikhayinethikhi eneji
- D Igravitheyishinali phothenshiyali eneji (2)

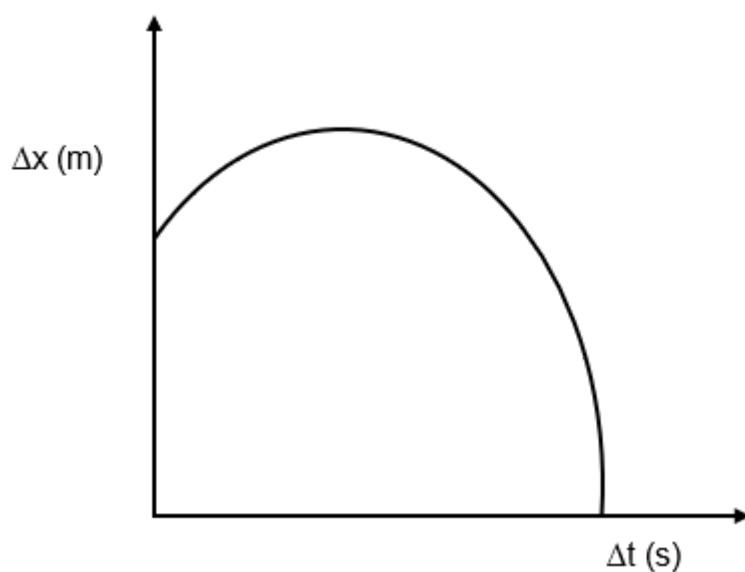
- 1.2 Isifiye sincanyathiselwe kwisitrangi, esijingiswe kwihorizontal bha eqinisiweyo, njengoko kubonisiwe kwidiyagram engezantsi.



Iriekshhini fosi kwigravitheyishinali fosi eyenziwa ngumhlaba kwisifiye yi ...

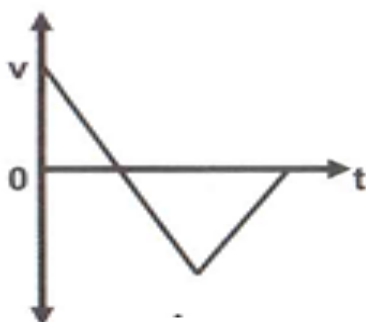
- A fosi yebha kwisifiye
- B fosi yesitrangi kwisifiye
- C fosi yesifiye kumhlaba.
- D fosi yebha kwisitrangi. (2)

- 1.3 Igrafu yepozishini vesaz thayim, engezantsi, ibonisa imowushini yeobhjekhthi kwidayirekhishini evethikhali. Thatha igrawundi njengeziro referensi.

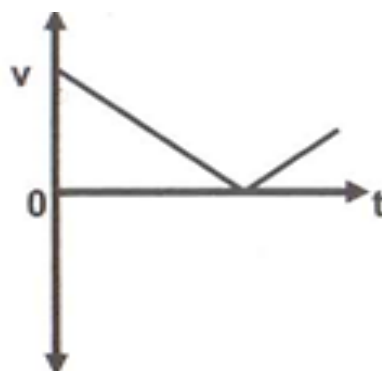


Yeyiphi ENYE kwezivelosithi-thayim grafu zilandelayo emele ngcono imowushini yeobhjekhthi?

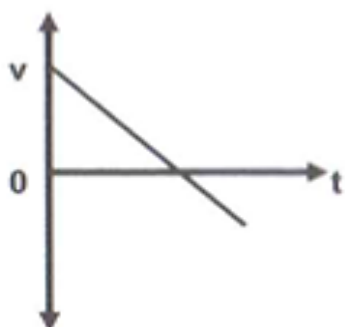
A



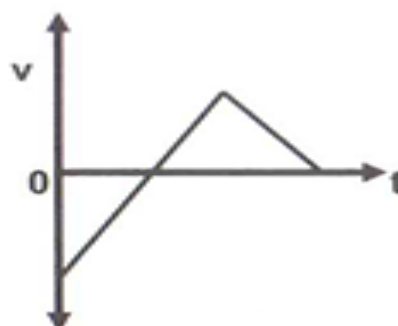
B



C

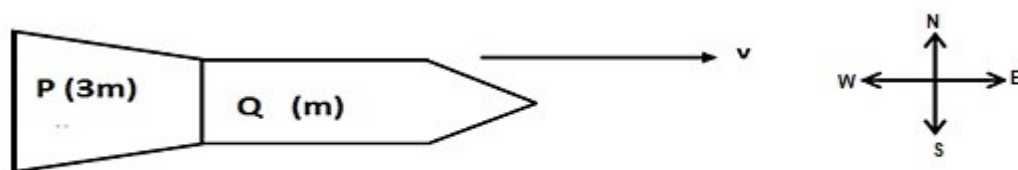


D



(2)

- 1.4 Isipeyisikhrafti, eyakhiwe ziimodyuli ezimbini uP no Q abaneemasi $u3m$ nom ngokulandelelana, ihamba ngokukahorizontali ngevelosithi uv ukuya ngase isti. I-ekhsplowuzhini yenza ezimodyuli zimbini zohlukane.

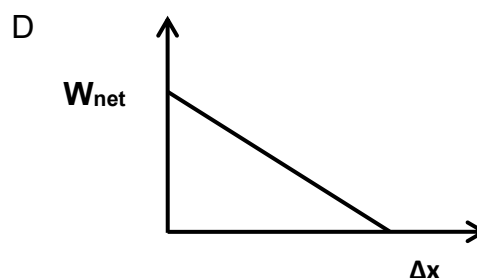
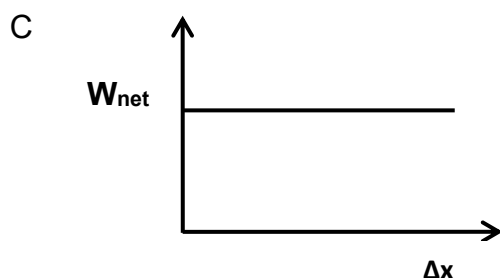
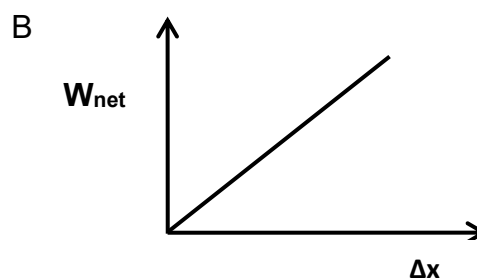
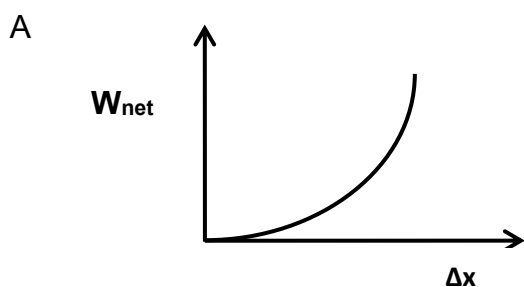


Imodyuli uQ iqhubeleka isiya kwakwidayirekhshini ebisiya kuyo nje emva kweekhsplowuzhini ngevelosithi engu $3v$. Izakubangubani **imagnithyudi nedayirekhshini** yevelosithi yemodyuli uP nje emva kweekhsplowuzhini?

	IMAGNITHYUDI YEVELOSITHI KAP	IDAYIREKHSHINI KAP EMVA KWE-EKHSPLOWUZHINI
A	$\frac{1}{3}v$	Isti
B	v	Westi
C	v	Isti
D	$\frac{1}{3}v$	Westi

- 1.5 Imoto ebimile ihamba kumgca ongqalileyo ngokuphenjelelwa yinethi fosi engaguqukiyo

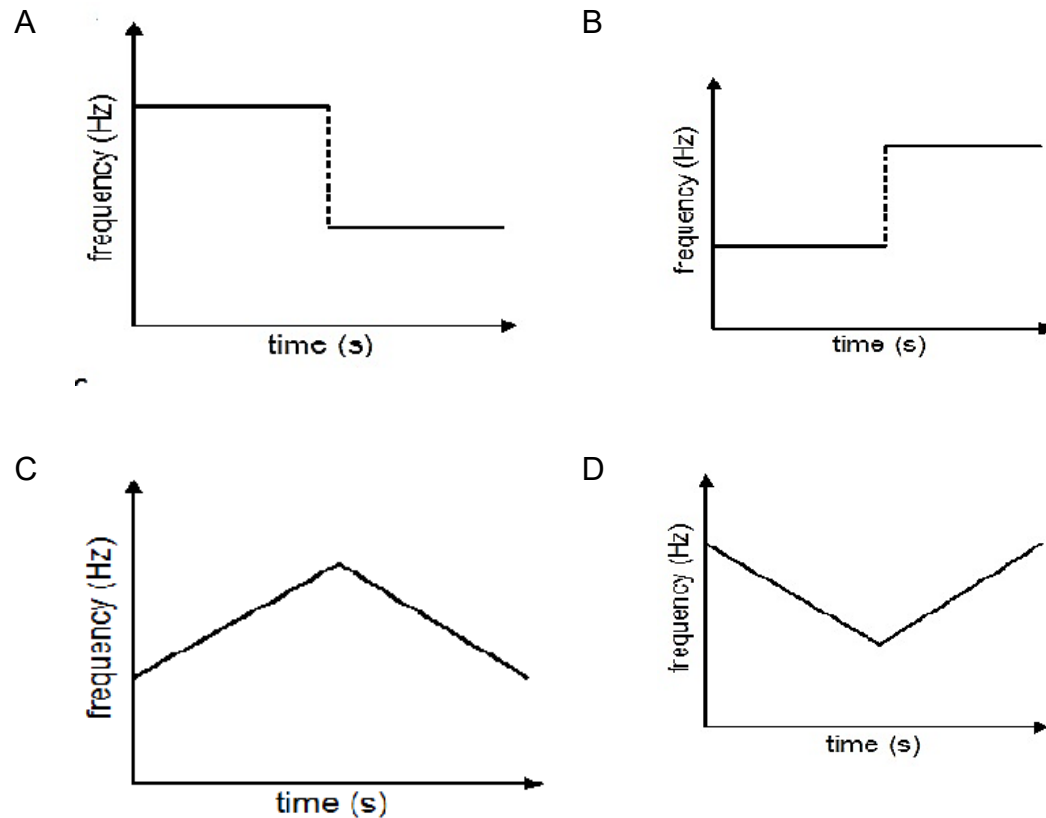
Yeyiphi ENYE kwezi zilandelayo iigrafu emele ngcono inethi wekhi dani (W_{net}) kwimoto ngokubhekiselele kwidisplayisimenti (Δx) yayo?



(2)

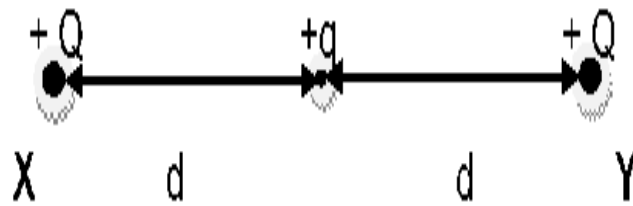
- 1.6 Isosi yesandi iya ngakwisisa emileyo kumgca ongqalileyo ngevelosithi engaguqukiyo. Idlula ilisina iye kude kunayo kwakulamgca ungqalileyo kwangalevelosithi ingaguqukiyo.

Yeyiphi ENYE kwezi zilandelayo iigrafu eyona imele ichange in observed frequency against time?



(2)

- 1.7 Ithesti tshaji encinci $+q$ ibekwe kanye ehafini phakathi kweephozithive tshaji ezimbini ezifanayo, $+Q$ no $-Q$, nganye inetshaji $+Q$, njengoko kuboniswe ngezantsi.

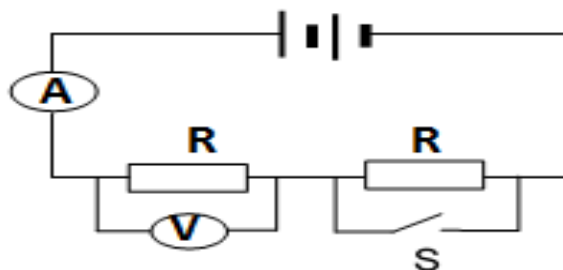


Ithesti tshaji $+q$ iza ...

- A kuya ezantsi ngokukavethikhali.
- B kuya ngakuX.
- C kuya ngakuY.
- D kuhlala imile.

(2)

- 1.8 I-inthenali rezistensi yebhethri kwisekhethi dayagram engezantsi ayinanzwanga.

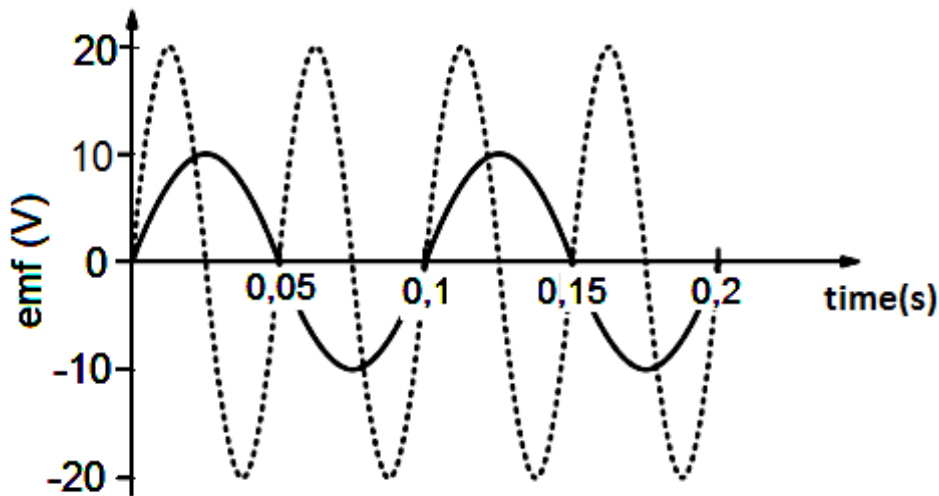


Xa iswitshi uS ivaliwe, yeyiphi ENYE kwezi zilandelayo emele utshintsho kwiiridingi zevolthimitha neamitha?

	IRIDINGI YEVOLTHIMITHA	IRIDINGI YEAMITHA
A	lyancipha	lyanda
B	lyanda	lyancipha
C	lyancipha	lyancipha
D	lyanda	lyanda

(2)

- 1.9 Kwigrafu engezantsi, isolidi layini grafu imele indlela iEmfu eyenziwa yisimpuli jenereyitha, etshintsha ngayo ngexesha. Idothedi layini ibonisa iEmfu yakwalaajenereyitha emva kokwenziwa kotshintsho.



Loluphi utshintsho olwenziweyo ukwenza iziphumo ezikwi dothedi layini grafu?

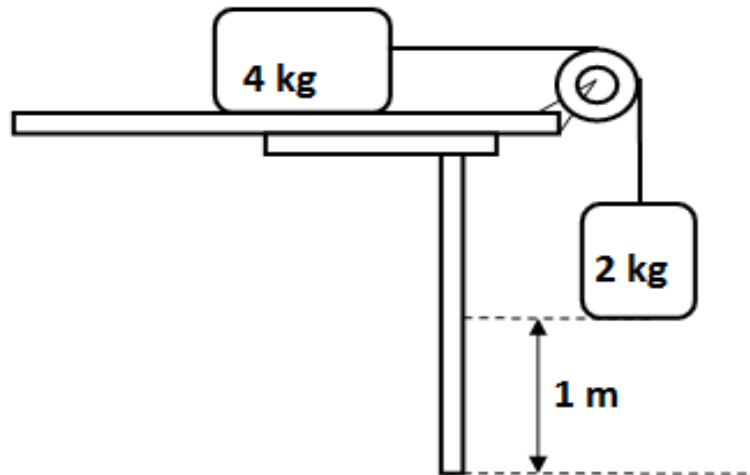
- A Isipidi seroteyishini sihafulishiwe
- B Isipidi seroteyishini sidabulishiwe.
- C Kufakelwe isipliti-ringi khomyutheyitha
- D Kongezelelwe iibhrashi (2)

- 1.10 Xa iekhsayithedi elekhtroni isuka kwi-eneji level ephezulu isiya kwi-eneji esezantsi ispesifikhi ...

- A emishini layini kwiemishini spekhthram iyaobhzevwa.
 - B emishini layini kwiabhzophshini spekhthram iyaobhzevwa.
 - C abhzophshini layini kwiemishini spekhthram iyaobhzevwa.
 - D abhzophshini layini abhzophshini spekhthram iyaobhzevwa.. (2)
- [20]

UMBUZO 2 (Qala kwiphepha elitsha.)

Ibhlokhi enemasi u4 kg igcinwe imile kwitheyibhuli erhabaxa ehorizontali. Ibhlokhi ikonekhthwe ngesitrini esikhaphu-khaphu esingandisekiyo esidlula kwiphuli engenafrikhshini ukuya kwenye ibhlokhi enemasi u2 kg. Ibhlokhi u2 kg ijinga ngokukavethikhali njengoko kubonisiwe kumzobo ongezantsi.



Ibhlokhi u4 kg ngoku ikhululwe, isistim yeemesi iya ngasekunene. Ikhoefishiyenti yekhayinethikhi frikhshini phakathi kwebhlokhi u4 kg nesafeyisi yetafile ngu0,25. Ungazinanzi iintumekelelo ze-efrikhshini.

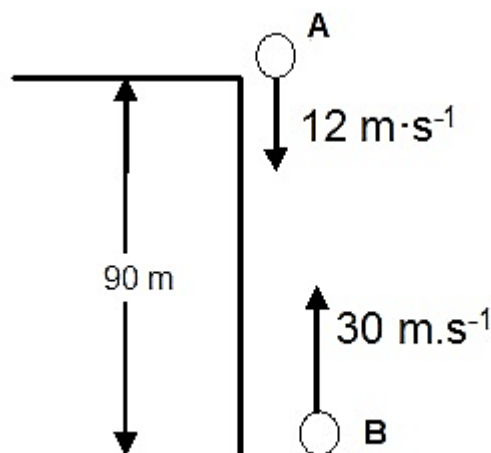
- 2.1 Chaza iNyuthon's sekhond lo of mowushini ngamagama. (2)
- 2.2 Zoba ifri-bhodi dayagram ebonisa ZONKE iifosi ezisebenza kwibhlokhi u4 kg ngaphambi kwemowushini. (4)
- 2.3 Khaltyhuleyitha imagnithuydi ye:
 - 2.3.1 Frikhshinali fosi esebenza kwiblokhi u4 kg (3)
 - 2.3.2 Sipidi ebetha ngaso phantsi imesi u2 kg (7)
- 2.4 Cacisa ukuba kutheni imowushini yebhlokhi u2 kg INGENObizwa njenge 'fri foli mowushini'. (2)

[18]

UMBUZO 3 (Qala kwiphepha elitsha.)

Ibhola u**A** iphoswe ezantsi ngokukavethikhali ukusuka enkcocheyini yesakhiwo, esiphakeme ngo 90m, ngevelosithi u $12 \text{ m}\cdot\text{s}^{-1}$. Kwangaxesha-nye, ibhola yesibini efanayo u**B** iphoswe phezulu ngevelosithi u $30 \text{ m}\cdot\text{s}^{-1}$. Ibhola u**A** nebhola u**B** zodlulana emva kwe2,135 s.

Ungayinanzi intumekelelo yefrikhshini.



- 3.1 Nika idayirekhshini yeakhselereyishini yebhola u**B** ngexesha ihamba isiya phezulu. (1)
- 3.2 Khaltyhuleyitha ivelosithi yebhola u**B** ngexesha idlula ibhola u**A**. (3)
- 3.3 Khaltyhuleyitha idistensi phakathi kwebhola u**A** no**B** emva kwe2,5 s iibhola ziprojekhthiwe. (5)
- 3.4 Kwisethi enye yee-ekhziz zoba isiketshi seeposhini-thayim grafu zemowushini yebhola u**A** nebhola u**B**.
 - Kwibhola u**A**, ukusukela ngexesha iprojekhthwa de iyofika ezantsi.
 - Kwibhola u**B** ukusukela ngexesha, iprojekhthwa de idlule ibhola u**A**.
 - Bonisa ngokucacileyo ixesha apho ezibhola zimbini zidluana
 - Sebenzisa igrawundi njengeziro pozishini.
 - Leyibhelisha iigrafu u**A** no**B**. (3)

[12]

UMBUZO 4 (Qala kwiphepha elitsha.)

Inqwelo ehambisa imithwalo enemesi u5 000 kg, ehamba ngevelosithi u15 m·s⁻¹ ukuya ngasekunene ingqubana ngeentloko nemoto enemesi u2 000 kg ehamba ngo20 m·s⁻¹ kwidayirekhshini eophozithi. Nje emva kwekholizhini, imoto ihamba ngevelosithi u5 m·s⁻¹ ukuya ngasekunene.

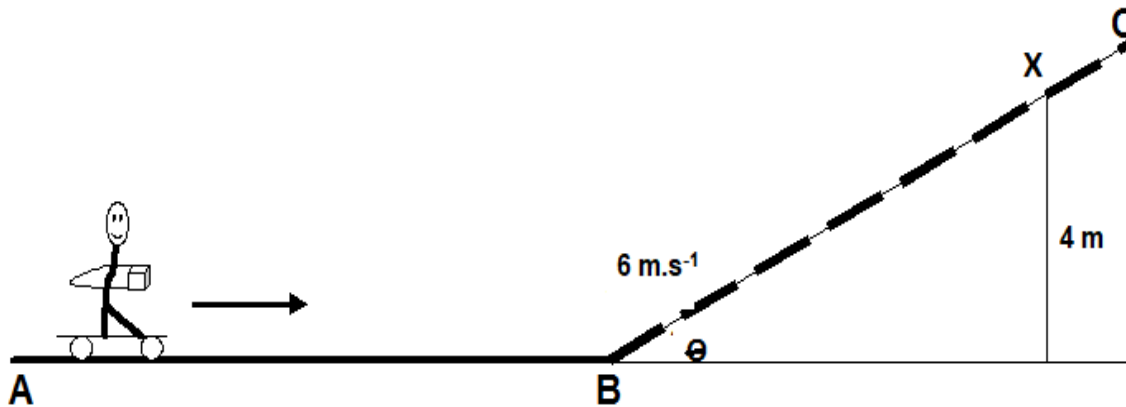


- 4.1 Bhala iphrinsipuli of khonzeveyishini of liniya momentam ngamagama. (2)
- 4.2 Khaltyhuleyitha imagnithyudi yevelosithi yenqwelo ehambisa imithwalo nje emva kwekholizhini. (4)
- 4.3 Ukuba ikholizhini ihlale iisekhondi eziyi0,4, khaltyhuleyitha ifosi esetyenziswa yinqwelo ehambisa imithwalo kwimoto ngexesha lekholizhini. (4)

[10]

UMBUZO 5 (Qala kwiphepha elitsha.)

Inkwenkwe ekwirola-sikeyiti ihamba ngevelosithi engaguqukiyo kwidayirekhshini yangase-isti kwindawo engu**AB**, ehorizontali engenafrikhshini yetreki ithwele ipasela. Igqiba ngokwandisa ivelosithi yayo ngokuphosa ipasela kude nayo ngokukahorizontali.



5.1 Mayiphoswe kweyiphi idayirekhshini ipaseli ukwenza okona kwanda kukhulu kwivelosithi yenkwenkwe? (1)

5.2 Yitsho uphinde ucacise *ngamagama* ilo yefizikhs esetyenziswe kuMBUZO u5.1. (3)

Ifika kwipoyinti u**B** ngevelosithi u6 m·s⁻¹ iqhubeka ihamba inyuka indawo yetreki u**BC** erhabaxa iyekuma kwipozishini u**X**, eku4 m ngaphezulu kwegrawundi njengokuboniswe kwidayagram engezantsi. Ifrikhshinali fosi engaguqukiyo engu40 N isebenza kwirola sikeyiti. Indibanisela yemesi yenkwenkwe neerola sikeyiti ngu57 kg.

5.3 Khalityhuleyitha ivelyu ka**θ** weinklayindi pleyini. (5)

5.4 Iremote-controlled car enemesi u4 kg iqhutywa ukunyuka kwi-inklayindi pleyini eyenza iengile u30° ukusuka kuhorizontali ngeavareyiji fosi eya phambili u80 N njengoko kubonisiwe kwidayagram engezantsi. Imoto iva ifrikhshinali fosi engaguqukiyo engu15 N, xa ihamba inyuka kwi-inklayindi pleyini. Isipidi semoto emazantsi einklayindi pleyini ngu3 m·s⁻¹.



Sebenzisa ii-eneji phrinsipuli ukukhalityhuleyitha isipidi semoto emva kokuhamba i5 m ukunyuka i-inklayindi pleyini.

(6)
[15]

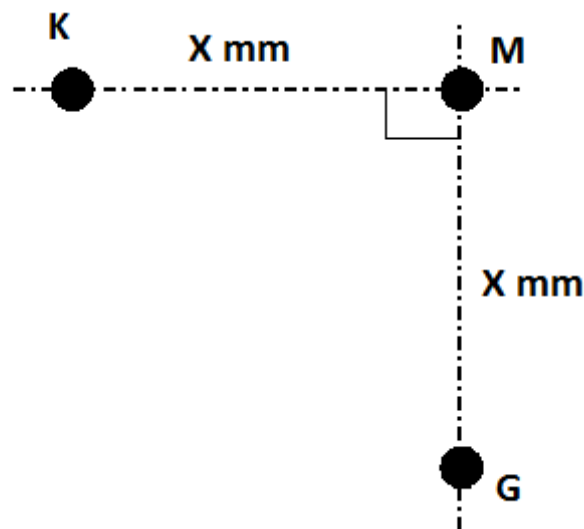
UMBUZO 6 (Qala kwiphepha elitsha.)

Isayireni yefaya thrakhi emileyo ikhupha iisawundi weyivu ezinefrikhwensi engu1 800 Hz. Imoto, ihamba kwindlela engqalileyo ehorizontali ngesipidi esingaguqukiyo esingu30 m.s⁻¹, idlula ifaya thrakhi iqhubeke kwangesosipidi singaguqukiyo.

- 6.1 Chaza iDopla Ifekthi ngamagama. (2)
- 6.2 Itshintsha njani ipitshi yesayireni, eviwa ngumqhubi wemoto, xa imoto ihamba ...
(Chaza kuphela ukuba IYANDA, IYANCIPHA okanye IHLALA INJALO.)
- 6.2.1 Ukuya ngakwifaya enjini? (1)
- 6.2.2 Ukuya kude nefaya thrakhi? (1)
- 6.3 Khalithuleyitha ifrikhwensi eviwe ngumqhubi wemoto njengoko imoto ihamba ukuya ngakwifaya thrakhi. (Thatha isipidi sesawundi emoyeni njengo330 m.s⁻¹.) (5)
- 6.4 Siketsha igrafu ukubonisa ukuba itshintsha njani ifrikhwensi njengefankhshini yexesha njengoko umqhubi esondela ze adlule ifayathrakhi.
(Akukho manana afunekayo.) (3)
- 6.5 Chaza imedikhali instrumenti esebenzisa iDopla Ifekthi. (1)
- [13]**

UMBUZO 7 (Qala kwiphepha elitsha.)

limethali sifiye ezintathu ezincinci, ezifanayo, u**K**, u**M** no**G** zibekwe kwivatyhum. Isifiye ngasinye sithwele itshaji engu6 nC. Izifiye zibekwe ngendlela yokuba u**K** no**G** baqaque nge**X mm** ukusuka ku**M** njengoko kubonisiwe kwidayagram engezantsi:



7.1 Chaza iKhulombz lo ngamagama.. (2)

Imagnityhudi yenethi fosi esetyenziswa ku**M** ngu**K** no**G** ingu $2,864 \times 10^{-6} \text{ N}$.

7.2 Khalityhuleyitha idistensi, u**X**, phakathi kuka**G** no**M**. (8)
[10]

UMBUZO 8 (Qala kwiphepha elitsha.)

Apha ngezantsi kukho i-ayisoleyithedi poyinti tshaji, uP , onemagnityhudi engu+ 200 nC.

8.1 Zoba i-elekhthrikhi fildi pateni ejikeleze ipoyinti tshaji uP .

(3)

Ipoyinti tshaji yesibini, uQ , nayo ethwele itshaji engu+200 nC, ibekwe kwi600 mm kude nepoyinti tshaji uP njengoko kubonisiwe kwidayagram engezantsi



uY yipoyinti eku200 mm ngasekunene kwepoyinti tshaji uP .

8.2 Chaza igama *electric field at a point*.

(2)

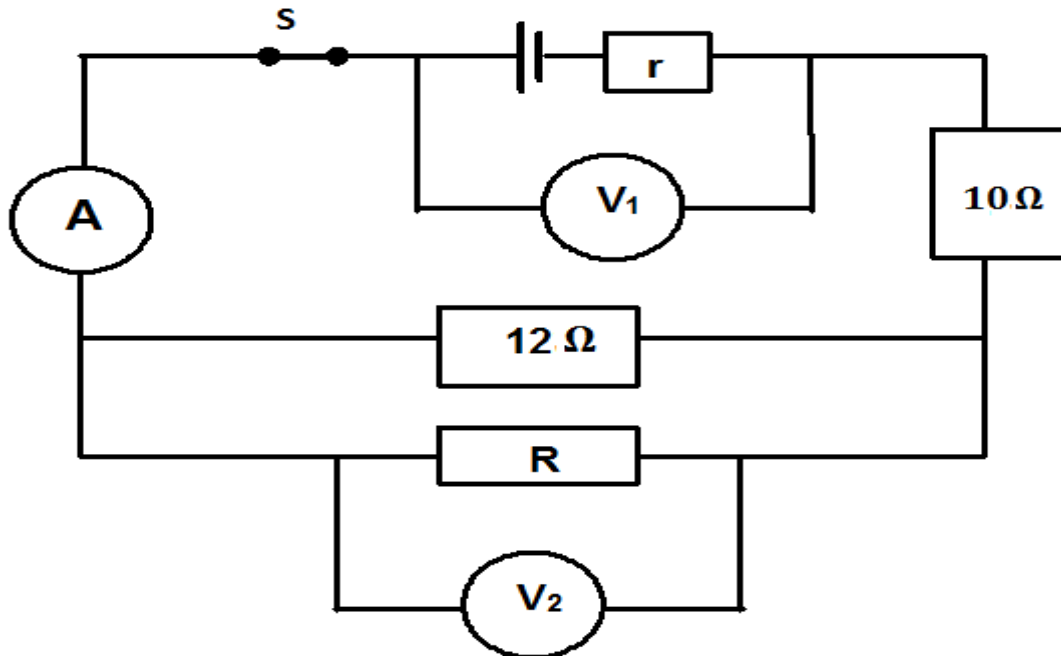
8.3 Khalityhuleyitha inethi elekhthrikhi fildi ekwipoyinti uY eyenziwa ziitshaji uP no Q .

(5)

[10]

UMBUZO 9 (Qala kwiphepha elitsha.)

Ibhethri ekwiskethi dayagram engezantsi, ineinthenali rezistensi ur . Xa iswitshi uS ivaliwe, iridingi kwivolthimitha uV_2 ngu18 V. Kwaye irezista uR ikhupha u13,5 W

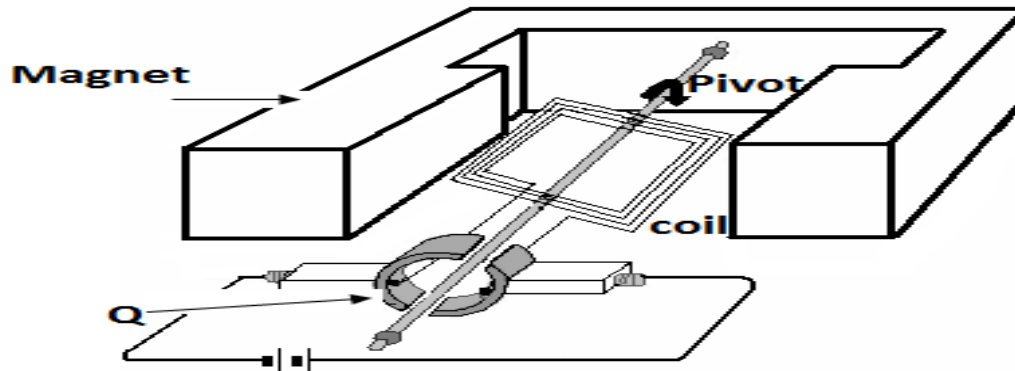


- 9.1 Chaza i-Ohmz Lo ngamagama. (2)
- 9.2 Khalityhuleyitha irezistensi yerezista uR . (3)
- 9.3 Khalityhuleyitha iridingi kwi-amitha uA . (5)
- 9.4 Cacisa, ngamagama, lithetha ukuthini igama *u-internal resistance* yebhethri (2)
- 9.5 Khalityhuleyitha iphothenshiyali diferensi edlula kwirezista u10 Ω (3)
- 9.6 Xa iswitshi uS ibivuliwe, iridingi kwivolthimitha uV_1 ibingu49,5 V.
Khalityhuleyitha i-inthenali rezistensi yebhethri. (5)
- 9.7 Ingaba i-inthenali rezistensi kwiskethi IYANDA, IYANCIPHA, ukanye IHALA INJALO xa irezista uR isusiwe? (1)

[21]

UMBUZO 10 (Qala kwiphepha elitsha.)

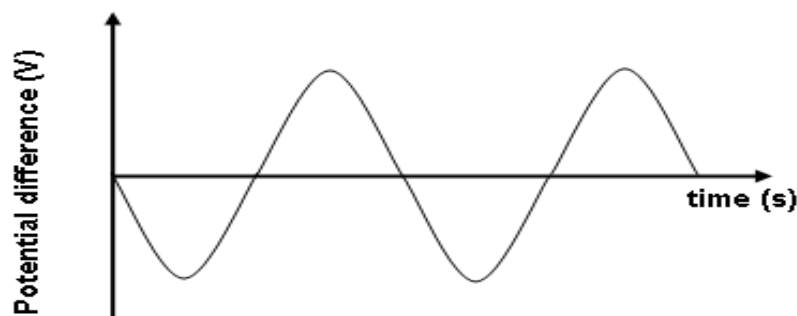
Qwalasela isiketshi esingezantsi.



- 10.1 Bhala umsebenzi wekhomponenti eleyibhelishwe **Q** kwidayagram. engasentla

(1)

litshaji ezimbini zenziwe ngokwembonakalo yedivayisi eboniswe kwisiketshi esingasentla ukufumana iawuthiphuthi phothenshiyali diferensi elandelayo.



- 10.2 Bhala iinguqu EZIMBINI ezenziwe kwidivayisi.

(2)

Xa i60 W layithi bhalbhu ikonekthwe kwidivayisi entsha, iphikhi kharenti ka0,45 A idlula kwilayithi bhalbhu.

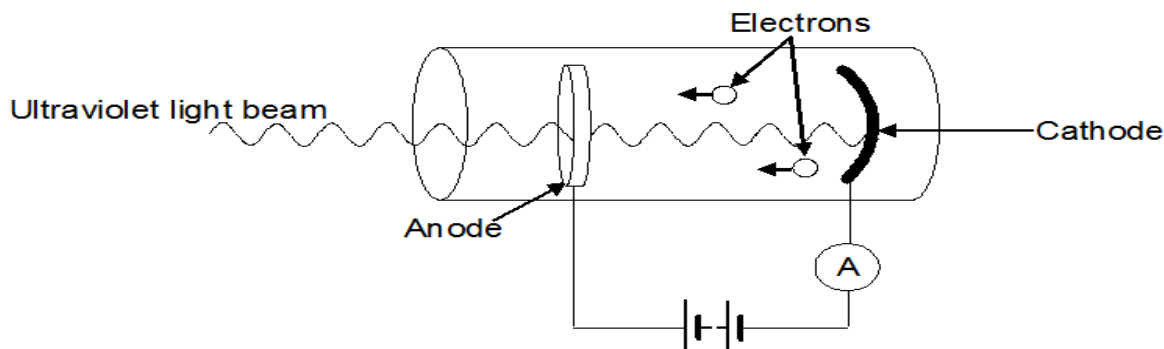
- 10.3 Khalityhuleyitha iphothenshiyali diferensi yeDC enokwenza ibhrayithinesi efana neyelayithi bhalbhu.

(5)

[8]

UMBUZO 11 (Qala kwiphepha elitsha.)

Ifoto-elektriki ifekthi inephakthikhali aplikheyshini ezininzi. Ifotoseli, nje ngale ingezantsi esetyenziswa kwiibhagla alam sistim, iyenye yeeaplikheyshini ezinje.



Eyona weyivulenti inkulu yemonokhromathikhi layithi enokwenza ukukhutshwa kweefothoelekthroni kulefotoseli ingasentla, ngu229 nm. Xa umntu ephazamisa ibhim, ukuhla ngesaquphe kwekharenti, kuvusa iswitshi, ecima ialam.

- 11.1 Khalityhuleyitha ifrikhwensi yemonokhromathikhi layithi yeweyivulenti u229 nm (3)
- 11.2 Nika isayentifikhi them yefrikhwensi oyibale kuMBUZO 11.1 ngasentla. (1)
- 11.3 Chaza igama *wekhi fankhshini* ngamagama. (2)
- 11.4 Khalityhuleyitha ifrikhwensi yemonokhromathikhi layithi emayisetyenziswe, uku-emitha iifothoelekthroni ezinevelosithi engu $1,57 \times 10^6 \text{ m.s}^{-1}$ ukusuka kwikhathodi yefotoseli engasentla. (4)
- 11.5 Iizakutshintsha njani impendulo ekuMBUZO u11.4 ukuba eyona weyivulenti inkulu yemonokhromathikhi layithi efunekayo ukuijekhtha iifothoelekthroni incitshisiwe ukuya ku 189 nm?

Bhala IYANDA, IYANCIPHA, okanye IHLALA INJALO.

Nika isizathu sempendulo yakho. (3)
[13]

AMANQAKU XA EWONKE: 150

IDATA YEFIZIKHALI SAYENSIZI KAGREYIDI 12

IPHEPHA 1 (FIZIKHSI)

ITHEYIBHILE 1: IIFIZIKHALI KHONSTENTI

IGAMA	ISIMBOLI	IVELYU
Akhselereyshini ye gravithi	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Iyunivesal gravitheyshinali khonstenti	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Ispidi selayithi kwi vakhthyum	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
IPlankiz khonstenti	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
IKhulombz khonstenti	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Itshaji ye-elektroni	e	$-1,6 \times 10^{-19} \text{ C}$
Imesi ye-elektroni	m_e	$9,11 \times 10^{-31} \text{ kg}$
Imesi yomhlaba	M	$5,98 \times 10^{24} \text{ kg}$
Ireyidiyasi yomhlaba	R_E	$6,38 \times 10^3 \text{ km}$

ITHEYIBHULI YE2: IIFOMYULA

IMOWUSHINI

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

IFOSI

$F_{net} = ma$	$p = mv$
$f_s^{\text{makhs}} = \mu_s N$	$f_k = \mu_k N$
$F_{net} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{d^2}$	$g = G \frac{M}{d^2}$

IWEKHI, IENEJI NEPHAWA

$W = F\Delta x \cos\theta$	$U = mgh$ or/okanye $E_p = mgh$
$K = \frac{1}{2}mv^2$ or/of $E_k = \frac{1}{2}mv^2$	$W_{\text{net}} = \Delta K$ or/okanye $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/okanye $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/okanye $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{\text{av}} = Fv_{\text{ave}}$	

AMAZA, ISANDI KWAYE UKUKHANYA

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

IELEKHTHROSTATIKI

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

IISEKETHE ZOMBANE

$R = \frac{V}{I}$	emf (ϵ) = $I(R + r)$ emk (ϵ) = $I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2 R\Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

OLTHANEYITHINGI KHARENTI

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{avereyiji} = V_{rms} I_{rms}$ / $P_{gemiddeld} = V_{wgk} I_{wgk}$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{makhs}}{\sqrt{2}}$	$P_{avereyiji} = I_{rms}^2 R$ / $P_{gemiddeld} = I_{wgk}^2 R$
	$P_{avereyiji} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$