IIMVAVANYO ZIKAZWELONKE ZOKUTHELEKISA:

UKULUNGISELELA ABAFUNDI BAKHO UVAVANYO LWEMATHEMATIKA (MAT)

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Iziqulatho

INTSHAYELELO

Le ncwadana iya kukunceda ukuqonda ukuba lumalunga nantoni uvavanyo lwe-NBT MAT kwanokukuxelela ukuba ungabalungiselela njani abafundi bakho.

IiMvavanyo zikaZwelonke zokuThelekisa (National Benchmark Tests) (NBTs) luluhlu leemvavanyo ezenza umlinganiselo wokulungela komenzi wesicelo kwimfundo ephakamileyo yaseyunivesithi. Zandisa zikwaxhasa, endaweni yokususa okanye ukuphinda iSiqinisekiso esiPhakamileyo sikaZwelonke (National Senior Certificate).

Iqela leeyunivesithi zaseMzantsi Afrika lisebenzisa i-NBTs ukuzinceda ukutolika iziphumo zesiQinisekiso esiPhakamileyo sikaZwelonke (NSC). Iiyunivesithi zisebenzisa iziphumo ze-NBT ngeendlela ezahlukileyo:

- Ezinye zizisebenzisa ekwenzeni izigqibo malunga nofikelelo lomenzi wesicelo eyunivesithi. Oku kuthetha ukuba iziphumo ze-NBT, ngokudibanisa neziphumo ze-NSC, zisetyenziswa ukumisela nokuba umenzi wesicelo ukulungele ukufunda imfundo ephakamileyo.
- Ezinye zizisebenzisa malunga nokufaneleka eyunivesithi. Oku kuthetha ukuba iziphumo zisetyenziswa ukwenza isigqibo nokuba umenzi wesicelo uya kudinga inkxaso eyongezelelweyo yemfundo ephakamileyo emva kokuba ethe wamkelwa eyunivesithi.
- Ezinye iiyunivesithi zizisebenzisa ekuphuhliseni iikharityhulam zazo.

Kukho iimvavanyo ezimbini: i-AQL, uvavanyo lobuChule bokuFunda nokuBhala lweMfundo ePhakamileyo (Academic Literacy) novavanyo lobuChule bokuFunda nokuBhala babo Bonke (Quantitative Literacy), kunye novavanyo lobuChule bokuFunda nokuBhala lweMathamatika (MAT).

1. IMVELAPHI NENJONGO YEEMVAVANYO ZE-MAT

1a. IMIGANGATHO YEMPUMELELO YOVAVANYO LWEMATHEMATIKA

Ukumisela ukuba abafundi banakho ukwenza utshintsho phakathi kwemathematika yomgangatho wasesekondari nowasetheshiyari, iimeko zobuchule ezifunekayo, kodwa ezingeyiyo imfuneko ngokucacileyo, yeMfundo ePhakamileyo, nazo kufuneka zivavanyiwe.

Ababhali be-NBT babekwa kwelinye lamaqela amathathu: eliSiseko, eliPhakathi, nelobuGcisa. Malunga neemvavanyo zeMathematika (MAT), oku kuthetha ntoni? Khawujonge iMigangatho yeMpumelelo ngezantsi. Uya kubona ukuba kufuneka okongezelelwe kangakanani kubabhali ukusuka kwinqanaba lesiSeko ukuya kweliPhakathi; ngokufanayo ukusuka kweliPhakathi ukuya kwelobuChule. Uluhlu lusekwe kwizihloko ezichazwe phantsi kwezihloko ezithi “IZIHLOKO ZOVAVANYO LWEMATHEMATIKA”. .

ISISEKO	PHAKATHI	UBUCHULE
Ababhali bovavanyo abasebenza kumgangatho *weSiseko* baya kuba nakho ukusebenzisa iingqikelelo ezilula yaye basebenzise iinkqubo ezaziwayo kwiimeko eziqhelekileyo. Ngokubanzi baya kumelana nemisebenzi ebandakanya ukukhumbula nokuvelisa kwakhona iinyaniso zesiseko zemathematika okanye ukwenza izibalo ezilula. Ababhali besiseko baya kuba nakho ngeyona ndlela ifanelekileyo ukusebenzisa unikelo okanye ubuchule kwisiqendu solwazi olunye.	**Ababhali bovavanyo abasebenza kumgangatho *oPhakathi* kufuneka babenakho ukusebenza kumgangatho *weSiseko*, yaye <u>ngaphezu koko</u> babenakho ukukhetha iindlela zobuchule ukusombulula iingxaki nokudibanisa izakhono, iingqikelelo neenkqubo. Ngokubanzi ababhali kulo mgangatho baya kuba nakho ukulawula imisebenzi yemathematika ebandakanya amanyathelo amaninzi afuna izakhono zokukuhlela ulwazi nokuthatha izigqibo. Ababhali ngokona kona baya kuba nakho ukwenza iindlela zonxibelelwano phakathi, nokudibanisa, isiqendu solwazi**	**Ababhali be-NBT abasebenza kumgangatho *wobuChule* kufuneka babenakho ukusebenza kumgangatho *oPhakathi*, yaye <u>ngaphezu koko</u> babonise ulwazi olunzulu lweengqikelelo zemathematika nokufaneleka kwiinkqubo zamanyathelo amaninzi amelweyo kwisakhelo. Ababhali bovavanyo kumgangatho *wobuChule*** kufuneka babenakho ukubonisa ingqiqo nokudibanisa ulwazi lokusombulula iingxaki ezintsonkothileyo. Kufuneka babenakho ukusebenzisa ubuchule bezakhono ezinengqiqo ezifana nokwenza iintelekelelo ezifana nokwenza neendlela zokuxabisa ukwamkeleka kwezigqibo.

	ezingaphezulu kwesinye, basebenzise iintlobo ngeentlobo zeenkqubo zemathematika neminikelo eliqela ngokulandelelana kwamanyathelo. Ababhali bovavanyo abasebenza kumgangatho ***oPhakathi*** kufuneka babenakho ukutolika iimpikiswano yaye benze izigqibo ezinengqiqo kumba weentlobo ngeentlobo zemisebenzi yemathematika.	
IiNkqubo ze-Aljibra: Ababhali bovavanyo kufuneka babenakho • ukusebenza imidibaniso yesiqhelo ngamani okwenene • ukusebenza ngobuchule izibalo ezilula ze-aljibra • ukuchonga iiphatheni ezilula zamanani (alandelelanayo) • usebenzisa iintlobo ngeentlobo ezimele imithamo engaziwayo • ukusebenzisa iingxelo neemilinganiso exela imilingano elula phakathi kwemithwalo engaziwayo • ukuqaphela nokusebenzisa iifomula eziqhelekileyo • ukusombulula imilinganiso yesiqhelo etshintshatshintsha kanye • ukwenza izibalo zesiqhelo zemali	**IiNkqubo ze-Aljibra**: : Ababhali bovavanyo kufuneka babenakho • ukuqikelela nokubala • ukuqaphela nokusebenza ngeepatheni (eziquka izilandelelwano zejometri nezibalo) • ukuthelekisa imilinganiso • ukubonisa ukuqonda iimpawu zokungalingani • ukwenza iinguqu zamanyathelo amaninzi e-aljibra • ukujikajika iintlobo ngeentlobo zeengxelo ze-aljibra ezibandakanye ii-surd, ii-eksponenti nee-logarithm • ukusombulula izilinganisi ezingaqhelekanga ngotshintsho olunye, • ukusombulula iinkqubo zezilinganiso zomgca • iimeko zomboniso (oko kuthi ukuhlahlela ulwazi olunikelweyo, ukwenza umnikelo ofanelekileyo wolwazi) nokusombulula iingxaki usebenzisa	**IiNkqubo ze-Aljibra**: Ababhali bovavanyo kufuneka babenakho • ukukhetha ifomula echanekileyo yokusombulula iingxaki ezingaqhelekanga • ukusombulula nokutolika iinkqubo zokufana nezingafaniyo

	iintlobontlobo zeenkqubo zemathematika.	
Imisebenzi neegrafu: Ababhali bovavanyo kufuneka bakwazi • ukuchonga iigrafu zemisebenzi exeliweyo ngentla • ukusombulula iingxaki zesiqhelo ezibandakanya imisebenzi exelwa ngendlela eyodwa, nokuba kungomlomo, nge-aljibra okanye ngemifanekiso	**Imisebenzi neegrafu:** Ababhali bovavanyo kufuneka bakwazi • ukusebenzisa nokutolika iigrafu ezixeliweyo ku-3a • ukusombulula iingxaki ezingezo zesiqhelo ezibandakanya imisebenzi exeliweyo kwiifomu ezininzi • ukulawula imiboniso yemisebenzi, nokutolika ulwazi • ukubonisa ukuqonda iimpawu zeentlobo ngeentlobo zemisebenzi ngaminye (kuquka imisebenzi yetrigonometri) efana nommandla noluhlu, • ukutolika iinguqu nemiboniso yemisebenzi	**Imisebenzi neegrafu:** Ababhali bovavanyo kufuneka bakwazi • ukutolika unxibelelwano phakathi kwemisebenzi neenguqulelo yayo • ukubonisa ukuqonda ummandla noluhlu lwemisebenzi ehlukahlukeneyo, equka imisebenzi yetrigonometri • ukumisela nokutolika intsingiselo yamathambeka emisebenzi ethile nomsebenzi wonxibelelwano phakathi kwethambeka nethanjenti • ukusebenzisa iinqobo zomahluko kwiikhalkuse kwimisebenzi, eboniswe ngokwemifanekiso okanye ngealjibra
ITrigonometri: Ababhali bovavanyo kufuneka babenakho • ukuchaza imilinganiselo ecacisiweyo kunxantathu-ngqo wetrigonometri • ukuqaphela iigrafu zetrigonometri • ukwenza izibalo zesiseko zemilinganiselo yetrigonometri • ukusombulula imilinganiselo elula yetrigonometri • ukuqaphela usebenzisa izalathisi, iifomula zamadiki ambaxa neefomula zokunciphisa	**ITrigonometri:** Ababhali bovavanyo kufuneka babenakho • ukusebenzisa imilinganiselo yetrigonometri ukusombulula iingxaki zemilinganiso emibini • ukuqonda iimpawu zeegrafu zetrigonometri, kuquka ukutolika ezi grafu • ukusebenzisa i-sine, i-cosine nemisebenzi ye-eriya kwiingqikelelo ezilula • ukusombulula imilinganiselo engeyiyo yesiqhelo yetrigonometri • ukusebenzisa izazisi zetrigonometri, ukunciphisa iifomula	**ITrigonometri:** Ababhali bovavanyo kufuneka babenakho • ukutolisa imisebenzi yeegrafu zetrigonometri, ngokuzimeleyo nangokunxulumene kwenye nenye • ukusebenzisa ingqikelelo yetrigonometri ukusombulula iingxaki ezingezo zesiqhelo kwimixholo yomlinganiso emibini nemithathu

	nolwazi lwamadolo akhethekileyo ukusombulula iingxaki	
Ingqiqo yesithuba: Ababhali bovavanyo kufuneka babenakho • ukuchonga iimpawu zemizobo nemilinganiso emibini nemithathu, efana nedolo okanye iimpawu zokufana amacala • ukwenza iimpawu zesiqhelo zezibalo eziquka iperimitha, i-eriya nomthamo • ukusebenzisa iifomula zifanelekileyo zejometri • ukuqaphela ii-axiom neetheorem zeJometri yeSangqa	**Ingqiqo yesithuba:** Ababhali bovavanyo kufuneka babenakho • ukuqonda iimpawu zomfanekiso wejometri kwimilinganiso emibini nemithethu nokumisela unxulumani phakathi kwezinto • ukwenza izibalo ezingesosiqhelo ezibandakanya umphantsi nomthamo • ukusebenzisa ii-axiom neetheyoremu zeSangqa seJometri ukusombulula iingxaki zokwenene zejometri	**Ingqiqo yesithuba:** Ababhali bovavanyo kufuneka babenakho • ukusebenzisa imifanekiso nezinto ezizintlobo ngeentlobo zejometri,kunye nonxibelelwano phakathi kwazo, ukusombulula iingxaki ezinxulumene ne-eriya nevolumu yezinto ezidibeneyo • ukusombulula iingxaki ezimbaxa zejometri ezifuna ukusetyenziswa kwee-exiom neetheyori zeSangqa seJometri
IMpatho yedatha noKunokwenzeka (probability) Ababhali bovavanyo kufuneka babenakho • ukuchonga nokusebenzisa imilinganiso yesiqhelo esisembindini • ukuqaphela imiboniso yeenkcukacha-manani zolwazi • ukusombulula iingxaki ezilula eziqhelekileyo zongathizo	**IMpatho yedatha noKunokwenzeka** Ababhali bovavanyo kufuneka babenakho • ukusebenzisa imilinganiso yeziqhelo ezisembindini nokutshintshatshintsha kolwabiwo lokwenza izigqibo neengqikelelo zexesha elizayo • ukutolika idatha eboniswe kwiigrafu neetheyibhile • ukusebenzisa imifanekiso yomthi neye-Venn • sebenzisa imithetho yokuqikelela ukusombulula iingxaki	**IMpatho yedatha noKunokwenzeka** Ababhali bovavanyo kufuneka babenakho • ukutolika idatha emele ngeendlela eziliqela • ukuqaphela ifuthe lemilinganiso esemacaleni yesiqhelo esisembindini neentlobo ngeentlobo • ukutolika nokusebenzisa imilinganiso nemigangatho yokuguquka • ukuhlahlela iingqikelelo ezisekwe kwiiseti zedatha ezininzi, nokusebenzisa ukuzathuza kweenkcukacha-manani kwiingxaki ezimbaxa nangakumbi • ukusombulula iingxaki ezimbaxa nangakumbi zokungathiza ezifuna kusetyenziswe imifanekiso ye-Venn neyemithi, kwakunye nemifanekiso eziintlobo ngeentlobo zokuthingaza

2. I-NSC ne-NBT

2a. IZIHLOKO ZE-NBT KWIMEKO YE-NSC

Kwi-NSC, iMathematika kwiNqanaba le-FET iquka imimandla ehlukahlukeneyo yesiqulatho. Ummandla wesiqulatho ngasinye unegalelo malunga nokufumana izakhono ezikhethekileyo. Izihloko ezingundoqo zesiGaba se-FET zezi: Imisebenzi; iipatroni zeNani, ulandelelwano nezintlu; Imali, uhlumo nokubola; iAljibra; ukwaHluka kwe-Khalkulusu; uQikelelo; iJometri ka-Euclidean nemilinganiso; iJometri yokuHlahlela; iTrigonometri; iiNkcukacha-manani (iSebe leMfundo esisiSeko) INGXELO YOMGAQO-NKQUBO WEKHARITYHULAM NOHLOLO (CAPS) I-FET ISIGABA SEMATHEMATIKA AMABANGA 10 – 12, p.12: www.thutong.doe.gov.za*, accessed 24/04/2015).*

Izikolo zinikelwe isikhokelo esimisela isantya (jonga iph. 22 loxwebhu lwe-CAPS FET Band Mathematics amaBanga 10 – 12; ubhekiso lungentla), oluqinisekisa ukuba abafundi beBanga le-12 banexesha elaneleyo lohlaziyo phambi koviwo lokugqibela leBanga le-12. Kukho izihloko ezimbalwa ezo isikhokelo sicebisa isimiselo sesantya sonyaka siqhuba ukuya kutsho kwikota yesithathu yeBanga le-12. Ngolwazi lokuba abenzi bezicelo kwiiyunivesithi kufuneka babhale iimvavanyo ze-NBTs kwangoko kangokuba ekupheleni kukaMeyi, iimvavanyo ze-MAT aziquki izihloko ekunokwenzeka ukuba azikafundiswa ngelo xesha.

Kwezinye izikolo, ngokukodwa ezo ezilandela iikharityhulam ngaphandle kwezo ze-NSC, iBanga le-12 abafundi sele betyhilelwe kwizihloko eziphambili nangakumbi zemathematika, ukwenza umzekelo imiphakamo ka-A, iNkqubo ehambele Phambili, njl. njl. Nangona kunjalo, **kucingelwa ukuba ukufunda izihloko ezihambele phambili akunakho ukwenzeka ngaphandle xa abafundi sele benesiseko ezingqingqwa kwizihloko eziyinxalenye ye-CAPS**. Ngako oko abafundi abanjalo kulindelwa ukuba baya kuba sebezilungele izihloko ze-CAPS.

Imibuzo yeemvavanyo ze-MAT isekelwe kwingqikelelo ezisekwe ukuphuma kwi-CAPS, kodwa ezi mvavanyo azibophelelwanga ukuvavanyo zonke izinto eziqulathwe kwi-CAPS. Kanti ke iimvavanyo zobuChule bokufunda nokubhala beMfundo ePhakamileyo (Academic Literacy) nezobuChule bokufunda nokubhala Babo Bonke (Quantitative Literacy) zinenjongo efana neyezakhono kuloo mimandla yohlobo oluthile kule mimandla, iimvavanyo ze-MAT zijolise ingakumbi kulwazi olukhethekileyo nezakhono ezifundiswa kumgangatho wesikolo, kodwa ke, njengakweminye imimandla, **ngokukodwa ziyilwe ukulinganisa ukufaneleka kwabahlolwa ukwenzela iMfundo ePhakamileyo**. Iimvavanyo zifuna ukuba ababhali babonise ukuqonda okwaneleyo kwengqikelelo ukwenzela bakwazi ukuzisebenzisa ezo ngqikelelo kwiintlobo ngeentlobo zemixholo. Ezi zakhono zodidi oluphezulu ezisekelwe kwimpumelelo kwiMathematika yeMfundo ePhakamileyo. Ezi zakhono, ziphuhliswe ngabom kwizifundo zemathematika ezifana neMathematika neNzululwazi ngezoBugqi, ngokuqukiweyo zidla ngokulindelwa ngamaziko eMfundo ePhakamileyo yaye ziqukiwe kuyilo lwekharityhulam yawo. **Kubalulekile ukuba ootitshala bajolise kwikharityhulam ekhethiweyo yaye bangabophelelwa ziindlela ezivavanywayo kwikharityhulam**.

IMIBUZO KWIIMVAVANYO ZE-MAT ISEKWE NGENDLELA YOKUBA OOMATSHINI BOKUBALA (II-CALCULATOR) ABADINGEKI. II-CALCULATOR NGAKO OKO AZIVUNYELWANGA KWIIMVAVANYO. Umzekelo wento esiyixelayo ngoku unikelwe kwicandelo elijongene nomzekelo wemibuzo.

2b. UKUFEZEKISANA KWEMATHEMATIKA YE-NSC NEEMVAVANYO ZE-NBT MAT

Ngenxa yezizathu ezininzi iimvavanyo ze-MAT azizami ukuphinda imizekelo yamaphepha eemviwo eMathematika ye-NSC. Iimviwo ze-NSC zibhalwa ngabo bonke abafundi beBanga le-12, yaye kufuneka zibonise yonke ikharityhulam yemathematika yesikolo. Iimvavanyo ze-MAT zibhalwa kuphela ngabafundi abalindelekileyo abazimisele ukwenza izifundo ezo imathematiki iyimfuneko kuzo. Xeshikweni iimvavanyo ze-MAT zingenakho ukuvavanya

nantoni engaphandle kwekharityhulam yesikolo, azibophelelekanga ukuqa zonke izihloko zemathematiki zesikolo, ngako oko ikhetha ukujolisa kulo miba yekharityhulam yesikolo ento eninzi yokwenza nezifundo zemathematika zonyaka wokuqala. Ngokucacileyo iimviwo zemathematika ze-NSC kunye neemvavanyo ze-MAT kufuneka zibonwe njengeentlobo zokuxabisa ezincedanayo.

Uxwebhu lwe-CAPS FET lweQela leMathematika yabeBanga le-10 – 12 (jonga ubhekiso ngentla) luchaza amaqela e-taxonomy entswelo yokufunda ebonisa ukuba akukalungi kwimigangatho yokufundisa, okanye ulwazi lwenyaniso yesiseko ivavanyiwe), kusenziwa iinkqubo, yaye kusombululwa neengxaki (jonga kuxwebhu lwe-CAPS FET Band Mathematics Grades 10 – 12, p. 55; kubhekiso olungentla). La maqela athwele ubunzima obusondeleyo kuma-20%, 35%, 30% ne-15%, ngokulandelelana.

Iimvavanyo ze-MAT nazo kananjalo zahluliwe ngokwemiphakamo yemfundo (cognitive), kuqalwa ngemibuzo ephantsi ngenjongo yokulungiselela intshayelelo elula ukuya kuvavanyo, kuze ke kuqhutyekwe ukuya kwimibuzo enentswelo enkudlwana. Izinto zovavanyo lwe-MAT zahluliwe ukuba yimigangatho emine ye-cognitive. Owona mgangatho uphezulu (ukubala malunga ne-8%) oquka imibuzo ebandakanya uluvo olukhulu, nowona mgangatho uphantsi, yaye owona mgangatho uphantsi (umalunga nama-45% enani lilonke), luquka imibuzo ebandakanya ulwazi, ukukhumbula, neenkqubo ezisetyenziswayo ezilula.

Ingqalelo enkulu inikelwe ukulinganisa imibuzo yeemvavanyo ze-MAT, ukuqinisekisa ukuba iingqikelelo ezifanelekileyo zemathematika zenziwe, kwimigangatho efanelekileyo yemfundo. **Zonke iimvavanyo zibambelela kwiseti efanayo yeenkcukacha, yaye zifana kakhulu phambi kokuba zibhalwe; ukufana ngokwenene kuqinisekiswa ngokuthelekisa inkqubo yeenkcukacha-manani emva kweeseshoni zokubhala ukuze ithuba lokuba ababhali baya kusilela ngenxa yohlobo oluthile lovavanyo liya kuncitshiswa.**

2c. UMAHLUKO PHAKATHI KOVIWO LWEMATHEMATIKA NEEMVAVANYO ZE-MAT

Umahluko owodwa phakathi kweemvavanyo ze-MAT namaphepha eMathematika awe-NSC ngokuthi imibuzo yeemvavanyo ye-MAT ayixelisi ababhali nangeyiphi indlela. Isiqhelo esokwakhela imibuzo phezu kweminye akwenzeki. Ukwenza umzekelo, kwiphepha le-NSC kungavela izinto ezilandelayo:

Xa benikwe isazobe, abafundi bayabuzwa:

Bala ithambeka le AC. **Ngako oko**, misela ungqinelaniso lwe-BN (apho i-BN luboniswa kwisazobe ukuba luthe nkqo kwi-AC).

Kuvavanyo lwe-MAT isazobe naso siya kunikelwa, kodwa siya kulandelwa *Lungqineliso lwe-BN kwi* … nezinto ezine okukhethwa kuzo.

Ngaphezu koko, iimvavanyo ze-MAT, akukho miqondiso inikelweyo (ukwenza umzekelo ngenyaniso yokuba umbuzo uyavela kwiPhepha 1 okanye kwiPhepha 2) malunga nokuba umbuzo kufuneka usetyenzwe ngezizathu zejometri okanye ze-aljibra, ngokusebenzisa iinqobo zetrigonometri, okanye ngomdibaniso wezi zinto. Inyaniso yokuba imathematika ifuna abafundi badibanise izakhono ezininzi ezahlukileyo neengqikelelo nakweyiphi ingxaki enikiweyo kuthetha ukuba imibuzo ezimeleyo iya kuxabisa ukunqamleza kuluhlu lwezakhono zemathematika. Ukwenza umzekelo, umbuzo ojongene nokubonisa igrafu yomsebenzi kananjalo ungavavanyo ubuchule kwindawo nesakhono se-aljibra. Oku kuthetha ukuba ababhali kufuneka babe nokuqonda okunzulu kwemathematika, yaye bazi ukuba loluphi uhlobo lokuzathuza olufanelekile kumxholo onikiweyo; baya kuzidinga ezi zakhono kwiMfundo ePhakamileyo.

Kunokucingelwa ukuba uvavanyo lokhetho oluninzi aluvumeli ababhali ukufumana inxenye yamanqaku ukwenzela ukucinga kwabo kwiimeko apho bezathuze ngokuchanekileyo kude kube kwinyathelo lokugqibela baze benze

impazamo yokugqibela yokungakhathali. Olu hlabo-madlala luyaqondakala, kodwa inkqubo yohlaziyo ye-NBTP, kwithuba leminyaka emininzi, lenze ukuba kwazeke ukulungisa inkqubo yokudala iindlela zokhetho yaye oku kunokungenzeki. Okokuqala, ukuba ukuzathuza ngamanani kuyabandakanyeka, amanani alula (ngokwaneleyo ukwenza iimatshini zokubala (ii-calculator zingafuneki); okwesibini izinto zokhetho ezinikiweyo zinikela ngempendulo enye echanekileyo kwakunye nezinye ezintathu elingekho ithuba lokuba zingafikelelwa ngokwenza iimpazamo zokungakhathali. Lilonke ababhali bovavanyo kufuneka bayazi into efanele ukwenziwa, yaye kwimeko enjalo bafumane ukhetho oluchanekileyo; okanye uqashiso, apho baya kukhetha ezinye ezinokukhethwa ezingachanekanga. Kwezinye iimeko iingqikelelo eziphosakeleyo zivavanywa ngabom, ukuze ezinye izinto zokhetho eziphosakeleyo ziya kuba yimpendulo ethandwayo ephosakeleyo. Esi siqhelo ‘singathiyisela’ abafundi ekukhetheni ukhetho oluphosakeleyo kwimekobume yokhetho loxinzelelo, yaye isetyenziswa kuphela ngamanye amaxesha, njengoko uvavanyo kufuneka ludale amathuba wokuba ababhali babonise into abayaziyo.

3. YINTONI ESINGAYILINDELA KWIIMVAVANYO ZE-MAT?

IZIHLOKO ZOVAVANYO LWE-MAT

Izihloko ekunokusekwa imibuzo kuzo zezi zilandelayo.

3a UKUSOMBULULA INGXAKI NOKWENZA UMZEKELO

Iinkqubo ze-Aljibra

- Ukuqonda iphatheni, iimeko zolandelelwano nezintlu, ukusebenzisa ingcinga ye-sigma (uphawu lwesiGriki)
- Imisebenzi ebandakanya izimo zonxibelelwano ezifana nezalamano neepesenti
- Iimeko zokuzoba ngokwenza izakhono zenkqubo yemathematika (uguqulo ukusuka kulwimi ukuya kwi-aljibra, isisombululo sengxaki)
- Imisebenzi ebandakanya iimeko zemathematika ezingenakho ukusebenzeka (ii-surd), ii-logarithm nezalathi (exponents), kuquka nezisombululo zemilinganiselo yezalathi
- Izibalo zemali (inzala eyimbumba, ukunyuka kwexabiso, ixabiso lexesha elizayo, njl. njl.)
- Ingqiqo ngamanani – iintsebenziso/iinkqubo zobalo ezilula ezibandakanya iminwe, amanani anengqiqo namanani achasene nengqiqo
- Umsebenzi we-aljibra (oquka iimeko zokuvakalisa, izicatshulwa/ iikoteyishini, izimo zokungalingani, ukwenza lula, ukwenza amanani angena kwamanye, ukugqibezela isikwere)

Imisebenzi emelwe ziigrafu nemilinganiselo; 'imisebenzi' equka eyomgca, e-quadratic, i-hyperbola, ityhubhu (cubic), inani lokuziphindaphinda (exponential) nenani lesibambiso (logarithmic). Ezinye iigrafu ezifana nezazinge nazo ziqukiwe.

- Imvisiso yomsebenzi wobhalo lwamanani, ukuthathela indawo, ummamndla, uluhlu
- Umsebenzi wokumela (i-aljibra neegrafu); iimpawu zemisebenzi neegrafu (efana nezingeneleli, iindawo zenguquko, ii-asymptotes); unxibelelwano lwegrafu nemilinganiselo yazo; utoliko lolwazi lwegrafu

- Iinguqu zeegrafu zemisebenzi exeliweyo ngentla; isisombululo seengxaki ezinxulumeneyo; imisebenzi yeenguqulelo
- Ukusetyenziswa kweenqobo zokwahlukana kwe-calculus neengxaki ezinxulumeneyo ezibandakanya ezilula zomgca, imisebenzi yezingenayo imigca (oko kukuthi, iimpawu ezibalulekileyo, imisebenzi yokwandisa/ukunciphisa imisebenzi, ii-tangent); ukutolika imisebenzi yokuziphatha nenguqulelo.

3b ITRIGONOMETRI YESISEKO, EQUKA IIGRAFU ZEMISEBENZI YETRIGONOMETRI, IINGXAKI EZIFUNA IZISOMBULULO ZEZILINGANISO ZETRIGONOMETRI KUNYE NEENGQIKELELO ZEMISEBENZI YETRIGONOMETRI

- Iinkcazelo zezalamano zetrigonometri (i-sine, i-cosine, i-tangent)
- Iimpawu nezitoliko zemisebenzi yetrigonometri neegrafu zazo (umz. ummandla, uluhlu, ixesha, ubuninzi), kuquka iinguqulelo zemisebenzi yetrigonometri
- Ukusombulula izilinganiso nokusebenzisa izilinganiso zetrigonometri nokusebenzisa izazisi; ukwenza lula iingxelo zetrigonometri usebenzisa izazisi nefomula yonciphiso apho kukho imfuneko; ii-engile ezikhethekileyo; ii-engile eziqukayo neziphindwe kubini
- Imithetho yokusebenzisa i-eriya, i-sine ne-cosine
- Ukusebenzisa iingqikelelo zetrigonometri ekusombululeni iingxaki, nokuquka iingxaki zemilinganiso emibini nemithathu

3c INGQIQO YESITHUBA UQUKA NEE-ENGILE, II-SYMMETRI, IMILINGANISO, IMINIKELO NOKUTOLIKA IIMILO ZEEMBONO EZIMBINI NEEMBONO EZINTATHU

Izinto zeGeometri

- Iimpawu zemizobo ye-2D nezinto ze-3D (ezifana nesangqa, uxande, i-trapezium, ingqukuva, ikhowuni, ipyramidi)
- Ifektha yesikali
- Umjikelezo, i-eriya, umthamo (kananjalo nemifanekiso nezinto ezidibeneyo)

Ijometri yokuhlahlela (edibanisa iimpawu zejometry ne-aljibra kummandla we-Cartesian)

Isangqa seJometri

- Ii-quadrilateral ezijikelezayo
- Unxulumano phakathi kwee-tangent, nee-chord, nee-engile kwisangqa

3d IMPATHO YEDATHA NOKUNOKWENZEKA

- Umlinganiselo (notoliko olunxulumene noku)
- Ubumeli (obufana nee-histogram, iigrafu zomgca, iitshati zepayi, ii-ogive, iiploti zebhokisi namabhovu) nezitoliko ezinonxulumano)
- Ukunokwenzeka

3e USETYENZISO LWEZAKHONO ZOBUCHULE OBUFANELEKILEYO EKWENZENI IZIGQIBO NOKUMISELA UBUNYANI BOBUNGQINA OBUNIKELWEYO

4. YINTONI EMAYENZIWE ZIITITSHALA?

4a. IZISEKO ZOKUFUNDISA EZINGQALE KWINGOMSO

Ukujongana nemibuzo yokhetho oluphindaphindayo

Ngaphandle xa imibuzo yokhetho oluphindaphindayo sele isetyenziswa eklasini, kungaba luncedo ukunika abafundi izikhokelo ezithile malunga nendlela yokujongana neemvavanyo kule fomathi. Kungaba luncedo ukuba ootitshala bangafunda amanqaku alandelayo, mhlawumbi ngemizekelo ethile ukwenza iinqobo zicace.

- Funda umbuzo ngononophelo olukhulu ngaphandle kokujonga naziphi izinto ezinokhethwa.
- Zama ukujongana nombuzo phambi kokujonga naziphi izinto ezinokukhethwa.
- Jongo izinto zokhetho uze ubone nokuba enye yazo ihambelana nempendulo efunyenweyo, kwimeko enjalo khetha olo khetho. **Kodwa** jongisisa uzathuzo olubandakanyekayo, xa kunokwenzeka ukuba impendulo ibonisa ingqikelelo ethile ephosakeleyo, njengoko kunjalo kumzekelo olandelayo:

  Malunga ne- $x > 0$, $\sqrt{9x^2 + 16x^2}$ ilingana ne-

  (A) $5x$ (B) $7x$ (C) $\pm 5x$ (D) $\pm 7x$

  Ukusebenzana nombuzo phambi kokujonga iimpendulo, nokuqaphela iingqikelelo eziphosakeleyo zokuba (a) ingcambu yesikwere sesibalo ayilingani nempendulo yengcambu esisikwere, yaye (b) ‘ingcambu yesikwere’ ngokwenkcazelo ichanekile, kuya kunceda ababhali ukwenza ukhetho oluchanekileyo.

- **Zibekele ixesha** ukuba akukho nanye yeempendulo zokhetho ehambelana nempendulo oyifumeneyo, phinda uqale umbuzo, yaye uzame kwakhona. Ukuba akukho nanye yezinto zokhetho efunyenweyo, shiyela umbuzo ixesha elizayo uze uqhubeke. Yonke imibuzo inokhetho olunye oluchanekileyo – oku kuhloliwe ngaphambili, yaye akukho mfuneko yokuba ababhali bakhathazeke ngokuthi singabakhona isiphosiso kumbuzo.
- Imibuzo apho kunokwenzeka ukuphungula izinto ezikhethwayo ngokuthathela indawo iphetshwe ngabom. Ngako oko, ukwenza umzekelo, ayinakuba khona imibuzo efuna isisombululo se-ikhweyizhini, ngenxa yokuba kulula ukuthathelana indawo enye nenye yamakhetho anikiweyo nokufumana elichanekileyo ngokunciphisa. Ukwenza umzekelo, ukuba besiza kubuza umzekelo olandelayo: "Nasi isisombululo $3x + 4 = -8$ is

  (A) -4 (B) $-\frac{4}{3}$ (C) 4 (D) $\frac{4}{3}$"

  Ungakwenza lula ukuthathela indawo -4 yaye ubone ukuba u-(A) kufuneka abe lukhetho olufanelekileyo.

Ukunceda abafundi ukuzilungiselela iimvavanyo ze-MAT

Amacebiso angezantsi ziinzame zokukhokela iititshala, amacebiso angezantsi azama ukukhokela ootitshala ekuphuhliseni ufaneleko nesakhono semathematika. Xa ukufaneleka kwabo kuphezulu, nokufaneleka kwabo ekuzuzeni amanqaku kwi-NBT kuya kuba phezulu.

- Qinisekisa ukuthatha inxaxheba eklasini okusebenzayo apho abafundi bekhuthazwa ukubuza imibuzo (oku kuthelekelela kwangaphambili ulwazi olungqongqo lotitshala nokuqonda).
- Qinisekisa abafundi – ukuba imbalwa kakhulu imibuzo engenayo ingqiqo; yonke imibuzo ngamathuba okubandakanyeka okunzulu nokubanzi.

- Phuhlisa ukuqonda ingqiqo kwabafundi ngokubacela ukuba bachaze indlela abacinga ngayo ngamaxa onke.
- Cacisa izakhono zokufunda nokubhala zemfundo ephakamileyo ezifunekayo zemathematika: kuluna ukucinga ukuba abafundi bayaziqonda iindlela zolwimi lwemathematika, kodwa oku akudli ngokubanjalo ngokuyimfuneko. Ukwenza umzekelo, ingaba bayawuqonda umahluko phakathi ‘kukakodwa’ kunye ‘nokunye, naphakathi kokuthi ‘kabini kangangoko’ nokuthi ‘mbini ngaphezu kwento.; ingaba bayalwazi ulwimi olunxulumene nokungalingani, okufana nokuthi ‘imivo emithathu okungenani’ okanye ‘hayi ngaphezulu kwesi-5’, njl. njl.?
- Yenza ngokucacileyo izakhono zobuchule bokufunda nokubhala kwabo bonke kwimathematika. Njengoko ukusebenza ngolwalamano, ngepesenti, ngokusebenza amanani, njl. njl., zingachazwa njengolwalamano, ipesenti, ukusebenza amanani, njl. njl. zingezizo izakhono ezikhethekileyo ezifunwayo kwikharityhulam yeBanga le-12 (nangona kucingelwa njalo kwangaphambili ngenyaniso yokuba bafundiswe njalo kumabanga angaphambili), abafundi badla ngokulibala (okanye abaziqondanga kwaphela) ezi ngqikelelo zobuchule bokufunda nokubhala kwabo bonke. Kwiimvavanyo ze-MAT abanakho ukusebenzisa iimatshini zokubala (ii-calculator), yaye kufuneka babonise ukuqonda iingqikelelo ezisemxholweni. Ukuthembela okungafunekiyo kwiimatshini zokubala nako kananjalo kwenza abafundi balahlekelwe sisakhono sezibalo, yaye balahlekelwe kukuqonda kwabo izibalo, ubukhulu bazo nendawo yazo kumgca-manani.
- Naphina apho kunokwenzeka cinga ngeendlela ezinye zokusombulula ingxaki: ingaba ingxaki yejometri (i-eriya, umthamo) ingasombululwa ngembono yetrigonometri, okanye ingaba ingxaki yolingano lwetrigonometri ingasombulwa ngokusebenzisa igrafu yetrigonometri?

- Naphina apho kunokwenzeka, thembela kwiingqikelelo zemathematika kunokuthembela koomatshini bokubala ukusombulula iingxaki. Kunokwenzeka ukuba umatshini wokubala usombulule ulingano, kodwa ke ingaba oku kubonisa ukuba umfundi uyaziqonda iingqikelelo ezifunekayo ekusombuleni iimeko zokulingana? Kunokwenzeka ukwenza umzekelo bangaqapheli ukuba ulingano olulandelayo $\frac{x^2(x+1)}{x}=0$ lunesisombululo esinye kuphela.
- **Okubaluleke nangakumbi: ingaba abafundi bayaqonda?**

5. UKULUNGISELELA II-NBT

5a. Uncedo lwe-Intanethi

Siyazi ukuba kukho abantu abaliqela abanikela abafundi abangalumkanga ithuba lokukhangela imateriyali kwi-Intanethi eziza kubalungiselela ukubhala ii-NBT. Xeshikweni zingabakhona iziza ezibonelela ngokufundia imathematika, nezinye ezinikela ngolwazi olunxulumene neentlobo zemibuzo yokhetho oluphindaphindayo lwemibuzo yemathematika, **awukho nomnye wale mibutho onegunya lokuthetha egameni le-NBTP, yaye awukho nawuphi onolwazi olukhethekileyo lwezinto i-NBT ezimisele ukuzivavanya.**

5b. Izifundo ezongezelelweyo

Kananjalo kukho iititshala ezininzi ezifuna ngokusemthethweni ukunceda abafundi bazo ukubalungiselela i-NBT. Ngako oko baya kujongana namanqaku axeliweyo ngentla, nokwenza konke okusemandleni abo ukunikela abafundi babo ngesiseko esingamandla semathematika kangangoko. Nangona kunjalo, **ayikho ititshala enegunya lokuthetha egameni le-NBTP,** yaye akukho naziphi iititshala ezinegunya lokusebenzisa imbasa ye-NBTP okanye ye-HESA kuyo nayiphina imateriyali yabo, nto leyo enokudala ukuba olo luluvo oluvunyelwe yi-NBTP.

6. IMIBUZO EBUZWA RHOQO MALUNGA NEEMVAVANYO ZE-MAT: IMIBUZO EMIBINI EKHATHAZA ABAZALI NOOTITSHALA

6a. Umntwana wam usebenze kakuhle kakhulu esikolweni – kutheni amanqaku akhe e-NBT ephantsi kangaka?

Ukuphendula oku kufuneka sibuze ukuba uthetha ntoni 'ukakuhle kakhulu'? Yaye 'uphantsi kakhulu' uthetha ntoni? Ngokuxhomekeke kubungakanani bokuqheliswa nokusebenza kwiintlobo ezithile zeemvavanyo neemviwo, kunokwenzeka abafundi bafumane amanqaku aphezulu kwiimvavanyo apho imibuzo

- ilandela iphatheni elindelweyo;
- yakhelwe njengesikafula (jonga uluvo ngentla);
- isetyenziwa rhoqo.

Oku akuthethi ngokuyimfuneko ukuba kukho ukuqonda okwaneleyo kwezihloko ezisemxholweni, kumxholo ofunwa yiMfundo ePhakamileyo.

Ukubhala uvavanyo lwe-MAT kubeka ababhali kumaqela amathathu (eleSiseko, eliPhakathi, eloBuchule). Akukho kuphumelela okanye ukungaphumeleli, yaye ababhali abahlelwa ngokunxulumana komnye nomnye. Isiphumo sinceda nje umbhali, kunye neziko afaka isicelo kulo, ukumisela imigangatho efanelekileyo yenkxaso enokufuneka, kamsinya kangangoko. Ukuba umbhali ukwiqela loBugcisa, inqaku lokwenene alibalulekanga yaye kufuneka lingathelekiswa naliphi inqaku elifunyenwe esikolweni kuvavanyo okanye uviwo, okanye nakuviwo lokugqibela lwe-NSC, eliluxabiso lwesiqhelo lokubhekisa.

6b. Linini elona xesha lilungileyo lokubhala uvavanyo lwe-MAT?

Ababhali kufuneka bakhethe ixesha lokubhala elibenza babenakho ukufikelela kwixesha elimiselwe ukugqiba leziko apho bafake isicelo khona. Uphando lwethu lucebisa ukuba nakweyiphi imeko akukho nzuzo ekulindeni ukubhala ngokusondeleyo kuviwo lwe-NSC. I-NBTP iyayicingela inyaniso yokuba ezinye izihloko ziya kwenziwa kuphela kwiiveki ezimbalwa zokugqibela zonyaka wokufundisa, nangona ootitshala bekhuthazwa ukulandela isimiseli sesantya ngenjongo yokuvumela ixesha lohlaziyo nokulungiselela iimviwo zokugqibela.