H

Teisteanais
Nàiseanta
EISIMPLEIR A-MHÀIN

Comharra

S873/76/01

Gnìomhachas Matamataig

Deit — Gun bhuinteanas

Ùine — 2 uair 5 mionaid

S8737601

Lìon na bogsaichean seo agus leugh na tha air a' chlò-bhualadh gu h-ìosal.

Làn ainm na sgoile no colaiste

Baile

Ciad ainm(ean)

Sloinneadh

Àireamh an t-suidheachain

Latha-breith

Latha   Mìos   Bliadhna   Àireamh an oileanaich

Comharran gu lèir — 65

Feuch na ceistean UILE.

Faodaidh tu àireamhair a chleachdadh.

Gus na comharran gu lèir fhaighinn, feumaidh tu d' obrachadh a-mach a shealltainn sna freagairtean agad.

Cuir na h-aonadan anns na freagairtean agad far a bheil sin iomchaidh.

Bu chòir dhut sùil a thoirt air na stuthan ro-sgaoil airson Gnìomhachas Matamataig Àrd-ìre a gheibh thu gu h-eileagtronaigeach.

Sgrìobh do fhreagairtean gu soilleir anns na beàrnan san leabhran seo. Tha àite a bharrachd airson fhreagairtean aig deireadh an leabhrain seo. Ma chleachdas tu an t-àite seo, feumaidh tu àireamh na ceiste a tha thu a' freagairt a chomharrachadh gu soilleir.

Feumar ceistean 4, 8 agus 10 a dhèanamh air bathar-bog agus an uair sin an clò-bhualadh.

Cleachd inc **gorm** no **dubh**.

Mus fàg thu seòmar na deuchainne feumaidh tu an leabhran seo agus na clò-bhualaidhean agad a chur a-staigh dhan chèis-litreach soilleir solaraichte. Feumaidh tu a' chèis seo a thoirt don Fhreiceadan; mura dèan thu sin, dh'fhaodadh tu na comharran gu lèir airson a' phàipear seo a chall.

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Fiosrachadh agus òrdughan airson luchd-deuchainn

Tha na faidhlichean eileagtronaigeach gu h-ìosal solaraichte dhut airson an cleachdadh san deuchainn seo:

- **'C4 Clàr na Sgoile.xlsx'** — faidhle cliath-dhuilleag anns a bheil 1 duilleag-obrach
- **'C8 Dàta Bith-thomaid'** — faidhle cliath-dhuilleig le 1 duilleag-obrach (Dàta Bith-thomaid)
- **'C8 Freagairtean Bith-thomaid'** — faidhle giullachd-teacsa
- **'C10 Tiodhlac Charol'** — faidhle cliath-dhuilleig le 1 duilleag-obrach (Iasad Tùsail)

Feumaidh tu leth-bhreac a dhèanamh dhen às-chur agad bhon bhathar-bhog staitistigeil ann an ceistean 8 (a) (i), (b) agus (c) agus a chur anns an fhaidhle **C8 Freagairtean Bith-thomaid** airson clò-bhualadh.

Feumaidh tu d' ainm, SCN agus ainm an ionaid a thaisbeanadh air gach duilleag air gach clò-bhualadh. Tha àiteachan air an toirt seachad anns gach faidhle eileagtronaigeach airson am fiosrachadh seo a lìonadh.

Nuair a bhios tu a' clò-bhualadh faidhlichean cliath-dhuilleag, dèan cinnteach gu bheil:

- stiùireadh cruth-tìre air a chleachdadh
- loidhnichean clèithe air an sealltainn
- cinn sreath is colbh air an sealltainn
- an roghainn 'Fit All Columns on One Page' air a thaghadh.

Nuair a bhios tu a' clò-bhualadh faidhlichean giullachd-teacsa dèan cinnteach gun cleachdar stiùireadh dhealbhan.

Cleachd an clàr seo gus dèanamh cinnteach gu bheil na clò-bhualaidhean uile agad.

Ceist	Clò-bhualadh	Coileanta (✓)
4 (a) (i) agus (c) (i)	Duilleag-obrach 'Clàr na Sgoile' • sealladh luachan • sealladh foirmle Bu chòir seo a bhith a' toirt a-steach an graf.	
8 (a) (i)	Diagram-sgapte	
8 (b)	Às-chur bhon bhathar-bhog staitistigeil	
8 (c)	Às-chur bhon bhathar-bhog staitistigeil	
10 (b)	Duilleag-obrach Iasad Tùsail • sealladh luachan • sealladh foirmle	
10 (c) (i) agus 10 (c) (ii)	Duilleag-obrach Pàigh Pàigheadh Aon Turais • sealladh luachan • sealladh foirmle	

Comharran gu lèir — 65

Feuch na ceistean UILE

1. Dèan tuairmse air an àireamh uairean de chadal a bhios aig neach àbhaisteach ann an Alba rè am beatha.

Innis barailean sam bith a th' agad. **4**



[Tionndaidh an duilleag

2. Chaidh faighneachd do bhuidheann de dh'oileanaich dè na seòrsaichean de phrògraman Tbh a bhios iad a' coimhead gu tric bho roghainn comadaidh, fìorachd agus dràma.

Bha na toraidhean mar a leanas:

- sheall 60 air comadaidh

- sheall 55 air fìorachd

- sheall 21 air dràma

- sheall 45 an dà chuid air comadaidh agus fìorachd

- sheall 12 an dà chuid air fìorachd agus dràma

- sheall 14 an dà chuid air dràma agus comadaidh

- sheall 8 air **na trì** prògraman gu tric

- cha robh 2 a' coimhead air **gin** dhe na prògraman sin gu tric.

(a) Cuir crìoch air an diagram Venn gus am fiosrachadh seo a shealltainnn: **3**

comadaidh   fìorachd
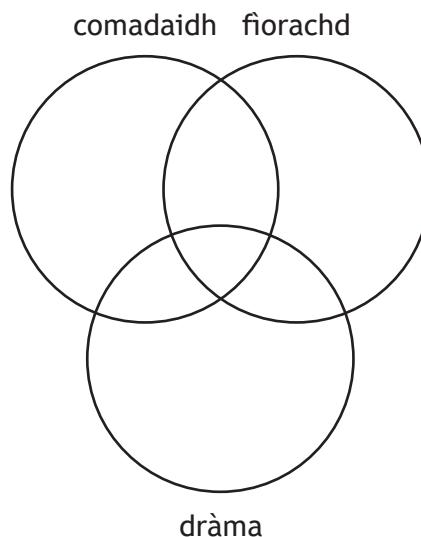
dràma

(b) Ma thèid oileanach a thaghadh gu tuaireamach, lorg an coltachd gum bi iad a' coimhead air prògraman TBh fìorachd agus dràma ach nach bi iad a' coimhead air prògraman comadaidh. **2**

NA SGRÌOBH AN SEO

3. Bidh Zac a' cur £500 a-steach do chunntas banca air 1 Faoilleach 2018, 1 Faoilleach 2019, agus 1 Faoilleach 2020.

Bidh am banca a' pàigheadh riadh a-steach don chunntas aige aig deireadh gach bliadhna, a' cleachdadh nan reataichean èifeachdach bliadhnail a leanas:

- 2018   3.3%
- 2019   2.4%
- 2020   1.0%

Chan eil e a' tarraing airgead bhon chunntas aige.

(a) Obraich a-mach an cothromachadh ann an cunntas Zac aig deireadh 2020.   **3**

Air 1 Faoilleach 2021 bidh Zac a' cur £500 eile dhan chunntas aige.

Cha bhith e a' cur airgead a bharrachd dhan chunntas aige ann an 2021.

(b) Obraich a-mach an ìre rèidh èifeachdach bliadhnail a tha a dhìth ann an 2021 airson gum bi cothromachadh a' chunntais aig £2100 ro dheireadh na bliadhna.   **2**

4. Feumaidh tu iomradh a thoirt air an fhaidhle cliath-dhuilleag 'C4 Clàr na Sgoile.xlsx' nuair a tha thu a' freagairt na ceiste seo.

Feumaidh tu crìoch a chur air pàirtean (a) (i) agus (c) (i) le bhith a' cleachdadh an fhaidhle cliath-dhuilleig.

Feumar crìoch a chur air pàirtean (a) (ii), (b) agus (c) (ii) anns na h-àitichean freagairt sònraichte.

Tha sgoil a' beachdachadh air togalach ùr agus i a' tighinn faisg air a làn chomas.

Bha 650 sgoilear air a' chlàr san Lùnastal 2021.

- Bidh mu 18% de sgoilearan a' falbh aig dheireadh gach bliadhna sgoile.

- Bidh 140 sgoilear ùr AS1 a' tighinn a-steach don chlàr san Lùnastal gach bliadhna.

(a)   (i)   Lìon a-steach an duilleag-obrach 'Clàr na Sgoile' gus ro-innse clàr na sgoile san Lùnastal 2031.   **3**

    (ii)   Thoir beachd air cho cinnteach sa tha an ro-innse seo.   **1**

(b)   Thoir beachd air a' cheangal eadar ùine agus clàr na sgoile ris a bheilear an dùil suas chun Lùnastal 2031.   **1**

4. (a' leantainn)

Tha an sgoil a' gluasad air adhart le planaichean airson togalach ùr.

Meudaichidh seo comas na sgoile gu 800 sgoilear.

(c)   (i)   Leudaich an clàr air an duilleag-obrach agad gus graf a thogail a sheallas dè thathar an dùil a thachras do chlàr na sgoile san fhad-ùine.

  Feumaidh tu beachdachadh air dè thachras do chlàr na sgoile nas fhaide na Lùnastal 2031.   **2**

  (ii)   Cleachd an graf agad gus faighinn a-mach a bheil an comas ùr freagarrach.   **1**

Clò-bhuail an duilleag-obrach 'Clàr na Sgoile' ann an sealladh luach agus ann an sealladh foirmle. Dèan cinnteach gu bheil an graf suidhichte fon chlàr agus gu bheil e air aon duilleag sa chlò-bhualadh.

[Tionndaidh an duilleag

5. Tha an lìonra gnìomhachd airson pròiseact ùrachaidh gàrraidh air a shealltainn gu h-ìosal.

A		
thoir air falbh an t-sean sheada		
0	2	3

B		
thoir air falbh feur is lusan		
0	3	3

C		
ullaich talamh		
3	4	7

D		
tog seada ùr		
7	3	10

E		
cuir ann feur is lusan ùra		
7	2	11

F		
peant seada		
10	2	12

G		
cuir àirneis ris		
9	1	12
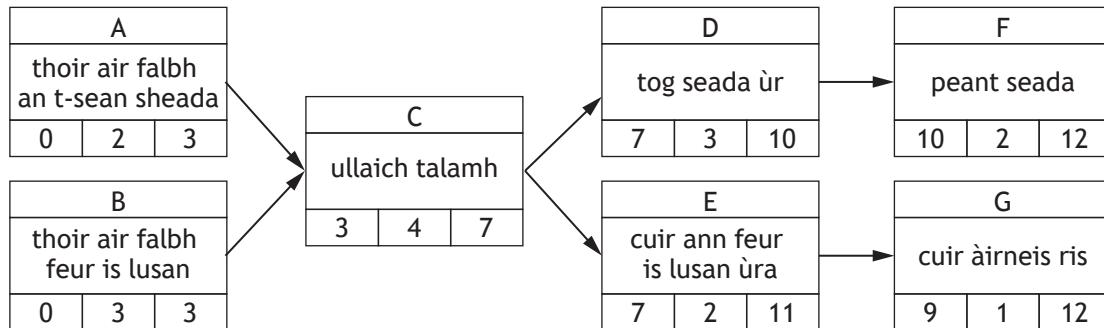
(a) Mìnich, a' cleachdadh eisimpleirean bhon phròiseact seo, an diofar eadar gnìomh a **tha riatanach (essential)** airson a' phròiseict agus gnìomh a tha **do-sheachanta (critical)** airson a' phròiseict. **2**

(b) Thoir cunntas air brìgh gach aon de na trì luachan ann an nòd Gnìomh C. **1**

(c) Cruthaich Cairt Gantt airson a' phròiseict gu h-àrd. Cha leig thu a leas ùineachan saora (float times) a thoirt a-steach don diagram agad. **4**

6. Tha na trì diagraman, gu h-ìosal, a' sealltainn mar a tha àirdean luchd-paraisiut ag atharrachadh os cionn na talmhainn thar ùine.
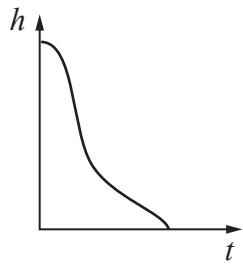
neach-paraisiut A   neach-paraisiut B   neach-paraisiut C
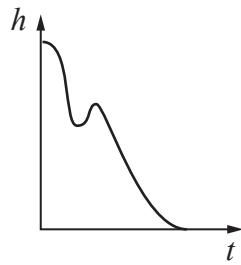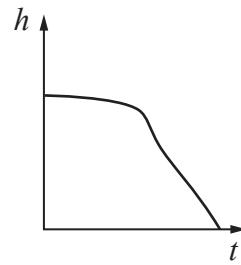
Innis dè an graf nach urrainn don leum aca a mhodaileadh.

Mìnich am freagairt agad gu soilleir.   **2**

[Tionndaidh an duilleag

7. Chaidh prìs chuibheasach peatrail suas aig na h-ìrean èifeachdach bliadhnail a leanas:

- Màrt 2018 gu 2019:   2.1%

- Màrt 2019 gu 2020:   0.5%

- Màrt 2020 gu 2021:   2.0%

(a) Obraich a-mach an àrdachadh sa cheud iomlan ann am prìs chuibheasach a' pheatrail thairis air na trì bliadhna bhon Mhàrt 2018 gu Màrt 2021.   **1**

B' e prìs chuibheasach peatrail sa Mhàrt 2021 136.4 sgillin gach liotair.

(b) Mar sin obraich a-mach a' chosgais chuibheasach airson tanca 45-liotair a lìonadh le peatrail sa Mhàrt 2018.   **2**

8. Feumaidh tu iomradh a thoirt air an fhaidhle cliath-dhuilleig 'C8 Dàta Bith-thomaid' nuair a tha thu a' freagairt na ceiste seo. Feumaidh tu na pàirtean (a)(i), (b) agus (c) a dhèanamh le **bathar-bog staitistigeil.** Feumaidh tu leth-bhreac a dhèanamh de na freagairtean agad airson phàirtean (a)(i), (b) agus (c) agus an cur dhan fhaidhle giullachd-teacsa 'C8 Freagairtean Bith-thomaid'. Feumar crìoch a chur air pàirtean (a)(ii), (b), (c), agus (d) anns na h-àitichean freagairt sònraichte.

Tha measgachadh eadar-dhealaichte de theicneòlasan agus connadh ath-nuadhachail san RA a' toirt a-steach bith-thomad a tha na phrìomh thùs connaidh airson dì-charbonachadh gineadh dealain agus solar teas. Tha criomagan fiodha nan eisimpleir de stòr bith-thomaid.

Tha an toradh teas bho chriomagan fiodha a thèid a chleachdadh gus lùth a ghineadh ag atharrachadh a rèir na tha annta de thaiseachd. Tha an dàta anns an fhaidhle cliath-dhuilleig a' sealltainn taiseachd (%) agus na toraidhean teas co-cheangailte (cilo-uat) de dhiofar shampaill air thuaiream de chriomagan fiodha.

(a)   (i)   Cruthaich diagram-sgapte airson an dàta.   **2**

(ii)   Thoir seachad dà bheachd mun diagram-sgapte.   **2**

(b)   Obraich a-mach co-aontar na loidhne ais-cheumnachaidh de thoradh teas air ceudad taiseachd.   **2**

(c)   Thoir tuairmse air toradh teas criomagan fiodha le taiseachd de 35% agus mìnich an tuairmse seo le bhith a' toirt iomradh air beàrn ro-innse.   **2**

[Tionndaidh an duilleag

8. (a' leantainn)

(d) Mìnich buaidh d' anailis do dhuine sam bith a tha an dùil criomagan fiodha a chleachdadh mar thùs teas. **1**

Clò-bhuail na freagairtean agad airson C8 (a) (i), (b) agus (c).

9. Tha e an urra ri companaidh TBh cuirm-cheist ùr a dhèanamh do shianal telebhisein nàiseanta.

Ma thèid dàil a chur air an obair, feumaidh a' chompanaidh £10,000 a bharrachd a phàigheadh.

Airson adhbharan anailis cosgais is buannachd, thathas a' gabhail ris nach eil ach dà thachartas ann a dh'adhbhraicheas dàil:

- coltachd 0.3 gum bi prìomh neach-obrach tinn
- coltachd 0.1 gum bi fàilligeadh uidheamachd ann.

(a) Obraich a-mach an luach ris a bheil dùil de chosgaisean air am bu chòir beachdachadh airson anailis cosgais is buannachd. **3**

Tha e comasach na ceumannan riaghlaidh a leanas a chleachdadh:

- Ceum Riaghlaidh 1 — Luchd-obrach cùl-taic fhastadh a dh'fhaodas obair neach sam bith tinn a ghabhail, aig cosgais £1000.
- Ceum Riaghlaidh 2 — £3000 a chaitheamh air sgrùdadh uidheamachd gus dèanamh cinnteach gu bheil gach pìos uidheamachd ag obair gu ceart.

(b) Obraich a-mach an luach ris a bheil dùil de chosgaisean ma thèid ceum riaghlaidh 1 a ghabhail. **1**

Is e an luach ris a bheil dùil de chosgaisean ma thèid ceum riaghlaidh 2 a ghabhail £6000.

(c) Can dè an ceum/ceumannan riaghlaidh a bu chòir a ghabhail.

Thoir seachad adhbhar mar thaic don mholadh agad. **1**

[Tionndaidh an duilleag

10. Feumaidh tu iomradh a thoirt air an fhaidhle cliath-dhuilleig 'C10 Tiodhlac Charol' nuair a tha thu a' freagairt na ceiste seo. Feumaidh tu crìoch a chur air pàirtean (b), (c)(i) agus (c)(ii) le bhith a' cleachdadh an fhaidhle cliath-dhuilleig. Feumar crìoch a chur air pàirtean (a) agus (d) anns na h-àitichean freagairt sònraichte.

Tha Carol air tiodhlac de £2500 fhaighinn, agus tha i a' beachdachadh air dè bu chòir a dhèanamh leis.

Tha cunntas sàbhalaidh aice a phàigheas riadh aig reat bliadhnail èifeachdach de 1.25%.

(a) Obraich a-mach dè an **riadh** a gheibheadh Carol nan tasgadh i an tiodhlac seo sa chunntas sàbhalaidh aice airson 34 mìosan. **2**

Tha iasad pearsanta aig Carol cuideachd. Fhuair i iasad de £8000 an toiseach gus a phàigheadh air ais le ath-phàighidhean mìosail neo-atharrachail airson 48 mìosan, leis a' chiad ath-phàigheadh air a dhèanamh mìos às dèidh dhi an t-iasad fhaighinn. Tha riadh aig reat èifeachdach bliadhnail de 4.9%.

(b) Fosgail an duilleag-obrach 'Iasad Tùsail'. Crìochnaich foirmlean ann an clàr an iasaid agus obraich a-mach an reat ath-phàighidh mìosail neo-atharrachail, agus an t-suim ath-phàighidh dheireannach. **4**

Tha Carol dìreach air an 14^{mh} ath-phàigheadh mìosail a dhèanamh air an iasad. Tha i a' co-dhùnadh faighinn a-mach dè a' bhuaidh a bhiodh ann nan cleachdadh i an tiodhlac £2500 mar phàigheadh aon-turais gus an còrr a tha fhathast ri phàigheadh air an iasad aice a lùghdachadh.

Tha solaraiche an iasaid ag aontachadh suim ath-phàighidh mhìosail neo-atharrachail ùr obrachadh a-mach, ri phàigheadh anns gach aon de na 34 mìosan a tha air fhàgail.

(c) (i) Dèan lethbhreac den duilleag-obrach 'Iasad Tùsail'. Cuir an t-ainm 'Pàigh Pàigheadh Aon Turais' air an lethbhreac.

Atharraich an duilleag-obrach 'Pàigh Pàigheadh Aon Turais' mar a dh'fheumar, agus mar sin obraich a-mach ath-phàigheadh mìosail neo-atharrachail ùr Charol. **3**

(ii) Air an duilleag-obrach 'Pàigh Pàigheadh Aon Turais', obraich a-mach dè a shàbhaileadh Carol ann am pàighidhean rèidh le bhith a' dèanamh a' phàigheadh aon turais seo. **2**

10. (a' leantainn)

(d) Innis aon adhbhar a dh'fhaodadh Carol co-dhùnadh an tiodhlac a chur don chunntas sàbhalaidh aiceseach a chleachdadh gus còrr an iasaid aice a lùghdachadh.

1

Clò-bhuail na freagairtean agad airson C10 (b), (c) (i) and (c) (ii) ann an:

- sealladh luachan

- sealladh foirmle.

[Tionndaidh an duilleag

11. Feumaidh tu iomradh a thoirt air an fhiosrachadh air 'Goiriolathan beinne' a tha air a thoirt seachad san stuth ro-sgaoilidh nuair a tha thu a' freagairt na ceiste seo.

Lorg sgrùdadh 2020 gu robh àireamh-sluaigh goiriolathan beinne air a dhol suas gu 1004.

Tha eòlaiche air a ràdh ma chumas àireamh-sluaigh goiriolathan beinne ann am Beanntan Virunga a' fàs gu mòr gum bi 1600 goiriolathan ann ron bhliadhna 2032.

(a) Faigh a-mach a bheil aithris an eòlaiche ceart.

Thoir adhbhar airson an fhreagairt agad. **2**

Bidh goiriola beinne inbheach àbhaisteach ag ithe 30 kg de bhiadh gach latha.

(b) Dèan tuairmse air an **ìre as àirde** de teirmitean agus seangan (ann an kg) a bhios goiriola beinne àbhaisteach ag ithe fhad 's a bhios iad nan inbheach.

Innis barailean sam bith a th' agad. **3**

[CRÌOCH A' PHÀIPEIR EISIMPLEIR]

ÀITE A BHARRACHD AIRSON FHREAGAIRTEAN

ÀITE A BHARRACHD AIRSON FHREAGAIRTEAN

Gnìomhachas Matamataig
Bileag dàta

Deit — Gun bhuinteanas

Ùine — 2 uair 5 mionaid

Stuthan ro-sgaoileadh

Thèid a' bhileag seo a thoirt a-mach gu ionadan ro ceann-latha na deuchainne.

Thèid leth-bhreac glan den bhileig seo a thoirt a-mach do luchd-deuchainn. Thèid leth-bhreacan a thoirt a-mach aig toiseach na deuchainne agus an cruinneachadh aig deireadh an seisein. Cha bu chòir tagraichean na leth-bhreacan aca fhèin den bhileig seo a thoirt a-staigh dhan deuchainn.

Bu chòir do ionadan dèanamh cinnteach gu bheil tagraichean eòlach air na co-theacsaichean agus an fhiosrachadh am broinn na bileige seo nuair a thathar ag ullachadh airson na deuchainne.

Bidh cuid de cheistean na deuchainne stèidhichte air na stuthan seo.

Tha seata de dhà sgrìobhainn anns a' bhileag seo:

1. Goiriolathan beinne

2. Grunn òrdughan cuideachail airson R.

1. Goiriolathan beinne

Tha dì-choillteachadh a' tachairt air sgèile mhòr air feadh an t-saoghail agus tha mòran bheathaichean a' fulang call àrainn. Tha sgiobaidhean glèidhteachais air a bhith ag iomairt an aghaidh dì-choillteachadh ann an oidhirp àireamhan fiadh-bheatha àrdachadh.

Is e aon sgeulachd shoirbheachail an goiriola beinne. Tha còrr air leth de goiriolathan beinne an t-saoghail a' fuireach ann am Beanntan Virunga, raon de bholcànothan a chaidh à bith a tha a' dol thairis air Poblachd Deamocratach a' Chongo, Rwanda agus Uganda.

Sheall sgrùdadh ann an 2008 nach robh ach 680 goiriolathan beinne ann am Beanntan Virunga. Sheall sgrùdadh eile ann an 2020, mar thoradh air oidhirpean glèidhteachais, a' toirt a-steach casg air logadh mì-laghail, gu robh àireamh-sluaigh goiriolthan beinne air a dhol suas.

Thathas den bheachd gu bheil goiriolathan beinne mar inbheach nuair a tha iad 10 bliadhna a dh'aois agus bidh iad beò airson cuibheasachd de 35 bliadhna.

Bidh goiriolathan beinne beò air daithead glasraich **sa mhòr-chuid** anns a bheil coilleagan bambù, measan agus dearcan. Le cothrom, bidh goiriolathan beinne cuideachd ag ithe seangan agus termites, ach bidh an daithead aca fhathast mar glasraich.

2. Grunn òrdughan cuideachail airson R

A' cur dàta a-steach gu R Studio

Gus dàta a leughadh bho fhaidhle Excel csv, air ainmeachadh *excel_data.csv*, gu R Studio agus an t-ainm *mydata* a chur air, an toiseach cleachd na clàir-thaice theàrnach ann an R Studio **Session > Set Working Directory > Choose Directory** gus sealltainn far a bheil *excel_data.csv* air a' choimpiutar agad. Bidh an còd a leanas an uair sin a' leughadh an dàta gu R Studio:

```
mydata<-read.csv("excel_data.csv")
```

`attach(mydata)` — bidh seo a' cur ainmean nan caochladairean ris

Aig deireadh a' mhion-sgrùdaidh cuimhnich gun cleachd thu `detach(mydata)` gus ainmean nan caochladairean a neo-cheangal.

(a) Grafaigean

Ma tha na caochladairean àireamhach X agus Y agad:

`hist(X, main= "Title",xlab="x-axis label",ylab="Frequency")` — bidh seo a' cruthachadh histogram den chaochladair air a bheil an t-ainm X, agus bidh e a' cur ris tiotal agus leubailean axis

`boxplot(Y, main="Title", ylab="y-axis label")` — a' cruthachadh plot-bhogsaichean den chaochladair àireamhach Y

`boxplot(X,Y, main="Title", xlab="x-axis label", ylab="y-axis label", names=c("X","Y"))` — a' cruthachadh plot-bhogsaichean coimeasach de na caochladairean àireamhach X agus Y

`plot(X,Y, main="Scatterplot of Y on X",xlab="x-axis label",ylab="y-axis label")` — a' cruthachadh plot-sgapte de Y air X

Ma tha an caochladair seòrsach X agad:

`table(X)` — a' coimpiutadh na h-àireimh de phuingean-aire anns gach ìre den chaochladair sheòrsach X

`pie(table(X), main="Title")` — bidh seo a' toirt seachad clàr-cearcaill sìmplidh de na seòrsaichean ann an caochladair X leis an tiotal air a thoirt seachad

`barplot(table(X), main="Title", xlab="x-axis label", ylab="Frequency")` — bidh seo a' toirt seachad clàr-cholbhan den chaochladair sheòrsach X leis an tiotal is leubailean axis a tha air an toirt seachad

(b) Staitistearachd thuairisgeulach

`mean(X)` — a' coimpiutadh cuibheas aritmeataigeach a' chaochladair àireamhaich X

`sd(X)` — a' coimpiutadh claonadh àbhaisteach den chaochladair àireamhach X

`summary(X)` — a' coimpiutadh cuibheas aritmeataigeach, meadhain, luach as ìsle, luach as àirde agus cairtealan àrda agus ìosal den chaochladair àireamhach X

`IQR(X)` — a' coimpiutadh raon eadar-chairtealach den chaochladair àireamhach X

`prop.table(table(X))` — a' tilleadh na co-chuid de phuingean-aire anns gach ìre den chaochladair sheòrsach X

`prop.table(table(X))*100` — a' tilleadh a' cheudaid de phuingean-aire anns gach ìre den chaochladair sheòrsach X

`table(X,Y)` — a' cruthachadh tàr-chlàrachadh eadar an dà chaochladair sheòrsach X agus Y

(c) Co-dhàimh agus Ais-cheumnachadh

`cor.test(X,Y)` — a' coimpiutadh na co-dhàimh eadar X agus Y agus a' dèanamh deuchainn air beachd-bharail nialais airson co-dhàimh neoni

`lm(Y~X)` — a' cur loidhne ais-cheumnachaidh loidhnich ris an dàta (tha lm a' seasamh airson modail loidhneach)

`abline(lm(Y~X))` — a' cur loidhne ais-cheumnachaidh loidhnich ceàrnagan as lugha ri plot-sgapte de Y air X

`summary(lm(Y~X))` — a' sealltainn co-èifeachdair a' chinnteachaidh (R-ceàrnaigichte)

Gus ro-innse a dhèanamh leis a' mhodail loidhnich agad:

`predict(lm(Y ~ X), newdata=data.frame(X=C),interval = "pred")` — a' coimpiutadh luach ro-innste de Y nuair a tha X=C còmhla ri eadaramh ro-innse de 95%

(d) A' Feuchainn Beachd-bharail

`t.test(X,Y)` — a' dèanamh deuchainn-t a' cleachdadh dà shampaill eadar X agus Y

`t.test(X,Y,paired=TRUE)` — a' dèanamh deuchainn-t paidhrichte eadar X agus Y

`prop.test(x = c(a, b), n = c(n1, n2))` — a' dèanamh deuchainn 2-shampaill airson co-ionannachd cho-chuidean

[CRÌOCH A' BHILEIG DÀTA]

H

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Qualifications
SPECIMEN ONLY

S844/76/01

Applications of Mathematics

Marking Instructions

These marking instructions have been provided to show how SQA would mark this specimen question paper.

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General marking principles for Higher Applications of Mathematics

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

For each question, the marking instructions are generally in two sections:

generic scheme — this indicates why each mark is awarded
illustrative scheme — this covers methods which are commonly seen throughout the marking

In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) If you are uncertain how to assess a specific candidate response because it is not covered by the general marking principles or the detailed marking instructions, you must seek guidance from your team leader.

(c) One mark is available for each •. There are no half marks.

(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(e) Only award full marks where the solution contains appropriate working. A correct answer with no working receives no mark, unless specifically mentioned in the marking instructions.

(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) If an error is trivial, casual or insignificant, for example $6 \times 6 = 12$, candidates lose the opportunity to gain a mark, except for instances such as the second example in point (h) overleaf.

(h) If a candidate makes a transcription error (question paper to script or within script), they lose the opportunity to gain the next process mark, for example

This is a transcription error and so the mark is not awarded.

This is no longer a solution of a quadratic equation, so the mark is not awarded.

$$x^2 + 5x + 7 = 9x + 4$$
$$x - 4x + 3 = 0$$
$$x = 1$$
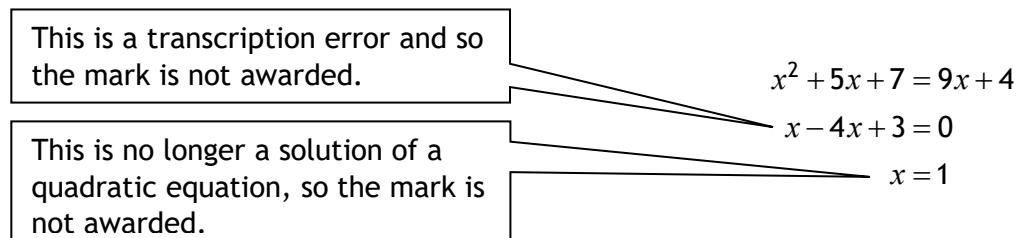
The following example is an exception to the above

This error is not treated as a transcription error, as the candidate deals with the intended quadratic equation. The candidate has been given the benefit of the doubt and all marks awarded.

$$x^2 + 5x + 7 = 9x + 4$$
$$x - 4x + 3 = 0$$
$$(x - 3)(x - 1) = 0$$
$$x = 1 \text{ or } 3$$
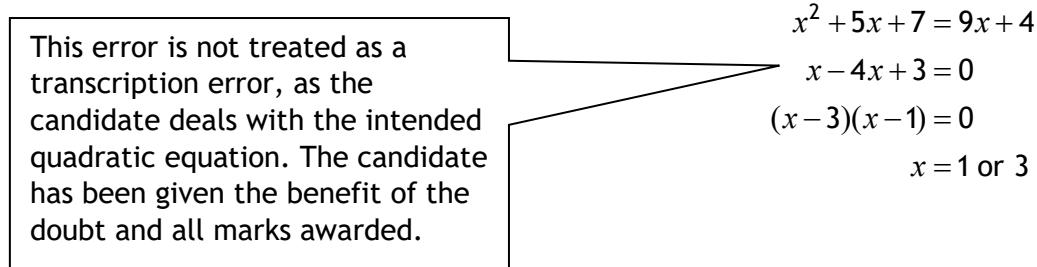
(i) **Horizontal/vertical marking**
If a question results in two pairs of solutions, apply the following technique, but only if indicated in the detailed marking instructions for the question.

Example:

$$\bullet^5 \qquad \bullet^6$$
$$\bullet^5 \quad x = 2 \quad x = -4$$
$$\bullet^6 \quad y = 5 \quad y = -7$$

Horizontal: $\bullet^5$ $x = 2$ and $x = -4$ Vertical: $\bullet^5$ $x = 2$ and $y = 5$
$\qquad\qquad$ $\bullet^6$ $y = 5$ and $y = -7$ $\qquad\qquad\qquad$ $\bullet^6$ $x = -4$ and $y = -7$

You must choose whichever method benefits the candidate, **not** a combination of both.

(j) In final answers, candidates should simplify numerical values as far as possible unless specifically mentioned in the detailed marking instruction. For example

$\dfrac{15}{12}$ must be simplified to $\dfrac{5}{4}$ or $1\dfrac{1}{4}$ $\qquad$ $\dfrac{43}{1}$ must be simplified to 43

$\dfrac{15}{0.3}$ must be simplified to 50 $\qquad$ $\dfrac{4/5}{3}$ must be simplified to $\dfrac{4}{15}$

$\sqrt{64}$ must be simplified to 8*

*The square root of perfect squares up to and including 144 must be known.

(k) Do not penalise candidates for any of the following, unless specifically mentioned in the detailed marking instructions:

- working subsequent to a correct answer
- correct working in the wrong part of a question
- legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
- omission of units
- bad form (bad form only becomes bad form if subsequent working is correct), for example

$(x^3 + 2x^2 + 3x + 2)(2x + 1)$ written as

$(x^3 + 2x^2 + 3x + 2) \times 2x + 1$

$= 2x^4 + 5x^3 + 8x^2 + 7x + 2$

gains full credit

- repeated error within a question, but not between questions or papers

(l) In any 'Show that . . .' question, where candidates have to arrive at a required result, the last mark is not awarded as a follow-through from a previous error, unless specified in the detailed marking instructions.

(m) You must check all working carefully, even where a fundamental misunderstanding is apparent early in a candidate's response. You may still be able to award marks later in the question so you must refer continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that you can award all the available marks to a candidate.

(n) You should mark legible scored-out working that has not been replaced. However, if the scored-out working has been replaced, you must only mark the replacement working.

(o) If candidates make multiple attempts using the same strategy and do not identify their final answer, mark all attempts and award the lowest mark. If candidates try different valid strategies, apply the above rule to attempts within each strategy and then award the highest mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Marking instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			$\bullet^1$ state an assumption about the number of hours sleep per night for an average person	$\bullet^1$ 6–10 hours	4
			$\bullet^2$ state an assumption about life expectancy for an average adult	$\bullet^2$ 65–90 years	
			$\bullet^3$ use a suitable number of days or weeks	$\bullet^3$ 365 days	
			$\bullet^4$ appropriate calculation leading to answer	$\bullet^4$ eg $\begin{array}{l}8\times365\times75\\=219000\text{ hours}\end{array}$	
2.	(a)		$\bullet^1$ Interpret 'watch **all three**'	$\bullet^1$ 8 placed where three circles overlap	3
			$\bullet^2$ Interpret 'watch **none**'	$\bullet^2$ 2 placed 'outside' circles	
			$\bullet^3$ Complete Venn diagram	$\bullet^3$ Remaining values completed correctly	
	(b)		$\bullet^4$ Find total number of students	$\bullet^4$ 75	2
			$\bullet^5$ Determine probability	$\bullet^5$ $\dfrac{4}{75}$	

	Question			Generic scheme	Illustrative scheme	Max mark
3.	(a)			Method 1	Method 1	**3**
				•^{1} Calculate balance on 1 January 2019	•^{1} $(500 \times 1.033 + 500) = 1016.50$	
				•^{2} Calculate balance 1 January 2020	•^{2} $(1016.50 \times 1.024 + 500) = 1540.90$	
				•^{3} Calculate balance at end of 2020	•^{3} $(1540.90 \times 1.01) = 1556.30$	
				Method 2	Method 2	
				•^{1} Accumulate initial deposit	•^{1} $(500 \times 1.033 \times 1.024 \times 1.01) = 534.18$	
				•^{2} Accumulate second deposit	•^{2} $(500 \times 1.024 \times 1.01) = 517.12$	
				•^{3} Accumulate third deposit and calculate balance at end of 2020	•^{3} $(500 \times 1.01 + 534.18 + 517.12)$ $= 1556.30$	

Notes:
1. If a candidate does not consider the additional £500 each year then only mark 1 in method 2 is available.
2. Final answer must be to 2 decimal places, ignore any rounding errors or truncation

| | (b) | | | •^{4} Calculate balance 1 January 2021 | •^{4} $1556.30 + 500 = £2056.30$ | **2** |
| | | | | •^{5} Calculate interest rate | •^{5} $\left(\left(\dfrac{2100}{2056.30} - 1\right) \times 100\right) = 2.125...\%$ | |

Notes:
1. •^{4} still available following from •^{3}
2. Final answer in the form of 1.02125... •^{5} not available,
3. Final answer must be stated explicitly in percentage form

4.	(a)	(i)		•^{1} calculate appropriate school roll at end of year in cell D8	•^{1} eg =1-D7	**3**
				•^{2} use appropriate formula in C14	•^{2} eg =ROUND($D$5*C8+$D$6,0)	
				•^{3} calculate school roll in August 2031	•^{3} 761 (pupils)	
		(ii)		•^{4} appropriate comment	•^{4} eg the number of pupils leaving each year is approximate	**1**

Notes:
1. •^{1} Can be implied by •^{2} (answer may not be in cell D9)
2. •^{2} can be found without the need for •^{1} eg =ROUND(C14(1-$D$8)+$D$10,0)
3. •^{3} is only available for a whole number answer
4. Rounding not needed, final answer will be 760, award 3/3

| | (b) | | | •^{5} appropriate comment about roll | •^{5} the school roll gradually increases each year | **1** |

Notes:
1. Accept positive linear relationship
2. Answer must be consistent with candidates working in (a)

Question			Generic scheme	Illustrative scheme	Max mark
4.	(c)	(i)	•[6] extend spreadsheet to (at least) August 2042 •[7] construct graph	•[6] evidence of 776 in C32 •[7] see below	**2**

Notes:

Number of pupils
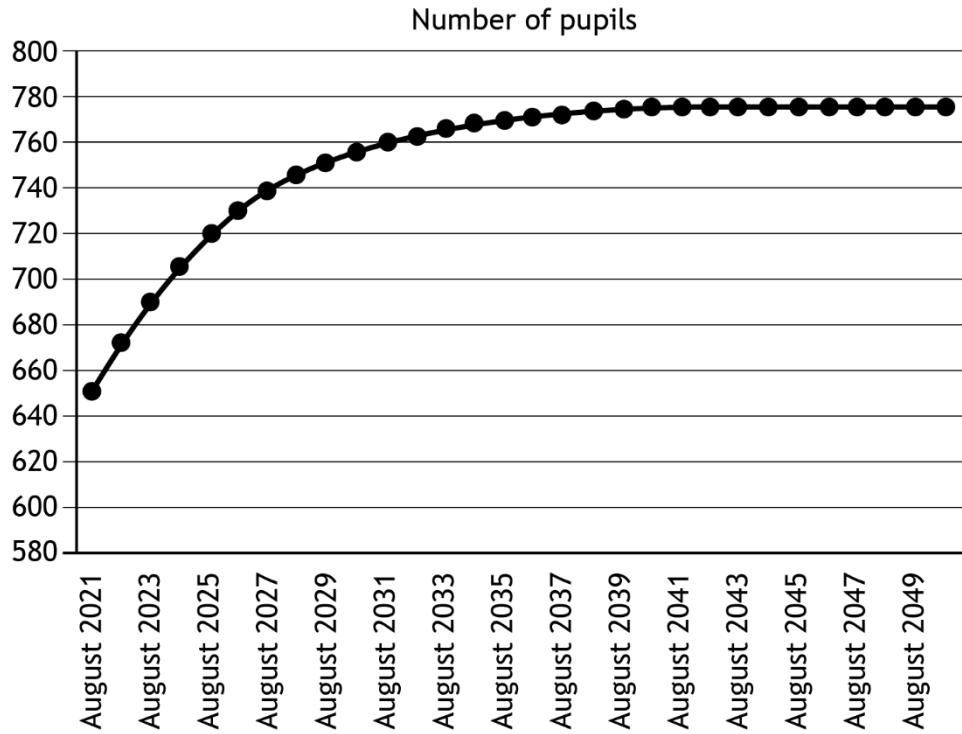
1. Labels not required as specifically assessed in a separate question.

		(ii)	•[8] conclusion with justification	•[8] Yes, the population is not expected to exceed 800 pupils.	**1**
5.	(a)		•[1] essential: select activity and give definition •[2] critical: select activity and give definition	•[1] A, E or G: an activity which is needed for the project to be finished but tends to have more flexibility in time constraints. •[2] B, C, D or F: an activity in the 'critical path', any delays to these activities would cause a delay in the project end date.	**2**
	(b)		•[3] explanation of values	•[3] Activity cannot start before the end of day 3. The duration of the activity is 4 days. The latest possible finish time of the activity is the end of day 7.	**1**

Question			Generic scheme	Illustrative scheme	Max mark
5.	(c)		•[4] correct labels and scales on diagram	•[4] 'Activity' and letters vertically, 'Day' and numbers horizontally	**4**
			•[5] task A or B plotted correctly	•[5] Task A or B correct duration and position	
			•[6] all remaining tasks plotted correctly	•[6] All tasks correct duration and position	
			•[7] complete chart with linked tasks	•[7] A&B to C, C to D&E, D to F and E to G	

Notes:
1. Example solution:
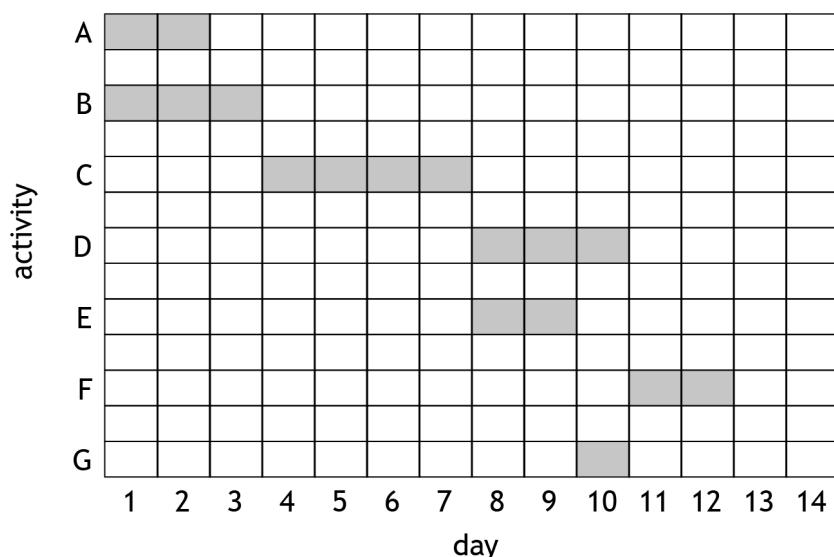
2. Activity A can be started 1 day later.
3. Activity E & G can be started 1 or 2 days later.

6.			•[1] State graph	•[1] Graph B	**2**
			•[2] Give appropriate explanation	•[2] Explain that the parachutist cannot go upwards at any point during the jump	

Question			Generic scheme	Illustrative scheme	Max mark
7.	(a)		•^{1} Calculate overall percentage increase	•^{1} $\left(\left(\left(1.021\times1.005\times1.02\right)-1\right)\times100\right)=4.66...$	1

Notes:
1. Percentage must be explicitly stated ie 1.021 x 1.005 x 1.02 = 1.0466... award 0/1

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		Method 1	Method 1	2
			•^{2} Calculate the price of petrol in 2018	•^{2} $\left(136\div1.0466...\right)=130.3$	
			•^{3} Calculate the cost of filling the tank	•^{3} $\left(45\times1.303\right)=58.64$	
			Method 2	Method 2	
			•^{2} Calculate cost of tank in 2021	•^{2} $\left(1.364\times45\right)=61.38$	
			•^{3} Calculate the cost of filling the tank	•^{3} $\left(61.38\div1.0466...\right)=58.64$	

Notes:
1. Accept 58.63, 58.65
2. Accept answers in pounds or pence

Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)	(i)	•^{1} generate scatterplot	•^{1} (See below)	2
			•^{2} appropriate title and axis labels	•^{2} (See below)	

Notes:

scatterplot of heat output on moisture content

	(ii)		•^{3} appropriate comment	•^{3} eg linear relationship	2
			•^{4} appropriate comment	•^{4} eg strong or negative association	
	(b)		•^{5} generate coefficient and intercept	•^{5} output from software (see below)	2
			•^{6} communicate equation	•^{6} $\text{heat output}=-0.06\times\text{moisture content}+7.96$	

Question			Generic scheme	Illustrative scheme	Max mark
Notes: Coefficients: (Intercept) moisture 7.95778 -0.05751					
8.	(c)		•[7] generate fitted value and prediction interval •[8] appropriate interpretation	•[7] (See below) •[8] The estimated heat output of woodchip with a moisture content of 35% is 5.9 kW, however the true value is likely to be between 5.3 and 6.6 kW.	2
Notes: fit lwr upr 5.944833 5.266433 6.623232					
	(d)		•[9] appropriate explanation	•[9] the lower the percentage moisture content of the woodchip the greater the heat output.	1
9.	(a)		•[1] calculate the probability of no issues occurring •[2] calculate the probability of at least one issue occurring •[3] calculate the expected penalty	•[1] $(1-0.3)\times(1-0.1)=0.63$ •[2] $1-0.63=0.37$ •[3] $0.37\times£10\,000=£3700$	3
	(b)		•[4] calculate expected penalty with control measure 1	•[4] $£1000+0.1\times£10\,000=£2000$	1
	(c)		•[5] decision with reason	•[5] Control measure 1 should be taken as it has the lowest expected cost	1
10.	(a)		•[1] calculate monthly interest rate •[2] calculate interest accrued over 34 months	•[1] $0.103...\%$ or $1.0125^{\frac{...}{12}}$ •[2] £89.56	2
	(b)		•[3] calculate monthly interest rate •[4] create formulae for interest, repayment and balance •[5] complete remainder of loan schedule for 48 months •[6] calculate monthly repayment and adjust final repayment	•[3] $0.399...\%$ •[4] D13, E13 and F13 (see spreadsheet) •[5] check cells D60, E60, F60 (see spreadsheet) •[6] £183.49 and £183.28	4

Question			Generic scheme	Illustrative scheme	Max mark
10.	(c)	(i)	$\bullet^7$ copy over spreadsheet and calculate outstanding balance	$\bullet^7$ £3322.54	**3**
			$\bullet^8$ change repayment amount at appropriate time	$\bullet^8$ C27 (see spreadsheet)	
			$\bullet^9$ calculate new monthly payments and adjust final repayment	$\bullet^9$ £104.71 and 104.44	
			$\bullet^{10}$ calculate total interest	$\bullet^{10}$ £628.73	**2**
			$\bullet^{11}$ calculate interest saved	$\bullet^{11}$ £178.58	
	(d)		$\bullet^{12}$ state valid reason	$\bullet^{12}$ eg money remains accessible	**1**
11.	(a)		$\bullet^1$ find multiplying factor	$\bullet^1$ $\dfrac{1004}{680}$	**2**
			$\bullet^2$ calculate the population in 2032 and state conclusion	$\bullet^2$ $\left(\text{eg } 1004 \times \dfrac{1004}{680}\right) \approx 1482$ The expert is incorrect since $1482 < 1600$.	

Notes:
1. (1600/680) x 1004 leading to 2032 and the expert is correct since 2032>1600 award ½
2. $\bullet^2$ can only be awarded for relating a calculated answer to the expert's prediction, no need for a numerical comparison

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		$\bullet^3$ estimate total amount of food eaten in adulthood	$\bullet^3$ eg $30\,\text{kg} \times 365\,\text{days} \times 25\,\text{years}$ $= 273\,750\,\text{kg}$	**3**
			$\bullet^4$ state assumption about maximum amount of termites and ants in diet	$\bullet^4$ eg assume 49% as a maximum percentage of diet (since mainly vegetarian).	
			$\bullet^5$ estimate amount of termites and ants eaten based assumption	$\bullet^5$ eg $\left(49\% \times 273\,750\right) \approx 134\,000\,\text{kg}$	

Notes:
1. Accept answers between 130 000 and 140 000 since the data in the question is given two significant figures.

[END OF SPECIMEN MARKING INSTRUCTIONS]