- 1 In a particular computer system, real numbers are stored using floating-point representation with:
 - 12 bits for the mantissa
 - 4 bits for the exponent
 - two's complement form for both mantissa and exponent.
 - (a) Calculate the normalised floating-point representation of +4.5 in this system. Show your working.

	Manti			Expone	J110	
Working						
	normalised flo	pating-point repr		f −4.5 in this		
		pating-point repr			system. Sho	
	normalised flo Manti	pating-point repr		f -4.5 in this Expone	system. Sho	
		pating-point repr			system. Sho	
		pating-point repr			system. Sho	
working.	Manti	pating-point repr	resentation of	Expone	system. Sho	OW
working.	Manti	pating-point repr	resentation of	Expone	system. Sho	OW
working.	Manti	pating-point repr	resentation of	Expone	system. Sho	OW
working.	Manti	pating-point repr	resentation of	Expone	system. Sho	OW
working.	Manti	pating-point repr	resentation of	Expone	system. Sho	OW
working.	Manti	pating-point repr	resentation of	Expone	system. Sho	OW

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(c)	Calculate the denary	value for the f	ollowing binary	floating-point n	umber. Show	your wo	rking

						Man	tissa	1							Ехр	onen	t				
	0	0	0	1	1	0	0	0	0	0	0	0		0	1	0	1				
	Woi																				
	Ans	swer		•••••				•••••	•••••		•••••					•••••					 [3]
d)	(i)	Stat	te wh	ether	the	floati	ng-p	oint r	numb	er gi	ven i	n pa ı	rt (c	;) is n	orma	lised	or n	ot n	orm	alise	d.
																				[1]
	(ii)	Jus	tify yo					_		-											
																				[1]
e)	The	syst	em c	hang	es so	o tha	t it no	w al	locat	es ei	ght b	its to	bo	th the	man	tissa	and	the	ехр	oner	nt.
	Ехр	lain 1	two e	effect	s this	s has	on t	he nı	umbe	ers th	at ca	ın be	rep	reser	nted.						
	1																				
	2																				
]	 [4]

- 1 (a) Numbers are stored in a computer using floating-point representation with:
 - 12 bits for the mantissa
 - 4 bits for the exponent
 - two's complement form for both the mantissa and exponent.
 - (i) Write the normalised floating-point representation of the following unsigned binary number using this system.

	1011100.011001	
	Working	
	Mantissa Exponent	
		[2]
(ii)	State the consequence of storing the binary number in part (a)(i) as a floating	ng-point
	number in this system. Justify your answer.	
	Consequence	
	Justification	
		[2]
Ехр	plain the reason why binary numbers are stored in normalised form.	

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(b)

5

(a)	Compare sequential and serial methods of file organisation.
	[4]
(b)	State the most suitable method of file access when a record is referenced by a unique address on a disk-type storage medium.
	[1]
(c)	State the most suitable method of file access when a bank stores its data records in ascending order of account number.
	[1]

1	Real numbers a	are stored in a	computer syster	n usina floatina	a-point repres	sentation with:

- 10 bits for the mantissa
- 6 bits for the exponent

(b)

- Two's complement form for both the mantissa and the exponent.
- (a) Calculate the normalised floating-point representation of –7.25 in this system. Show your working.

				Man	tissa	l							Ехро	onen	t		
					I				ı	_				1		ı	J
Wor	king																
		•••••															
		•••••									•••••					•••••	
											•••••						[3]
		the ur wo		ary va g.	alue d	of the	e give	en bi	nary	float	ing-p	oint :	numl	oer.			
				Man	tissa	l							Ехро	onen	t		
1	0	1	1	0	0	0	1	1	1		0	0	0	1	1	1	
Wor	king																
Ansv	wer.																[3]

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				N/I	41	_							Example 1		.4			
				wan	tiss	a 				_			Ехр	onen	IT		_	
0	0	0	0	0	0	0	1	1	1		1	0	0	1	1	1		
				Man	itiss	a							Ехр	onen	ıt			
				-						J								
Woı	rking																	
	3																	
	dena	arv nı	umbe	 er 51	 3 cai	nnot	 be st	ored	accu	ıratel		a no	ormal	ised	floati	 	oint nu	mk
	dena				 3 caı	nnot l	be st	ored	accu	ıratel	ly as	a no	ormal	ised	floati	ng-p	oint nu	ml
this	com	outer	syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised [•]	floati	ng-p	oint nu	ml
	com		syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised	floati	ng-p	oint nu	mk
this	com	outer	syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised [·]	floati	ng-p	oint nu	mk
this	com	outer	syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised ·	floati	ng-p	oint nu	mk
this	com	outer	syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised	floati	ng-p	oint nu	mk
this	com	outer	syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised	floati	ng-p	oint nu	mk
this	com	outer	syst	em.			be st	ored	accu	ıratel	ly as	a no	ormal	ised	floati	ng-p	oint nu	mk
this	com	outer	syst	em.			be st	ored									oint nu	
this	com	outer	syst	em.			be st	ored										
this	com	outer	syst	em.			be st	ored										
this	com	outer	syst	em.			be st											
this (i)	Exp	ain th	syst	easor	n for	this.												
this (i)	Expl	outer	syst	easor	n for	this.	 e way		ting- _F	 	num	nbers	s are					
this	Expl	outer	syst	easor	n for	this.	 e way			 	num	nbers	s are					
this (i)	Expl	outer	syst	easor	n for	this.	 e way		ting- _F	 	num	nbers	s are					

2	(a)	Describe the purpose of a user-defined data type.											
				[2]									
	(b)	Def	ine, using pseudocode, the following enumerated data types:										
		(i)	SchoolDay to hold data about the days students are usually in school.										
		(ii)	WeekEnd to hold data about the days that are not school days.										
	(c)		ine, using pseudocode, the composite data type <code>ClubMeet</code> . This will hold data about clubers that includes:	lub									
		•	first name and last name the two days they attend: o one on a school day o one not on a school day.										
		Use	e the enumerated types you created in part (b) .										
				••••									
				••••									
				[/]									

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	(b)	Explain the use of graphs to aid Artificial Intelligence (AI).
		[3]
6	Giv	e two benefits and two drawbacks of packet switching.
	Ber	nefit 1
	Ber	nefit 2
	Dra	wback 1
	Dra	wback 2
		[4]

~, (·,	Con		nent u							•								
		old Ol		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	l parr	J		<u> </u>	1 Г									
	0	1	1	0	1	0	0	0		0	1	0		0				
	Wha	at nun	nber i	s this	in de	enary	? Sho	ow yo	ur w	orkir	ng.							
			•••••							•••••								
(ii)	The	repre	esenta	ation	show	n in p	oart (a)(i) is	s no	rmal	ised.							
(ii)			esenta hy flo				-											
(ii)							-											
(ii)							-											
	Expl	lain w	hy flo	pating	ı-poin	t nun	nbers	are r	norm	alise	ed.							
(ii)	Expl	lain w	hy flo	eating	-poin	for t	nbers	are r	norm	ositiv	ed.	mber	· wl	 nich	ca	n be	store	d us
	Shornorn	lain w	hy flo	eating	-poin	for t	nbers	are r	norm	ositiv	ed.	mber	· wl	nich	 ca	n be	store	d us
	Shornorn	w the	hy flo	eating	-poin	for t	nbers	are r	norm	ositiv	ed.	mber		nich	ca	n be	store	d us
	Shornorn	w the	hy flo	eating	-poin	for t	nbers	are r	norm	ositiv	ed.	mber		nich	ca	n be	store	d us
	Shornorn	w the	bina ded 12-	eating	-poin	for t	nbers	are r	norm	ositiv	ed.	mber	· wl	nich		n be	store	d us
	Shornorn	w the	bina ded 12-	eating	-poin	for t	nbers	are r	norm	ositiv	ed.	mber	· wł	nich	ca	n be	store	d us

Denary: [3]

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(b)	The developer of a new programming language decides that all real numbers will be stored using 20-bit normalised floating-point representation. She cannot decide how many bits to use for the mantissa and how many for the exponent.
	Explain the trade-off between using either a large number of bits for the mantissa, or a large number of bits for the exponent.
	[2]

1	In a particular	computer	system,	two	real	numbers,	Α	and	В,	are	stored	using	floating-poin	t
	representation v	vith:												

•	12	bits	for	the	mantissa	а
---	----	------	-----	-----	----------	---

- 4 bits for the exponent
- two's complement form for both mantissa and exponent.

Number	Α	Mantissa													Exponent					
		1	1	0	0	0	0	0	0	0	0	0	0		0	0	1	0		
Number	В						Man	tissa	ì						Exp	one	nt			
		0	1	1	1	0	0	0	0	0	0	0	0		1	1	1	1		
(a) (i)	Number Number	A B																		
<i>(</i>)																		[2]		
(ii)	Convert separate					of the	e ma	intis	sa ar	nd th	e ex	pone	ent fo	or ea	ich n	umb	er to	their		
	A mantis	sa																		
	A expone	ent																		
	B mantis																			
	B expone	ent																		
																		[4]		

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	(iii)	Calculate the part (a)(ii).	denary	value c	of each	floating-point	number	using	your	values	from
		Number A									
		Number B									
											[2]
(b)	Stat	te which number	r, A or B ,	is store	ed in nor	malised floatir	ng-point fo	orm. Ju	stify y	our ans	wer.
	Nun	nber									
	Just	tification									
											[3]

In a computer system, two real numbers, A and B, are stored using floating-point representation with:
12 bits for the mantissa

4 bits for the exponent

two's complement form for both mantissa and exponent. Number A **Mantissa Exponent** 0 1 1 0 0 0 0 0 0 0 0 0 1 1 1 1 **Number B Mantissa Exponent** 1 1 0 0 1 0 Convert the binary values of the mantissa and the exponent for each number to their separate denary values. A mantissa

[2]

A exponent

B mantissa

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2

(b)	State which number, A	or B , is stored in normalised floating-point form. Justify your answer.
	Number	
	Justification	
		[3]
		[-]
The	TCP/IP protocol suite ca	an be viewed as a stack with four layers.
(a)	Write the correct descrip given in the following to	ptions for the two layers and the correct layers for the two descriptions able.
	Layer	Description
	Application	
	Transport	
		Handles transmission of data
		Handles how data is physically sent
		[4]
(b)	Identify and state the p	urpose of two communication protocols other than TCP/IP.
	Protocol 1	
	Purpose	
	Protocol 2	
	Purpose	
		[4]

												2									
1	In a	par	icul	lar c	omp	oute	er sy	/ste	m, re	eal nu	umbe	ers aı	e sto	ored (using	, floa	ting-	point	repr	esen	tation with:
	•	4 b	its f	or th	ne e	mar xpoi nent	ner	nt	or bo	th m	antis	sa ar	nd ex	pone	ent.						
	(a)	The	e fol	lowi	ing f	float	ting	-poi	nt nı	ımbe	r sto	red is	s not	norn	nalise	ed.					
		Cal	cula	ate t	he d	dena	ary	valu	ie fo	r the	float	ing-p	oint	numb	er. S	Show	you	r wor	king.		
									Man	tissa	a							Ехро	onen	t	
			0	0	0	(0	1	1	0	0	0	0	0	0		0	1	0	1	
																					[3]
	(b)	(i)	No	orma	alise	e the	e flo	atin	g-po	int n	umbe	er giv	en ir	n par	t (a).						
			W	rite	you	r an	SW	er in	the	follo	wing	boxe	S.								
									Man	tissa	a							Ехр	onen	t	
		(ii)	De	escr	ibe ·	one	pro	oble	m th	at ca	ın oc	cur w	/hen	floati	ng-p	oint ı	numl	bers	are n	ot no	[2] ormalised.

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2 Data types can be classified as composite or non-composite.

A record is declared of type box using the following pseudocode.

TYPE size = (small, medium,	large)
TYPE box	
DECLARE volume : size	
DECLARE price : REAL	
DECLARE colour : STRING	
ENDTYPE	
DECLARE myBox : ARRAY [1:6]	OF box

(a)	(i)	Identify one composite and three non-composite data types used in the pseudocode.
		Composite data type
		Non-composite data type 1
		Non-composite data type 2
		Non-composite data type 3[4]
	(ii)	Identify the data type in the pseudocode that is enumerated.
		[1]
(b)	A bo	ox is red, with medium volume and a price of \$10.99.
	Wri	te pseudocode to store the details of this box in the first element of the array.
		[3]

•	4 bit	oits for s cor	the	e exp	oone		or bo	th ma	antis	sa a	nd e	expo	nent	t.							
(a)	Cald	culate	e th	ne de	enary	valu	ie for	the	follo	wing	floa	ating	-poii	nt nu	ımbe	r. S	how	yo.	ur w	ork	ing.
							Man	tissa	1							E	Ехро	one	nt		
)	1	0	1	0	0	0	0	0	0	() (0		0	1	1	()	
	Wor	king																			
	_																				
			/alı	10																	
	Den	ary v	ait	Je																	
	Den	ary v	rait	 																	
(b)	A n	ew c	ре	ratin	g sy	stem	has	s bee	en ir	stall	ed	that	has	cha	ingeo	d th	e w	⁄ay	the		
(b)	A no	ew c	pe ar	ratin e us	g sy ed. T	stem he o	has rder	s bee	en ir e ex	stall	ed ent a	that and t	has he n	cha nanti	inged issa a	d th are	e w	ay erse	the	floa	ating
(b)	A n	ew control	pe ar	ratin e us	g sy ed. T	stem	has rder enary	s bee of th	en ir e ex ue fo	stall cone	ed ent a	that and t	has he n	cha nanti	inged issa a	d th are	e w	ay erse	the	floa	ating
(b)	A no	ew conbers Calcobit p	ppe ar cula	ratin e use ate th ern a	g sy ed. T ne ne	stem he o	has rder enary	s bee of th	en ir e ex ue fo	stall cone	ed ent a	that and t owin you	has he n g flo ur wo	cha nanti atinç orkin	anged issa a g-poi g.	d th are	e w	ay erse	the	floa	ating
(b)	A no	ew conbers Calcobit p	ppe ar cula	ratin e us	g sy ed. T ne ne	stem he o	has rder enary	s bee of th	en ir e ex ue fo	stall cone	ed ent a	that and t owin you	has he n g flo ur wo	cha nanti	anged issa a g-poi g.	d th are	e w	ay erse	the	floa	ating
(b)	A no	ew conbers Calcobit p	ppe ar cula	ratin e use ate th ern a	g sy ed. T ne ne	stem he o	has rder enary mber	s bee of th valu	en ir e ex ue fo art (a	stall cone	ed ent a	that and t owin you	has he n g flo ur wo	cha nanti atinç orkin	anged issa a g-poi g.	d th are	e w reve	ay erse	the	floa	ating the
(b)	A no	ew on the second	ppe ar cula	ratin e use ate th ern a	g sy ed. T ne ne as th ent	stem The o ew de e nur	has rder enary mber	s bee of th valu	en ir e ex ue fo art (a	stall cone the a). S	ed ent a follo show	that and t owin y you	has the n g flo ur wo	cha nanti ating orkin	angedissa a g-poi g. a	d thare	e w reve	ay erse	the ed. that	floa	ating the
(b)	A no	ew conbers Calconbit p	e arcula	ratin e use ate th ern a pon e	g sy ed. T ne ne as th ent	stem The o ew de e nur	has rder enary mber	s bee of the value in p	en ir e ex ue fo art (a	stall coone the the a). S	ed ent a folk how	that that that the theta the that the theta the the that the the that the the the the the the the the the th	has the n g flo ur wo Mar	cha nanti atinç orkin ntiss	angedissa ag-poilig.	d thare	e w reve	ay erse	the ed. that	floa	ating the

Denary value

[3]

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(ii)	Identify two problems that can occur due to the change in the representation of floating-point number.	f the
	Problem 1	
	Problem 2	
		[2

2	Data types	can be	classified	as composite	or non-composite.
---	------------	--------	------------	--------------	-------------------

(a) Draw one line from each data type to its correct classification	cauon
---	-------

_		Data type	_	Classification						
		Pointer								
		Record		Composite						
		Set								
		Class		Non-composite						
		Integer								
					[2]					
(b)	A u	ser-defined data type, t	imeOfDay, is declared using	g the following pseudocode.						
		TYPE timeOfDay =	(morning, afternoon,	, evening, night)						
	(i)	Identify the type of use	r-defined data type declared	d and state its classification.						
		Туре								
		Classification			[2]					
	(ii)		eclare the variable session rnoon to the variable sess							
					1					

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- 1 In a particular computer system, real numbers are stored using floating-point representation with:
 - 10 bits for the mantissa
 - 6 bits for the exponent
 - two's complement form for both mantissa and exponent.
 - (a) Calculate the normalised floating-point representation of +192.5 in this system. Show your working.

Mantissa										Exponent									
Norki	ng																		
				alised		ting-							 92.5	 5 in		s sy			
				alised	d floa	ting-							 92.5	 5 in	this	s sy			
Calcu workir	late	the n	orma	Man	d floa	ating-	point	repr	reser	ntatio	on of	f –19	92.5 Ex	in r	thi:	s sy	rste	m.	
workir	late	the n	orma	Man	d floa	ating-	point	repr	reser	ntatio	on of	f –19	Ex	in in	thi:	s sy	rste	m.	Sho
workir	late	the n	orma	Man	d floa	ating-	point	repr	reser	ntatio	on of	f –19	Ex	in in	thi:	s sy	rste	m.	Sho

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3 (c) The floating-point representation has changed. There are now 12 bits for the mantissa and 4 bits for the exponent as shown. **Exponent Mantissa** Explain why +192.5 cannot be accurately represented in this format. The diagram shows four files and three methods of file organisation. Draw **one** line to match each file with its most appropriate method of file organisation. File File organisation Text file Sequential File for recording the temperature every hour Random

2

[4]

Serial

Master file for paying each employee every month

Customer user name and password file

1 Real numbers are stored using floating-point representation in a computer system.

This representation uses:

- 8 bits for the mantissa, followed by
- 4 bits for the exponent.

Two's complement form is used for both the mantissa and the exponent.

(a) (i) A real number is stored as a 12-bit normalised binary number as follows:

				Man	tissa	1			Exponent	
	0	1	0	1	0	0	1	0	0 0 1 0	
	Calcu	ulate	the (dena	ry va	ılue 1	or th	is bir	ry number. Show your working.	
	Work	king .								
	 Dens									
	Dene	ary ve	aiue							
(ii)	Calcu	ulate	the	norm	alise	d bir	nary	numb	r for –3.75. Show your working.	
				Man	tissa	1			Exponent	
	Work	king .								
-										
							•		real number is increased to 16.	
Sta	te the	effec	t of I	ncre	asınç	the	size	of th	exponent by 4 bits.	

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(c)	State why some binary representations can lead to rounding errors.
	[1]
(d)	Complete the following descriptions by inserting the two missing terms.
	can occur in the exponent of a floating-point number, when the
	exponent has become too large to be represented using the number of bits available.
	A calculation results in a number so small that it cannot be represented by the number of bits
	available. This is called
	[2]

8 (a) The following 16-bit binary pattern represents a floating-point number stored in two's complement form. The twelve most significant bits are used for the mantissa and the four least significant bits are used for the exponent.

Mos sigr	t nificant	bit											sig	l nifica	Least nt bit
0	1	1	1	0	0	0	0	0	0	0	0	1	1	0	1
(i)	Identify	y the b	oinary	value	of the	·									[1]
(ii)	Identify	y the b	oinary	value	of the	mant	issa.								
<i>(</i> 111)															[1]
(iii)	State v						-								
	Positiv	e or n	egativ	e											
	Justific	ation													
															[2]
(iv)	Conve	rt the	binary	floatii	ng-poi	nt nur	nber i	n part	(a) in	to der	nary. S	Show y	our w	orking	
	Workin	ıg													
	Denary	y value	э												1

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(b)	The number of bits used for the exponent is increased to eight, and the number of bits used for the mantissa is decreased to eight.
	State the effects of this change.
	[2]

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6

(a)	Sta	te what is meant by a user-defined data type .	
(b)	A ps	seudocode declaration for a user-defined data type for the months of the year is as follow	/S:
		PE DECLARE Months: (January, February, March, April, May, June, July August, September, October, November, December) DTYPE	⁷ ,
	(i)	Identify this type of user-defined data type.	
	(ii)	Write a pseudocode statement to declare a variable CurrentMonth of data tylements.	
((iii)	Write a pseudocode statement to assign the value August to the variable CurrentMonth.	ole

- 1 In a computer system, real numbers are stored using normalised floating-point representation with:
 - twelve bits for the mantissa
 - four bits for the exponent.

The mantissa and exponent are both in two's complement form.

(a) Calculate the denary value for the following binary floating-point number.
Show your working.

	Mantissa															Ехро	onen	ıt
1	0	0	1	0	1	1	1	0	0	1	1				0	1	1	1
١	Work	ing .																
,	Ansv	er							•••••									
												n of +		25 in	this s	yster	n.	
(ılate	the i	norm	ıalise									25 in	this s	yster	m.	
(Calcı Shov	ılate / you	the i	norm	alise	ed flo	ating	-poir	nt rep	rese	ntatio		1.562		this s	yster	n.	
) (Calcı Shov	ılate / you	the i	norm	alise	ed flo	ating	-poir	nt rep	rese	ntatio	n of +	1.562	25 in ¹	this s	yster	n.	
) (Calcı Shov	ılate / you	the i	norm	alise	ed flo	ating	-poir	nt rep	rese	ntatio	n of +	1.562	25 in	this s	yster	n.	
) (Calcı Shov	ılate / you	the i	norm	alise	ed flo	ating	-poir	nt rep	rese	ntatio	n of +	1.562	25 in ¹	this s	yster	n.	
) (Calcı Shov	ılate / you	the i	norm	alise	ed flo	ating	-poir	nt rep	rese	ntatio	n of +	1.562	25 in	this s	yster	n.	
) (Calcı Shov	ılate / you	the i	norm	alise	ed flo	ating	-poir	nt rep	rese	ntatio	n of +	1.562	25 in		yster		

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(c)	(i)	Write the largest positive number that can be stored as a number using this format.	normalised floating-poin
		Mantissa	Exponent
			[2
	(ii)	Write the smallest non-zero positive number that can be floating-point number using this format.	stored as a normalised
		Mantissa	Exponent
			[2]
(d)	stor to u	e developer of a new programming language decides that all reducing 20-bit normalised floating-point representation. She muse for the mantissa and how many bits for the exponent. Dolain the trade-off between using either a large number of bits for the exponent.	ust decide how many bits
			[3]

- **1 (a)** A computer stores real numbers using floating-point representation. The floating-point numbers have:
 - eight bits for the mantissa
 - four bits for the exponent.

The mantissa and exponent are both stored in two's complement format.

(i) Calculate the denary value of the following floating-point number.Show your working.

				Man	tissa	ì					Expo	onen	t		
	0	0	1	1	0	1	1	1		0	1	0	1		
	Work	king													
							•••••	•••••							
	Ansv	ver .													[3]
(ii)	State	why	/ the	float	ing-p	oint	num	ber i	n part (a)(i) is no t	t norr	nalis	ed.			
															[1]
(iii)	Give	the 1	floati	ng-p	oint r	numb	er in	par	t (a)(i) in normalis	ed tv	vo's (comp	leme	ent form	nat.
				Man	tissa	ı					Expo	onen	t		
															[2]
															[ک]

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(b)	(i)	Convert the denary number +11.625 i	nto a normalised floating-point number.
		Show your working.	
		Working	
		Mantissa	Exponent
			[3]
	(ii)	Convert the denary number -11.625 i	nto a normalised floating-point number.
		Show your working.	
		Working	
		Mantissa	Exponent
			[3]

((c)	Α	student	enters	the	following	into	an	internre	ter.
١		, ,	Student	CHILCHS	uic	TOHOWING	IIII	an	lilleipie	ici.

OUTPUT(0.2 * 0.4)

The student is sur	prised to see that t	he interpreter o	outputs the f	following:
--------------------	----------------------	------------------	---------------	------------

0.080000000000000002

	Explain why the interpreter outputs this value.
	[3]
Pac	ket switching can be used to transmit data across the Internet.
Pac	ket switching is not always the most appropriate method of transferring data.
(a)	Name an alternative method of transferring data across the Internet.
	[1]
(b)	Give an example of a situation where the method you identified in part (a) is more appropriate.
	Justify your choice.
	Example
	Justification
	Pac (a)

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1 Consider the following user-defined data type.

TYPE	В	ook									
	DE	ECLARE	ISBN	:	INTEGER						
	DE	ECLARE	Author	:	STRING						
	DE	ECLARE	Title	:	STRING						
	DE	ECLARE	Supplier		(Amazone, Stone		Smiths,	Blackwai	lls,	Greens	,
ENDI	'YPE	Ξ			Coals, Boarders	1					
(a)	Nan	ne the da	ata type of Bo	ook							
											[4]
	• • • • • •			• • • • •							[1]
(b)	Nan	ne the no	on-composite	e da	ta type used in the s	מנו	plier de	claration.			
()					,	1-1	F				
											[1]
()	/ *\	147.11									
(C)	(1)	vvrite a	pseudocode	Sta	tement to declare a	/arı	lable, Bes	tSeller, C	от тур	e Book.	
											[1]
											[.]
(ii)	Write a	a pseudoco	de	statement to assi	gn	"John W	illiams"	to t	he autho	or of
		BestSe	eller.								

2	(a)	A computer system stores real numbers using floating-point representation. The floating-point
		numbers have:

- eight bits for the mantissa
- four bits for the exponent.

(ii)

(iii)

(b) (i)

The mantissa and exponent are both in two's complement form.

(i) Calculate the denary value of the following floating-point number.

			Man	tissa	a			Exponent	
0	0	1	1	1	0	0	0	0 1 1 1	
Shov	v you	ır wo	rking].					
Work	king								
Ansv	ver .								[3]
State	e how	v you	ı kno	w the	e floa	iting-	poin	nt number in part (a)(i) is not normalised.	1
									[1]
Norn	nalise	e the	float	ting-p	ooint	num		in part (a)(i) .	
			Man	tissa	a			Exponent	
									[2]
Write floati								that this system can represent as a norma	alised
			Man	tissa	a			Exponent	
									[2]

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	(ii)	Write the smallest positive number that can be store number in this format.	d as a normalised	floating-point
		Mantissa	Exponent	
				[2]
(c)	The	number of bits available to represent a real number is in	ncreased to 16.	
		e the effect this has on the numbers that can be represe d in the:	nted, if the additiona	ll four bits are
	(i)	mantissa		
				[1]
	(ii)	exponent		
				[1]
(d)	A stu	udent enters the following code into an interpreter.		
		X = 0.1 Y = 0.2 Z = 0.3 OUTPUT $(X + Y + Z)$		
	The	student is surprised to see the output:		
		0.600000000000001		
	Expl	ain why this is output.		

- **1 (a)** A computer system uses floating-point representation to store real numbers. The floating-point numbers have:
 - 8 bits for the mantissa
 - 8 bits for the exponent

The mantissa and exponent are both in two's complement form.

(i) Calculate the denary value of the following floating-point number. It is **not** in normalised form.

				Man	tissa	1						I	Expo	nen	t			
	0	0	1	0	1	0	1	0		0	0	0	0	0	1	0	1	
	Sł	now	your	work	ing.													
	W	'orkir	ng															
	Ar	ารพ	er															[3]
(ii)	Co	onve	ert the	e der	ary r	numb	oer +	7.5 i	nto a	norn	nalis	ed flo	oatin	g-poi	nt nu	ımbe	r.	
	Sł	now	your	work	ing.													
				Man	tissa	ı						I	Expo	nen	t			
	W	orkir	ng															
																		[3]

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(iii) Convert the denary number –7.5 into a normalised floating-point number.

Mantissa		I	Ехро	nent	t		
Working							
normalised floating-point numbe	r is shown.						
normalised floating-point numbe	r is shown.	I	Ехро	nent	t		
Mantissa						1	1
-	r is shown.	1 1	Expo	nent	1	1	1
Mantissa 0 1 1 1 1 1 1	1 0					1	1
Mantissa 0 1 1 1 1 1 1	1 0					1	1
0 1 1 1 1 1 1	inary number.		1	1	1		
Mantissa 0 1 1 1 1 1 1 1 State the significance of this b	1 0 pinary number.	1 1	1	1	1		
Mantissa 0 1 1 1 1 1 1	1 0 pinary number.	1 1	1	1	1		

- 1 In a computer system, real numbers are stored using normalised floating-point representation with:
 - 12 bits for the mantissa
 - 4 bits for the exponent
 - Two's complement form for both mantissa and exponent.
 - (a) Find the denary value for the following binary floating-point number.

	Mantissa											Exponent					
1	0	1	1	1	0	0	1	1	0	1	0			0	1	0	1
	Shov	v you	ır wo	rking].												
	Work	ing .											 				
	Ansv	ver											 				
	Calci work Work	ing.										tion o					
					Mant											onen	

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	(c)	The size of the mantissa is decreased and the size of the exponent is increased.	
		State how this affects the range and precision of the numbers that the computer syste represent.	m can
2	A pr	rogrammer uses non-composite and composite data types to create a program.	
	(a)	Define the term non-composite data type .	
	(b)	Describe two different non-composite data types.	
		Data type 1	
		Description	•••••
		Data type 2 Description	•••••
		Description	
			[4]
	(c)	Define the term composite data type.	
			[1]
			1

(d)	Des	cribe two different composite data types.	
	Data	a type 1	
	Des	cription	
	Data	a type 2	
	Des	cription	
			 [4]
Star	and	bus are two types of topology that can be used in a Local Area Network (LAN).	
		Bus topology	
		Star topology	
(a)	(i)	State one benefit and one drawback of the star topology.	
(-)	()	Benefit	
		Drawback	
			[2]
	(ii)	State one benefit and one drawback of the bus topology.	
		Benefit	
		Drawback	
			 [2]

3

1 Data types can be defined in a programming language.

The data type, StudentRecord, is defined by the code:

	- L	tudentRecord	
	DEC	LARE StudentID	: INTEGER
	DEC	LARE StudentFirstName	: STRING
	DEC	LARE StudentSurname	: STRING
		LARE StudentDOB	
			: ARRAY[1:10] OF STRING
ENI	TYP:		
Αv	ariab	le, CollegeStudent, is decla	ared with the code:
	DEC	LARE CollegeStudent : S	StudentRecord
(2)	\//rit	to a psoudocodo statement to	assign 6539 to the StudentID of CollegeStudent.
(a)	VVIII	te a pseudocode statement to	assign 6559 to the Studentib of Corregestudent.
			[1]
			[1]
(h)	The	e type definition for StudentRe	ecord is changed
(~)		typo dominati for beddefrence	occurrence of an england
	(i)	Students can take six course Physics, Chemistry, Music, D	es from: Computer Science, Engineering, Science, Maths, rama and English Language.
	(i)	Physics, Chemistry, Music, D	
	(i)	Physics, Chemistry, Music, D	rama and English Language.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type	rama and English Language.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type	rama and English Language. e definition of StudentRecord to implement the change.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	rama and English Language. e definition of StudentRecord to implement the change.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	rama and English Language. e definition of StudentRecord to implement the change.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	rama and English Language. e definition of StudentRecord to implement the change.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	e definition of StudentRecord to implement the change.
	(i)	Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	e definition of StudentRecord to implement the change.
		Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	rama and English Language. e definition of StudentRecord to implement the change. [2]
	(i) (ii)	Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	e definition of StudentRecord to implement the change.
		Physics, Chemistry, Music, D Rewrite one line from the type DECLARE	rama and English Language. e definition of StudentRecord to implement the change. [2]
		Physics, Chemistry, Music, D Rewrite one line from the type DECLARE The values for the field Stude Rewrite one line from the type	rama and English Language. e definition of StudentRecord to implement the change. [2] entID must be between 1 and 8000 inclusive.

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(c) A programmer is asked to write a program to process the assessment data for each student. Students sit one exam in every course they take.

A composite data type, StudentAssessment, needs to be defined with the following three fields.

- a student assessment code (a unique code of three letters and two digits)
- the marks for the six exams
- the average mark of the six exams

(i)	Write pseudocode to define the data type StudentAssessment.
	[4]
(ii)	Data about all students and their assessments are stored in a file that uses random organisation. The StudentID is used as the key field.
	The program allows a user to enter data for a new student.
	Explain how the program adds the new data to the file.
	[3]

	(c)	The syntax of variable is changed to allow one or more letters followed by an unsigned integer.	d
		Draw a syntax diagram for the new syntax of the variable.	
		[3	21
		Įc	'J
3	In a	a computer system, real numbers are stored using normalised-floating point representation:	n
	•	8 bits for the mantissa 4 bits for the exponent two's complement form for both mantissa and exponent.	
	(a)	Calculate the normalised floating-point representation of + 21.75 in this system. Show you working.	ır
		Working	
		Mantissa Exponent	. •
		[3	}]

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(b) Find the denary value for the following binary floating-point number.

	Mantissa	Exponent	
	1 0 1 1 0 0 0 0	1 1 1 0	
	Show your working.		
	Working		
	Answer		[3]
The	TCD//D protocol quito is used on the Internet		
	TCP/IP protocol suite is used on the Internet.	orace the Internet	
(a)	The table has statements about transmitting data at Put a tick (\checkmark) in each row to identify whether the res		
	Responsibility	TCP IP	
	Correct routing		
	Host to host communication		
	Communication between networks		
	Retransmitting missing packets		
	Reassembling packets into the correct order		
			[5]
(b)	Identify two other internet protocols. State a use for	each protocol	
(6)	Protocol 1	·	
	Use		

1 In a particular computer system, real numbers are stored using floating-point representation with:

(a) Calculate the floating-point representation of +2.5 in this system. Show your working.

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both mantissa and exponent

					Man	tissa								Expo	onent		
	•																
			•••••		•••••												
																	[3]
(b)	Calcula	ite the	float	ting-p	oint r	epres	entat	ion of	-2.5	in th	is sys	stem.	Show	v youi	r work	ing.	
					Man	tissa								Expo	onent		
	•																

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(c) Find the denary value for the following binary floating-point number. Show your working.

						Man	tissa								Expo	onent	t	
	0	0	1	1	0	0	0	0	0	0	0	0		0	0	1	1	
	,		1		•								_					
																		[3]
(d)	(i)																	alised.
(u)	(1)	Oli										_	-					
	/!! \																•••••	[1]
	(ii)	Ju	stiry y	our a	nswe	r give	n in F	oart (a)(I).									
																		[1]
(e)	The	e sy:	stem	chan	ges so	that	it nov	w allo	cates	8 bit	s to b	oth tl	ne ma	ntiss	a and	the o	expon	ent.
	Sta	ite t v	vo ef	fects	this h	as on	the r	numb	ers th	at ca	n be ı	repre	sente	d.				
	1 .																	
	2 .																	
																		[0]

1	(a)	Consider	the following	user-defined	data type:
---	-----	----------	---------------	--------------	------------

	TYE	PE Libra	ryBookRec	ord	
		DECLARE	ISBN	:	INTEGER
		DECLARE	Title	:	STRING
	ENI	DTYPE			
	(i)	Write a ps	eudocode s	tater	ment to declare a variable, Book, of type LibraryBookRecord.
					[1]
	(ii)	Write a ps	seudocode	state	ement that assigns 'Dune' to the Title of Book.
					[1]
(b)		user-defin owing fields		/pe ː	LibraryBookRecord needs to be modified by adding the
	•				h can take two values, fiction or non-fiction oans which can be an integer value in the range 1 to 99
	Wri	te the upda	ated version	of L	ibraryBookRecord.

.....[3

(c) A pointer is a variable that stores the address of a variable of a particular type.

Consider the code on page 3, which uses the following identifiers:

Identifier	Data type	Description
IntPointer	^INTEGER	pointer to an integer
IntVar	INTEGER	an integer variable
Temp1	INTEGER	an integer variable
Temp2	INTEGER	an integer variable

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The four assignment statements are executed. The diagram shows the memory contents after execution.

Variable	Memory address	Contents
	8217	
IntVar	8216	88
	8215	
	8214	
	7307	
IntPointer	7306	8216
	7305	
	6717	
Temp1	6716	88
Temp2	6715	57
	6714	

Use the diagram to state the current values of the following expressions:

(i)	@Temp2	[1]
(ii)	IntPointer	[1]
(iii)	IntPointer^	[1]
(iv)	<pre>IntPointer^ = Temp2 + 6</pre>	[1]

(d)	(d) Write pseudocode statements that will achieve the following:						
	(i)	Assign the value 22 to the variable Temp2.					
		[1]					
	(ii)	Place the address of Temp1 in IntPointer.					
		[1]					
	(iii)	Copy the value in Temp2 into the memory location currently pointed at by IntPointer.					

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1	(a)	Consider the	following	pseudocode	user-defined	data type:
---	-----	--------------	-----------	------------	--------------	------------

	TYF	PE MyContactDetail
		DECLARE Name : STRING
		DECLARE HouseNumber : INTEGER
	END	DTYPE
	(i)	Write a pseudocode statement to declare a variable, NewFriend, of type MyContactDetail.
		[1
	(ii)	Write a pseudocode statement that assigns 129 to the HouseNumber of NewFriend.
		[1
(b)	The	e user-defined data type MyContactDetail needs to be modified by:
	•	adding a field called Area which can take three values, uptown, downtown or midtown amending the field HouseNumber so that house numbers can only be in the range 1 to 499.
	Wri	te the updated version of MyContactDetail.

(c) A pointer is a variable that stores the address of a variable of a particular type.

Consider the pseudocode on page 3, which uses the following identifiers:

Identifier	Data type	Description
IPointer	^INTEGER	pointer to an integer
Sum	INTEGER	an integer variable
MyInt1	INTEGER	an integer variable
MyInt2	INTEGER	an integer variable

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The four assignment statements are executed. The diagram shows the memory contents after execution.

Variable	Memory Address	Contents
	5848	
	5847	
IPointer	5846	4402
	5845	
	4403	
Sum	4402	33
	4401	
	3428	
MyInt1	3427	91
MyInt2	3426	33
	3425	

Use the diagram to state the current values of the following expressions:

(i)	IPointer[1]
(ii)	IPointer [^] [1]
(iii)	@MyInt1[1]
(iv)	IPointer^ = MyInt2[1]

d)	Writ	te pseudocode statements that will achieve the following:	
	(i)	Place the address of MyInt2 in IPointer.	
			[1
	(ii)	Assign the value 33 to the variable MyInt1.	
			[1
((iii)	Copy the value in MyInt2 into the memory location currently pointed at by IPointer	ĵ.
			[4

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4 (a) Three file organisation methods and two file access methods are shown below.

Draw lines to link each file organisation method to its appropriate file access method(s).

File organisation method random sequential serial direct

(b) An energy company supplies electricity to a large number of customers. Each customer has a meter that records the amount of electricity used. Customers submit meter readings using their online account.

[4]

The company's computer system stores data about its customers.

This data includes:

- account number
- personal data (name, address, telephone number)
- meter readings
- username and encrypted password.

The computer system uses three files:

File	Content	Use				
Α	Account number and meter readings for the current month.	Each time a customer submits their reading, a new record is added to the file.				
В	Customer's personal data.	At the end of the month to create a statement that shows the electricity supplied and the total cost.				
С	Usernames and encrypted passwords.	When customers log in to their accounts to submit meter readings.				

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For each of the files A, B and C, state an appropriate file organisation method for the use given in the table.

All three file organisation methods must be different.

Justify your choice.

(i)	File A organisation	
	Justification	
	[3
(ii)	File B organisation	
	Justification	
	[
(iii)	File C organisation	
	Justification	
	[3

			2							
1	In a	a particular computer system, real num	nbers ar	e stored u	ısing fl	oatin	g-poiı	nt rep	resenta	ation with:
	•	8 bits for the mantissa								
	•	8 bits for the exponent								
	•	two's complement form for both man	tissa an	d exponer	nt					
	(a)	Calculate the floating point represent	tation of	+3.5 in th	nis sys	stem.	Show	your	workin	g.
		Mantissa				Ехро	onent			
		•								
						<u> </u>	<u> </u>	l		
										[3
	/l-\	Calaulata tha floating maint warmanan								-
	(D)	Calculate the floating-point represen	tation of	-3.5 In tr	iis sys			-	workin	g.
		Mantissa				Expo	nent		ı ı	
		ф								

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(c) Find the denary value for the following binary floating-point number. Show your working.

			Man	tissa								Expo	nent	İ		
0	1	1	1	0	0	0	0		0	0	0	0	0	1	0	0
	I							ļ								
•••																•••••
•••																
(i)) Sta	ate wl	hethe	r the	floatir	ig-po	int nu	mber	giver	n in pa	art (c) is no	ormal	ised o	or not	norm
/::\	\ l	o+if	(O) F O	20110												
(ii)) Ju	Sury y	our a	nswe	r give	en in k	oart (d	a)(I).								
	•••															
	•••															
G	ive th	e bina	ary tw	o's co	omple	ment	patte	rn foi	the r	negati	ive nu	ımbeı	r with	the la	arges	t mag
			Man	tissa								Ехро	onent	:		
												•				
4																

4 (a) Three file organisation methods and two file access methods are shown below.

Draw lines to link each file organisation method to its appropriate file access method or methods.

File organisation method	File access method
serial	direct
sequential	sequential
random	

[4]

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- **(b)** A bank has a very large number of customers. The bank stores data for each customer. This includes:
 - unique customer number
 - personal data (name, address, telephone number)
 - transactions

The bank computer system makes use of three files:

- A a file that stores customer personal data. This file is used at the end of each month for the production of the monthly statement.
- B a file that stores encrypted personal identification numbers (PINs) for customer bank cards. This file is accessed when the customer attempts to withdraw cash at a cash machine (ATM).
- C a file that stores all customer transaction records for the current month. Every time
 the customer makes a transaction, a new record is created.

For each of the files A, B and C, state an appropriate method of organisation. Justify your choice.

(i)	File A organisation
	Justification
	[3]
(ii)	File B organisation
(11)	File B organisation
	Justification
	[3]
(iii)	File C organisation
	Justification
	[3]

4 (a) Three file organisation methods and two file access methods are shown below.

Draw lines to link each file organisation method to its appropriate file access method or methods.

File organisation method	File access method
serial	direct
sequential	sequential
random	

[4]

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- **(b)** A bank has a very large number of customers. The bank stores data for each customer. This includes:
 - unique customer number
 - personal data (name, address, telephone number)
 - transactions

The bank computer system makes use of three files:

- A a file that stores customer personal data. This file is used at the end of each month for the production of the monthly statement.
- B a file that stores encrypted personal identification numbers (PINs) for customer bank cards. This file is accessed when the customer attempts to withdraw cash at a cash machine (ATM).
- C a file that stores all customer transaction records for the current month. Every time the customer makes a transaction, a new record is created.

For each of the files A, B and C, state an appropriate method of organisation. Justify your choice.

(i)	File A organisation
	Justification
	[3]
(ii)	File B organisation
(11)	File B organisation
	Justification
	[3]
(iii)	File C organisation
	Justification
	[3]

- 1 In a particular computer system, real numbers are stored using floating-point representation with:
 - 8 bits for the mantissa, followed by
 - 8 bits for the exponent

Two's complement form is used for both mantissa and exponent.

(a) (i) A real number is stored as the following two bytes:

			Man	tissa					Exponent								
0	0	1	0	1	0	0	0		0	0	0	0	0	0	1	1	
		Calcu	ulate t	he der	nary v	alue c	of this	numb	er. Sh	ow yo	our wo	rking.					
																[3	
	(ii)	Expla	ain wh	y the f	loatin	g-poin	ıt num	ber ir	n part	(a)(i)	is not	norm	alised				
																[2	
	(iii)	Norm	alise	the flo	ating-	point	numb	er in I	oart (a	ı)(i).							
			Man	tissa					Exponent								

[2]

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(b)	(i)			arges this fo	t posi rmat.	tive	numb	er 1	that	can	be	wr	ritten	as a	norma	alised	floatii	ng-poi	int
			Man	tissa										Ехро	nent				
																			[2]
	(ii)			smalle this fo	st pos rmat.	sitive	numl	ber	tha	it ca	n be	W	ritten	as a	norma	alised	floati		
			Man	tissa										Ехро	onent				
			1		ı	ı			'					I		ı		[[2]
	(iii)	If a p	ositive	numl	oer is	adde	ed to th	he r	num	nber	in p a	ırt	(b)(i)	explai	n wha	t will h	nappe	n.	
																		[[2]
(c)	A st	udent	writes	a pro	gram	to o	utput r	num	nbei	rs us	ing t	he	follow	ing co	ode:				
		X ←		0 50	100	0													
		X	< ← :	X + C	100	U													
		O ENDF	UTPU 'OR	ТХ															
	The	stude	nt is s	surpris	ed to	see 1	that th	ne p	rog	ram	outp	uts	the fo	ollowir	ng sec	uence	∋:		
	0.0	0.1	0.2	0.299	9999	0.3	39999	99 .											
	Exp	lain wl	hy this	s outpi	ut has	occi	urred.												
			,																
								•••••											••••
	•••••							•••••											••••
								••••											
																		[[3]

- 1 In a particular computer system, real numbers are stored using floating-point representation with:
 - 8 bits for the mantissa, followed by
 - 4 bits for the exponent

Two's complement form is used for both mantissa and exponent.

(a)	(i)	A real number is stored as the following 12-bit binary pattern:

	0	1	1	0	1	0	0	0		0	0	1	1	
	Calcı	ulate t	he de	nary v	alue c	of this	numb	er. Sh	ow yo	ur wor	king.			
														[3]
(ii)	Give	the no	ormali	sed bi	nary r	atterr	n for +	3.5. S	how y	our wo	orking			
` '														
														[3]
(iii)	Give	the no	ormali	sed bi	nary p	atterr	n for –	3.5. S	how y	our wo	orking			
														[3]

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The number of bits available to represent a real number is increased to 16.

(b)	(i)	If the system were to use the extra 4 bits for the mantissa, state what the effect would be on the numbers that can be represented.
		[14]
	(ii)	If the system were to use the extra 4 bits for the exponent instead, state what the effect would be on the numbers that can be represented.
		[1]
(c)	A st	udent enters the following expression into an interpreter:
		OUTPUT (0.1 + 0.2)
	The	student is surprised to see the following output:
	0.30	000000000001
	Ехр	lain why this output has occurred.
		[3]

4 (a) A particular programming language allows the programmer to define their own data types.

An example of a user-defined data type for an address is:

TYPE ThisAddress

	DECLARE	ThisHouseNo	:	INTEGER	
		ThisStreet			
		ThisTown	:	STRING	
ENI	DTYPE				
A v	ariable of th	nis new type is d	ec	lared as follows:	
DEC	CLARE Hor	meAddress : '	ľh:	isAddress	
(i)	Write the	statement that a	ssi	igns the house number 34 to HomeAddress.	
					[1]
					[']
(ii)	The type	definition for Th	İsA	Address is to be changed .	
	Rewrite o	ne line from the	de	finition for each of the following changes.	
	House nu	mbers are in the	ra	ange from 1 to 10.	
	DECLARE				
	The possi	ble towns are lir	nite	ed to: Brightown, Arunde and Shoram.	

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(b) Temperature data from a number of weather stations are to be processed by a program.

The following data are to be stored:

- weather station ID (a unique four-letter code)
- latitude (to 2 decimal places)
- average temperature (to the nearest whole number) for each year from 2001 to 2015 inclusive

A programmer designs a composite data type WeatherStation. A variable of this type can be used to store all the data for one particular station.

(i)	Write the definition for the user-defined data type WeatherStation.
	[5]
(ii)	The programmer decides to store all the data in a file. The number of weather stations could grow to reach 20000, but not all stations will be present at first.
	The programmer decides on random organisation for the file.
	Describe three steps which show how a new weather station record is added to the file.
	1
	2
	3
	[3]

3 (a) A particular programming language allows the programmer to define their own data types.

ThisDate is an example of a user-defined structured data type.

```
TYPE ThisDate

DECLARE ThisDay : (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31)

DECLARE ThisMonth : (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)

DECLARE ThisYear : INTEGER

ENDTYPE
```

A variable of this new type is declared as follows:

DEC	CLARE DateOfBirth : ThisDate
(i)	Name the non-composite data type used in the ThisDay and ThisMonth declarations.
	[1]
(ii)	Name the data type of ThisDate.
	[1]
(iii)	The month value of DateOfBirth needs to be assigned to the variable MyMonthOfBirth.
	Write the required statement.
	[1]

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(b) Annual rainfall data from a number of locations are to be processed in a program.

The following data are to be stored:

- location name
- height above sea level (to the nearest metre)
- total rainfall for each month of the year (centimetres to 1 decimal place)

A user-defined, composite data type is needed. The programmer chooses ${\tt LocationRainfall}$ as the name of this data type.

A variable of this type can be used to store all the data for one particular location.

(i)	Write the definition for the data type LocationRainfall.
	[5]
(ii)	The programmer decides to store all the data in a file. Initially, data from 27 locations will be stored. More rainfall locations will be added over time and will never exceed 100.
	The programmer has to choose between two types of file organisation. The two types are serial and sequential.
	Give two reasons for choosing serial file organisation.
	[2]