10 Natural Language Processing (AAC)

The following grammar fragment associates context free syntax rules with lambda calculus rules for semantic composition:

`S -> NP VP`	`Vditrans -> gives`
$\text{VP}'(\text{NP}')$	$\lambda y \lambda x \lambda z[\text{give}'(z, y, x)]$
`VP -> Vditrans NP PPto`	`Vintrans -> sleeps`
$(\text{Vditrans}'(\text{NP}'))(\text{PPto}')$	$\lambda w[\text{sleep}'(w)]$
`VP -> Vintrans`	`NP -> Sandy`
$\text{Vintrans}'$	s
`PPto -> to NP`	`NP -> Kim`
NP'	k
	`NP -> Fido`
	f

(*a*) Show the semantics that the grammar above would assign to:
Kim sleeps
Kim gives Fido to Sandy [2 marks]

(*b*) Extend the grammar to also allow:
Kim gives Sandy Fido
Show the semantics your grammar gives for this sentence. [2 marks]

(*c*) Extend the grammar so the following sentences are all given the semantics $\text{reject}'(k, f)$, explaining the reasons for the choices you have made.
Kim rejects Fido
Kim turns Fido down [7 marks]
Kim turns down Fido

(*d*) Most native English speakers accept sentences like (*d*)(*i*) below as grammatical but find sentences like (*d*)(*ii*) ungrammatical. Outline how you would augment the grammar you gave in answer to (*c*) so that (*d*)(*i*) was accepted but (*d*)(*ii*) was not.

(*i*) Kim turns it down

(*ii*) *Kim turns down it

[3 marks]

(*e*) What alternative strategy might you use in a large-scale language generation system to ensure that (*d*)(*i*) was generated in preference to (*d*)(*ii*)? In general, what are the advantages and disadvantages of this approach in comparison with constraining generation by the grammar? [6 marks]