Question 1: some technicalities

A. Let $E = \{a, b, c\}$

(i) Give $D$ according to the union theory.
(ii) Give $D_0$ and $D_1$ according to the set formation theory.
(iii) How many members does $D_2$ (as defined in the set formation theory) have?

B. According to Link (1984) and Landman (1989 & subsequent work), sums can shift into atoms by means of the operation $\uparrow$. The result is called an ‘impure atom’; Landman (but not Link, who as you will recall uses lattice theory rather than set theory) formalises them in terms of singleton sets. So for example:

\[ \uparrow([\text{John and Mary}]) = \uparrow([j, m]) = \{j, m\} \]
\[ \text{given that } [\text{the men}] = \{j, b\}; \ \uparrow([\text{the men}]) = \uparrow([j, b]) = \{j, b\} \]

Assuming that Link and Landman are right, and assuming a model in which $\{a, b, c\}$ is the set of cows and $\{d, e, f\}$ the set of pigs, write down the four possible semantic analyses for the NP The cows and the pigs.

Question 2: the semantics of the D-operator

The distributivity operator $D$ ensures that sentence (1), on its distributive interpretation, has the logical form in (2) (we ignore non-maximality for the moment, and assume a set-theoretical approach to plurality where $*\{a, b, c\} = \{\{a\}, \{b\}, \{c\}, \{ab\}, \{ac\}, \{bc\}, \{abc\}\}$. You may also ignore the contribution of the and simply assume that $[\text{the girls}] = [\text{girl}]$):

1. The girls laughed.
2. $\forall X \in *\text{girl} \ [*\text{laugh}(X)]$
In principle, the D-operator could either apply to the denotation of the subject NP *the girls*, or to the denotation of the VP *laugh*.

A. (i) Assuming the structure of (1) is [[D[the girls]] *laughed*], give the semantics of the D-operator as a lambda term.
(ii) Assuming the structure of (1) is [[the girls] [D[*laughed*]]], give the semantics of the D-operator as a lambda term.
(iii) Assume a model M1 in which girl = {a,b,c} and laugh = {a,b}. Pick one of your denotations for D and explain informally how it follows from your denotation that sentence (1) is false in this model.

B. Collective predicates like *meet* do not need to be starred, because they have only sets in their denotation to begin with. Assume a model M2 in which girl = {a,b,c}, laugh = {a,b,c,d} and meet = {a,b,c}. How would you analyse the semantics of *The girls met* so it comes out true in M2?

C. Now, consider the following sentence:

3. The girls met and laughed.

(i) The denotation of *and* is $\lambda P \lambda Q \lambda X [P(X) \land Q(X)]$. What problem do you see if you analyse (3) as [[D[the girls]] [met and *laughed*]]? Give the derivation and explain why it results in the wrong truth conditions (you can use M2 to illustrate your point).
(ii) Using instead the denotation for D you have given in (A-ii), give a derivation that results in the right truth conditions. Show that (3) is true in M2 under this analysis.

**Question 3: event semantics and adverbial modification**

Consider the following sentence:

1. John is a blond blue-eyed American in his midlife crisis.

An early account of modifiers like *blond* and *in his midlife crisis* takes them to form complex predicates like in (2):

2. (in_his_midlife_crisis(blue_eyed(blond(american))))(j)

The problem with this is how to ensure that (1) entails the sentences in (3), in which the modifiers have changed order, and (4), in which one of the modifiers has been dropped:

3. John is a blue-eyed blond American in his midlife crisis.

(\textproc{in_his_midlife_crisis(blond(blue_eyed(american))))(j)}
4. John is a blond blue-eyed American.

\((\text{blue-eyed}(\text{blond}(\text{american}()))(j))\)

These problems are solved by treating these adjectival modifiers as intersective: for instance, \([\text{blond}] = \lambda P \lambda x \ [P(x) \land \text{blond}(x)]\). In this way, the result we get when we apply multiple modifiers is an increasingly long conjunction of predicates. Applying \([\text{blond}]\) to \([\text{American}]\) we get \([\text{blond American}] = \lambda x \ [\text{american}(x) \land \text{blond}(x)]\) (a new predicate of type \((et)\)); applying \([\text{blue-eyed}]\) to this gives us \(\lambda x \ [\text{american}(x) \land \text{blond}(x) \land \text{blue-eyed}(x)]\), and so on. The semantics of (1) is not as in (2), but as in (5):

5. \(\text{american}(j) \land \text{blond}(j) \land \text{blue-eyed}(j) \land \text{in_his_midlife_crisis}(j)\)

Now the permutation (3) and drop (4) facts follow from the properties of conjunction: \(a \land b\) is equivalent to \(b \land a\), and \(a \land b\) entails \(a\).

Now consider the following sentence:

6. John ran lightly in the park with his dog.

A. Show how the argument above pertains to adverbial modification (as in (6)) as well.

Considering the similarities you have pointed out in (A), it makes sense to treat adverbial modifiers as intersective as well. But what should these intersective modifiers predicate over?

B. Someone says: The modifiers in (6) should be analysed as intersective predicates over the individual \(\text{john}\) (just as in (5)). What problems do you see with this?

The problems you identified in (B) are a reason to adopt an implicit event argument that the adverbial modifiers in (6) are predicates of. The semantics of (6) looks as follows:

7. \(\exists e \ [\text{run}(e) \land \text{agent}(e)(j) \land \text{light}(e) \land \text{in_the_park}(e) \land \text{with_j’s_dog}(e)]\)

Informally, we could say that ‘there was a running event \(e\) such that \(e\) was light, with a dog, and in the park’.

Now, consider the following sentences:

8. John ran to the park.

9. *The running was to the park.

Would you analyse the modifier in (8) in the same way as the ones in (6)? Why (not)? If not, could you suggest another analysis?
Question 4: nominalisation

Consider the entailments in (1-3):

1. John danced the tango
2. There was a dancing
3. John is a dancer

We can analyse (1) as follows:

4. $\exists e \ [\text{dance}(e) \land (\text{agent}(e))(j) \land (\text{theme}(e))(\text{the_tango})]$ 

A. Give the denotation of $\text{dance}$, as a lambda term, so that the result of applying it to the arguments $j$ and $\text{the_tango}$ gives you the semantics in (4).

The entailment from (1) to (2) follows from the semantics in (4) (if there is a dancing event whose agent is John and whose theme is the tango, it follows that there is a dancing event). The problem is how to get the right meaning for (2) based on the denotation of $\text{dance}$ as you have given it in (A).

B. Why is this a problem? I.e., why can’t you use the denotation of $\text{dance}$ in its current form to give a semantics for (2) that is entailed by the semantics in (4)?

To solve the problem, we assume that the morpheme -ing saturates the agent and theme arguments of $[\text{dance}]$ by existentially closing them. The result is as follows:

(a) $\exists x \exists y \exists e \ [\text{dance}(e) \land (\text{agent}(e))(x) \land (\text{theme}(e))(y)]$

C. Give the denotation for -ing, so that the result of applying it to $[\text{dance}]$ gives you the semantics in (5).

D. According to the same lines, give a denotation of -er in (3) that can be applied to $[\text{dance}]$ and guarantees the entailment from (1) to (3).