Problem 1.
(a) \( \Pi_{tname}(\sigma_{pname="Michael Jordan"}(\text{PLAYER} \bowtie \text{REGISTER} \bowtie \text{TEAM})) \)
(b) \( \Pi_{pname}(\sigma_{tname="Heat" \land year=2012}(\text{PLAYER} \bowtie \text{REGISTER} \bowtie \text{TEAM})) \)
(c) 
\[
T_1 \leftarrow \sigma_{pname="Michael Jordan"}(\text{PLAYER} \bowtie \text{REGISTER}) \\
T_2 \leftarrow \sigma_{pname\neq "Michael Jordan"}(\text{PLAYER} \bowtie \text{REGISTER}) \\
\Pi_{T_2.pname}(\sigma_{T_1.tid=T_2.tid \land T_1.year=T_2.year}(T_1 \times T_2))
\]
(d) 
\[
T_1 \leftarrow \sigma_{pnation=\text{"China"}}(\text{PLAYER} \bowtie \text{REGISTER}) \\
T_2 \leftarrow T_1 \\
T_3 \leftarrow \Pi_{T_2.year}(\sigma_{T_1.year<T_2.year}(T_1 \times T_2)) \\
\Pi_{year}(T_1) - T_3
\]
(e) 
\[
T_1 \leftarrow \Pi_{year}(\sigma_{pname="Michael Jordan"}(\text{PLAYER} \bowtie \text{REGISTER})) \\
T_2 \leftarrow \Pi_{pid,pname,year}(\sigma_{pname\neq "Michael Jordan"}(\text{PLAYER} \bowtie \text{REGISTER})) \\
\Pi_{pname}(T_2 \div T_1)
\]

Problem 2.
(a) select \(pname\) from \text{PLAYER} where \text{nation} = \text{"China"}
(b) 
select \(pid, \min(year), \max(year)\) from \text{REGISTER}
group by \text{pid}
(c) 
select \(pid\) from \text{REGISTER}
where \(year \geq 1996\) and \(year \leq 2005\)
group by \text{pid}
having count(*) = 10
(d) 
select \(year\) from \text{REGISTER}
where \(salary > 20000000\)
group by \text{year}
having count(*) > 10
(e) 
select \(pid\) from 
select pid, \text{sum(salary) as wealth, count(year) as lifetime}\nfrom \text{REGISTER}
group by pid\) as T
where not exists 
select * from T
where \(wealth < T.\text{wealth and lifetime > T.lifetime}\)
Problem 3.
Find the pids of all such players $p$ that $p$ made more money in one year (it does not matter which year) than the wealth of every player from Japan.

Problem 4.
(a) $profId \rightarrow stuId$
(b) $stuId \rightarrow projId$
(c) $projId \rightarrow profId$

Problem 5.
(a) $ABD$
(b) From $D \rightarrow A$, we have $CD \rightarrow AC$ by augmentation. By transitivity on $CD \rightarrow AC$ and $AC \rightarrow E$, we have $CD \rightarrow E$.
(c) $AC$ and $DC$
(d) $R$ is not in 3NF. This is because of $A \rightarrow B$, which is not a trivial functional dependency, its left side does not contain any key, and its right side is not included by any key.
(e) No, because the common attribute $C$ of $R_1$ and $R_2$ is a candidate key of neither. Note that $R_1$ has candidate keys $AC$ and $DC$, whereas $R_2$ has only one candidate key $CE$.
(f) First, we decompose $R$ using $A \rightarrow BD$ into $R_1(ABD)$ and $R_2(ACE)$. $R_1$ has candidate keys $A$ and $D$. $R_2$ has only one candidate key $AC$. Both tables are already in BCNF.