FLAVOUR PHYSICS ASSESSMENT

To be returned to Tim Gershon (T.J.Gershon@warwick.ac.uk) by April 6th 2007

Answer the following, each in 100 words or less. (10 marks each)

1. What is the experimental evidence for the existence of exactly three pairs of quarks?

2. In terms of the quark model, what is the explanation for the success of hadronic isospin symmetry?

3. How does the existence of three generations of quarks allow CP violation within the Standard Model?

4. The lightest charmonia state, the η_c, was discovered in 1980 by the Mark II (see PRL 45 1146 (1980)) and Crystal Ball (see PRL 45 1150 (1980)) experiments. Why was it not discovered before its (heavier) counterpart, the J/ψ – discovered in 1974?

5. Why were the first measurements of the B lifetime and of mixing in the B system surprising?

Give brief answers to the following (5 marks each). Use diagrams and calculations as appropriate.

6. What property of the Unitarity Triangle can be measured from the rate of the rare kaon decay $K_L \rightarrow \pi^0 \nu\nu$?

7. Estimate the maximum size of direct CP violation in $D^0 \rightarrow \pi^+\pi^-$ within the Standard Model.

8. The mass differences in the B_d and B_s systems are measured to be
$\Delta m_d = (0.511 \pm 0.005 \pm 0.006)$ ps^{-1} and $\Delta m_s = (17.77 \pm 0.10 \pm 0.07)$ ps^{-1} respectively. Estimate the ratio of CKM matrix elements $|V_{td}/V_{ts}|$.

9. The phase of Bs oscillations can be measured in $B_s \rightarrow J/\psi\phi$ decays (in analogy to the measurement of $\sin(2\beta)$ in $B_d \rightarrow J/\psi K_S$ decays. Estimate its value within the Standard Model.

10. Why has it not been measured by the B factories?

Finally, in as many words as you like (25 marks)

11. How might physics beyond the Standard Model reveal itself in flavour observables?