Quiz 4

NAME: _____ **SCORE:** _____

Subject: Introduction to Nuclear and Particle Physics
Date: Tuesday 7th March 2023
Duration: 60 minutes
Credits: 16 points, each question is worth 1 point

This quiz consists of closed-book concept questions. Provide answers to the following items.

mesons: $D^0(c\bar{u})$, $K^-(s\bar{u})$, $\pi^+(u\bar{d})$, $\pi^-(d\bar{u})$, $\pi^+(u\bar{u}), (\bar{d}d)$

1. Are the following processes possible or impossible? If impossible, which conservation law is violated? If possible, which force is involved in the interaction?

   $e^- + p^+ \to \nu_e + \pi^0$

   $\bar{\nu}_e + p \to n + e^+$

   $\pi^0 \to \gamma + \gamma$

   $\mu^- \to e^- + \bar{\nu}_e$

   $\pi^+ + n \to \pi^- + p$

2. Briefly explain what is the asymptotic freedom.

3. What type of interaction (trough which force) do we have if there are neutrinos involved in the interaction?

4. Briefly explain why can gluons couple to other gluons directly and form glueballs?

5. What is the overall colour of a neutron? Briefly explain.

6. Can muons (μ) interact trough the strong force?

7. Briefly explain what is the OZI rule?

8. Briefly explain what is a semi leptonic process?

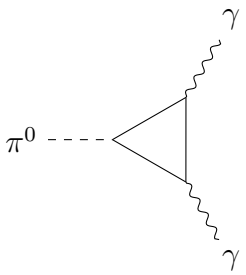
9. Which ones are the stable particles in nature?

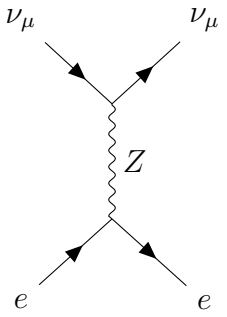
10. Is flavour conserved in the weak interaction? Briefly explain.

11. Why does the neutron have a relatively long lifetime compared to other particles that decay trough the weak interaction?

12. Draw Feynman diagrams for these decays: $D^0 \to K^- + \pi^+$, $D^0 \to \pi^- + \pi^+$ Which of these decays is more likely to happen? Briefly state why.

13. What processes do the following Feynman diagrams represent?





14. Draw a Feynman diagram for β^+ decay.

15. Draw a Feynman diagram for electron capture.

16. Draw a Feynman diagram for muon decay: $\mu^- \to \nu_\mu + e^- + \bar{\nu}_e$.