Student Name: **Student Number:**

1. A motor is rigidly coupled to a load and each structure has an inertia of 0.029 kgm^2. Calculate the required electromagnetic torque if the speed is to increase linearly from rest to 1800 rpm in 5 seconds.

2. An electric vehicle has the following attributes: mass M = 500 kg, wheel diameter d_W = 1m, gear ratio from rotor to drive axle n = 10, and a nominal gear efficiency of 95%. The vehicle is required to accelerate from 0 to 72 km/hr in 10 s on a flat road surface under calm wind conditions.   Neglecting load forces, instantaneously at 36 km/hr calculate the electromagnetic torque from the electric motor to achieve this acceleration torque.

3. The above electric vehicle has the following attributes: drag co-efficient C_W = 0.2, vehicle cross section A = 3 m^2. Use density of air ρ_{air} = 1.202 kg m^{-3}. Recalculate, instantaneously at 72 km/hr, the electromagnetic torque required at the axle to achieve this acceleration when driving with a 3.6 km/hr tailwind.

4. At highway speed, the power generated by car engines is mostly used to overcome aerodynamic drag, and thus the fuel consumption is nearly proportional to the drag force on a level road.   Determine the percentage savings in fuel consumption of a car per unit time when a person who normally drives at 55 mph now starts driving at 40 mph.

5. Sketch a plot of torque vs. speed for a constant-power load.

6. Derive an expression for the back emf, E, in a single-coil, primitive two-pole dc motor in terms of the angular speed ω, field flux density B, length l and radius r.

7. A Nd-Fe-B magnet has the following B-H characteristics. What is the relative permeability of the magnet at it maximum energy point? (0.87 T, -300 kA/m), (0.71 T, -400 kA/m), (0.59 T, -500 kA/m), (0.43 T, -600 kA/m)

8. Sketch the compound configuration circuit for a dc machines.

9. A generator develops a back emf of 100 V at 1000 rpm. Under full-load current draw of 10 A, the field flux is weakened by 5 % due to armature reaction. Calculate the full-load terminal voltage when the armature resistance is 0.5 Ω .

10. A 250 V, 400A compound generator has 1000 shunt-field turns per pole and 3 series-field turns per pole. What is the effective field current when the series-field current is 5 A?

11. A permanent-magnet dc motor is known to have an armature resistance of 1Ω . When operated at no load from a dc source of 50 V, it is observed to operate at a speed of 1200 rpm and to draw 1 A. Find the no-load rotational losses of the motor.

12. Sketch the three phase currents for constant torque in the trapezoidal-waveform electronically-commutated motor.

13. A star-connected EC dc motor is sourced by a 50 V supply, and pulls 10 A from the source. The phase-phase resistance is 0.5Ω . What are the amplitude of per-phase back emf and the rms per-phase current?