1. Which of these factors determine a vehicle’s maximum speed in 1st gear? Circle all that apply.

<table>
<thead>
<tr>
<th>Differential ratio</th>
<th>Differential efficiency</th>
<th>Max engine RPM</th>
<th>Max engine power</th>
<th>Drag coefficient</th>
<th>Transmission gear</th>
<th>Transmission efficiency</th>
<th>Tire size</th>
</tr>
</thead>
</table>

2. Which of these factors determine a vehicle’s maximum speed in the highest gear? Circle all that apply.

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<th>Differential ratio</th>
<th>Differential efficiency</th>
<th>Max engine RPM</th>
<th>Max engine power</th>
<th>Drag coefficient</th>
<th>Transmission gear</th>
<th>Transmission efficiency</th>
<th>Tire size</th>
</tr>
</thead>
</table>

3. When new drivers attend the meeting before a race that is held on a track that is wet from rain, they are advised to shift their brake bias more towards the rear of their vehicle. What is the technical reason for this recommendation?

4. Identify the name of the ride model and identify the 4 items indicated by arrows. Use words, not symbols.

Name of the ride model = ______________________

5. Circle the effect on rolling resistance of the following:

   6. increasing vehicle center of gravity height
      
      - decrease rolling resistance
      - no effect on rolling resistance
      - increase rolling resistance

   - increasing tire inflation pressure – hard surfaces
      
      - decrease rolling resistance
      - no effect on rolling resistance
      - increase rolling resistance

   - increasing vehicle speed
      
      - decrease rolling resistance
      - no effect on rolling resistance
      - increase rolling resistance

   - increasing tire temperature
      
      - decrease rolling resistance
      - no effect on rolling resistance
      - increase rolling resistance
Closed book, closed notes, one 8.5 x 11 inch page of handwritten formulas allowed. Show all work!

Data sheets for a test vehicle are attached to this test. Use this vehicle’s data in all subsequent problems.

7. Determine the longitudinal location for the center of gravity of the vehicle if a 400 lb load (driver and passenger) is added 8 inches behind the current center of gravity, i.e., find the new $b$ and $c$. 
8. Use the graph to determine the slope of the brake proportioning line that creates simultaneous “lock up” of the front and rear brakes when the coefficient of friction is $\mu = 0.85$.

Assume the same 400 lb load (driver and passenger) is added to the curb weight for your calculations.
Your test vehicle is traveling at 45 mph (=66 ft/s) in 3rd gear when the driver presses the accelerator pedal fully to accelerate the vehicle as quickly as possible.

Use one time step to estimate the speed of the test vehicle after 1.0 second. Fill in the table below to help with your calculation, but also show all of your actual calculations on this test sheet.

The 2nd order engine model for your test vehicle is given at the bottom of the data sheet. Assume the following:

- vehicle weight = curb weight + 450 lb
- transmission and differential efficiency, $\eta_t = \eta_f = 95\%$
- mass factor = 1.2
- rolling resistance coefficient = 0.014
- drag coefficient, $C_D = 0.35$

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**Jaguar XF Supercharged**

**Pricing**
- List price: $562,200
- Price as tested: $565,675

**General Data**
- Car weight: 4,910 lb
- Ground clearance: 7.0 in
- Trunk space: 17.5 cu ft
- Wheelbase: 116.5 in
- Track, fr: 61.4 in
- Track, rr: 63.8 in
- Length: 196.1 in
- Width: 73.9 in
- Height: 57.5 in
- Transmission: 6-speed automatic
- Gear ratio: 4.17:1

**Chassis & Body**
- Layout: Front Engine, Rear Wheel Drive
- Brakes: 14.0 in x 0.8 in, 1.52 in x 0.9 in
- Tires: Front: 255/55ZR19, Rear: 255/55ZR19
- Suspension: Front: MacPherson Strut, Rear: Multi-link

**Instrumentation**
- 180-mph speedometer, 7,000-rpm tachometer, fuel level

**Safety**
- Dual airbags, side curtain airbags, traction & yaw control, front seatbelt pretensioners, front seatbelt rear limiters, active head restraints (all standard equip.)

**Warranty**
- Basic warranty: 4 years/50,000 miles
- Powertrain: 4 years/60,000 miles
- Rust-through: 6 years/unlimited miles

**Engine**
- Type/size: Aluminum, 6.0 L V-8
- Valve train: OHV, 4 valves/2 valves
- Cylinder configuration: V-8
- Displacement: 5,933 cc
- Compression ratio: 10.5:1
- Horsepower: 400 hp @ 5,250 rpm
- Torque: 420 lb-ft @ 4,250 rpm

**Transmission**
- Overall ratio: 4.17:1
- First gear: 12.88:1
- Second gear: 7.06:1
- Third gear: 4.63:1
- Fourth gear: 2.76:1
- Fifth gear: 2.12:1

**Acceleration**
- 0-100 ft: 5.2 sec
- 0-60 mph: 5.0 sec
- 0-140 mph: 13.4 sec
- Top speed: 155 mph

**Handling**
- Lateral acceleration: 0.82 g
- Slalom: 66.8 mph
- Tire size: 255/55ZR19

**Fuel Economy**
- EPA city: 16.6 mpg
- EPA highway: 13.2 mpg
- Combined: 15.4 mpg

**Interior Noise**
- Idle in neutral: 51 dBA
- Maximum in turn, 100 km/h: 75 dBA

**Test Conditions**
- Temperature: 71°F
- Humidity: 49%
- Elevation: 350 ft
- Wind: Calm
- Location: Irvine, California