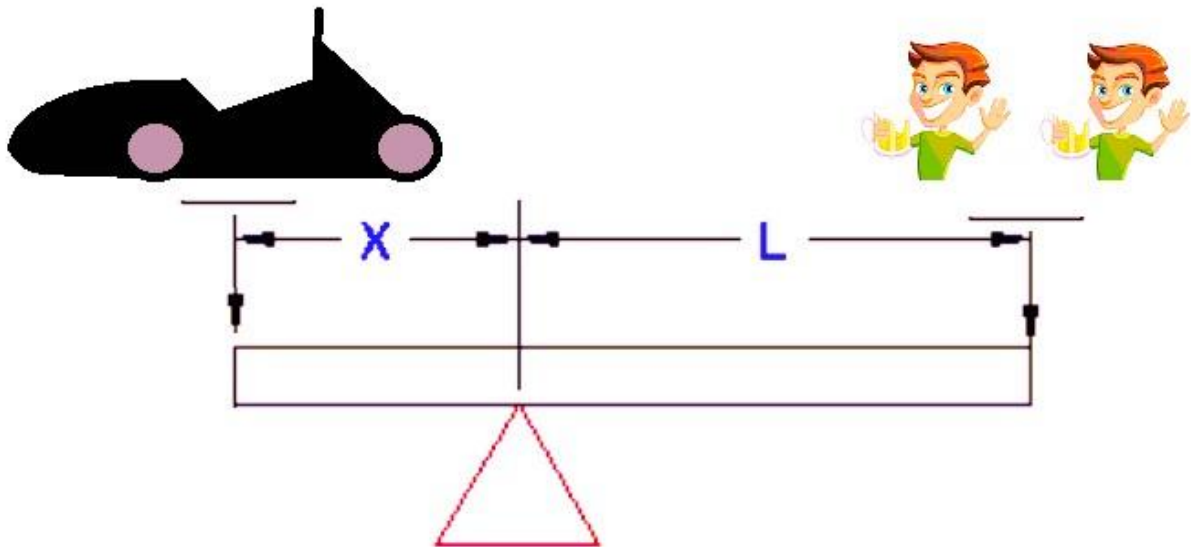


1. You are at the FSBk after-party, and you want to win the mechanical advantage competition.
Mechanical advantage.

Use as many team members as you consider bringing the lever to equilibrium.



CW (car weight) = 275.5 kg

$X = 1.1216 \text{ m}$

$L = 2 \text{ m}$

You've decided to use two team members, $TM1 = 71.3 \text{ kg}$; $TM2 = 78.6 \text{ kg}$.

Rules of the game:

- the lever needs to be in equilibrium (level with the ground)
- you can lose weight (murder, and dismemberment are prohibited)
- you can gain weight only by drinking beer $1\text{l}=1\text{kg}$
- you can have a beer 0.7kg in hand while on the lever

Knowing the above-mentioned, $TM1$ can drink 1.9 l/h ; $TM2$ can drink 2.4 l/h , being a competition, they need to drink fast.

How much weight do they need to gain/lose in the shortest time possible to bring the lever in equilibrium?

- a) **Gain 3.2kg – 44min39sec**
- b) Gain 2.3kg – 41min41sec
- c) Loose 2.3kg – 45min47sec
- d) Gain 3.2kg – 32min32sec
2. It is 2 days before submitting the cost report, because of an accident in testing 10 pcs. of class 8.8 M8x16 screws broke, you did the calculation, and it costs half the price to make 10 pcs. class 12.9 M8x16 screws, how will you add these in the BOM part of the cost report if they are made?
- a) Fastener
- b) **Part**
- c) Assembly
- d) Sub-assembly

3. For whatever reason you did not write down your tire pressure when you run endurance at your previous formula student event, and now at FSBk you have the same meteorological conditions, clouds, 17°C and an atmospheric pressure of 735mmHg. Luckily you have the data logger from last year, but you only have the last values saved, absolute tire pressure 2.2bar and a temperature in your tire of 42°C. Calculate the pressure that your team must inflate in your tires before endurance. (neglect the expansion of the air volume in the tire and the total volume of the air inside the tire is 0.01 m³).

- a) 0.45 bar
- b) 0.50 bar**
- c) 0.55 bar
- d) 0.60 bar

4. Due to a huge thunderstorm the business presentation finals were rescheduled by 1 day overlapping the engineering design event finals, your team is qualified for both engineering design and business presentation finals, what is minimum number of points that you can get in the business presentation finals if only 1 person presents the business presentation instead of 2? (answer format round to nearest decimal eg:12.34)

Correct answer: **71.00**

5. According to ISO 2768 - mK, what is the tolerance class for length dimension with exception of those for broken edges for a nominal dimension of 12mm under the fine class.

- a) ±0.05
- b) ±0.1**
- c) ±0.15
- d) ±0.2

6. What is the resistance of a piece of nichrome wire 0.24 meter in length with a cross-sectional area of 0.015 square centimeter? (answer format round to nearest decimal eg:12.34)

Correct answer: **13.49 ohms**

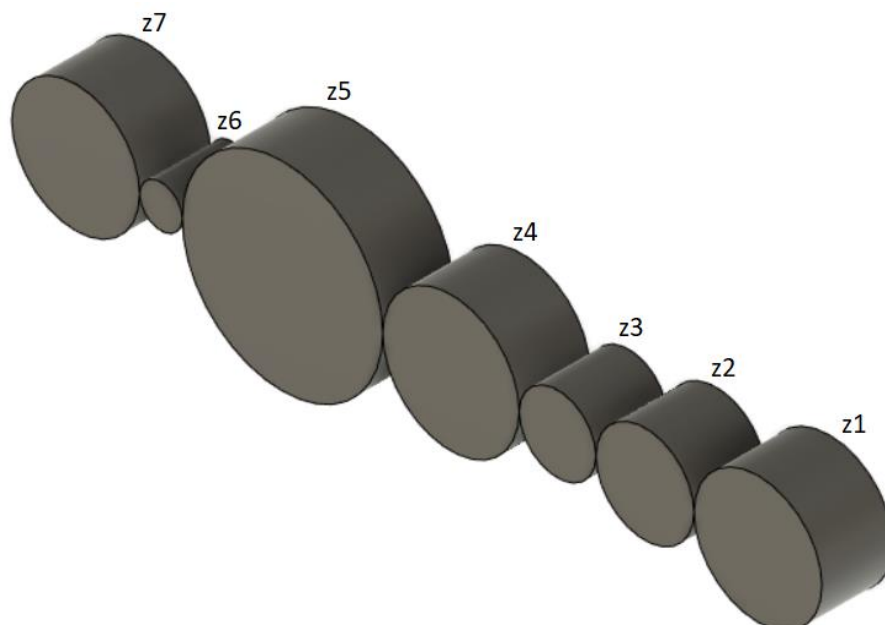
7. Which of the following are not characteristics of the phenomenon of combustion with detonation:

- a) appearance of a characteristic metallic noise
- b) increased indicated power of the engine**
- c) reduced engine durability
- d) engine overheating

8. A copper coil has a resistance of 100 ohms at 20°C. What is its resistance at 50°C if the temperature coefficient of resistivity for copper is 0.0038 $\Omega/\Omega^\circ\text{C}$? (answer format round to nearest decimal eg:12.34)

Correct answer: **111.40 ohms**

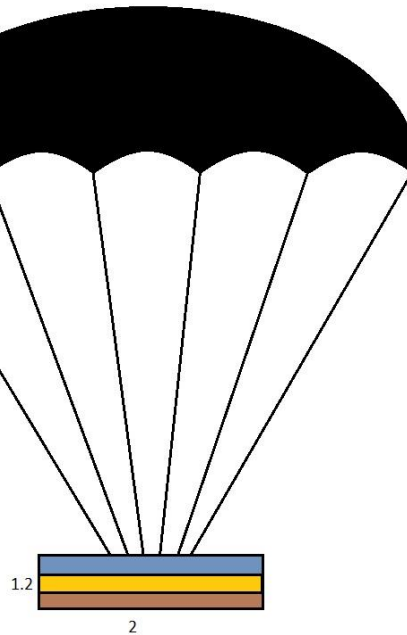
9. Your team is running in FSBk CV class with a pneumatic shifter, and today it's a hot summer day in Romania, with temperatures of 40°C and 750 mmHg, thus you must determine how many shifts you may have during endurance. Knowing that the gas bottle has a pressure inside of 115 bar with a total volume of 0.6 L and for one gear shift you measured the volume of air expelled into the atmosphere and you got 500 mL.
- 181
 - 138**
 - 338
 - 227
10. What is true about the BSPD?
- It opens the SDC when hard braking is detected and TPS position is 25% over idle**
 - It opens the SDC if an implausibility persists for 250ms or more
 - It can be supplied directly from a DC/DC converter
 - The BSPD can close the SDC through either a relay or a MOSFET
11. What is the maximum voltage permitted for low voltage?
- 60V AC RMS and 50V DC
 - 55V DC and 60V AC RMS
 - 60V DC and 50V AC RMS**
 - 55V AC RMS and 60V DC
12. For the shown gear train, the input RPM is 3600, and the number of teeth of the input gear is $z_1=30$.



The number of teeth of the rest of gears are: $z_2=23$, $z_3=18$, $z_4=32$, $z_5=47$, $z_6=10$, $z_7=30$. Calculate the RPM of the final gear z_7 . (answer format round to nearest decimal eg:12.34)

Correct answer: **3600.00 rpm**

13. Under what conditions does the relative humidity decrease while the absolute humidity increases?
- a) **only if the temperature rises fast enough**
 - b) only if the pressure rises fast enough
 - c) only if the temperature drops fast enough
 - d) only if the pressure drops fast enough
14. What is the coefficient of friction of brake pads lining generally?
- a) 0.1-0.5
 - b) 0.7-0.9
 - c) 0.5-1.0
 - d) **0.35-0.65**
15. Team A, B, C and D finished autocross. Team A has a clean run with 59.4 seconds, team B has 3 cones down with a best time of 55.1 seconds and team C has 1 cone down with a best time of 58.5 seconds and team D has a clean run with 1min15.2 seconds. How many points should team B and D get for the autocross event?
- a) **Team B = 86.7 and Team D = 5**
 - b) Team B = 88.7 and Team D = 31.3
 - c) Team B = 86.7 and Team D = 6.3
 - d) Team B = 88.7 and Team D = 1.3
16. The following cars finished the endurance with the given times and amount of fuel/energy units:
- Car 225 time **19:20.53** and used **4.68** liters of **E85** fuel.
Car 311 time **20.21.52** and used **3.28** liters of **RON 98** fuel.
Car E11 time of **18:20.45** and used **4200** units of energy.
Car E27 time of **18:47.53** and used **4525** units of energy.
- Chose the number of points for efficiency that each team gets:
- a) Car 225 - 75 points, Car 311- 57.22 points, Car E11 - 75 points, Car E27 -56.22 points
 - b) **Car 225 - 75 points, Car 311 - 56.11 points, Car E11 - 75 points, Car E27 - 55.36 points**
 - c) Car 225 -75 points, Car 311- 55.75 points, Car E11 - 75 points, Car E27 - 54.85 points
 - d) Car 225 - 56.22 points, Car 311 - 75 points, Car E11 - 65.72 points, Car E27 - 75 points
 - e) Car 225 - 54.25 points, Car 311 -75 points, Car E11 -56.11 points, Car E 27- 75 points
17. Cargo Drop. Because of time constraints, you decide to parachute your car and tools. All of them will be placed in a box 2 x 1.7 x 1.2 m from 1000 m height weighing 500 kg. Knowing that the parachute must open at 50m above the ground. At what time the parachute must open from the time it is being dropped, what is the total time of descent, knowing the descent velocity with the parachute open of 3.5 m/s, and what is the parachute diameter? (the parachute has no delay on opening, earth gravity acceleration= 9.81 m/s², drag coefficient of the box= 1.05, drag coefficient of the assembly = 1.35, air density= 1.204 kg/m³)



- a) time to open the parachute 23.75 s; time of total decent 38.03 s; radius 12.52 m.
- b) time to open the parachute 38.03 s; time of total decent 58.75 s; radius 18.52 m.
- c) time to open the parachute 13.75 s; time of total decent 28.03 s; radius 8.52 m.
- d) time to open the parachute 43.03 s; time of total decent 48.75 s; radius 2.52 m.

18. Before the endurance it rained quite badly, the track conditions were set to wet, after the endurance started and the cars started to spread the water, later the track conditions changed to damp. Later it started to rain again, and the conditions of the track changed to wet, and after a while the rain stopped and the track started to dry slowly. So, your team started the endurance event with wet tires on a damp track. The track surface is drying fast, and your telemetry shows that the tires are overheating. The officials did not announce any changes of the track condition. What can you do?

- a) Make a separate pit stop in the driver change area and change to a new set of wet tires for the remaining laps. The pit stop time is added to the overall time.
- b) You may change to dry tires during the driver change. The pit stop time is not added to overall time if you manage to get it under 13 minutes.
- c) You must not change the tires. You can try driving off the ideal race line within the track boundaries to cool down the tires.
- d) Make a separate pit stop in the driver change area and change to dry tires. The pit stop time is added to the overall time.**

19. What is true about the driver change:

- a) The driver change time will start once the vehicle is stopped in the driver change area and the first driver has climbed out of the vehicle.
- b) If the driver change takes longer than 3 minutes, extra time will be penalized with -40 points to the overall score.

- c) **You will get a penalty of 2 minutes if you make suspension adjustments to the vehicle.**
- d) The driver change time is stopped when the second driver is inside the vehicle. Team members are not allowed to secure him from this moment, he will have to secure himself.
20. You are a provider of E85 for the formula student Balkans competition. You must provide E85 fuel for 20 teams for the 2024 event. Knowing that one team uses 16 liters of E85 for the whole event (practice included). You decide to make it in the Balkan way, so how many kg of fruits you must collect in order to obtain the required amount of E85 fuel, knowing that from 25kg of fruits (plums, bananas, apricots, etc.) you get around of 8 liters of pure ethanol. You will also have to find how many barrels of 50kg do you need to deposit the fruits.



- a) **850kg of fruits; 17 barrels**
- b) 800kg of fruits; 17 barrels
- c) 900kg of fruits; 18 barrels
- d) 950kg of fruits; 18 barrels