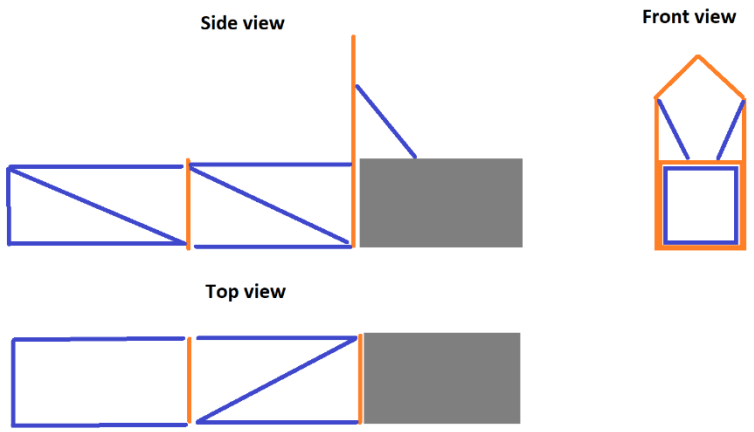
Q1

Your team is designing a hybrid chassis the following unique way: The rear of the chassis after the main hoop is CFRP monocoque and the front is tubular frame. You are the chassis designer and your goal is to use the least amount of structural tubes possible in the primary stucture. Not counting the roll hoops how many tubes does your chassis need?

Note: Bent tubes shall counted as separate tubes.

a) 16
b) 18
c) 19
d) 20



Q2

Your team wants to make a part lighter by changing its original aluminum material to CFRP composite. The part has complex load cases, so the team optimizes for a quasi-isotropic and symmetrical layup. You want to optimize to the minimum number of layers to be competitive while meeting the requirements. The original part has a thickness of 3 mm, widht of 1 m and has a modulus of 70 GPa. The CFRP fabric has the following parameters:

E_1	**55000**	**MPa**
E_2	**55000**	**MPa**
G_{12}	**4100**	**MPa**
V_{12}	**0,3**	**-**
t	**0,2**	**Mm**

How many layers does it take to match the stiffness parameters (both axial and bending stiff ness) of the original plate? *give an engineering approximation, use constant composite membrane stiffness throughout the calculations

a) 20
b) 24
c) 26
d) 28

Q3

Your team is using a 200gsm UD carbon material called „East". You have the opportunity to switch to another 200 gsm UD called „Easter" with the same matrix. Knowing only the following material properties is it worth it to use Easter instead of East if you need higher stiffness?

	East	**Easter**
Fiber E [GPa]	**100**	**70**
Resin %	**60**	**50**

a) Yes, Easter has more stiffness
b) No, East has more stiffness
c) They have the same stiffness
d) Not enough data

Q4

You are using passive balance in your TS Accumulator. The BMS can only balance up to 5 potentials at the same time, and it cannot balance neighboring cells (only in series) at the same time. The cells are selected to be balanced based on the OCV in descending order. One balancing cycle is shown in Figure 1. During OCV Meas the BMS select the cells to be balanced. When the smallest OCV difference is no more than 10 [mV], the next Balance ON does not start and the balancing ends.

The balancing resistors are 5 [Ω] each.

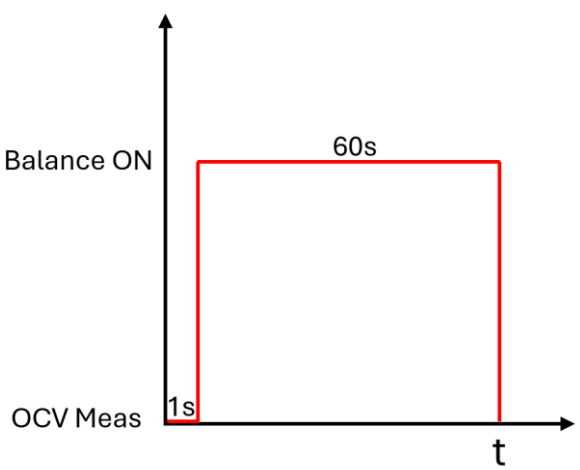
One module with the actual cell voltages can be seen on Figure 2. The cell parameters are the following:

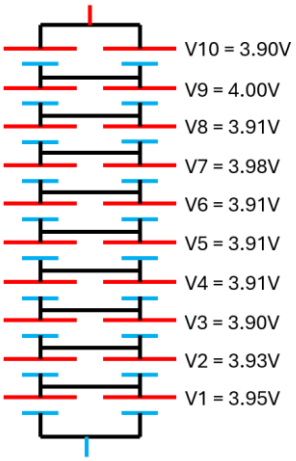
- **Minimum voltage is 3.2 [V]**
- **Maximum voltage is 4.2 [V]**
- **The capacity of one cell is 3700 [mAh]**

How long does the balancing last?

Use the following assumptions:

- **The cell characteristic is completely linear between 3.2 [V] and 4.2 [V].**
- **10 [mV] voltage difference in one cell equals 37 [mAh].**
- **There is no charging currently.**

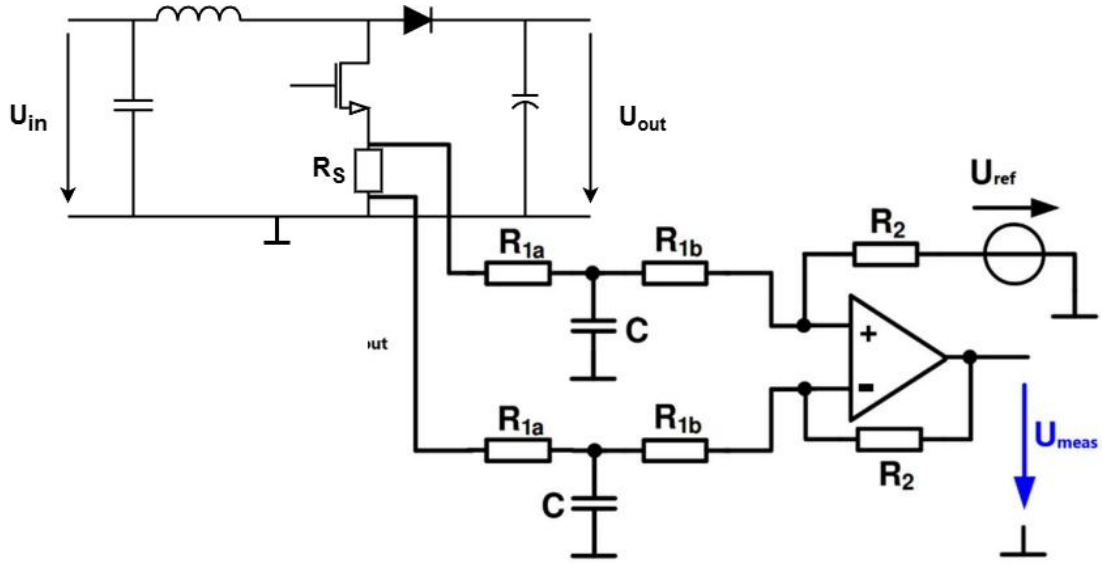




a) 1464 [s]
b) 1525 [s]
c) 3060 [s]
d) 3112 [s]

Q5

A boost converter has 24 V on its input and 100 V at its output. The converter must deliver up to 8 A to the load at 100 V (steady state). The switching frequency is 100 kHz. The input inductor is 47 µH. You will measure the switch/inductor current with a low-side shunt (placed between the MOSFET source and ground). Your processor ADC can handle 0 ... 3.3 V at its input and the RMS power dissipation in the shunt is 1 W. Choose the highest available E96 shunt resistance that does not exceed the power limit at converter peak current, round to three significant digits. Select a practical amplifier feedback resistor from E96 series (R_2) if you use R_1 = 2.00 kΩ in a differential amplifier. The value of C is chosen so the anti-aliasing filter (formed by R1a and C) doesn't affect the amplitude of the signal connected to the amplifier.



a) 232kΩ
b) 120kΩ
c) 115kΩ
d) 158kΩ

Q6

You are using an NTC in a voltage divider to measure temperature. The nominal resistance of the NTC is 10 000 Ω @ 25 °C and 680 Ω @ 100 °C. Supply voltage for the divider is 5 V.

The temperature tolerance of the NTC is ± 0.2 K.

You use ERJ-UP3F1001V (temperature coefficient of resistance is neglected) as R1 (pullup resistor), and your ADC resolution is 12 bit.

Round your partial results to 3 decimals.

What is the lowest and highest ADC value at 100 °C?

a) 1840 ; 1845
b) 259 ; 262
c) 1642 ; 1673
d) 1256 ; 1266

Q7

What is the size of a 3216 SMD resistor (metric standard)? (length x width)

a) 12 mm x 6 mm
b) 12 mil x 6 mil
c) 0,0035 yd x 0,0017 yd
d) 1,2 mm x 0,6 mm

Q8

Line (wire) resistance for CAN should be less than...

a) 120 Ω
b) 60 Ω
c) 10 kΩ
d) 60 mΩ

Q9

Which of the below items could be the core of your business plan on the BPP Event, if you use the items them as per their intended use?

a) M12 Socket Head Cap Screw
b) Custom-made Battery Management System design by your team captain
c) FNIRSI DSO152 Handheld Oscilloscope
d) The tyres you used while testing but not using them for the competition

Q10

What is the earliest date you can finish a project with the following constraints:

- The team only works on weekdays, (Monday-Friday), except on national holidays.
- The duration is not changed if the amount of the associated resource change.
- Following days are national holidays:
    - 22/February/2025
    - 15/March/2025
    - 7/April/2025
- The project starts on 12/February/2025.

Dependencies and start of tasks:

Task Name	Duration	Predecessors	Task start date is not earlier than
Task1	5 days	2	12-Feb-25
Task2	10 days	5	25-Feb-25
Task3	2 days	4;1	12-Feb-25
Task4	5 days	6	01-Mar-25
Task5	4 days		14-Feb-25
Task6	6 days	10	19-Feb-25
Task7	10 days	4	12-Mar-25
Task8	10 days	5;6	20-Mar-25
Task9	2 days	6;10;7	1-Mar-25
Task10	3 days		12-Feb-25

a) 21-March-2025
b) 25-March-2025
c) 1-April-2025
d) 3-April-2025

Q11

What is false?

a) Your team most modify your front wing made of carbon fiber by cutting off a large piece of it. You cannot do it outside your pit even if it is a well-ventilated area.
b) When you are pushing your car in a dynamic area with the push bar, the driver must be seated inside while wearing a dynamic vest.
c) You are the only one recording your VSV but one team member walks in front of by your camera blocking the visibility of your car while it is turning. You need to retake your video.
d) Safety un-critical violations with a minor benefit which cannot be changed at the event may result in at least 40 penalty points.

Q12

What is false about tilt test?

a) Tilt test is done 2 times, tilting the vehicle towards both sides.
b) The vehicle is tilted to an angle of π/3 rad with a driver fully strapped in normal driving position.
c) After failing tilt test for the third consecutive attempt the team is not disqualified from the competition.
d) If a team passes on the fifth consecutive attempt on first staging to tilt test, they got a penalty of 40 points for the competition.

Q13

Which sentence is true?

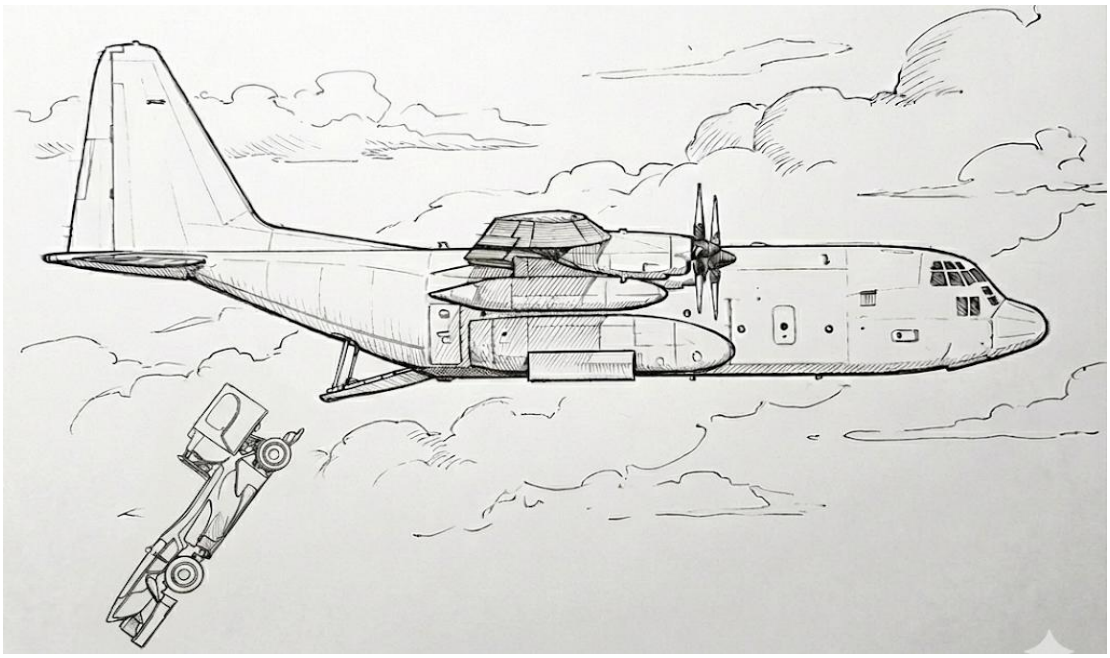
a) During technical inspection, officials will check the rule compliance only for the points which are listed on the inspection sheet.
b) Before egress the driver needs to disconnect the connector of the driver's communication equipment.
c) The team can place a rectangular sticker for the university name with total length of 500 mm and area of 325 cm^2 with its horizontal centerline 82.5 mm from the top of the bodywork. (the size of the text is exactly the same as the size of the cut-out rectangle)
d) The pickup points of the jacks should be indicated on both sides of the vehicle by triangles with the colour code #47944c.

Q14

How many times does our mascot, George the rabbit, appear in Formula Student East Instagram posts between January 1, 2024, and January 1, 2026?

a) 13
b) 14
c) 10
d) 7

Q15



Your team is traveling to FS China by airplane. Above Kazakhstan, one of the team members sees through the window that your car is falling out of the plane with a position you can see on the picture.

What will be the speed (in m/s) of our car when it hits the ground if the airplane is flying at an altitude of 40 000 ft? (round to 2 decimal)
A = 1.1 m^2
CD = 1.4
Air density = 1.2 kg/m^3 (constant)
m = 165 kg
g = 9.81 m/s^2 (constant)

a) 52.23 m/s
b) 39.78 m/s
c) 41.85 m/s
d) 42.11 m/s

Q16

What is the falling time of the car (in seconds)? (round to whole number)

a) 288 sec
b) 311 sec
c) 302 sec
d) 294 sec