Q: What is the available capacity of a battery cell when discharged by 100 A if the measured available capacity when discharged by 10 A is 10 Ah? The Peukert exponent can be assumed to be 1.2.

a) 10 Ah
b) 12 Ah
c) 8.33 Ah
d) 6.31 Ah
e) 9.25 Ah

A: d

Q: Your team designs its current Tractive System Accumulator using LiPo cells with the following characteristics:

- **Max cell voltage: 4.25 V**
- **Nominal cell capacity: 14.7 Ah**
- **Nominal cell voltage: 3.7 V**
- **Cell weight: 410 g**

To achieve the desired capacity of the Tractive System Accumulator, your team decides to use 148 cells in series and to limit the charging of the cells to 4.05 V per cell. You are tasked with finding a good segment layout for the cells for the mechanical configuration of the TSAC.

Maximum how many cells can you fit into one segment of the Tractive System Accumulator?

a) 25
b) 26
c) 27
d) 28
e) 29

A: b

Q: Which of the following is not rule compliant?

a) You measure a voltage drop of 1 V between LVS ground and one of your parts that may become electrically conductive and is 75 mm away from the nearest TS component. The current used for the measurement is 15 mA.
b) You measure a voltage drop of 1 V between LVS ground and one of your parts that may become electrically conductive and is 125 mm away from the nearest TS component. The current used for the measurement is 7 mA.
c) Your measure a voltage drop of 0.5 V between LVS ground and one of your electrically conductive driver harness mounting points which is 150 mm away from the nearest TS component. The current used for the measurement is 1 A.
d) You measure a voltage drop of 0.5 V between LVS ground and your electrically non-conductive driver seat which is 50 mm away from your TSAC. The current used for the measurement is 0.1 A.

A: c

Q: What is the average power dissipated during an avalanche on a MOFSET that is used in switching mode in a series R-L circuit where L = 10 µH, R = 50 Ω and the switching frequency is 25 kHz? The input voltage is 24 V and the Avalanche current is 0.5 A.

a) 2.5 µJ
b) 31.25 mW
c) 1.25 mW
d) 6.25 µJ

A: b

Q: One of your critical parts just broke. You can either repair it or buy a new one. A new one costs 1000 EUR, repair would cost 800 EUR. You have a pending sponsorship that depends on you keeping to your schedule and your decision on buy or repair. If you buy a new part and you keep to the schedule, you receive 1200 EUR. If you keep to the schedule with repairing the broken part, you receive 1500 EUR. If you can't keep to the schedule, you receive 800 EUR independent of your decision. The probability of keeping to the schedule with a new part is 90%. It is only 20% if you decide to repair the current part. You optimize for maximal Expected Monetary Value (EMV).

Pick the optimal choice with maximal EMV.

a) Buy a new part. EMV = 200 EUR
b) Buy a new part. EMV = 160 EUR
c) Repair the broken part. EMV = 140 EUR
d) Repair the broken part. EMV = 700 EUR.

A: b

Q: Calculate drag with the following parameters.

Frontal surface area:	**0.7 m^2**
Drag coefficient:	**1.6**
Velocity:	**50 km/h**
Air density:	**1.22 kg/m^3**

a) 121.79 N
b) 0.1318 kN
c) 1.317 kN
d) 1.708 kN

A: b

Q: Which of the following are NOT Engineering Design Event scoring categories at FS East 2024? There can be multiple correct answers, mark all of them.

a) Overall Vehicle Concept
b) Team & Project Management
c) Chassis & Ergonomics
d) Electronics & Control System
e) Performance Engineering
f) Vehicle Testing

A: e and f

Q: A vehicle completes a 1100 m course in 60 seconds. The energy consumption during this lap is 1 MJ. What is the average traction force of this vehicle during the run?

a) 1 kN
b) 880 N
c) 909 N
d) 786 N

A: c

Q: Find X.

$$\frac{a + (b - c) + d}{e} + f = X$$

where

a = Maximum points awarded for Cost & Manufacturing Event at FS East 2024 for all classes.
b = Maximum points awarded for DV Skidpad at FS East 2024.
c = Maximum points awarded for EV & CV Skidpad at FS East 2024.
d = Maximum points awarded for DV Efficiency at FS East 2024.
e = Penalty points for a 1 day late submission of DSS at FS East 2024 for all classes.
f = Maximum points awarded for Vehicle Dynamics & Suspension at Engineering Design Event at FS East 2024 for all classes.

a) 50
b) 160
c) 45
d) 100

A: c

Q: Your LiPo cells have a mass of 80 g, a capacity of 5 Ah and 4.2 V maximum voltage. You design a Tractive System Accumulator with 4 segments. Which segment configuration is rule compliant if you intend to charge your cells to maximum voltage?

a) 26s3p
b) 29s2p
c) 28s3p
d) 29s3p

A: a

Q: What is the resistance of this resistor?

a) 100 Ω ± 5%
b) 100 kΩ ± 5%
c) 10 kΩ ± 5%
d) 1 kΩ ± 5%

A: c

Q: All live parts of the TS must be protected from being accidentally touched. This is tested by…

a) a 150 mm long, 6 mm diameter probe.
b) a 100 mm long, 3 mm radius probe.
c) a 100 mm long, 10 mm diameter probe.
d) nothing. Common sense must be applied.

A: b

Q: George, the bunny of FS East wants to drive on the ceiling. To obtain his greatest wish he dreamed of last week, he wants to use one of his team's previous FS cars with some modifications. This vehicle has a mass of 180 kg, 2.35 m^2 frontal area, a downforce coefficient of 3.5 and a drag coefficient of 0.8. He fits tires with a friction coefficient of 1.8 (assume cylindrical friction ellipses) and a rolling resistance coefficient of 0.1. For the gravitational acceleration, assume the value that can be measured at the Hungaroring (ca. Budapest) rounded to 2 decimals. On the day of driving, George sees that the temperatures reach room temperature values according to ISO 13443 natural gas reference conditions. As he steps on the scale to measure his own weight, he also sees, that the poppy seed rolls from Christmas are still measurable in his belly and he still weighs 15 kg. At least how much speed does he need to maintain while driving on the ceiling when the stated circumstances occur? Assume just the main forces acting on George and his vehicle (a point mass may be equivalent) in an equilibrium state to determine the minimum needed speed in a moment of bottom-up driving. Mark the answer rounded to the integer value of the minimal speed needed.

a) 44 mph
b) 20 m/s
c) 75 km/h
d) 1 km/min

A: c

Q: Mark the correct statement from below.

a) The increase of slip does not affect the lateral force the tire can generate on the contact patch.
b) Cornering on the edge of the friction ellipse with constant speed on a constant circular flat track with a front wheel driven car, the car is understeered if more throttle is applied, because on the edge of the friction ellipse one can only generate more longitudinal force on the contact patch with the decreasing of lateral forces.
c) Single track model behaviour can be described with variables of steer angle, longitudinal speed, cornering stiffness etc., and constants mass, inertia and CoG position.
d) A 4-wheeled car touches the ground on 4 points along a corner, until the acting line of the overall resultant force projected to the centre of mass pierces the ground surface within the geometrical shape of the vertical projection of the outer suspension pickup points on the ground.

A: b

Q: Your team uses a 200 gsm UD carbon composite material called "East". You have the opportunity to switch to another 200 gsm UD material called "Easter" with the same matrix. Knowing only the following material properties, is it worth it to use Easter instead of East if you want to achieve higher stiffness?

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

a) Yes, Easter has higher stiffness.
b) No, East has higher stiffness.
c) They have the same stiffness.
d) There is not enough data to answer the question.

A: b