
FORMULA
IHU

EV Answers

Question	Answer
Question 1 After conducting your I.A. test you obtain the data from the accelerometer and you realize that the data matches perfectly with the following function a(t) in g. Calculate the mean deceleration force excreted from the I.A. to the m=300kg mass used in the test. Consider g=9.81 m/s^2 Answer in kN using three significant digits. Answer Format: Rounded to three significant digits Example: 12.678 → 12.7	**8.83**
Question 2 The following diagram is a parody of a phase diagram, describing the mixture of bad-good decisions. Considering a 30% of good decisions at a blood-alcohol content of 0.1%, calculate the 'calling an ex' percentage in the good decisions phase. Use the lever's rule. Answer in a percentage (for example 32 instead of 0.32) using 3 significant digits (The following diagram is not drawn to scale). Answer Format: Rounded to three significant digits Example: 28.743 → 28.7	**40.5**

Question 3 As the person responsible for the steering system of your Rule-compliant Formula Student vehicle, you must address the following requirements: - The ergonomics department requires 100° of steering wheel rotation in both directions. - The kinematics department demands 40 mm of steering rack travel in both directions. - The chassis department has used a steel tube with the same properties as those in the SES calculations, featuring a 1-inch outer diameter and the minimum rule-compliant thickness for the front bulkhead support. - The financial department suggests using this same tube as the steering column to reduce costs. Given a load case where the axial load on the steering rack is 1 kN, what is the safety factor for this steel column? Round your answer to the nearest one decimal. Answer Format: X.X (Rounded to the nearest one decimal place) Example: 4.268 → 4.3	**14.0**
Question 4 How many boxes can you stack? (All the boxes are exactly the same and protrude the same amount)	**7**
Question 5 Does the following structure roll-over? Shaft: Density 7850 kg/m^3, Mass 13.32 g Plate: Density 11000 kg/m^3, Mass 254.56 g Hinge: Density 2810 kg/m^3, Mass 10.44 g Pin: Density 7900 kg/m^3, Mass 8.71 g Sides A ∥ B (Parallel) Sides C ∥ D (Parallel) PDF Drawings for better visibility	**No**

Question 6 Which of the following statements are true?	**The TS can be active if the precharge relay is closed.** **If the TSAC is made from composite material, we will be asked to present samples, even if it has been approved by ASES.** **Babis, who acquired his Mechanical Engineering Diploma on 14-01-2025 can be registered as a team member in FS Greece 2025.**
Question 7 Your team uses a square beam that is 13 mm as a brake pedal, with the master cylinders attached at 40 mm from the pivot point. The length of the pedal is 17 cm, and it is made from aluminum 7075 T6. Is the pedal rule compliant?	**No**
Question 8 A bucket containing antifreeze has two small holes, labeled 1 and 2, from which two laminar streams emerge. The height of the liquid column in the bucket is H=800mm, and the height of hole (1) from the bottom of the bucket is h1=50cm. What is the height h2 of hole (2) from the bottom of the bucket, assuming the two streams travel equal horizontal distances x? (assume ideal conditions)	**300 mm**
Question 9 An M8 threaded ISO 4762 socket head cap screw is used in a rocker arm (thickness 50 mm) located in the suspension assembly of a rule compliant FS car. The socket head cap screw is fastened with a DIN 980 (maximum height) lock nut. What is the minimum length (mm) of the fastener? Provide your answer in millimeters, rounded to the nearest decimal. Answer Format: X.X (Rounded to one decimal place) Example: 10.463 → 10.5	**60.5**

Question 10 Identify the maximum permissible metric bolt size, conforming to DIN 931 Grade 8.8 specifications, for the mounting assembly of the front wing located ahead of the front bulkhead. The mounting design incorporates one bolt per side of the bulkhead, with each bolt secured through two aligned brackets (double shear). Ensure the design adheres to Formula Student regulations. Assuming you are using Standard IA. Answer Format: MXX Example: M9	**M4**
Question 11 You have a spring-damper combination with 100mm of travel. What is the minimum possible Motion Ratio (Wheel/Spring) you can have in your suspension system? Assume a conventional pushrod suspension system where one spring-damper is used per wheel. (round your answer to one decimal) Answer Format: X.X (Rounded to one decimal place) Example: 0.729 → 0.7	**0.5**
Question 12 After assembling your vehicle, you decide to remove the 10mm bump stop from the dampers (Question 11) to increase the travel of your suspension (using the same motion ratio you found in Question 11). You are using Hoosier 18.0x6.0-10 R20 FSAE H43100R20 tires on the front axle, and your front wing is 15mm shorter than the maximum allowable length per the Formula Student Rules. Additional information: Your car's wheelbase is 1.5 meters. The braking pitch center is located on the rear axle. At maximum braking, the front springs are fully compressed. At standstill, the spring is at 50% compression. What is the minimum height of the frontmost point of the front wing after removing the bump stop to ensure the front wing does not contact the ground during maximum braking in a straight track? Answer Format: X.X (Rounded to one decimal place)	**44.2**

Example: 12.457 → 12.5	
Question 13 You test your Formula Student car's limits by racing it on an infinite dragstrip located at the highest point of Mount Olympus. During this high-altitude test, your car eventually reaches a maximum speed. Encouraged by the results, you take your car to another infinite dragstrip at sea level. You repeat the same test under identical car conditions (ignoring rolling resistance and other factors), and your car achieves a different maximum speed. Air density at Mount Olympus: 0.9 kg/m^3 Air density at sea level: 1.225 kg/m^3 Drag coefficient: 0.70 Car mass: 250 kg What is the ratio of the maximum speeds the car achieved in the two dragstrips (uolympus/usea), rounded to one decimal place? Answer Format: X.X (Rounded to one decimal place) Example: 1.783 → 1.8	**1.2**
Question 14 Two cars, A and B, are traveling on the same straight road. Car A has an initial velocity of 120 km/h and accelerates at a constant rate of 1 m/s^2. Car B has an initial velocity of 160 km/h and decelerates at a constant rate of 2 m/s^2. The two cars are initially separated by a distance of 100 meters. At some point, the two cars collide in a perfectly inelastic collision. Assume that Car B has a mass twice that of Car A (mass of B equals 2 times mass of A) and that the acceleration and deceleration apply only until the moment of collision. Both cars are moving in the same direction. Calculate the velocities (m/s) of both cars immediately after the collision and round to the nearest integer Answer Format: Va, Vb Example: 42, 42	**28, 28**

Question 15 Which of the geometries has a larger area and which has a larger perimeter?	**D,C**
Question 16 Your team was unable to submit the VSV for FSGR on time, so you managed to upload it with a 4-day delay. Additionally, you submitted the Design Spec Sheet 2 days before the submission deadline and the EDR with a 5-day delay. What is the maximum number of points your team can score in FSGR after the point deductions for late submission penalties? Round to one decimal Answer Format: X.X (Rounded to one decimal place) Example: 431.256 → 431.3	**929.3**
Question 17 Your team is participating in Formula IHU 2025, and you have decided to allocate the dynamic event runs as shown in the table below. You now have the following proposals for the remaining runs. Determine which of the proposed driver allocation scenarios are possible for your team to follow.	**Yuki can run 1 additional Acceleration, 1 additional Skid Pad**
Question 18 What type of suspension is shown in the picture below ?	**Five link Front Suspension**

Question 19 You have finally secured a sponsor to create a custom baseline FS Rules-compliant steel tube for this year's car's Main Hoop. You requested the sponsor to manufacture the lightest possible rule-compliant tube with the minimum possible thickness. You perform a 3-point bending test on the custom manufactured tube. The tube is placed on two supports that are 500mm apart and the actuator is applying a force of 2.5kN in the exact middle of the two supports. Calculate: The maximum stress (MPa), rounded to the nearest ten. The maximum deflection (mm), rounded to no decimal. Answer format: Maximum stress (MPa), maximum deflection (mm) Answer Format: Stress rounded to the nearest ten, deflection to no decimals Example: 542.7, 7.9 → 540, 8	**280, 2**

Question 20 A CFO at a factory has two options to manufacture a part for a vehicle. Plan A says, to outsource the manufacturing process by getting a 20.000 euros loan with an annual interest of 1.5% for 10 years. The production, costs 50 euros per part for the first 100, 45 for the next 100 parts, 40 for the next 100 parts, 35 for the next 100 and 30 for the final 100. The maximum production 500 parts in a year. The company can sell them at a price of 55 euros per part. Plan B says, to insource the production using another loan of 10.000 euros from the bank with an annual interest rate of 5,2% for 10 years. The production costs 20 euros for the first 100, 15 euros for the next 100 and 100 for the rest of the production until it reaches 500 parts produced in a year. For each inhouse part the CO2 emissions are 2gr per part. For every 500gr CO2 emissions production, the government fines the company with an extra 1500 euros each year. The company then can sell the parts for 35 euros each. Which of the 2 Plans will be the most profitable at the 10th running year and by how much compared to the other one (rounded to one decimal place) ? All loan payments are made once a year. Answer format: Plan X, difference Example answer: Plan A, 25000.1	**The format of the question was not clear, and since no team answered it correctly it will be removed.**

Question 21 In the Formula IHU competition, Team A and Team B collected the same amount of points after all the static and dynamic events. To decide the winner, a drag race at the Acceleration straight was organized. Both teams use identical vehicles of 270kg, use 40.5cm diameter tires and they have the following specifications: Team A's car: 75 horsepower (hp) @7500rpm and 100 Newton-meters (Nm) of torque @ 5000rpm. Team B's car: 100 horsepower (hp) @7500rpm and 75 Newton-meters (Nm) of torque @ 5000rpm. Both Hp and Torque refer to Peak Values. Choose for each different occasion described which car will finish first. There are two different Tire brands available: Siris tire coefficient: 0.7 Athena Tire coefficient: 0.85 g=9.81m/s^2 [Both cars have Direct Drive (No gearbox) operate with a clutch coupling and Final Drive ratio of 3:1. Both cars use Athena tires with typical track conditions.]	**A,A,A**

Question 22 Considering the max power output of your engine is 45kW and 30% of the max power must be dissipated by the cooling system, calculate the effective heat exchange area of your radiator. Use the simple formula for a counter-flow heat exchanger (any correction factor should be negligible and set to 100%), that uses the logarithmic mean temperature difference. Consider everything mentioned below to be known. Answer in m^2 using 2 significant digits. Coolant input temperature 105deg, Coolant output temperature 95deg, Air input temperature 30deg, Air output temperature 58deg, Heat transfer coefficient U: 1/U=1/hwater+1/hair, hwater=2000 W/(m^2K) hair=90W/(m^2K) Answer Format: Two significant digits Example: 0.03762 → 0.038	**2.8**
Question 23 Consider the following symbol and corresponding footprint.	**Are recognized by the EDA tool as a valid component**
Question 24 An analog signal is to be encoded and transmitted using a digital system. The frequencies contained in the signal reach up to 6 kHz. The quantization error must be less than 1% of the signal's maximum value. Assuming the sampling theorem is satisfied, find the minimum transmission rate in bits per second. Answer in bits/s.	**72000**
Question 25 Consider the system represented by the following difference equation: y[n] = x[n] + (1/2)*(5y[n − 1] + 3y[n − 2]) where x th [n] and y[n] represent the nth samples of the input and output signals, respectively. Which are the poles of the system?	**3 , (-1/2)**

Question 26 Your accumulator consists of 2 Segments in series (14s10p) and you are using the 21700 P45B as your cell with the maximum voltage as stated in the datasheet. At some point, the voltage at the TSMPs is 55V. Which sentence is true?	**Voltage Indicator is OFF and TSAL is RED**
Question 27 Your team designs your first electric vehicle after many successful years in the CV category. Your only data to help you design your new accumulator are last year's efficiency consumption. Your team managed to finish the endurance (22km) using 11L/100km (RON98). Your powertrain consisted of an engine with combustion efficiency of 96% and 70% losses due to thermal efficiency of the ICE, and total drivetrain mechanical losses of 10% . This year's powertrain consists of an inverter with an efficiency of 98%, a single electric motor with an efficiency of 94% and the same mechanical losses as last year's car (neglecting any additional mechanical or electrical losses) . You decided to use the 21700 P45B cell with the maximum cell voltage as stated in the datasheet. Which of the following configurations is rule compliant and satisfies your total energy requirement?	**8 segments in series of 14s5p** **7 segments in series of 11s7p**
Question 28 Using the configuration and data of the EV (Car specifications, Accumulator, etc.) provided in Question 27 , determine the maximum number of acceleration runs achievable, given a terminal velocity of 30 m/s measured at the finish line. Assume a driver mass equal to the minimum FIA requirement for Formula 1 drivers in the 2025–2026 season, and a vehicle mass of 210 kg. For the sake of this calculation, consider that energy consumption occurs solely from the start line to the finish line. Example Answer: 1024	8 segments in series of 14s5p →**206** 7 segments in series of 11s7p →**198**
Question 29 Which equation describes the gain?	**b)**

CV Answers

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Question 23 Your fuel tank contains 5 kg of RON98 gasoline. The powertrain consists of an internal combustion engine (ICE) with a combustion efficiency of 96%, a thermal efficiency of 30%, and total drivetrain mechanical losses of 10%. Determine the maximum number of acceleration runs achievable, assuming a terminal velocity of 30m/s at the finish line. The vehicle has a mass of 210kg, and the driver's mass is equal to the minimum FIA requirement for Formula 1 drivers in the 2025–2026 season . For this calculation, consider that energy consumption occurs exclusively during acceleration from the start line to the finish line.	**429**

Question 24 The exhaust of your engine produces 50lt/sec of fumes. The fumes exit at an atmospheric pressure of 10^5 Pa and a temperature of 220deg Celsius. Calculate the propulsion produced to the direction of the exhaust outlet, if its diameter is 42mm. Find the density of the fumes considering the ideal gas equation applies (P=ρRT) and the fume's ideal gas constant is R=292J/(kgK). Answer in Newtons using 3 significant digits. Answer Format: Three significant digits Example: 10.4876 → 10.5	**1.25**