

# Quiz 2024



# Question 1 – Tech Inspection

## Tech Inspection

Which of the following things can you change on your car after the technical inspection?

- Adjustment of the head restraint
- Swap the damper of the front suspension
- Add a gurney flap to your rear wing
- Replace organic brake pads by ceramic brake pads

# Question 2 – Endurance Scoring

## Endurance Scoring

Your team just finished endurance. Well done. Your total time is 1760 seconds, excluding the driver-change.

You had no cones counted "down or out" nor any off-courses.

However, you had several issues before, during and after endurance.

You missed your time slot and had to start out of order.

After three laps, a small part of your front wing endplate fell off.

As a result, you were given a mechanical black flag.

During the inspection, no mechanical integrity problems were found, and you continued endurance.

After endurance the height of your rear wing is measured, and it is significantly higher than the allowed height.

What is the corrected elapsed time for your run?

- 1940 s
- 1760 s
- 2000 s
- 1880 s

# Question 3 – Weight Deviation

## Weight deviation

During post inspection your vehicle is found to be 7.3 kg below the official technical inspection weight.

What are the consequences for your team?

- You receive 60 penalty points
- You receive 46 penalty points
- You receive a Group B penalty
- You will be disqualified from all runs since entering the dynamic area

# Question 4 – Ride Height

## Ride height

Calculate the end-of-straight ride height at the front axle of your RWD race car at its top speed of 108 kph.

From CFD simulation you obtained your down force coefficient ( $c_L \cdot A$ ) to be  $5.7 \text{ m}^2$  at an aero balance of 45% at the front.

The stiffness of your front suspension spring is 55 N/mm, one spring per wheel.

The motion ratio is 1.2 and the vertical stiffness of each tyre is 95 N/mm.

The static ride height at the front axle was set to the minimum allowed by the rules.

(Air density =  $1.1 \text{ kg/m}^3$  ; motion ratio is defined as: wheel travel / spring travel ; round to one digit after the decimal point)

- 3.9 mm
- 9.5 mm
- 6.7 mm
- 11.8 mm

# Question 5 – Impact Attenuator Bonding

## IAP

What must be considered when selecting the adhesive for bonding the "standard" honeycomb IA to the AIP under the assumption that you do not want to do physical testing yourself?

- The adhesive must exceed the required tensile strength when bonded to steel or aluminium
- You choose an adhesive which has the required strength only when bonded to a laminated structure
- No special considerations must be taken as long as the adhesive is marketed as "high-strength"
- You choose an adhesive which has worked in combination with a different IA in the past, proof is in the 2023 IAD
- The adhesive must exceed the required shear strength when bonded to steel or aluminium

# Question 6 – Banked Corner

## Banked corner

You are driving your race car on a test track with a cornering radius of 50 m (measured in the horizontal plane) and a bank angle of  $20^\circ$ .

How fast must the car travel to experience no lateral acceleration (measured in the vehicle coordinate system)?

(round to one digit after the decimal point)  $g = 9.81 \text{ m/s}^2$

- 48.1 kph
- 53.1 kph
- 50.3 kph
- 46.6 kph

# Question 7 – Fasteners

## Fasteners

What is incorrect with regards to fasteners?

- Bolts of type UNC 5#-40 may be used as critical fasteners in OEM parts
- The brake balance adjustment mechanism can be secured by a jam nut
- Retaining rings can be used in the brake disc attachment as supplied by the original equipment manufacturer
- Titanium bolts can be used for the steering rack, if equivalency is shown



# Question 8 – Thermodynamics

## Thermodynamics

You want to heat up your pool at the FSA campsite by burning wood. You brought a heat exchanger like shown in the sketch.

Unfortunately, you didn't bring any wood, and now you have to buy it from the campground owner.

How much wood do you need to buy to raise the temperature in your 4 m diameter pool with a 0.95 m water height from 12 °C to 20 °C, given the following values?

Overall efficiency of the water heating system: 35 %

Energy content of the firewood: 4 kWh/kg

Specific heat capacity of water: 4184 J/kgK

Water capacity of the heating system outside the pool: 15 l

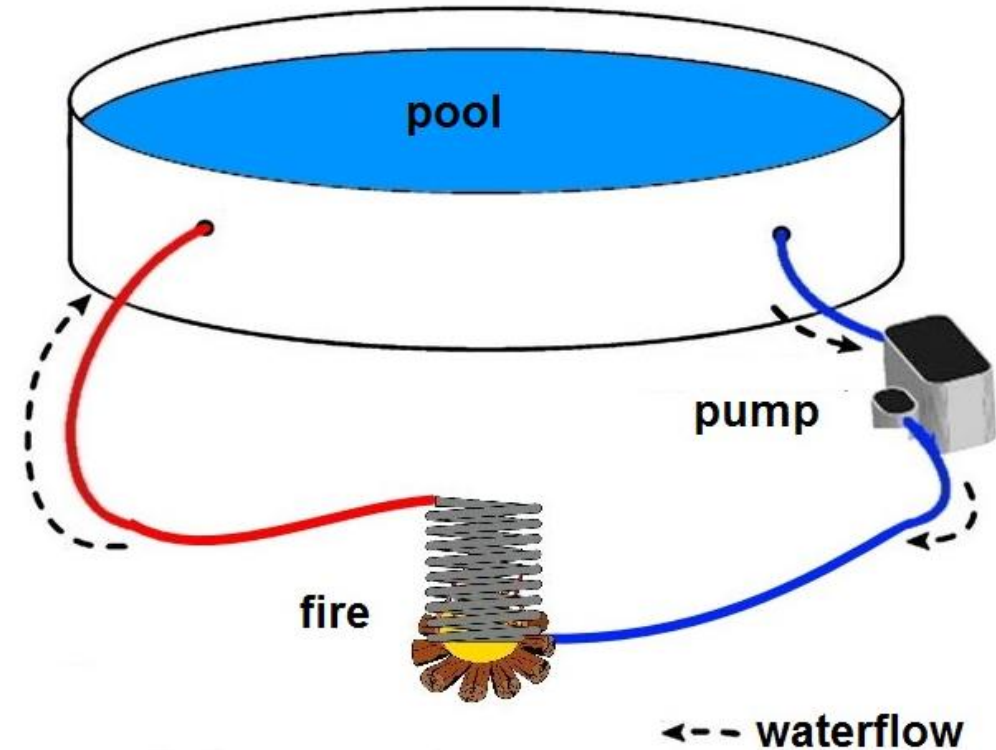
Density of water 1000 kg/m<sup>3</sup>

Other influences on the temperature other than the heating system itself are not taken into account (e.g. ambient temperature, heat capacity of the pool itself)

(Give your answer in kg, round to two digit after the decimal points)

Please use the following format: 12.34

Answer



# Question 9 – Driver's Equipment

## Drivers equipment

Which of the following driver's equipment can be used during the competition?

- A helmet with the certification FIA 8860-2010 with insignificant scratches and multiple stickers of competitions going back to 2015
- A suit with the standard SFI 3.2A/5 which has a manufacturing defect which has been covered with a sponsor's logo made from regular cotton
- Shoes with the standard FIA Standard 8856-2000 without a FIA hologram label on it.
- A frontal head restraint system which has no label, that has probably been supplied together with a helmet certified according to FIA 8860-2004
- A helmet with the certification SFI 31.1/2010 which is in pristine condition and has been properly stored

# Question 10 – Gases

## Gases

Which parameters do you need to measure to determine the air density?

- Wind speed, air temperature and sea level
- Air pressure, air temperature and air humidity
- Altitude and temperature
- Nothing, because the density is constant

# Question 11 – Standard Impact Attenuator

**IA**

What is the length of the standard FSAE aluminum honeycomb impact attenuator?

- 200 mm
- 205 mm
- 203 mm
- 201 mm

# Question 12 – Long Running FS Career

## Long running FS career

One of your team members has been officially registered for a competition in 2019, but was not able to attend.

They actually attended their first competition at FSA 2021.

What are they allowed to do at the FSA 2024 competition?

- Act as a stand-in if one of your regular drivers falls ill
- Participate in the award ceremony at the campsite
- Be connected virtually during the Business Plan Presentation in order to answer the judge's questions, given that this person has been introduced to the judges
- Answer the Scrutineer's questions during the time slot for Tech Inspection
- Help out with repairs in the team's pit and help with final adjustments in the Practice Area

# Question 13 – Lunar Crash Test

## Lunar Crash Tests

The moon cat Formula Student Team was able to qualify for FSA for the first time.

To get the best out of their car they decide to test an alternative IA design.

Their only useful weight to be used to accelerate the IA assembly is a moon rock (total mass: 249.88 kg). What is the minimum height the test sample has to be dropped from and will the cats be allowed to use their alternative IA if the speed at impact is 7.8 m/s?

$g(\text{moon})=1.622 \text{ m/s}^2$

- No, dropped at  $h=7.90 \text{ m}$
- No, dropped at  $h=15.10 \text{ m}$
- Yes, dropped at  $h=7.90 \text{ m}$
- No, dropped at  $h=18.13 \text{ m}$
- Yes, dropped at  $h=15.10 \text{ m}$
- Yes, dropped at  $h=18.13 \text{ m}$

# Question 14 – Business Presentation

## Business Presentation

To what must the business case presented in the BPP event relate to?

- To the team's specific prototype race car or a specific component
- To the team's specific prototype race car
- To an existing racing series
- To a specific component, not the overall race car

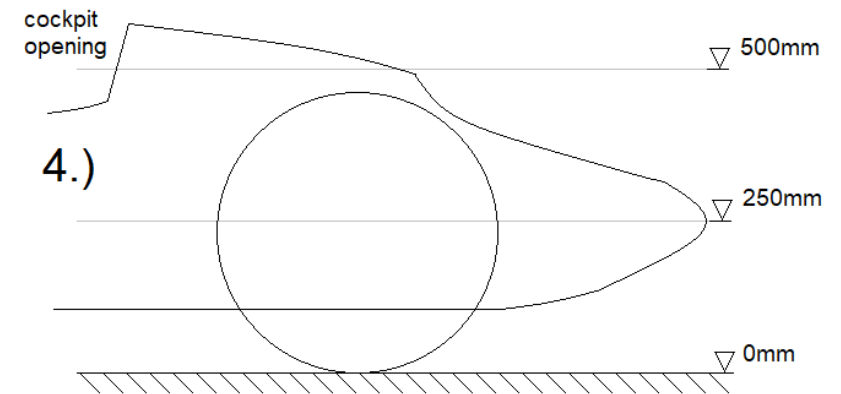
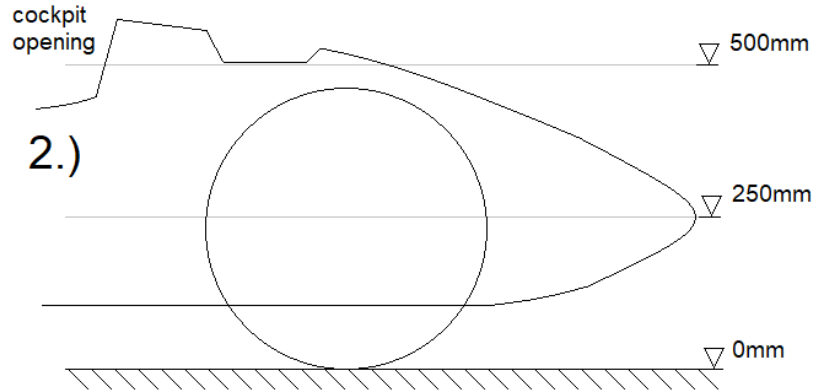
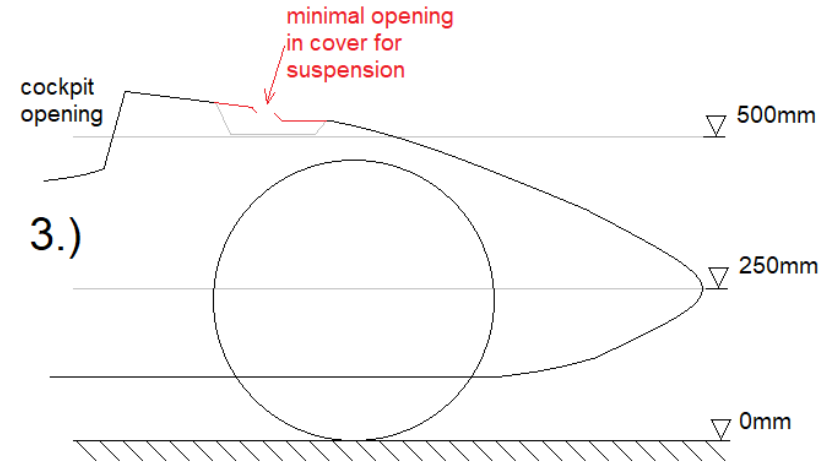
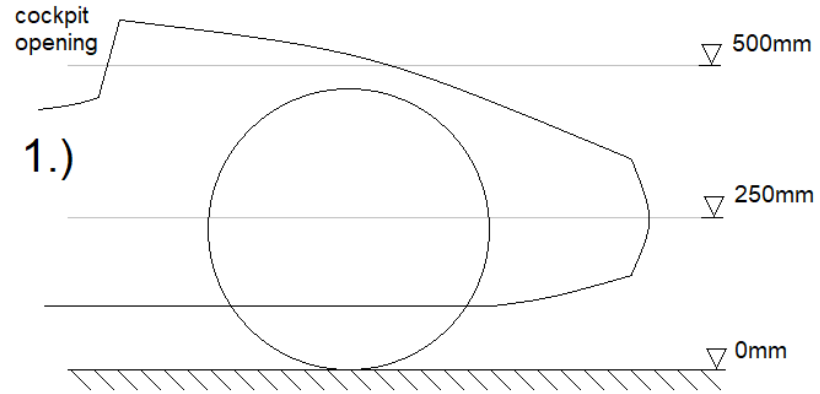
# Question 15 – Bodywork

## Bodywork

Which of the following front bodywork designs is rules compliant?

The drawings show a cross-section in side view at the vehicle center-line

- Drawing 2
- Drawing 4
- Drawing 1
- Drawing 3





# Question 16 – Brake System

## Brake system

What is incorrect regarding the brake system?

- The brake pedal must be able to hold up even when the strongest officials are pressing the brake pedal by foot as intended
- The brake system can be split diagonally into two independent hydraulic circuits - one for the front-left and rear-right wheel and one for the front-right and rear-left wheel
- Regenerative braking is not possible in a vehicle with combustion engine
- The brake disk may be attached by clamping between the hub and the wheel, using the wheel lug bolts as the fasteners
- The function of the BOTS may be tested after the endurance by opening a bleed valve at one of the brake calipers. If the BOTS is not triggered during this test, this will result in a DQ

# Question 17 – CV only Question – Batteries

## Batteries

You want to enhance your CV vehicle with electric motors in the front wheels.

You found motors and decided on an inverter, here are the specs:

Maximum Voltage	80 V
Maximum Current	200 A

You choose the following cells for your HSC:

Manufacturer	Samsung SDI
Model	25S (2)
Size	18650
Positive Terminal	Flat Top
Nominal Capacity	2500 mAh
Continuous Discharge Rating (max)	25A without temperature cut / 35A with 80°C temperature cut
Peak Discharge Rating (max 10s)	100 A
Nominal Voltage	3.6 V
Maximum Voltage	4.2V
Discharge cut-off Voltage	2.5 V
Protected	No
Rechargeable	Yes
Dimensions	18.33 mm x 64.85 mm
Weight	49 g
Country of Origin	Republic of Korea or Malaysia
Associated Names	INR18650-25S, 25S2

The weight of your other components in your HSC are:

Housing	450 g
AIR	350 g
Busbars	120 g
Connectors	80 g
Fuse	110 g
Electronics	130 g
BMS	130 g

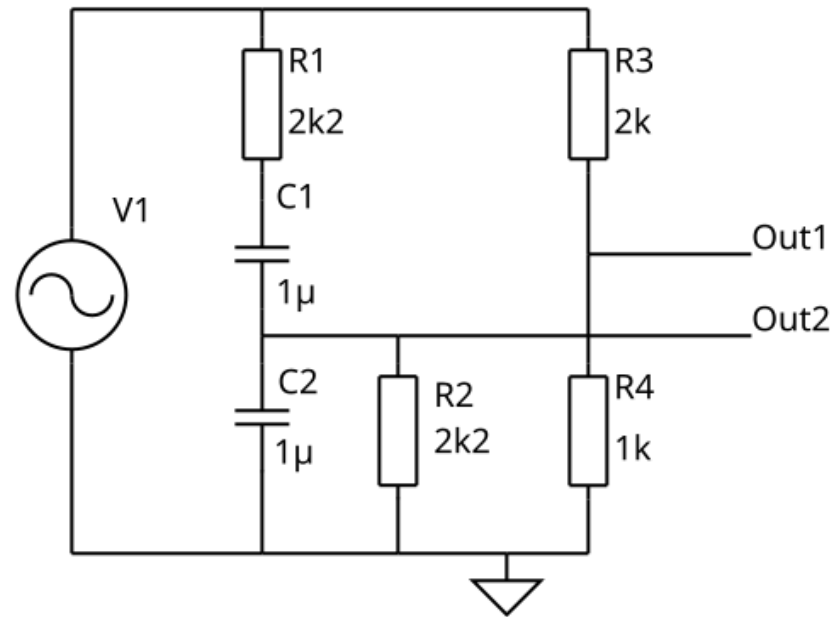
What is the rules compliant configuration of your fully charged cells for your hybrid car with the maximum stored energy?

- s13p5
- s14p4
- s14p5
- s4p12
- s10p3
- s5p15
- s15p4
- s14p2

# Question 17 – EV only Question – Batteries

## Circuitry

Given the following circuit, what is the frequency with to maximum attenuation?  
(Give your answer in Hz, round to two digit after the decimal points)



Please use the following format: 12.34

Answer