FSA 2021 Quiz

Answer Key

General Info

The numeric answers are agnostic to decimals, so:

12 == 12.0 == 12.00

12.3 == 12.30

etc.

Heating up an ideal block of aluminum:

Mass 2.4kg; specific heat capacity 900J/kgK; heating power 2000W.
Calculate the time in seconds [s] necessary to heat up this ideal block to 80°C starting at 25°C.
Round to nearest integer.

Please use the following format: 12.34

Answer 59

Hint: Exact result: 59.4, rounded to 59.0

Hint:
The FSA-Specific
scoring rules apply

Business Plan Scoring

During the initial judging at FSA your team was awarded 55 points.
You are not eligible for the business plan finals since the finalists scored 62, 70 and 68 points respectively. The best team not in the finals scored 61 points.
What is your final score (rounded to 1 decimal place)?

○ 62.1 Points

○ Your score will depend on the result of the finals

○ 63.1 Points

○ 55.0 Points

◉ 63.0 Points

Gotta catch 'em all!

How many cones are placed on a Skidpad track
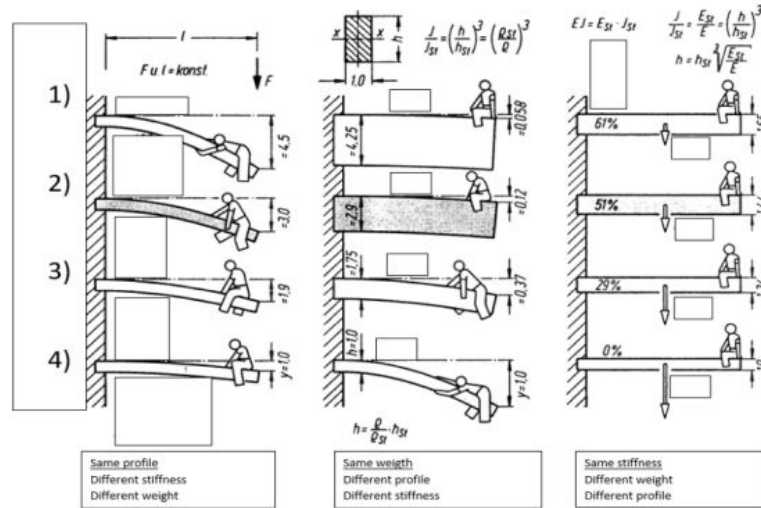

- ● 58
- ○ 63
- ○ 59
- ○ 54

Cone-an the Barbarian

During Endurance, you hit a cone with your car. When will this result in a penalty?

○ The cone has been lifted off the ground and landed in its marked box in upright position.

○ The cone is halfway outside of its marked box.

○ Hitting a cone always results in a penalty of 2s.

● The cone has been thrown over but it is not outside its marked box.

Beams - which is which?

$$\frac{J}{J_{St}} = \left(\frac{h}{h_{St}}\right)^3 = \left(\frac{\rho_{St}}{\rho}\right)^3$$

$$EJ = E_{St} \cdot J_{St} \qquad \frac{J}{J_{St}} = \frac{E_{St}}{E} = \left(\frac{h}{h_{St}}\right)^3$$

$$h = h_{St}\sqrt[3]{\frac{E_{St}}{E}}$$

$F u l = konst.$

$$h = \frac{\rho}{\rho_{St}} \cdot h_{St}$$

Same profile
Different stiffness
Different weight

Same weigth
Different profile
Different stiffness

Same stiffness
Different weight
Different profile

A	B	C	D
1) aluminium 2) magnesium 3) titanium 4) steel	1) aluminium 2) magnesium 3) steel 4) titanium	1) aluminium 2) steel 3) titanium 4) magnesium	1) magnesium 2) aluminium 3) titanium 4) steel

○ B

○ C

⦿ D

○ A

Does the race car have to be part of the BPP?

Business business business. Numbers.

- ⦿ Yes, the BPP has to cover the actual race car entering the competition.
- ○ No, the business case doesn't have to be related to the race car entering the competition
- ○ No, the business idea has to be comprehensive and a rewarding opportunity to the potential investors.
- ○ Yes, the BPP has to cover a race car for a weekend racing driver

Is the quality of the car assessed at the BPP?

○ Yes, therefore it is necessary that a technical expert joins the presenters at the BPP.

○ No, as the actual car is not mandatory to be part of the BPP, the quality is also not assessed.

○ Yes, the BPP covers also the main specs of the race car and the judges take these also into their assessment.

⦿ No, the quality of the actual car is not part of the BPP. The Judges assess the business capability of the team.

Your Team has built a steering system using a CFRP steering column

It is bonded to the steering rack pinion shaft. During scrutineering you get told that a bonded connection is not allowed (T 2.6.10).
In order to create the necessary mechanical connection you decide to add a shoulder bolt going through the column and the pinion shaft.
What is the necessary diameter of the shoulder bolt?

Consider only one bolt and a required safety factor of 1.5 or higher.
Allowed average contact pressure for the CFRP column is p_max= 60MPa
Your steering column comes with an outer diameter of 25mm and an inner diameter of 20mm.
The steering system is designed for a torque of 20Nm
Use the simplification of projected area for average contact pressure calcualtion p= F/(d*t)
F:Force
d:diameter of shoulder Bolt
t:material thickness.

ForGIFs.com

- ○ 8mm
- ● 10mm
- ○ 5mm
- ○ 6mm

Brake Lines

The maximum pressure in your hydraulic brake lines is estimated to be 85 bar. How thick does the shielding of those lines need to be?

- ○ min. 1 mm steel or 2 mm aluminum
- ● no shielding is required because brake lines require no shielding
- ○ no shielding is required if the pressure is below 95 bar (9.5 MPa)
- ○ min. 1 mm aluminum or steel

The Track is declared wet

What is the minimum tread depth for wet tires for dynamic events at Formula Student Austria?

- ● 2.4mm
- ○ no minimum tread depth is specified in the rules
- ○ 2mm
- ○ 1/16 inch

Skid Pad

Your car has an overall width of 1.45 m and can pull 15 m/s² of lateral acceleration during skidpad. What is the fastest skid pad time you can achieve?

Hint: assume steady-state cornering for one full circle. Consider the best possible driving line; lateral acceleration is measured at the center of the car.

- ● 4.688 s
- ○ 4.964 s
- ○ 5.071 s
- ○ 4.573 s

Three-legged cat

The cat of an FSA technical inspector stays away from balconies but has lost a leg in a terrible racing accident.

The simplified mechanical model of the cat consists of a solid body (B_1) that represents the head, torso and legs.

The body B_1 has the mass m and the dimensions that can be taken from the sketch (top view of the cat).

The 3 legs are assumed to be vertical bars. The cat's tail is modeled as a beam B_2 with the line load q.

This is connected at the height of the center of gravity with B_1 and can be pivoted in the horizontal plane.

x_1 in mm: 100
x_2 in mm: 250
x_3 in mm: 275
w in mm: 125
l_t in mm: 400
m in kg: 2
q in kg/m: 0.5
alpha in deg: 30

The cat moves its tail by the angle alpha to the right. Which of the following statements is true?

B1   B2
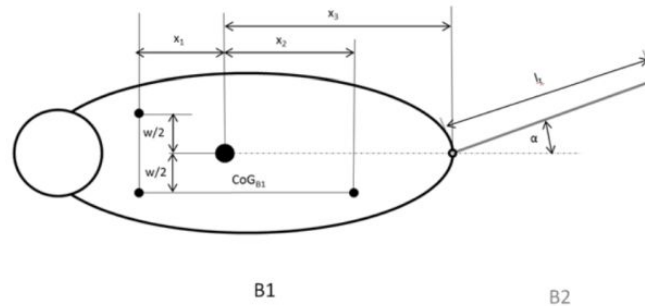
○ The cat is in an unstable equilibrium.
○ The cat loses stability and falls over to the left.
○ The cat loses stability and falls over to the right.
● The cat is in a stable equilibrium.

Fasteners

Which of the following mechanical connector(s) does not comply with rule T10?

- ○ Clevis pin with a minimum yield strength of 560 MPa secured with cotter pin
- ○ Socket head screw with all-metal torque prevailing nut
- ● Hexagon Bolt with a minimum yield strength of 560 MPa
- ○ M6 titanium lens head bolt with 17 kN minimum tensile strength
- ○ Bolt with Nordlock spring locking washer and nylon locking nut

Strap in!

Which requirement(s) concerning the driver restraint harness is true?

#FLACK

- ○ If a belt passes through a firewall, the edges must be sealed by a grommet and it has to be protected against chafing.
- ○ The shoulder belt must always be 50mm wide
- ○ The distance between the shoulder harness straps must be between 105 mm and 155 mm, measured at the mounting points.
- ● both lap belts must be releasable by only one release mechanism
- ○ Each and every belt must be fastened to an attachment point that is able to withstand a load of at least 13 kN

Cats on a String

At FSA 2020, three cats, Kitty (5kg), Mauzi (3kg) and Schnurli (4kg), are climbing up and down along a rope.

At a certain moment Kitty descends with an acceleration of 1.6m/s^2, Schnurli pulls herself up with an acceleration of 90 Gal, while Mauzi climbs up with the constant speed of 1.968feet/s.

What is the load on the rope hanger at this moment?

(mass of rope neglected, consider gravity g=9.80665m/s^2) Round to first decimal.
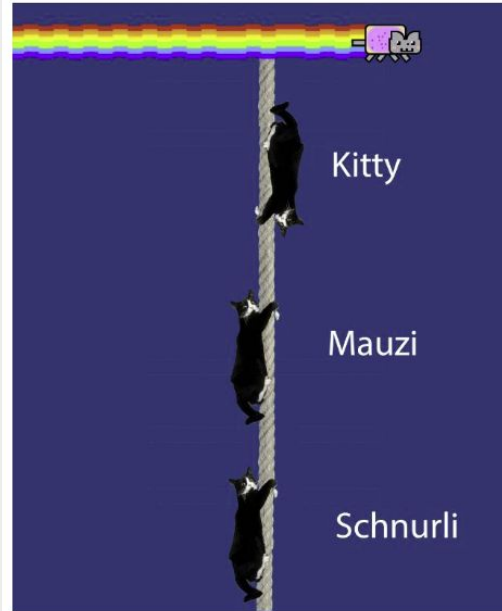
- ○ 115.8N
- ○ 122.8 N
- ○ 130.0 N
- ◉ 114.0 N

Brake Balance

Calculate the optimum brake balance for the following FSAE car during full braking:

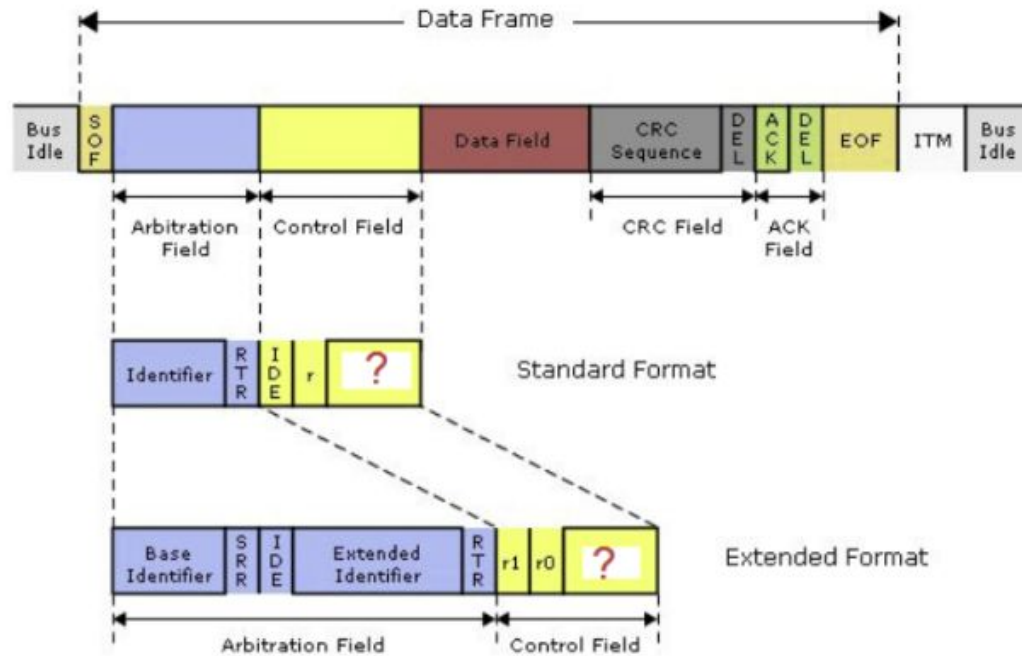overall mass = 275kg

wheel base = 1.6m

CoG height = 0.25m

tire coefficient of friction = 1.5

Weight distribution front/rear is 50/50, aerodynamic forces can be neglected.

- (●) 73.4% front
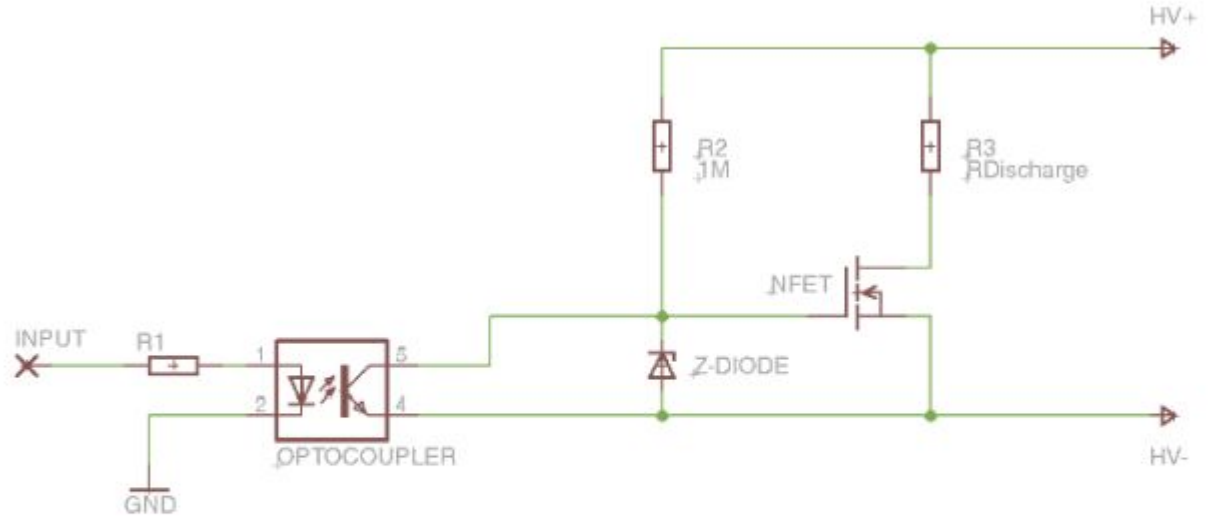- ( ) 71.1% front
- ( ) 68.7% front
- ( ) 66.6% front

Which Field is missing from this CAN Datagram ?

- ○ DCD
- ○ CRC
- ● DLC
- ○ RTS

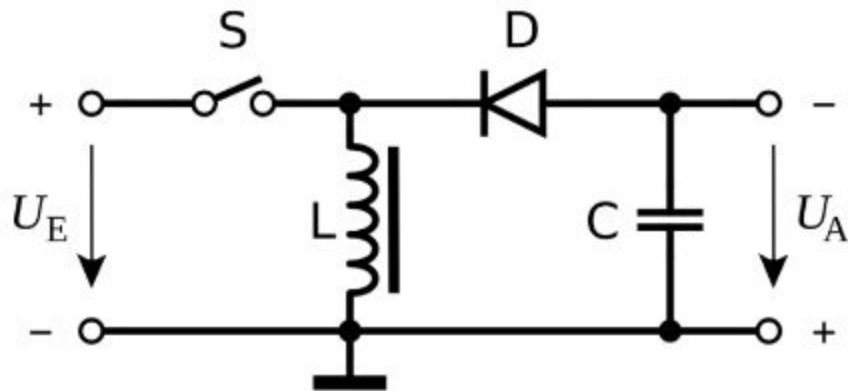Hint:
Input low
LED off
OPTO Hi-Z
FET gate pulled up
FET on
RDS ~0
Discharge on

Consider this discharge Circuit. What does the input do?

○ Input HIGH shorts the HV

○ Input HIGH enables the discharge

○ The input does nothing

● Input LOW enables the discharge

Which kind of DC-DC Converter is this?

- ○ Not a DC-DC Converter
- ○ Charge Pump
- ● Buck-Boost
- ○ SEPIC
- ○ Flyback
- ○ Boost
- ○ Buck

Emissions

Your current race car burns 4 liters of RON100 gasoline in your IC engine during an endurance race.

By what amount [kg] you may lower your fossil carbon dioxide emissions by using a E85 mixture (per volume) as biofuel?

Assume complete combustion and the same amount of chemical energy needed to run your engine on E85 fuel during an endurance.

Consider the properties below.

Round to 2 decimal places and number format be like "3.14".

	density	fossil CO_2 emission	Calorific Value
	[kg/m³]	[kg/L]	[MJ/kg]
pure Ethanol	789	0	26.71
Gasoline (RON100)	740	2.32	43.88

Please use the following format: 12.34

Answer 7.30

Hint:
The mixture is 85 volume-% Ethanol.
The density has to be considered.

Which of these conditions does not need to be met when you want to crank your car's engine in the pits?

- ○ The injection system has to be disconnected
- ○ All driven axles must be jacked up
- ○ All driven wheels have been removed from the car
- ● All team members must wear fire resistant suits as defined by T 13.3.4
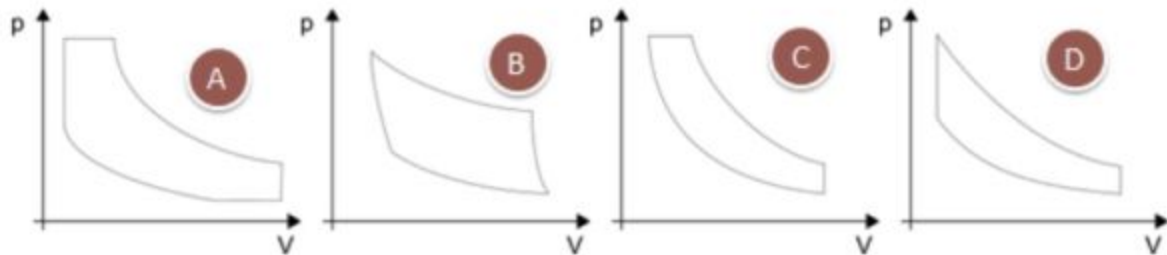
Pop-off

If you use a pop-off valve in your car for FSA 2021, where would you place it?

- ○ Between restrictor and compressor
- ● Between compressor and throttle body
- ○ Between intercooler and motor
- ○ Between throttle roll and intercooler

Which pressure- specific volume diagram depicts the ideal Otto-cycle?

- ○ B
- ○ C
- ● D
- ○ A