Formula Student Austria

2022 Quiz Answers
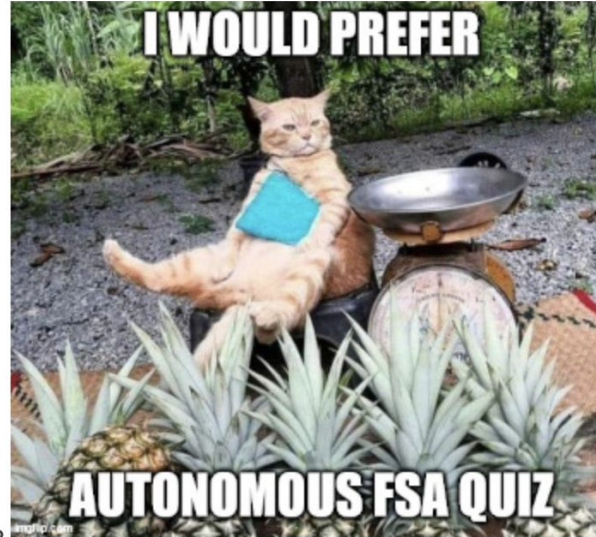
General Info

The numeric answers are agnostic to decimals, so:

12 == 12.0 == 12.00

12.3 == 12.30

etc.

Autonomous cars at FSA 2022

What is true regarding autonomous cars?

○ At no point in the FSA 2022 competition will it be required or an advantage to have an autonomous car or autonomous system components mounted in the car

○ The autonomous system can be presented in Engineering Design in order to gain extra points but can be removed for the Acceleration Event.

○ Autonomous systems must not be activated in any dynamic discipline, but they can be tested at a dedicated practice area on the competition site

○ Autonomous system components may stay in the car but at scrutineering it will not be checked that they are fully disabled by putting the ASMS in the "Off" position.

Percy

How tall is Sir Percy (the 95th percentile male specified by the rules) when standing fully upright?

- ⦿ min. 1835 mm
- ○ 1935 mm
- ○ 1732 mm
- ○ max. 1835 mm

Tire Pressure

During a usual test day at 20°C ambient temperature and ambient air pressure of 1.013 bar you want a tire overpressure of exactly 1.5 bar at a tire surface temperature of 60°C.

As one manometer is broken and the other one is lost you want to pressurize your tires by measuring the needed air mass which has an ideal gas constant of 287 J/(kg*K).

In order to choose an appropriate scale, you have to calculate the **added air mass in gram [g]** during this pressurize process.

Assume that:

- The tire dimensions remain the same over the whole process.
- The tire is neither over-pressurized nor under-pressurized at the starting point.
- The whole air in the tire has the same temperature as the tire surface at the end point.

Assume following tire dimensions:

- Outer diameter: 18 inches
- Inner diameter: 10 inches
- Tire width: 7 inches

Round to the nearest integer.

AAAAAHH, FSA QUIZ DIFFICULT

Please use the following format: 12.34

Answer [29.00]
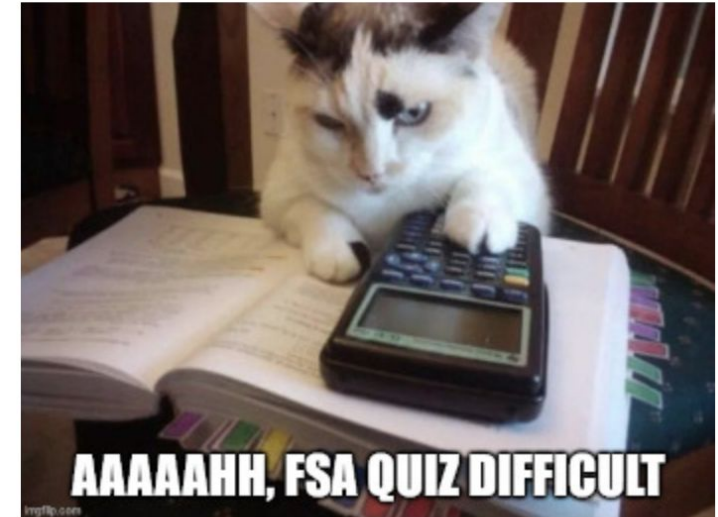
Springs

Which cat causes the greatest displacement?

Cat A, 3.6kg

k1=5000N/m

k2=11N/mm

k3=4.5kN/m
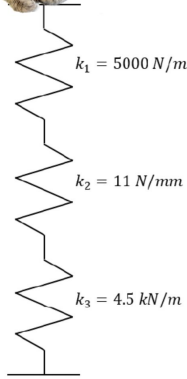
Cat B, 4.8kg

k1=2500kN/km

k2=15N/mm

k3=80N/m
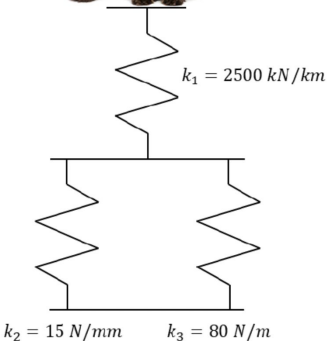
Cat C, 6.0kg

k1=1200N/m

k2=5.4kN/m

k3=0.035N/mm

Cat D, 11.5lbs

k1=12.5lbs/inch

k2=27lbs/inch

k3=4lbs/inch

Cat A 3.6 kg

$k_1 = 5000\ N/m$

$k_2 = 11\ N/mm$

$k_3 = 4.5\ kN/m$

Cat B 4.8 kg

$k_1 = 2500\ kN/km$

$k_2 = 15\ N/mm$ $k_3 = 80\ N/m$

Cat C 6 kg

$k_1 = 1200\ N/m$ $k_2 = 5.4\ kN/m$ $k_3 = 0.035\ N/mm$
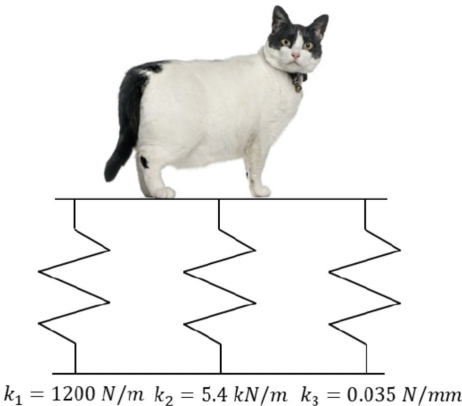
Cat D 11.5 lbs

$k_1 = 12.5\ lbs/inch$

$k_2 = 27\ lbs/inch$

$k_3 = 4\ lbs/inch$
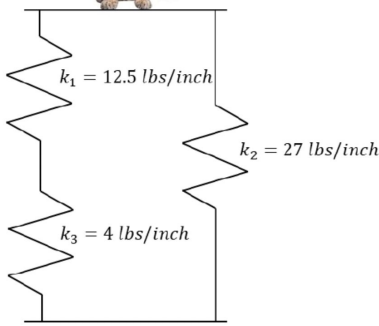
- ◯ Cat C
- ◯ Cat A
- ◉ Cat B
- ◯ Cat D

Gas Pressure

What is the maximum allowed pressure inside a compressed gas tank?

CAUTION
Pressure
hazard

○ 5 bar

◉ more than 10 bar

○ 8 bar

○ 10 bar

Farmer with racing ambitions

The campground operator has developed a new business model and offers firewood for sale to the teams.
Some teams accept the offer and have firewood delivered for their pools and sauna.
To deliver the firewood, he has mounted a platform on the rear of his tractor and a counter weight on the front (see sketch).
While the campsite operator is delivering the firewood with his rear wheel driven tractor, he is challenged by some team members to do a wheelie.
What is the highest gear in which a wheelie is still possible?
Neglect rolling and air resistance as well as rotational inertia for your calculations.

Description	Symbol	Value
mass of the tractor (incl. driver) without attachments	m	2000kg
weight distribution of the tractor (incl. driver) without attachements	w	63% rear
mass of the load (platform + firewood)	ml	1000kg
mass of the counterweight	mc	100kg
maximum engine torque	Tmax	150Nm
gear ratio 1st gear	i1	60.59:1
gear ratio 2nd gear	i2	45.20:1
gear ratio 3rd gear	i3	29.57:1
gear ratio 4th gear	i4	20.79:1
radius of the rear wheels	rr	680mm
distance l	l	1995mm
distance ll	ll	1000mm
distance lc	lc	500mm
distance h	h	800mm
distance hl	hl	1400mm
distance hc	hc	500mm
gravity	g	9.81N/kg
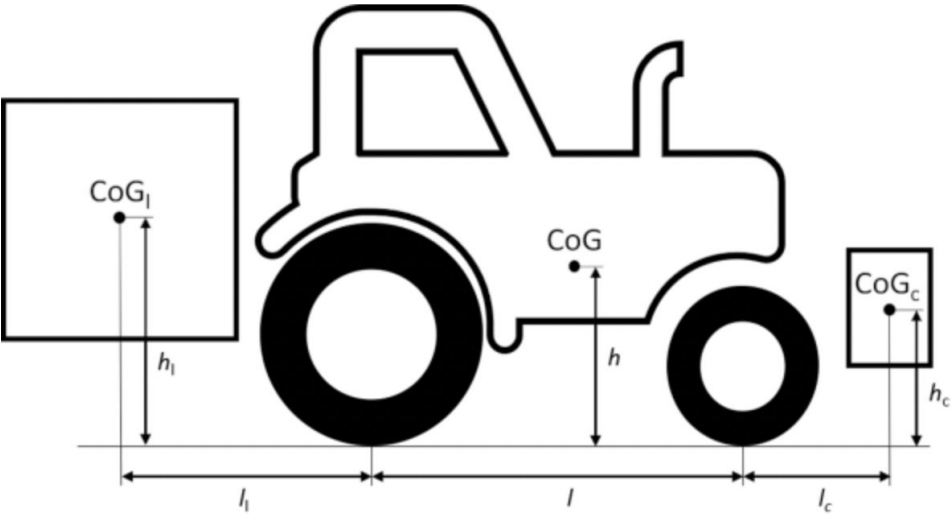
○ 4th gear

◉ 2nd gear

○ 1st gear

○ it is not possible to do a wheelie in this configuration

○ 3rd gear

Emergency Braking

A Formula student racing car weighing 185 kg and a driver weighing 75 kg is traveling 80 km/h on a flat and level surface.

The driver sees a cat and starts braking 1.5 seconds later with full braking force.

This time includes reaction time and pre-braking time.

The race car then decelerates with 10 m/s².

After how many meters after seeing the cat does the driver come to a stop?

Round result to the nearest integer.

Please use the following format: 12.34

Answer 58.00

Tires

What is true regarding tires used at Formula Student Austria?

○ You need one set of tires for dry weather, another set of tires for wet conditions, and you are allowed to use another set for practice.

○ After the acceleration event the rear tires are worn down, you are allowed to replace them with tires of the same manufacturer, size and compound for the endurance event.

○ You are allowed to use exactly one set of dry tires and one set of wet tires.

○ Weather forecast is sunny, so it is possible to use only 2 sets of dry tires.

CAN Bus

On your vehicles CAN network, two nodes have a message with the same ID queued:

- Node A: ID 0x123, DLC 4, Data 0x55 0x55 0x55 0x55
- Node B: ID 0x123, DLC 2, Data 0x00 0x00

Both nodes start transmitting at the same time,
which message will reach node C,
which is setup to receive any 0x123 message,
first if there is only a single attempt to transmit?

- ○ Node B, because Data Byte 0 has the lower value.
- ○ Node A, because Data Byte 0 has the higher value.
- ◉ neither, this will cause a collision on the bus.
- ○ Node B, because the DLC has the lower value.

Cost event

For what DBOM entries are processes needed?

○ For the manufacturing steps of every made part.

◉ For every made part, building assemblies out of parts and mounting it to the car.

○ For the manufacturing steps of every bought part and made part.

○ For every made part and building assemblies out of parts.

Material Science

Substances A and B both have a Face Centered Cubic Structure.
The atomic mass of B is twice that of A, and the lattice constant of B is half that of A.
What is the ratio of the theoretical density of B to the theoretical density of A ($\rho B / \rho A$)?
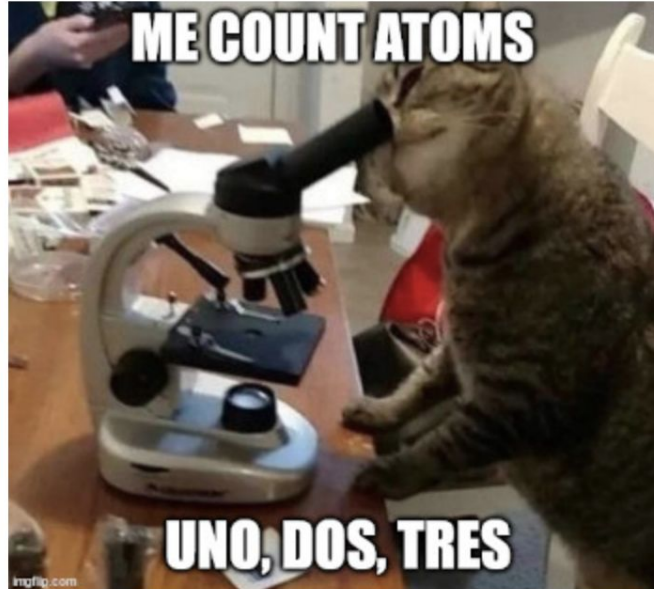
- ○ 9
- ○ 8
- ○ 4
- ◉ 16

Combustion Specific

Engine Power

You have a reciprocating single piston engine with 500 cm³ displacement and a bore to stroke ratio of 1/0.7 which generates a peak power of 50 hp @ 8850 rpm.

You want MORE power and switch to a four piston engine with the same total displacement, same bore to stroke ratio and the same average piston speed and same torque at its peak power point.

What is your new peak power figure?

Give the answer in Horsepower [hp], and round to two decimals (i.e. 1.12).

Please use the following format: 12.34

Answer 79.37

Electrics Specific

Accumulator

What is true regarding the tractive system accumulator container (TSAC)?

ⓧ A steel bracket used to mount the TSAC to the primary structure with M6 bolts and the mounting holes on its centerline must be at least 18mm wide.

○ The name of the ESO must be clearly written on the lid of each TSAC.

○ The sufficient resistance against penetration of the insulating barrier on the inside of the TSAC can only be determined by review of the ESF and SES documentation.

○ A TS accumulator container made from composite materials must be fastened to the primary structure using steel or aluminium brackets and 2mm steel backing plates.

Thank you for beeing with us!