**Newton’s Laws**

Newton’s First Law of Motion (The Inertia Law)

The first law states that every object at rest or in uniform motion will stay at rest or in its uniform motion until it is acted on by an external force.

* This law will be used within the testing by showing that until the phone case is dropped it will not move, but once the case is dropped it will remain in its state of motion until it impacts the ground where the ground interacts with force. This then stops the phone case’s fall.

Newton’s Second Law of Motion (The Acceleration Law)

The acceleration of an object is directly proportional to the net force that is acting upon the object and is inversely proportional to the mass of the object.

* This law is shown by gravity. The acceleration that is put onto the phone cases is all due to gravity. This being so, no matter which case is being tested the acceleration will always be 9.8m/s.

Newton’s Third Law of Motion (The Action-Reaction Law)

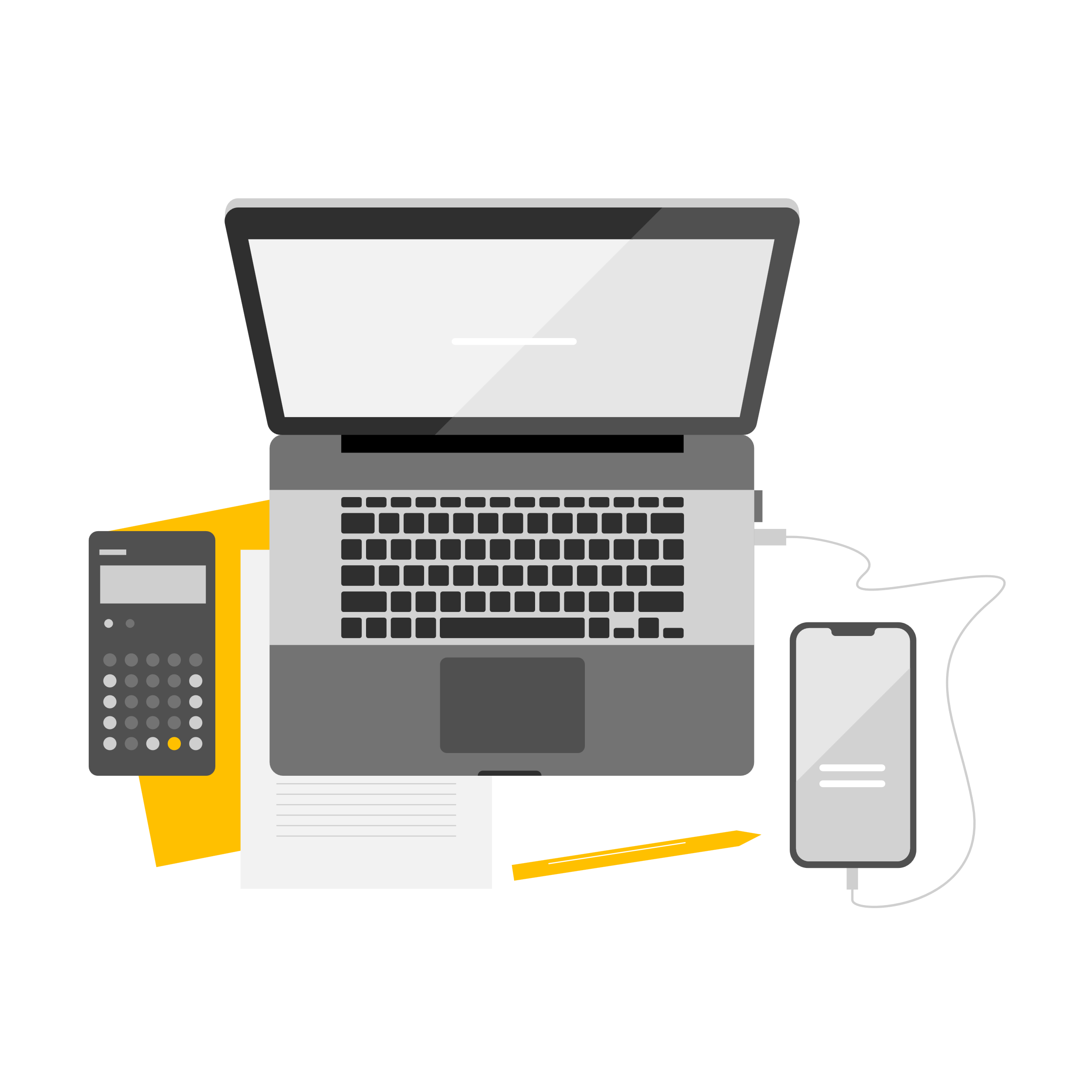
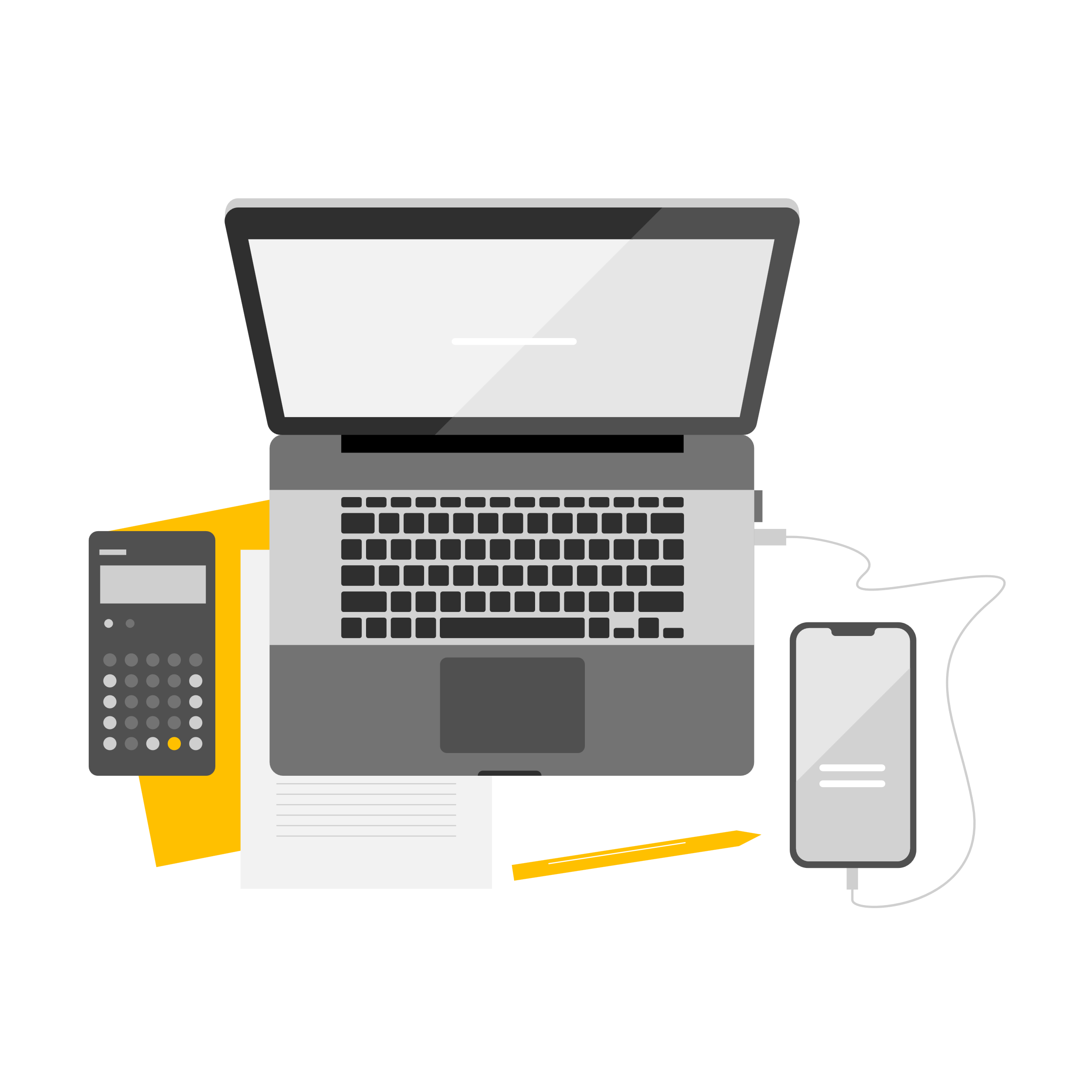
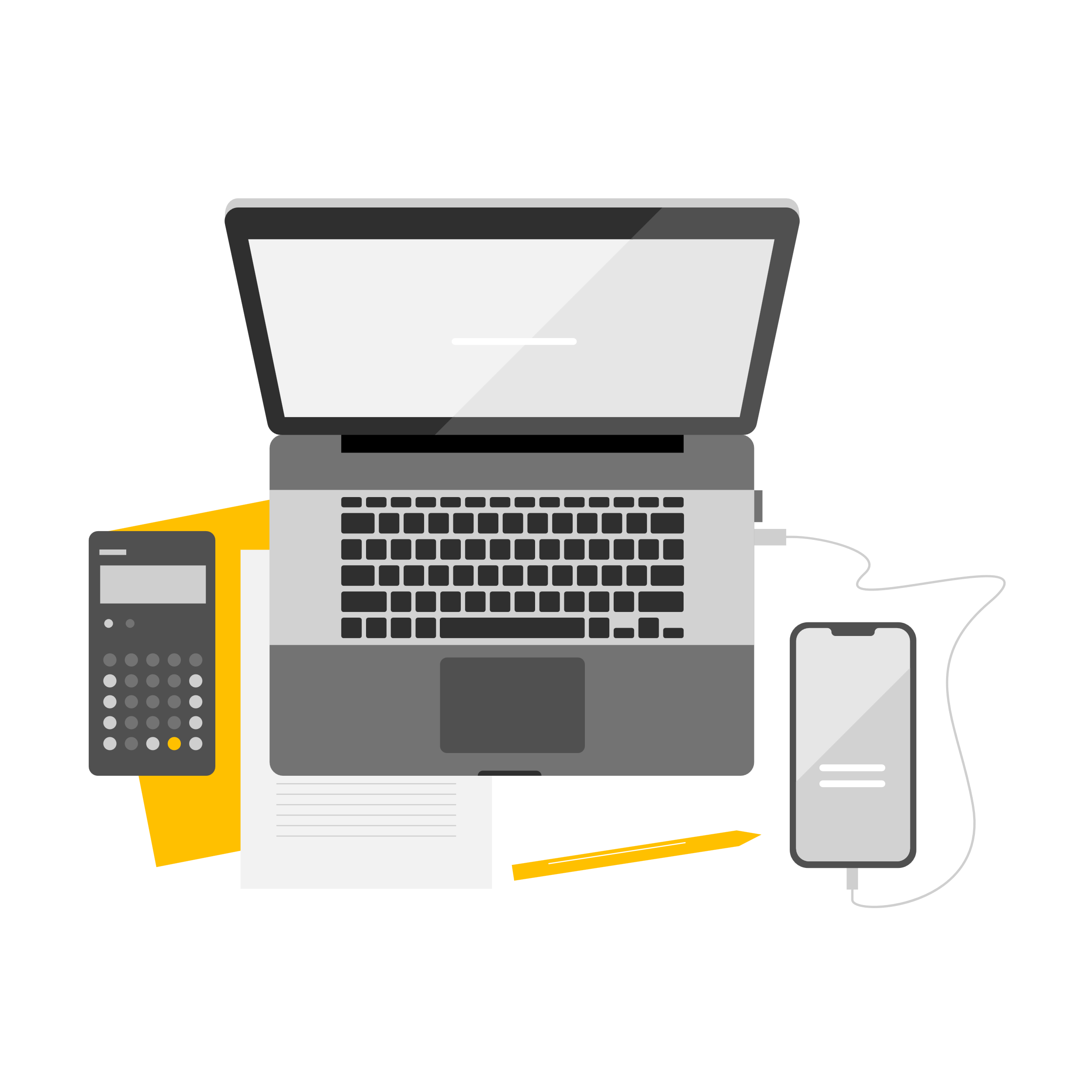
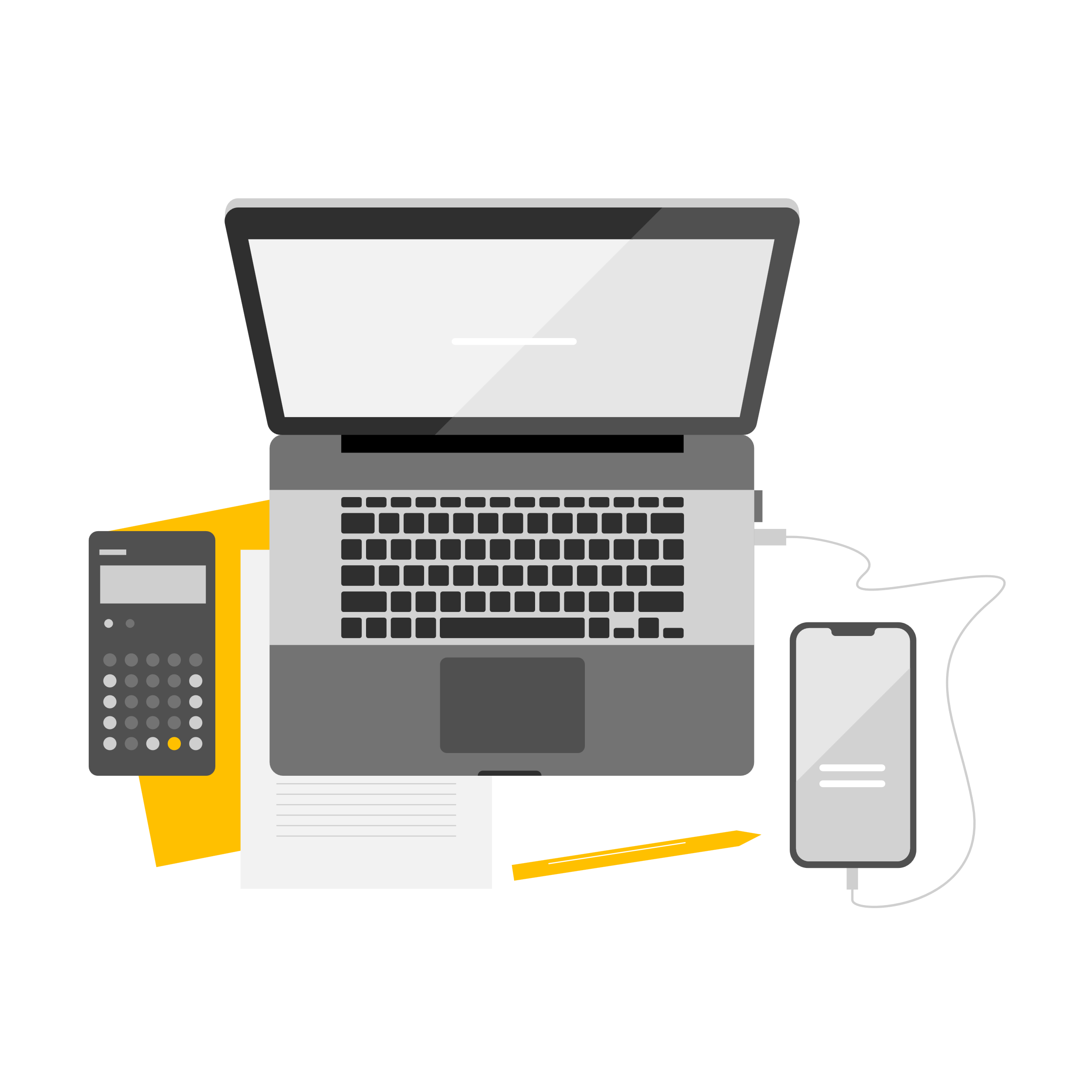
When two objects interact, the force exerted on one object is equal in size and opposite in direction to the force exerted on the other object.

For every action, there is an equal and opposite reaction.

-During the test this law is demonstrated during the impact of the fall. The force of the phone case to the ground is then distributed equally to the case from the ground. Each case will have a slightly different impact recoil based on the mass of the case.

The phone case test will be held by dropping 4 different case scenarios at a 2-meter height. A phone without a case with a mass of 6.2 ounces(0.18kg), a silicone case with a mass of 1.7 ounces(0.05kg), a hard plastic case with a mass of 1.1 ounces(0.03kg), and a rubber case with a mass of 3.2 ounces(0.09kg).

In all scenarios: v = velocity, m = mass, f = force, g = gravity(9.8m/s), a = acceleration, d = distance, t = time.



Phone with silicone case

m = 0.23kg

t = 0.05s

d = 2m

v = 40 m/s

2 meters

2 meters

Time of Ground impact

At time of drop

2 meters

Phone without case

m = 0.18kg

t = 0.01s

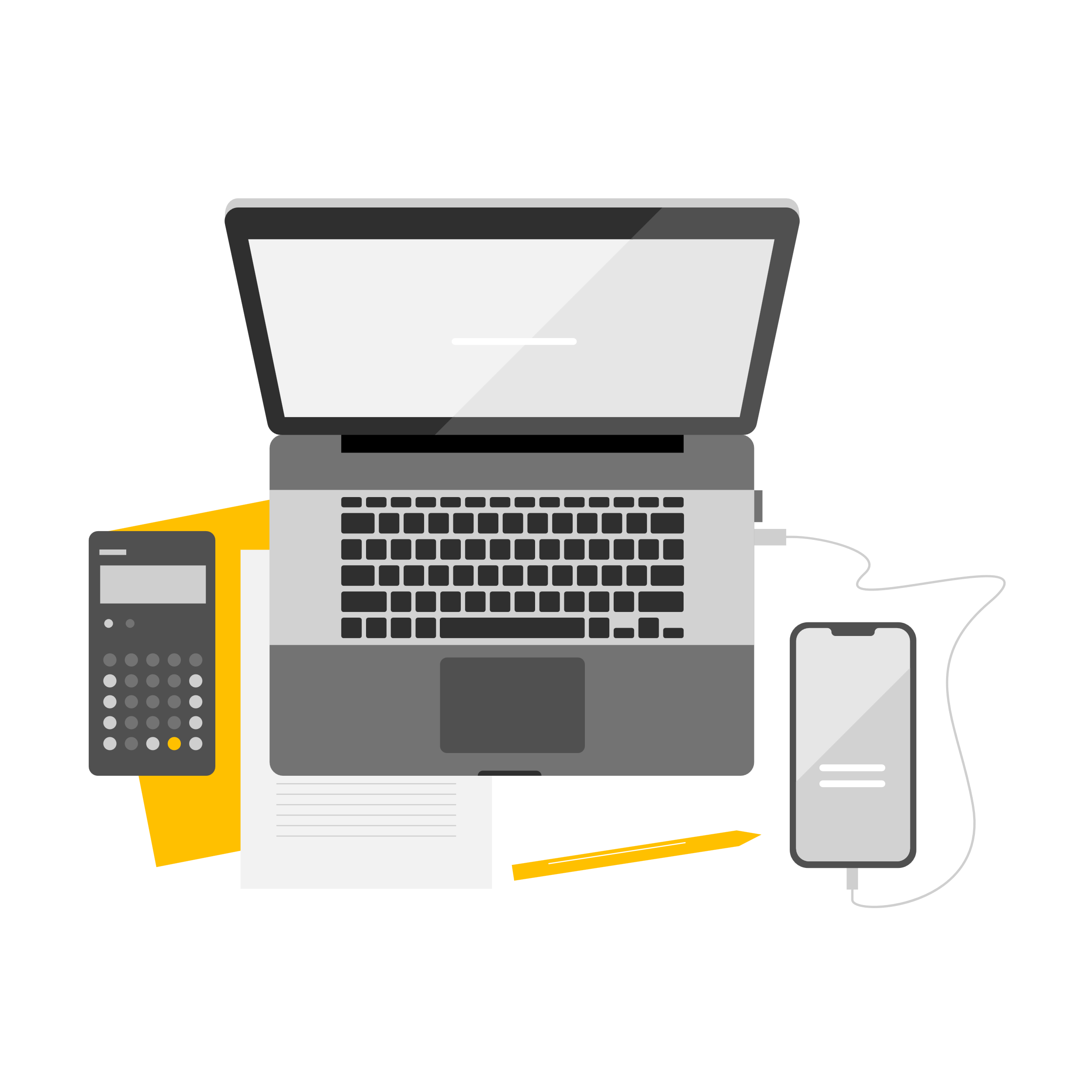
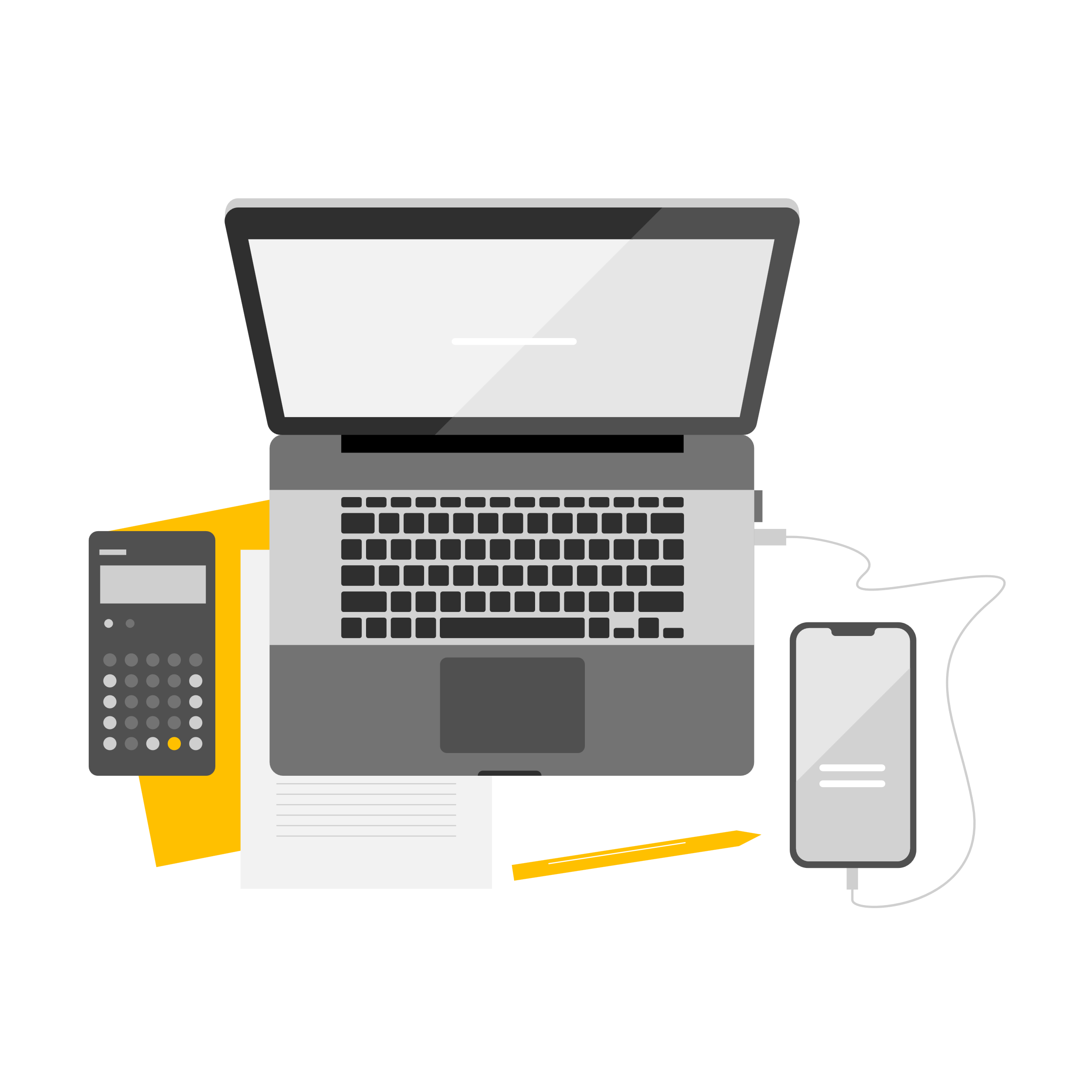
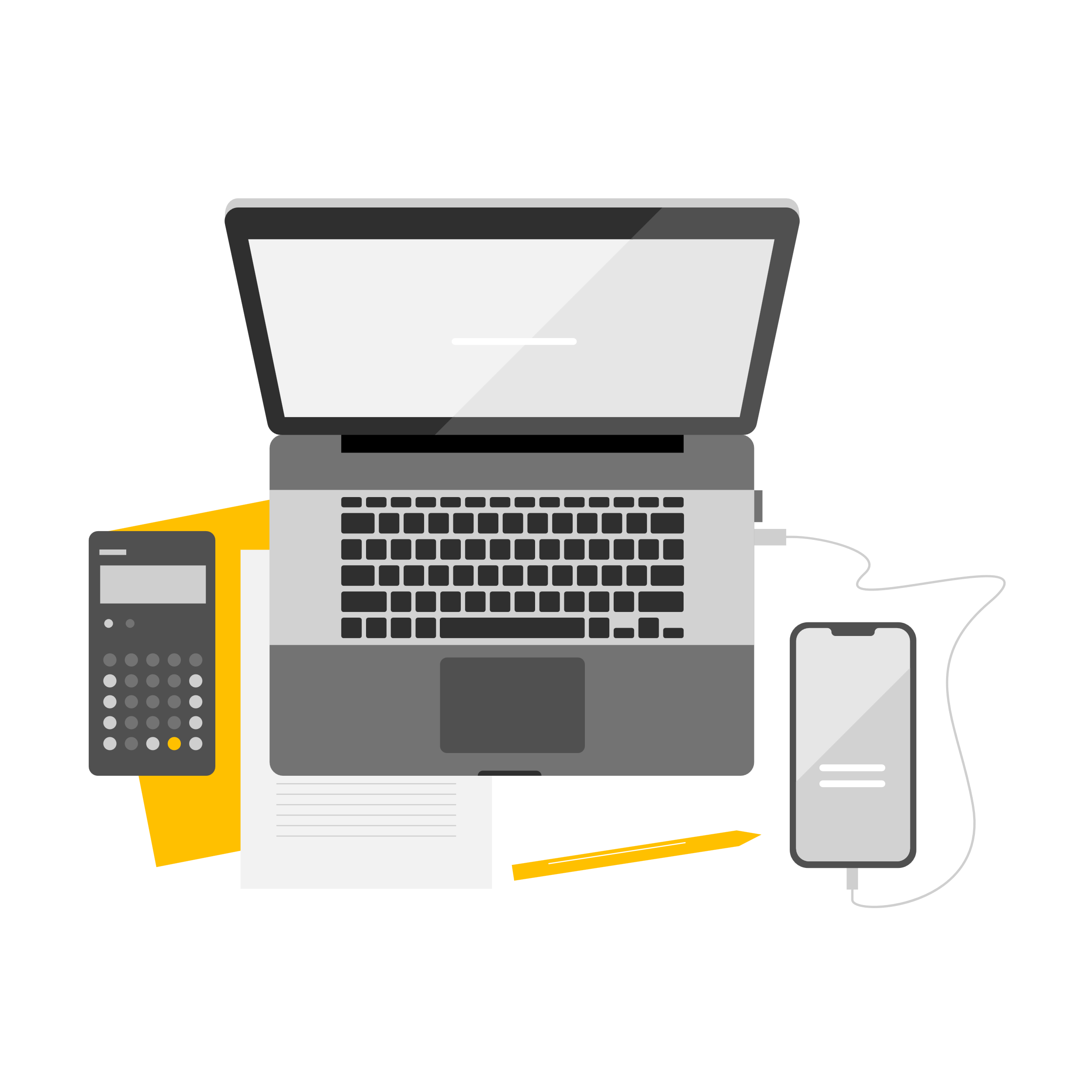
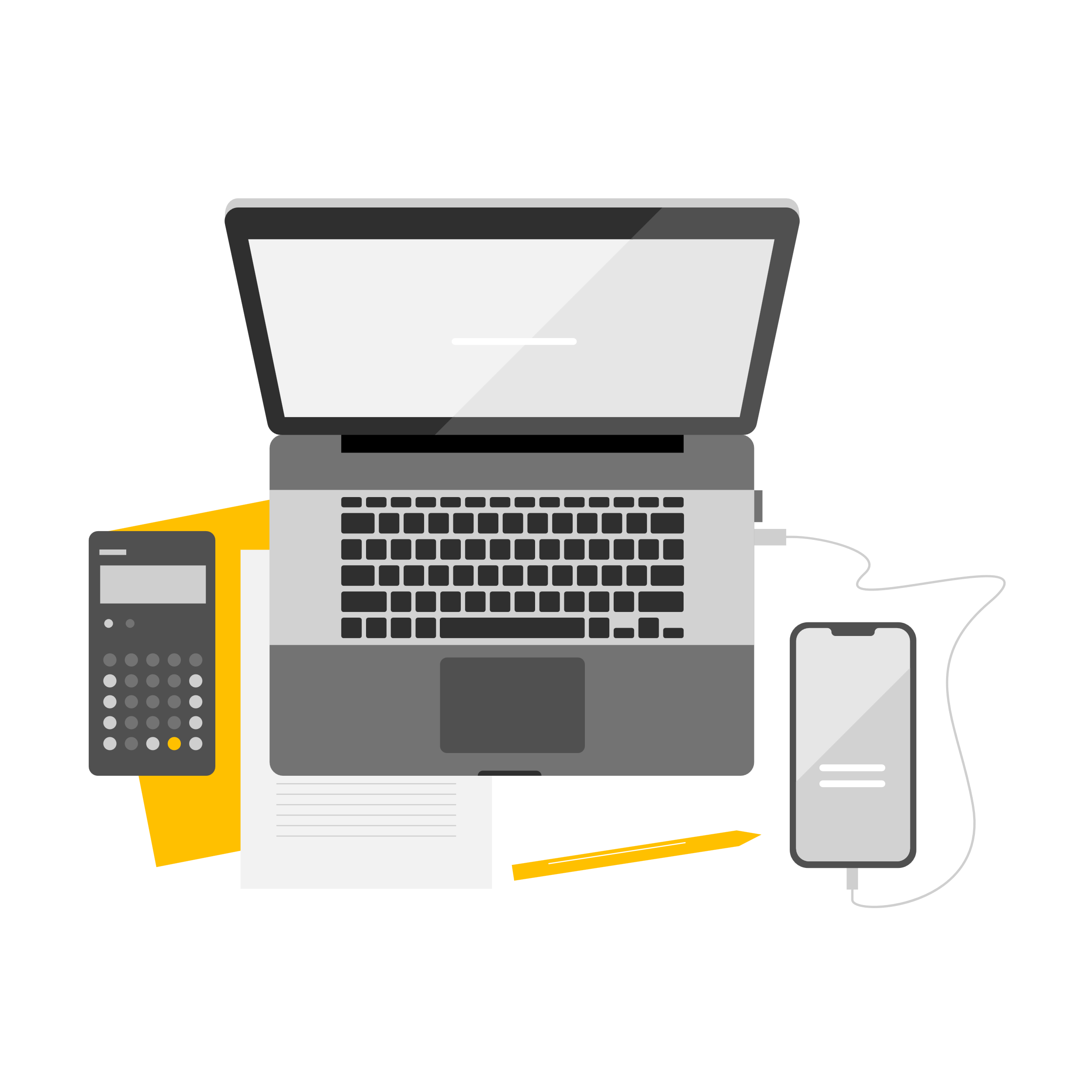
d = 2m

v = 200 m/s

2 meters

At time of drop

Time of Ground impact



At time of drop

2 meters

2 meters

Time of Ground impact

Time of Ground impact

2 meters

At time of drop

2 meters

Phone with hard plastic case

m = 0.21kg

t = 0.03s

d = 2m

v = 66.67 m/s

Phone with rubber case

m = 0.27kg

t = 0.08s

d = 2m

v = 25 m/s

Due to the formula for velocity for time of in pact V=, the velocity for all the scenarios is going to equal 6.26 m/s because the height for each test is consistent. The velocity of the impact for all tests will be considered 0 m/s. The formula I will be using to find the force of impact on each scenario is the work formula. (W = PE) This formula can be expanded to look like Fd = mgh and then expanded a bit more F = to make it easier to plug in the variables. The acceleration at time of impact with be calculated with the formula a = . To find the velocity of each test during the fall I used the formula v = .

In the first test(without the case):

F =

= 1.76N

a =

= 9.78

V =

= 200 m/s

In the second test(silicone case):

F =

= 2.25N

a =

= 9.78

V =

= 40 m/s

In the third test(plastic case):

F =

= 2.06N

a =

= 9.80

V =

= 66.67 m/s

In the fourth test(rubber case):

F =   
 = 2.65N

a =

= 9.81

V =

= 25 m/s

After reviewing the tests based on just the force impact I would have picked the hard plastic case with the impact being 2.06N. The best test in just the impact would have been the case without a case(1.76N) but that would mean the impact force would be directly transferred to the cell with no protection. That leaving the plastic case being the better option. Another thing to take into consideration with choosing a phone case is the absorbency of shock the case can provide. If you look at the results the rubber case provided the slowest impact, but the force was much greater. So overall I would of went with the well-rounded choice of the silicone cases since the velocity would be a bit slower and the impact force not completely terrible.