FORCES

I. What kind of forces do you know? Think of any kind of words connected with FORCE and draw a diagram with them;

II. Listen to the recording about types of forces in physics and answer the questions below (source: http:/science.discovery.com)

1. What were the first two basic forces known?
2. When were nuclear forces discovered? What are they?
3. Which nuclear force gives us radioactive decay? Gives some examples of this force in nature.
4. What are examples of electromagnetic force?
5. How do we detect strong nuclear forces?
6. What is the „standard model“?

III. Friction is the force resisting the relative motion of solid surfaces, fluid layers, and/or material elements sliding against each other. Read the text about overcoming friction and fill in the gaps with the words below:[1]

effort, hinders, lubricant, oil, plastic, rolling, rotates, rub, slide, smoother

Try putting a heavy book over the surface of your desk, then placing the same book on a few round pencils and pushing the book again. 1._____ the book on the pencil will require least 2._____ to move the book. On the desk, the tiny crests and hollows on the surface of the book interlock with those on the surface of the desk and this 3._____ motion. But when the book is placed on the pencils, the surfaces no longer have to 4._____ across each other. Making one or both of the surfaces 5._____ will also reduce the friction force between them. For example, if heavy furniture has to be dragged across the floor, pads of the 6._____ PTFE can be fixed to it. This is a very smooth solid and makes moving furniture much easier. A 7._____ is a slippery material which is not fixed to the moving object, but goes between it and the fixed surface. The lubricant forces the two surfaces apart so that they do not 8._____ against one another. 9._____ is a common lubricant. Most machinery uses a lubricant wherever two surfaces move over one another, such as where an axle 10._____ inside a bearing or a valve slides up and down in a tube.

IV. Read the text above once again and form 3 questions to check its comprehension, then cover the text and ask your neighbour to answer your questions. Next answer his/her questions.

V. Examples of forces; read the sentences below and put them in the correct order[2];

A. Paddling a boat
   a) The answer is that the two forces act on different objects.
   b) The reaction to this acts on the man, who is attached to the boat, and pushes them into opposite direction – forward.
   c) First, a man paddling a boat applies a force to water, trying to push it backwards with the paddle.
   d) This means that the paddle acts on the water and the water acts on the paddle.
   e) You may ask why, if the action and reaction are equal and opposite, the boat moves at all

B. Firing a rifle
   a) The rifle kicks against the person holding it.
   b) These forces only act as long as the bullet is inside the rifle.
   c) They vanish when the bullet leaves the muzzle.
   d) This results in the reaction of a backward force exerted on the rifle.
   e) When a rifle is fired it exerts a forward force on the bullet (action).

C. The jet engine
   a) Here it is expelled at high speed.
   b) So the plane moves forwards.
   c) The engine forces the Gates backwards.
   d) The jet engine forces air from the front of the engine to the back.
   e) The reaction to this is the forwards force exerted by the gas on the engine and hence, the plane.

VI. Law of moments; Read the sentences below and underline the correct word in each sentence[3].

1. A ruler is balanced and the central point is the pivot point or (fulcrum/vacuum/pendulum/Velcro).
2. If a 25g mass is placed on the right-hand side of the ruler, its weight, or (factor/fraction/force/faction) will cause the ruler to turn in a clock-wise direction.
3. The moment of the force is the (present/product/addition/deduction) of the force and its distance from the pivot point.

4. This (anticlockwise/clockwise) moment can be counteracted by another force on the left-hand side of the pivot, to turn the ruler (anti)clockwise.
5. By shifting that (weight/load/mass/product) along the ruler it will reach a distance from the fulcrum where its turning force equals that of the first mass.
6. The ruler balances. The clockwise moment of the 25g mass at a perpendicular distance of 16 centimetres from the (pivotal/hinge/pivot/pendulum) is exactly equalled by the anticlockwise moment of the 10g mass at a distance of 40cm from the (*same word*).
7. This is (added/calculated/totalled/summed) up in the law of moments. This law states that when an object is in equilibrium the sum of the clockwise moments is equal to the sum of the anticlockwise moments about the same pivot.[i]

VII. Read the text and fill in the gaps with the words provided beneath the reading passage

New vocabulary:

feature- rys, znak, prvek	to cushion – ztlumit, zmírnit, chránit
seat belts- bezpečnostní pásy	mounted- upevněný, uchycený (k podstavci/rámu)
head-on (adj)- čelní, frontální	steering wheel-volant
immovable- nepohyblivý	dashboard- palubní, přístrojová deska
instantaneously-okamžitě	thereby- tím(to), a tím, přitom
to restrain- zadržet, udržet pod kontrolou	inquisitive- zvědavý, všetečný
injury – zranění, úraz	in a fraction of a- ve zlomku
to occur-stát se, vyskytovat se	decelaration- zpomalení, snížení rychlosti
threshold- práh, hranice (np. intenzity)	severe- vážný, těžký
braking- brzdění	fluffy- načechraný, nadýchaný
igniter- rozněcovač, zapalovač	equipped with- vybavený
to set off- odpálit, aktivovat, spustit	to buckle up – připásat se, připoutat se
to deploy- rozvinout (se)	to inflate –nafouknout (se)

THE "FOURTH LAW OF MOTION": THE AUTOMOBILE AIR BAG

A major automobile safety feature is the air bag. Seat belts 1_____ you so you don't follow along with Newton's first law when the car comes to a sudden stop. But where does the air bag come in, and what is its principle?

When a car has a head-on collision with another vehicle or hits an 2_____ such as a tree, it stops almost 3_____. Even with seat belts, the impact of a

head-on collision could be such that seat belts might not restrain you completely, and injuries could occur.

Enter the air bag. This balloon-like bag inflates automatically 4_____ and cushions the driver. Front air bags are mounted in the center of the steering wheel on the driver's side and in the dashboard on the passenger side.

The air bag tends to increase the 5_____ in stopping a person, thereby reducing the 6_____ (as compared with hitting the dashboard or steering column). Also, the 7_____ is spread over a large general area and not applied to certain parts of the body as in the case of the seat belts.

Being inquisitive, you might wonder what causes an air bag to inflate and what inflates it. Keep in mind that an inflation must occur in a fraction of a second to do any good. (How much time would there be between the 8_____ contact and a driver hitting the steering wheel column?) The air bag inflation is initiated by an electronic sensing unit. This unit contains sensor that detect 9_____, such as those that occur in high-impact collisions. The sensors have threshold settings so that normal 10_____ does not activate them.

Sensing an impact, a control unit sends an electric current to an igniter in the air bag system that sets off a 11_____. The gases (mostly nitrogen) rapidly inflate the thin nylon bag. The total process of sensing to complete inflation takes about 25 thousandths of a second (0.025 s).

Unfortunately, injuries and deaths have resulted from the 12_____ of air bags. An air bag is not a soft, fluffy pillow. When activated, it deploys at speed of up to 320 km/h (200 mi/h) and could hit a person close by with enough force to cause severe injury and even death.

Specific problems may exist, but air bags save many lives. Even if your car is equipped with air bags, however, always remember to 13_____. Maybe we should make that Newton's "fourth law of motion."

impact force x2
buckle up
chemical explosion
restrain
instantaneously
contact time
hard breaking
initial collision
deployment
rapid decelerations
on hard impact
immovable objects

[i] 1,2,3 – Kelly, Keith; 2007, *Science* (Macmillan)