Science Olympiad Foundation Uganda

Uganda National Junior Science Olympiad 2020 - Paper 2

Exam ID: 113

Name: _____

Date: _____

Question: 1 of 20 QID: 309 Marks: 1

Trapped heat inside the earth is known as_____

- **A.** Heat energy
- **B.** Kinetic energy
- **C.** Geothermal energy
- **D.** Thermal energy

Question: 2 of 20 QID: 308 Marks: 1

Solar panels generate electricity.

- **A.** True
- **B.** False

Question: 3 of 20 QID: 307 Marks: 1

In hydroelectricity power_____

- **A.** Kinetic energy is transferred to potential
- **B.** Potential energy is transferred to kinetic
- **C.** Solar energy is transferred to wind energy
- **D.** Wind energy is transferred to solar energy

Question: 4 of 20 QID: 306 Marks: 1

Oils release sulfur dioxide gas when they burn.

- **A.** True
- **B.** False

Question: 5 of 20 QID: 305 Marks: 1

Dead organisms are transformed into petroleum and natural gas in

- **A.** presence of air
- **B.** absence of air
- **C.** presence of sunlight
- **D.** none of the above

Question: 6 of 20 QID: 304 Marks: 1

An ideal source of energy should have

- **A.** higher calorific value
- **B.** easy transportability
- **C.** easy accessibility
- **D.** All of these

Question: 7 of 20 QID: 303 Marks: 1

Energy is released from fossil fuels when they are_____

- **A.** Pumped
- **B.** Cooled
- **C.** Burned
- **D.** Pressurized

Question: 8 of 20 QID: 302 Marks: 1

Suppose a boy is enjoying a ride on a merry-go-round which is moving with a constant speed of 10 m/s. It implies that the boy is

- **A.** at rest
- **B.** moving with no acceleration
- **C.** in accelerated motion
- **D.** moving with uniform velocity

Question: 9 of 20 QID: 301 Marks: 1

The numerical ratio of displacement to distance for a moving object is

- **A.** always less than 1
- **B.** always equal to 1
- **C.** always more than 1
- **D.** equal or less than 1

Question: 10 of 20 QID: 300 Marks: 1

If the displacement of an object is proportional to square of time, then the object moves with

- **A.** uniform velocity
- **B.** uniform acceleration
- **C.** increasing acceleration
- **D.** decreasing acceleration

Question: 11 of 20 QID: 299 Marks: 1

A body is thrown vertically upward with velocity u, the greatest height h to which it will rise is,

- **A.** u/g
- **B.** $u^2/2g$
- **C.** u^2/g
- **D.** u/2g

Question: 12 of 20 QID: 290 Marks: 2

A cheetah is a wild cat. Its most prominent feature is its high running speed and fast acceleration. It can accelerate from rest to its maximum running speed of about 30 ms^{-1} in just 3.0s. (For comparison, a fast sports car like a Porsche takes about 4.0 s to attain the same speed).

Though the cheetah can accelerate and run very fast, it cannot run a long distance at its maximum speed because it quickly gets tired. Thus, if it cannot catch its prey within that limit, it has to forgo the hunt.

Consider a cheetah of mass 50kg. It starts from rest and accelerates for 3.0s to reach its maximum speed of 30ms^{-1}. It then continues to run for 20s at this speed.

a) Calculate the average acceleration of this cheetah required to reach its maximum speed. **(2 MARKS)**

Question: 13 of 20 QID: 291 Marks: 2

b) Calculate the distance travelled during the first 3.0s, assuming that the acceleration is uniform. **(02 MARKS)**

Question: 14 of 20 QID: 292 Marks: 4

c) The cheetah has to do work against friction, mostly due to air. Assume that this frictional force is always 100 N. Calculate the total mechanical work done by the cheetah during the first 23.0s of its motion.

Question: 15 of 20 QID: 293 Marks: 2

d) During the first 23.0s, the body temperature of the cheetah rises from 38.5^0C to 40.0^0C. Take the specific heat of the body of the cheetah to be 4.2 kJ kg^{-1} K^{-1}.

If the rise in body temperature is linear during this time, calculate the total heat generated by the cheetah's metabolism. Neglect any heat loss to the surroundings. **(02 MARKS)**

Question: 16 of 20 QID: 294 Marks: 2

e) Assume that some of the energy generated by the cheetah's body increases its temperature and the rest corresponds to the mechanical work done. Calculate the fraction of the total generated energy that is converted to kinetic energy. **(2 MARKS)**

Question: 17 of 20 QID: 295 Marks: 2

f) Write down the balanced chemical reaction for aerobic respiration. **(2 MARKS)**

Question: 18 of 20 QID: 296 Marks: 4

g) If the cheetah requires 400 kJ of energy, calculate the volume of oxygen required if all this energy is to be obtained by aerobic respiration. Take the molar volume of oxygen gas to be 24.5 litres. **(4 MARKS)**

Forces in a Fluid

When an object moves through a fluid, in addition to the buoyant force, it also experiences a force due to the resistance of the fluid. This force is known as the drag force F_D. It is known that for objects moving with low velocities, F_D is proportional to the velocity *v* of the object relative to the fluid and the linear size *R* of the object (if the object is a sphere *R* is the radius of the sphere).

Therefore, we can write $F_D = CvR$, where C is a constant that depends on properties of fluids and the geometry of the object. Using this fact and assuming the velocities involved in below are low, answer the following questions.

a) What is the unit of C? (in terms of SI units: kg, s, m.). Show how you derive the unit. **(1 mark)**

Question: 20 of 20 QID: 298 Marks: 1

Following your answer in the previous question, consider a dust particle of radius, **R = 3.0 * 10^{-6}m**, falls in air at 20°C.

The numerical value of C for this particle in the air at 20°C is 3.4×10^{-4} (in SI units). The density of the particle, ρ, is 2.0×10^{3}kg·m^{-3}.

Suppose that the particle can move indefinitely without being blocked by the surface of the earth. The falling particle will soon move with a fixed velocity, known as the terminal speed.

If the acceleration due to gravity g is fixed at the value 9.8 m·s^{-2} and the density of the air is 1.2 kg·m^{-3}, find the terminal speed of the dust particle. **(5 MARKS)**

--- END OF QUESTION PAPER ---