SEVENOAKS SCHOOL

YEAR 9 (13+) SCHOLARSHIP

May 2021
for entry in September 2021

SCIENCE 1

Your Name: _____

Your School: _____

Time allowed: 1 hour

Equipment needed: Pen, pencil, and ruler.
You may use an eraser and a calculator if needed.

Information for candidates:

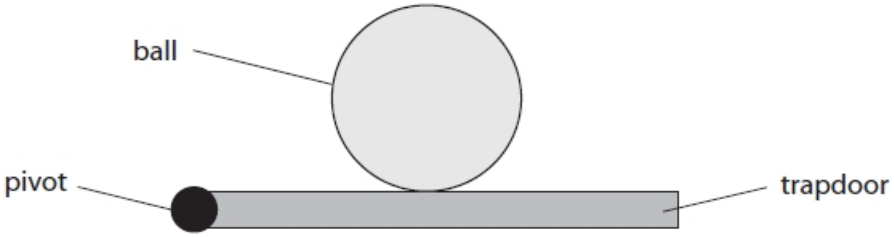
1. Write your name and school on this page.
2. Write all of your answers on the question papers in the space provided. If you need additional paper then please ask the invigilator. Please put your name on the sheets of paper you use.
3. The marks for each question or part question are shown in square brackets [ ] after the question.
4. Answer **ALL QUESTIONS**.
5. The total mark for this paper is 60.

PHYSICS

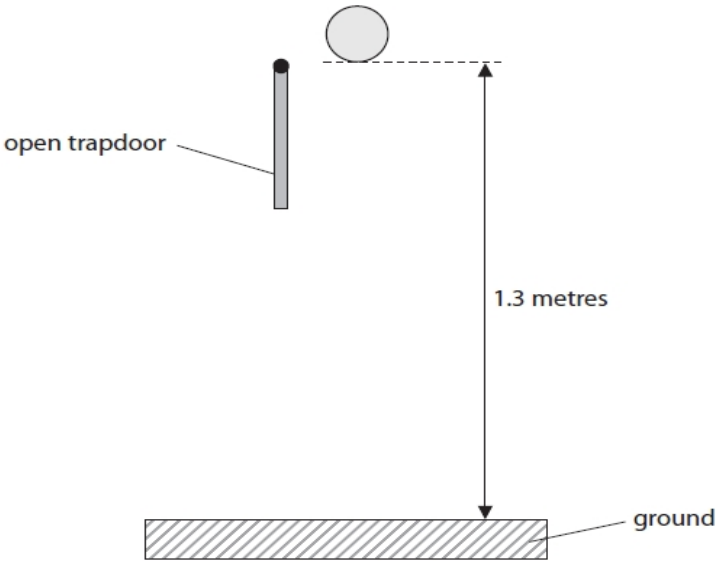
Question 1

This question is about the motion of a ball.

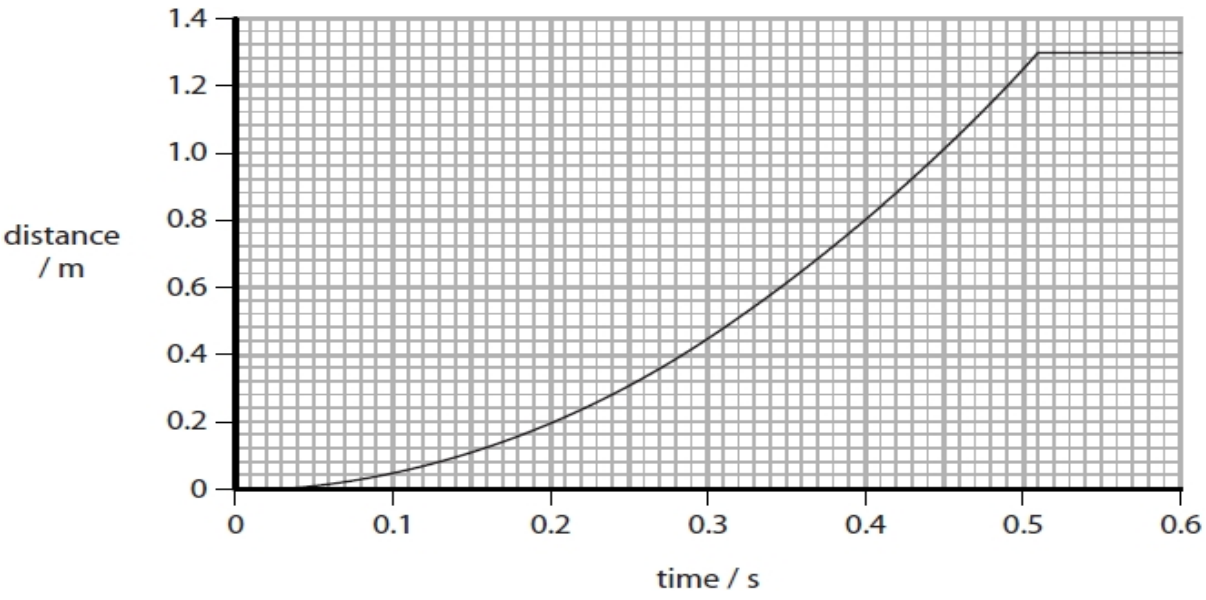
a. A ball is at rest on a trapdoor.
Complete the diagram to show the forces acting on the ball and label each one. [3]



b. The trapdoor swings open and the ball falls to the ground. The ball does not bounce when it hits the ground.



The graph shows how the distance travelled by the ball changes with time.



i. Determine the time taken for the ball to hit the ground. [1]

_____

_____

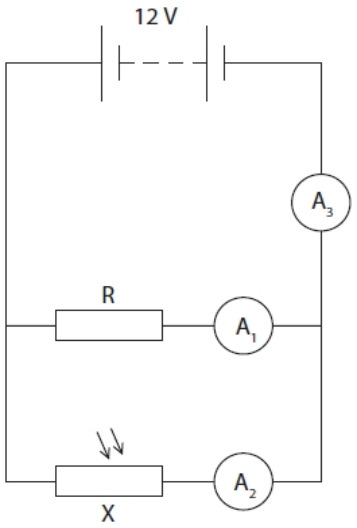
ii. Explain how the graph shows that the ball accelerates when it falls. [2]

_____

_____

Question 2

A 12 V battery is connected to a component, X, and a fixed resistor, R, as shown



Component X is a "light dependent resistor". As it detects more light in the room, its resistance goes down. If there is less light in the room, its resistance goes up.

a. Draw a voltmeter on the circuit diagram connected to show the voltage of component X. [2]

b. There are three ammeters in the circuit. State an equation linking A_1, A_2 and A_3 to compare the value that each one displays. [1]

_____

c. When the circuit is placed in daylight, the current in A_2 is 0.011 A. A_1 reads 0.024 A.

i. Calculate the value of the current through A_3. [1]

current = _____ A

continued…….

ii Explain what happens to the current through A_3 when the circuit is placed in a darkened room. [2]

_____

_____

_____

_____

Question 3

Wind is a renewable resource used to generate electricity.

d. State one advantage and one disadvantage of producing electricity using wind turbines. [2]

Advantage

_____

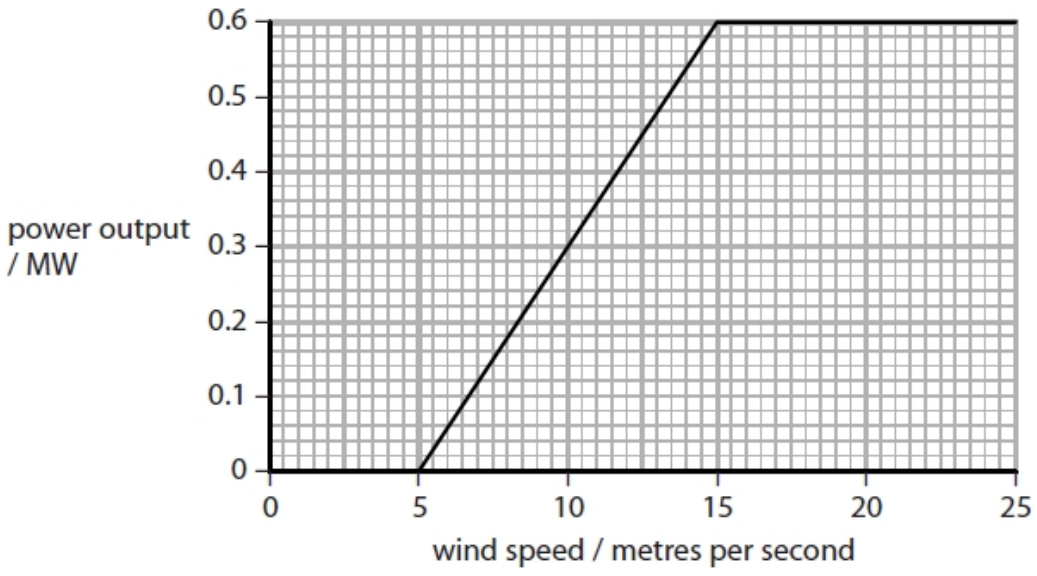
_____

Disadvantage

_____

_____

The graph shows how the power output of a wind turbine varies with wind speed.



e. Describe how the power output of a wind turbine varies with wind speed.
You should mention some specific data points from the graph in your answer. [3]

_____

_____

_____

_____

_____

_____

f. The wind at this location is blowing at 10 metres per second and exactly a third of the wind turbine's power output can be turned into useful electricity. How many wind turbines would be needed to provide power for a factory that requires 8 MW of electricity? (Remember to show all your working.) [3]

_____

_____

_____

_____

_____

_____

Total for PHYSICS: 20 marks

Biology

Question 1

Alice was walking near the seashore and noticed limpets attached to the rocks. She decided to investigate if the distance from the sea affects the population size of the limpets. To do this, she ran a string (known as a transect) from the shoreline 20 metres inland. At every metre along this string, she counted the number of limpets she observed in a $0.5m^2$ area using a quadrat (shown below). She decided to only count the common limpet within the quadrat and ignore other species.

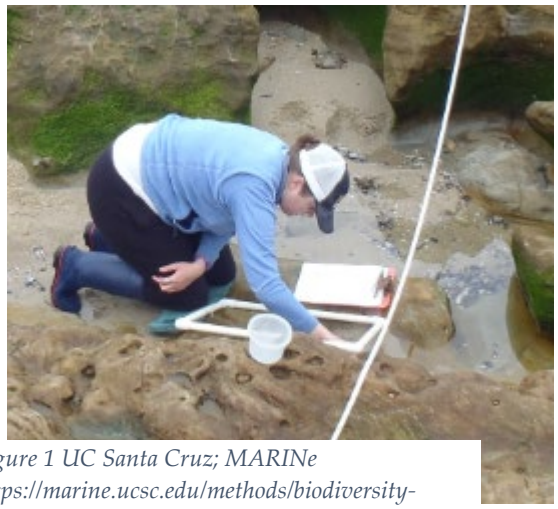


Figure 1 UC Santa Cruz; MARINe https://marine.ucsc.edu/methods/biodiversity-methods.html

a. What are the independent and dependent variables in this investigation? [2]

Independent variable:

_____

Dependent variable:

_____

b. Alice wants to repeat her investigation on another day. Give two other variables that would need to be kept constant when she repeats her sampling. [2]

_____

_____

c. Describe one possible source of error in this investigation which could have caused inaccuracies in her results. [1]

_____

_____

d. Limpets are marine snails and reside in the intertidal zone, meaning they spend time both in and out of the water. While submerged in water, many limpets practise external fertilisation in order to reproduce. What is meant by external fertilisation? [2]

_____

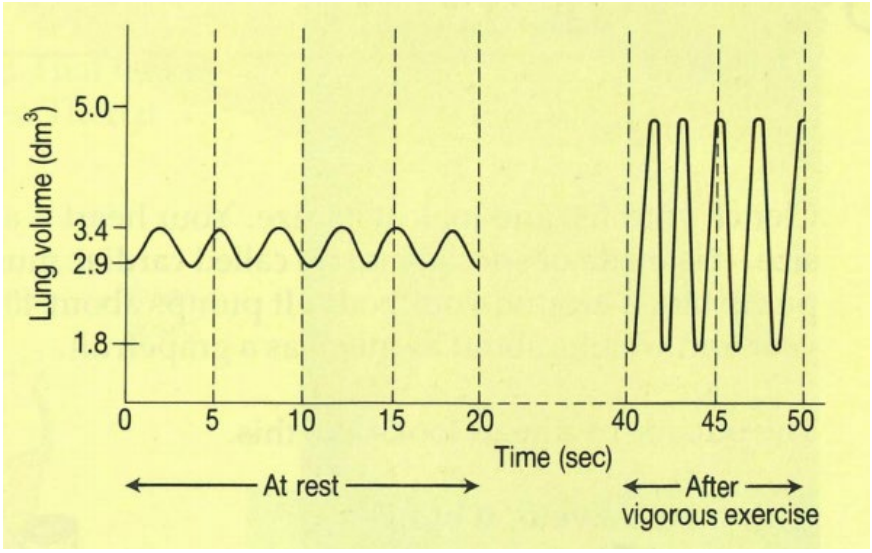
_____

_____

_____

Question 2

The graph below shows Kate's breathing rate before and after competing in a race. The distance between a peak and a trough on the graph is the volume of one breath.



a. Calculate the number of breaths per minute at rest and after running. [2]

At rest: _____

per minute

After running: _____ per minute

b. Calculate the volume of air breathed out each minute at rest and after running. [2]

At rest: _____ dm^3

After running: _____ dm^3

c. Explain the difference between these two volumes. [2]

_____

_____

_____

d. If this investigation was repeated, name two variables which should be kept the same. [2]

_____

_____

_____

Question 3

Sea otters are aquatic mammals which reside in shallow coastal waters of the Pacific Ocean in North America and Asia. Temperatures in these waters can range between 2 and 15°C. Sea otters sleep, hunt and give birth in water, rarely coming ashore. They have blunt teeth, sensitive forepaws, retractable claws and good vision above and below the water's surface. They feed on hard-shelled marine invertebrates such as sea urchins, clams, mussels and crabs. Sea otters have been known to use stone tools to break open the shells of their prey.

Figure 2 A sea otter photographed at Minnesota Zoo in Apple Valley PHOTOGRAPH BY JOEL SARTORE, NATIONAL GEOGRAPHIC PHOTO ARK

a. Using the information and image above, suggest how three of the sea otter's adaptations would aid its survival. [3]

_____

_____

_____

_____

_____

_____

b. Sea otters often prey on sea urchins, which in turn feed on kelp (large brown algae seaweeds). Kelp covers up to 25% of the world's coastline. An increase in the population of sea urchins has been known to devastate kelp forests.

Suggest two benefits for reducing the number of sea urchins in this food chain and maintaining kelp forests. [2]

_____

_____

_____

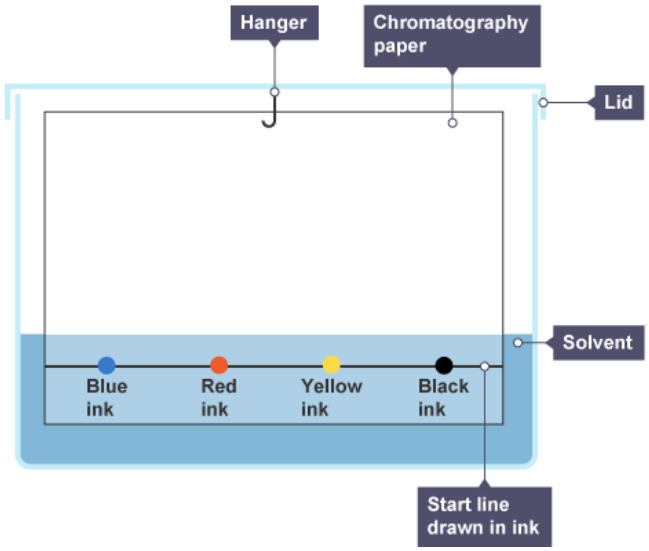
_____

Total for BIOLOGY: 20 marks

CHEMISTRY

Question 1

A student wants to find out the composition of a black ink. They use reference samples of red, blue and yellow inks which are pure substances. They set up their apparatus as shown below:



a. Describe what is meant by the term 'pure'. [1]

_____

_____

b. Explain how the student would be able to tell if the black ink contained any of the blue, red or yellow inks? [2]

_____

_____

c. The student has made two mistakes whilst setting up their apparatus. State and explain what these two mistakes are. [4]

Mistake 1: _____

Explanation: _____

_____

Mistake 2: _____

Explanation: _____

_____

Question 2

A flash grenade (pictured below) is used by the military and police to disorientate. The principles of the device are surprisingly simple.

A thick cardboard tube is filled with solid low explosive chemicals. Twisting the cap of the tube ignites a fuse which allows time for the device to be thrown. Upon detonation, the **solid** explosives turn into **gases**, the cardboard tube ruptures and a very loud noise and bright flash are created.

a. **With the aid of diagrams**, explain what happens to the arrangement of the particles in the grenade as they change from solid to gas. [4]

b. With reference to your answer to (a), explain why the cardboard tube ruptures. [2]

_____

_____

_____

c. Suggest the identity of a **metal** that could be added to the grenade in order to produce a bright white flash. [1]

_____

_____

_____

Question 3

When looking at the history of ancient civilisations, the chemistry of metals is a dominant feature. After all, two of the major 'ages of man' are the Bronze Age and the Iron Age. The main metals of ancient metallurgy were:

Gold	Lead
Silver	Iron
Copper	Bronze (copper-tin alloy)
Tin	Brass (copper-zinc alloy)

a. The Bronze Age began c.3300 BCE whereas the Iron Age began c.1200 BCE. Using your knowledge of the reactivity of metals, explain why the Bronze Age pre-dated the Iron Age. [3]

b. Despite being metals of the ancient world, copper and iron are still used abundantly in today's society. Copper is still used in home plumbing for creating water pipes. Explain why copper is more suitable for this purpose than iron. [1]

c. Modern production of iron involves the following reaction:

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

With reference to the equation, discuss the environmental impact of the production of iron. [2]

Total for CHEMISTRY: 20 marks