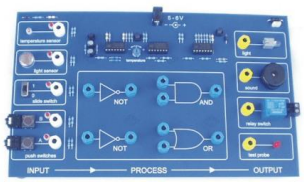
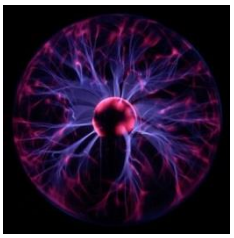
S3 CfE Physics

Homework Booklet

Monifieth High School





Name:

Form Class:

Physics teacher:

Table of Contents

EXPLORING SPACE

1. Explain why astronomers want to explore the universe.

2. State how you make use of a part of the electromagnetic spectrum in your everyday life.

3. Describe the difference between a reflecting telescope and a refracting telescope.

4. Draw a labelled diagram of a refracting telescope.

5. Write an A4 newspaper article about the Hubble space telescope. Include the following points:

- Who owns the telescope
- How much the telescope cost
- How the cost compares to other telescopes
- How the cost compares to other things
- What the telescope has taught us about the universe
- Whether you think the cost of the telescope is worth it or not

6. Pick a planet within our solar systems and find out:

a. When it was discovered
b. Who discovered it
c. What type of telescope they used
d. How far away from Earth it is

7. State what is meant by an exo-planet.

8. Explain how astronomers can detect exo-planets.

9. Describe what is meant by the term “Goldilocks zone”.

10. An astronomer measures the brightness of a distant star for 2 years.

The data is shown in the table below:

Date of data collection	Brightness of star (Lux)
January 2012	5
April 2012	4
July 2012	3
October 2012	2
January 2013	3
April 2013	4
July 2013	5
October 2013	4

a. Plot a graph of the data collected by the astronomer.
b. What brightness does the astronomer measure in October 2013?
c. Predict the brightness the astronomer would measure in January 2014?
d. Sketch a line on the graph to show what data the astronomer would expect for a second planet which is closer to the star.

11. The table below represents the electromagnetic spectrum

Radio & TV waves	A	Infrared radiation	Visible light	Ultraviolet light	X-rays	Gamma radiation

a) What is meant by the term “electromagnetic spectrum”?
b) What speed do the all of the members of the electromagnetic spectrum travel at?
c) Name part A.
d) What property do all the parts of the electromagnetic spectrum have in common?

e) Which part of the spectrum has the highest energy?

12. Now that you have studied Space Physics you are all destined to be astronauts. It may get a little crowded in space so think of the knowledge and skills you have acquired from this part of the course and how they could be used in careers here on Earth. Make a list and justify your choices.

13. Read ‘Mission to Mars’, on the page opposite so that you can answer the following questions.

a. What is certain in this article?

b. What is uncertain in this article?

c. What is the purpose of the mission?

d. What do you think the scientists analysing data from this mission might find?

14. Make a table, in your jotter, to show which objects, or bodies, in space give out which parts of the electromagnetic spectrum.

15. A student wants to investigate how the apparent brightness of a star is affected by its distance from Earth and sets up a ‘mini experiment’ in her physics class. She gathers her equipment: ray box, power supply, metre stick and a light level metre.

a) With the aid of a labelled diagram describe how she could set up her apparatus.

b) State what her independent variable is, what her dependent variable is and what her controlled variables are.

c) One of her classmates says that the investigation would be better if she did it alone in a darkened room. Is the classmate correct? Justify your answer.

16. List some of the advantages and disadvantages of exploration.

THE NEED FOR SPEED

1. Explain the difference between measuring average and instantaneous speed.

2. In an experiment to measure instantaneous speed, these measurements were obtained:-

   Time on light gate = 0.125 s

   Length of car = 5 cm

   (a) Can these values be used to calculate average or instantaneous speed?

   (b) Calculate the speed of the vehicle in m/s.

3. Describe how you would measure the acceleration of a small vehicle as it runs down a slope in the laboratory.

4. A car reaches 30 m/s from a speed of 18 m/s in 6 s. What is its acceleration?

5. Copy and complete:

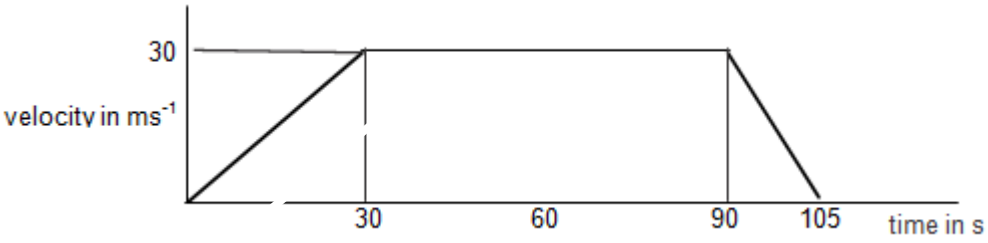
Starting speed (ms^{-1})	Final speed (ms^{-1})	Acceleration (ms^{-2})	Time (s)
0	15	(a)	5
30	10	(b)	5
0	18	6	(c)
0	(d)	9	3
(e)	32	4	7

6. Explain the difference between the terms speed and acceleration

7. Calculate the acceleration of these vehicles in **m/s/s**:

Make	Model	Photo	Top speed	Time from 0 – 60mph	Time to cover 1 mile
BMW	Active E Coupe		90 mph	8.9s	67.3s
BMW	M Coupe		120 mph	4.4s	53.1s
Ford	Fiesta SES		99mph	8.6s	66.4s
Ford	C Max		127 mph	9.7s	51.2s
Nissan	Juke SL		130 mph	7.4	52.4s

8. Use the graph below to answer the following questions.



(a) During which time is the vehicle travelling at a constant speed?

(b) Calculate the values of

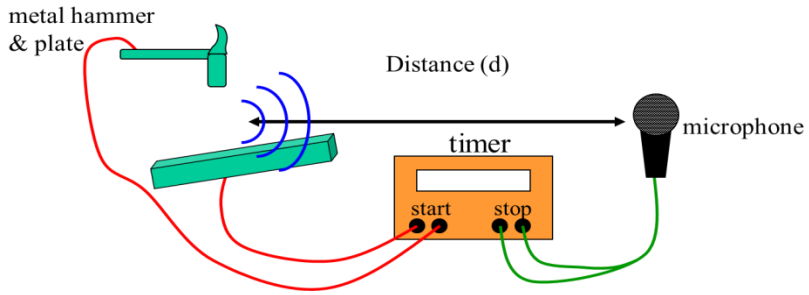
(i) the initial acceleration

(ii) the final deceleration

9. In your view is it worth trying to build a car that can reach 1000 mph? Explain and justify your view.

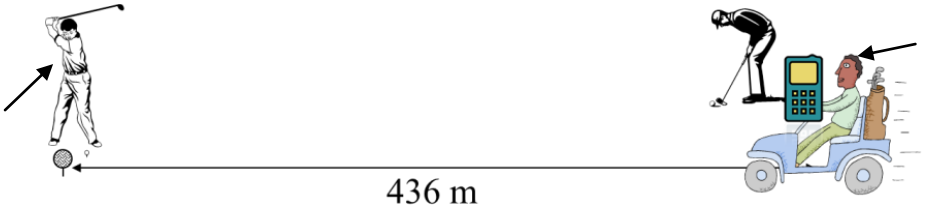
SOUND ENGINEERING

1. The following apparatus was set up to measure the speed of sound:



(a) Describe how you would use this apparatus to measure the speed of sound.
(b) If the distance between the hammer and microphone was increased, would this give you a more accurate or less accurate result? Explain your answer.

2. Physics teacher, Paul, is waiting at the green of the 18th hole at Monifieth golf course. He sees his friend, Danny, about to tee off. The tee is 436 metres away from Paul, who quickly decides that this would be a perfect opportunity to measure the speed of sound. Luckily his mobile phone is equipped with a stopwatch.



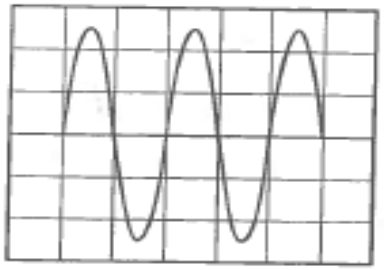
(a) Describe how Paul measures the speed of sound on the golf course.
(b) Explain whether or not you think he will get an accurate result.

3. What is the speed of sound in air in m/s?

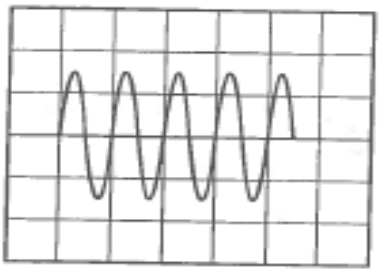
4. Calculate how far travels in air in sound:

(a) 1 second (*b*) 3 seconds (*c*) 10 seconds.

5. The diagram shows waves for whistles 2 and whistle 3:



whistle 2

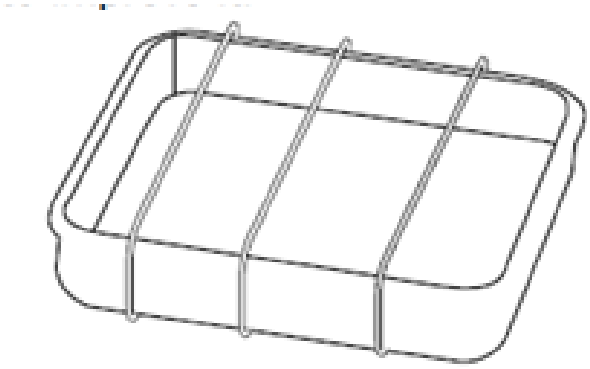


whistle 3

Compare the loudness and pitch of whistle 2 and whistle 3.

6. What do waves carry?

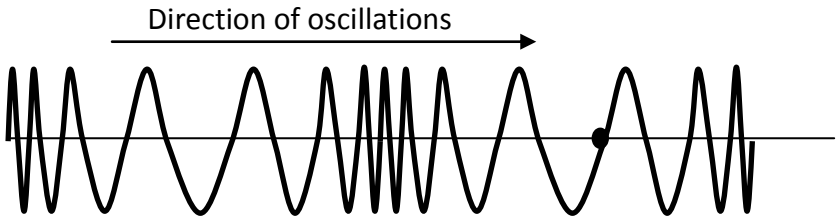
7. Fiona has made a musical instrument with three stretched strings on a metal tin. She wants to improve it.



a. What can she do to make it louder?

b. All the strings make a similar-pitched note when plucked. How can she change a string to make it higher pitched?

8. A “slinky” can be used to show different types of wave.



(a) The diagram above shows a sound wave. What type of wave are sound waves?
(b) The wave is moving from left to right. Describe how point X on the wave is moving.

9. Complete the sentences using the words below:

vibrations particles solids liquids gases vacuum

Sound is caused by _____ .These can pass through _____ ,

_____, and _____, but not through a_____ ,

because there are no _____ .

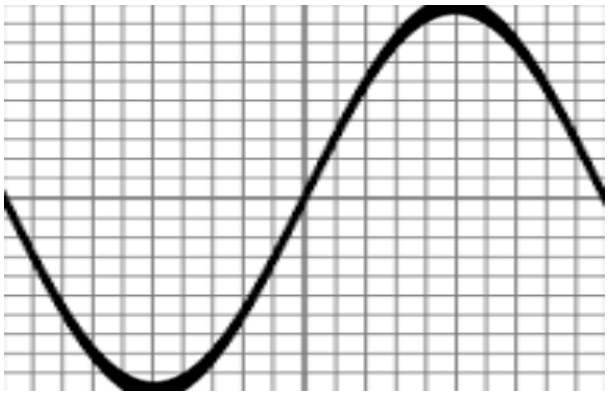
10. If a wave machine produces 5 waves each second what is the frequency of the machine?

11. A man stands on a beach and counts 40 waves hitting the shore in 10 seconds. What is the frequency of these waves?

12. Some sound waves have a frequency of 10 000 Hz. How many of these waves will be produced in 100 seconds?

13. A tuning fork makes a sound with a frequency of 440 Hz. How long does it take to produce 2 200 waves at this frequency?

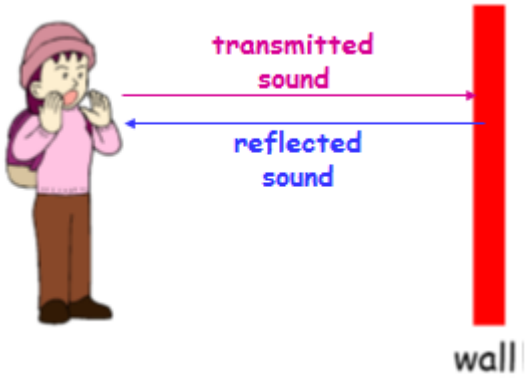
14. Look at the oscilloscope trace below, which represents a sound from a keyboard.



(a) Draw the trace that would be obtained if a note of higher pitch but same volume was played.

(b) Draw the trace that would be obtained if the same note was played at a louder volume.

15. Neve shouts at a brick wall. After 0.8 s she hears an “echo” – the sound of her shout reflected off the wall.



Calculate how far away from the wall Neve is.

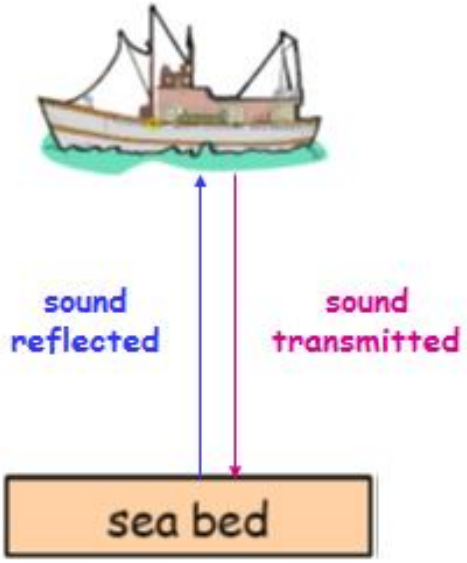
16.

To find the depth of water beneath its hull, a fishing boat sends a pulse of sound through the water from its hull to the sea bed.

After 1.4 s, the fishing boat detects the sound pulse reflected from the sea bed.

How deep is the sea?

The speed of sound in water is 1500m/s.



17. State the frequency range of human hearing.

SHOCK AND AWE

1a. Where and when have you used electricity today?

1b. Explain how the need for electricity impacts on society in large.

2a. What is an electrical current?

2b. What is used to measure electrical current and how is it connected into a circuit?

2c. In what units is electrical current measured?

2d. Draw a circuit diagram to show how the current through a bulb could be measured.

3a. What is voltage?

3b. What is used to measure voltage and how is it connected into a circuit?

3c. In what units is voltage measured?

3d. Draw a circuit diagram to show how the voltage across a bulb could be measured.

4a. Plot a graph of this data collected for a resistor

Voltage (V)	Current (A)
0	0
1	0.14
2	0.31
3	0.46
4	0.58

5	0.77
6	0.93

4b. What conclusion can be made from this data?

4c. What variables would need to have been controlled to make this data collection fair?

4d. What current would be read from the ammeter if a voltage of 13V was accidentally applied across the resistor?

5a. State Ohm's Law.

5c. Use Ohm's Law to calculate the missing values in this table: V = I R

	Voltage (V)	*Current* (A)	*Resistance* (Ω)
(*a*)		*15*	*35*
(*b*)	*230*		*125*
(*c*)	*120*	*12*	

6a. How many amperes is 0.1 mA?

6b. How many volts is 13 kV?

6c. What current flows through a 20 kΩ monkey struck by a 500 V lightning bolt?

7a. What is resistance?

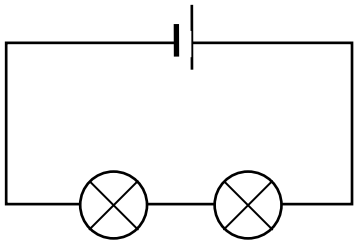
7b. State and explain three factors that affect resistance

7c. Describe how resistors can be used in everyday life.

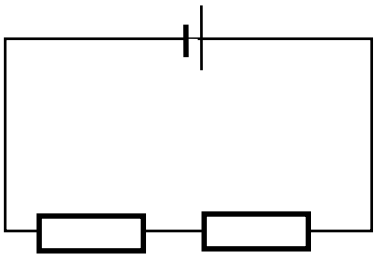
8a. Draw a circuit diagram to show how the resistance of a variable resistor could be determined?

8b. What happens to the current in the circuit as the resistance of the variable resistor increases?

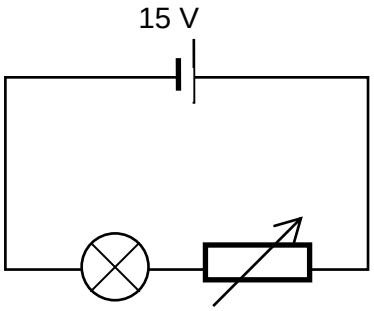
9a. Two bulbs are connected to a supply as shown. What is the voltage of the cell if both lamps have 3 V across them?



9b. Two resistors are connected in series to a supply as shown in the diagram. If the supply voltage is 12 V and one of the resistors is found to have 5 V across it, what will be the reading on a voltmeter placed across the other resistor?



10. A rheostat (variable resistor) is used as a dimmer switch in a series circuit as shown.

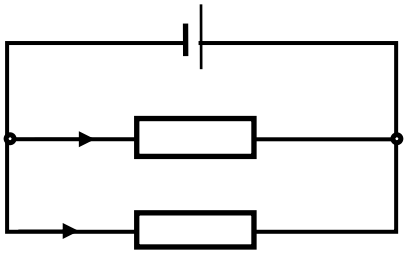


The rheostat is adjusted until the bulb is shining brightly. The voltage across the bulb is 13·8 V and the current through the rheostat at this setting is 1·7 A.

(a) Calculate the voltage across the rheostat.

(c) Determine the current flowing in the bulb.

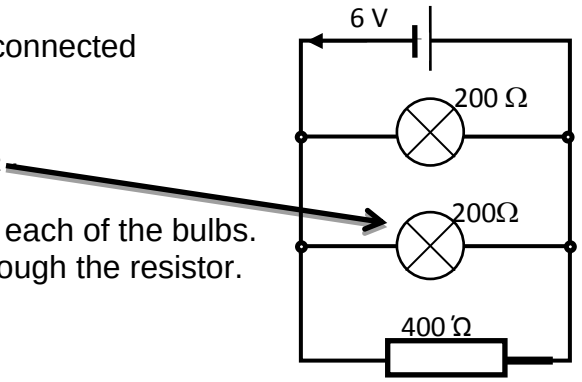
11. Two identical resistors are connected in parallel to a 12 V battery.



(a) Determine the voltage across R_1.

(b) Determine the voltage across R_2.

12. Two identical bulbs and a resistor are connected in parallel to a 6 V supply.



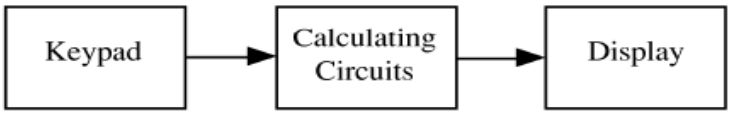
(*a*) Determine the voltage across L_2

(*b*) A current of 1·8 A flows through each of the bulbs. Calculate the current flowing through the resistor.

ELECTRONICS

1. Describe what is meant by an electronic system. Give two examples.

2. The block diagram for a calculator is shown below. Copy the block diagram and identify the input, process and output subsystems.



3. Draw a block diagram of the following systems. Identify the input, process and output subsystems in each case.

   (a) A public address system
   (b) A smoke alarm
   (c) An automatic porch light (lamp lights when it gets dark)
   (d) An automatic fan (fan operates when it gets too warm)
   (e) A radio

4. What is sensed by each of the following input devices?

   (a) microphone
   (b) thermistor
   (c) light dependent resistor
   (d) switch

5. What can change the resistance of a thermistor?

6. State how the resistance of a light dependent resistor changes with light level.

7. Describe an experiment you would perform to determine how the resistance of a thermistor changes with temperature.

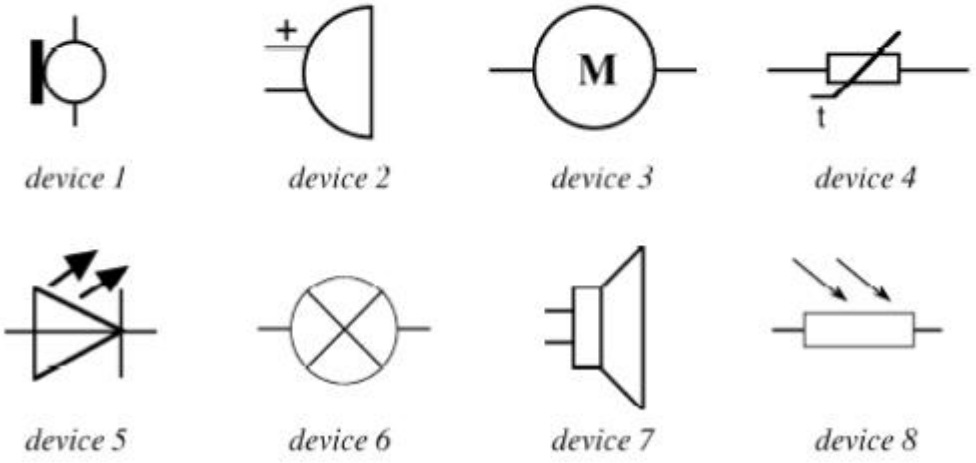
8. Describe an experiment you would perform to determine how the resistance of a light dependent resistor changes with light level.

9. Describe how you would use an oscilloscope to examine the output signal from a microphone. Describe what is seen on the oscilloscope screen.

10. Describe the energy changes which take place in the following output devices:
    loudspeaker, buzzer, lamp, light emitting diode (LED), electric motor.

11. Study the circuit symbols below. In each case:

(a) name the device
(b) state whether it is an input or output device
(c) state the energy changes in the device
(d) give an example of where it could be used.



device 1 *device 2* *device 3* *device 4*

device 5 *device 6* *device 7* *device 8*

12. In the applications below identify which of the above devices would be suitable. Give a reason for the choice of each device.

(a) Output of a radio
(b) Input of an automatic lamp
(c) Input of a heating controller
(d) Output of a fan
(e) Output of an electronic timer

13. Describe what is meant by a "digital signal".

14. Draw an oscilloscope trace of a digital signal.

15. Draw the symbol for the following logic gates:

(a) NOT gate or Inverter
(b) AND gate
(c) OR gate.

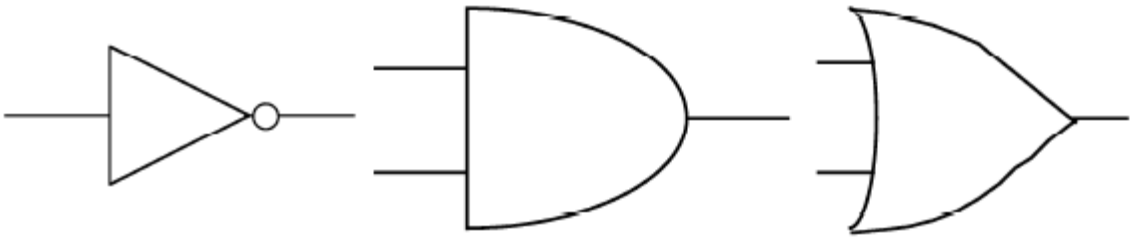
16. The following is a truth table for a logic gate.

Input	Output
0	1
1	0

(a) Name the logic gate.
(b) Explain in terms of voltage levels, what is meant by the "1"s and "0"s.

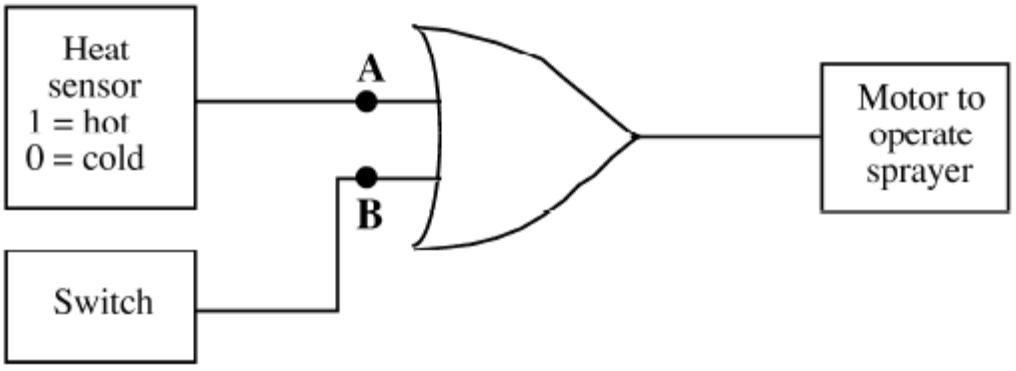
17. For each of the logic gates shown below:

(a) Name the gate
(b) Draw the truth table
(c) Describe the operation of the gate in words.



Gate 1 *Gate 2* *Gate 3*

18. The system below is designed to allow water to be sprayed on to plants if the air becomes too hot **or** the gardener switches the sprayer on.



(a) Identify the logic gate used in the system.
(b) The gardener switches the sprayer on. What is the logic level at B?
(c) What input device could be used in the heat sensor?

19. (a) Plot a graph of this data collected for a temperature sensor.

Temperature (^{0}C)	Resistance (kΩ)
10	62
20	34
30	17
40	9
50	5
60	3
70	1

(b) What can you conclusion can be made from this data?

(c) What variables would need to have been controlled to make this data collection fair?

(d) What resistance would the temperature sensor have at 25^{0}C?

20. (a) Give an example of an electronic system.

(b) What are the input, process and output devices needed for the example you gave?

(c) Draw a truth table for the example you gave.

UNDER PRESSURE

1. Calculate the weight of each of the following on Earth where the gravitational field strength is approximately 9.8 N/kg :

   (a) a girl whose mass is 50 kg
   (b) a dog of mass 20 kg
   (c) a 9 kg box
   (d) a ball of mass 0·5 kg

2. Which row of values in the table would result in the largest weight of an object?

	Mass	**Gravitational field strength**	**Height**	**Speed**
A	10	10	200	10
B	100	10	200	10
C	10	10	400	10
D	10	10	400	20
E	200	10	400	10

3. A student makes the following statements about the weight of an object.

   I Weight is measured in kilograms.
   II An object's weight will never change.
   III Weight is a force.

   Which of the statements is/ are correct?

   A I only
   B III only
   C I and II only
   D II and III only
   E I, II and III

4. A car weighs 13 kN on Earth.
   (a) What is the mass of the car?
   (b) What is the downwards force, caused by gravity, on the vehicle on Earth?

5. Tyre manufacturers list the recommended pressures for tyres.

(a) State what is meant by pressure.

(b) Explain why the use of large tyres helps to prevent a tractor from sinking into soft ground.

6. What happens to the inside of a tyre when air is pumped into it?
   A the temperature increases
   B the pressure decreases
   C the temperature decreases
   D the pressure increases
   E the pressure stays the same

7. Pressure is measured in
   A Newtons
   B Amps
   C Kilograms
   D metres per second
   E Pascals

8. If you want to rescue someone who has fallen through ice on a pond, would it be easier to walk or crawl across the ice towards them? Explain why.

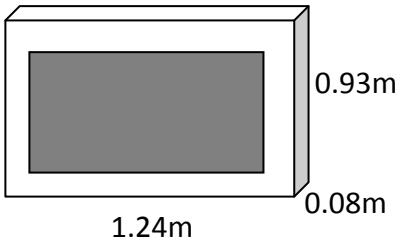
9. An elephant can exert a force of 5000 N by pressing his foot on the ground. If the area of his foot is 0.02 m^2, calculate the pressure exerted by his foot.

10. A water tank has a weight of 9 800 N and a base area of 20 m^2. It sits on a floor. Calculate the pressure exerted by the tank on the surface of the floor.

11. A syringe has a piston with a cross-sectional area of 2 x 10^{-4} m^2. The piston is pushed with a force of 12 N. Calculate the pressure.

12. A drawing pin has a sharp point with an area of 1x 10^{-8} m^2. Calculate the pressure exerted by the point when the head is pushed with a force of 8 N.

13. A television has a length of 1.24 m, a height of 0.93 m and a depth of 0.08 m.



The mass of the television is 30 kg and it sits on a table.

(a) Calculate the weight of the television. This is the force it exerts on the table.

(b) Calculate the area of the television in contact with the table.

(c) Calculate the pressure on the table caused by the television.

14. Atmospheric pressure is the measure of the pressure generated by air in the atmosphere at sea level.

(a) Explain how the air generates this pressure.

(b) If atmospheric pressure is 100000 Pa, what force does the air exert on a wall of area 10 m^2?

15. A cyclist checks the tyre pressure before a long cycle on a hot sunny day.

The cyclist then checks the pressure after the long cycle.

Compare the value of the tyre pressure after the long run with the value before.

16. Explain, using the appropriate gas law, why a balloon will burst if you squeeze it.

17. Read the information below and use it to answer the questions that follow:

The Dangers of Scuba Diving

As scuba diving is a popular recreational sport, beautiful coral reefs and eerie shipwrecks around the world have become major tourist draws in their own right. However, it should not be forgotten that scuba diving is an extreme sport with its own peculiar injuries and potentially life-threatening hazards. Most of these scuba diving dangers stem from the effects of the increased water pressure of the undersea environment, but there are also dangers posed by sea life and faulty equipment.

<u>Barotrauma</u>

Barotrauma is caused by the damage done by increased underwater pressure on the air pocket in the middle ear. Divers usually "equalize" during a dive by pinching their nose shut and blowing, by chewing or by swallowing to push more air into the middle air. However, a descent that is too fast can result in severe pain and even injury to the middle ear.

<u>Decompression Sickness</u>

Often called "the bends," decompression sickness is caused by increased underwater pressure causing the body's tissues to absorb more nitrogen. If that

pressure is suddenly reduced, this extra nitrogen forms potentially harmful bubbles. Deep divers return to the surface in carefully monitored stages so as to control the rate at which this absorbed nitrogen is released. A case of the bends can range from aching joints or a skin rash to paralysis and death.

Nitrogen Narcosis

Another nitrogen-related danger is the narcotic effect of all that extra nitrogen in the body. Nitrogen narcosis is a danger because it impairs judgement and sensory perception. As with the bends, the degree of nitrogen narcosis is related to how deep a diver goes and how much nitrogen they absorb.

Oxygen Toxicity

Oxygen toxicity is usually a problem only encountered by deep divers who go below 135 feet. The body absorbs extra oxygen under increased underwater pressure. For most divers this is not a problem, but at extreme depths so much extra oxygen is absorbed that this life-giving gas becomes a poison. The effects range from tunnel vision and/or nausea to twitching to loss of consciousness and/or seizures.

Pulmonary Embolism

Another risk facing a diver who rapidly ascends to the surface is pulmonary embolism. The increased pressure of the undersea environment results in extra gas being crammed into the same lung space. A rapid rise to the surface can cause the lungs to swell and even pop like a balloon because the water pressure decreases. Scuba divers guard against pulmonary embolism by making slow, controlled ascents to the surface and by never holding their breath.

Sea Life

Divers should never forget that each dive is the equivalent of entering an untamed wilderness. While most sea creatures are not aggressive towards divers and attacks are extremely rare, incidents do happen and a diver cannot afford to forget that she is surrounded by wild animals. The famed TV wildlife host "Crocodile Hunter" Steve Irwin was killed in 2006 when he was stung through the chest by a stingray, a frequently encountered and usually harmless sea creature. Divers should always treat sea life with great care and respect.

Defective Equipment

Many casual scuba divers do not own their own equipment, and are therefore reliant on renting equipment from the scuba diving operator who is conducting their dive trip. A broken depth gauge could lead to a mild case of decompression sickness, while a bad regulator might result in drowning. A diver should always thoroughly check rented scuba diving equipment, and never be shy about asking for a new piece of gear if they suspect something is wrong with what they have.

(a) Which part of the body can be damaged by “barotrauma”?

(b) How can a diver prevent or reduce the effect of barotrauma?

(c) What is the scientific term for “The Bends”?

(d) “The Bends” is caused by the body absorbing which gas?

(e) What other condition can be caused by the body absorbing too much of the gas in part (d)?

(f) In high pressure environments, like deep sea, the body can absorb too much oxygen.
What are the effects of this?

(g) If a diver gets into difficulty underwater, should the diver swim to the surface as quickly as possible? Explain your answer.

(h) Apart from the dangers due to the change in water pressure, name two other hazards that might face a diver.