Name: …….

Year 11 Preparation
Wyke 2020
A-level Physics

A Level Physics is a difficult but rewarding subject for the dedicated student.

This booklet is designed to prepare you for A-Level Physics.

It covers many areas of physics which **you must be competent** in before starting an A-level physics course.

These questions require the use of **knowledge and understanding from GCSE** and may require some **research** in order to find the answers.

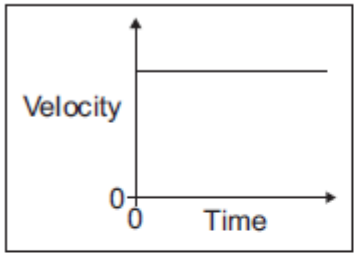
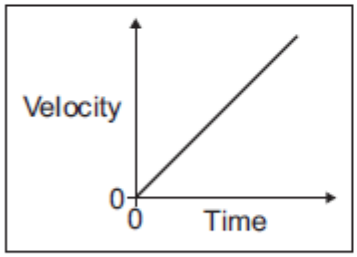
This booklet **must be completed and handed in** to your physics teacher during the **first lesson** of the Year 1 Physics course in September.

At the beginning of each of the 5 sections there is be a weblink should you need any help.

Wyke Physics Summer Work 2020

Section 1: Energy (https://www.bbc.co.uk/bitesize/guides/z8pk3k7/revision/1)

Q1.(a) Draw **one** line from each velocity−time graph to the statement describing the motion shown by the graph.

Velocity–time graph	Motion shown by graph
	Constant acceleration
	Not moving
	Constant deceleration
	Constant velocity

(2)

(b) Use the correct answer from the box to complete the sentence.

energy	momentum	speed

The velocity of an object includes both the _____ of the object and the direction the object is moving.

(1)

(c) At the start of a race, a horse accelerates from a velocity of 0 m/s to a velocity of 9 m/s in 4 seconds.

(i) Calculate the acceleration of the horse.

_____

_____

Acceleration = _____ m/s^2

(2)

(ii) When the horse accelerates, what, if anything, happens to the air resistance acting against the horse?

Tick (✓) **one** box.

The air resistance decreases	☐
The air resistance is constant	☐
The air resistance increases	☐

(1)

(d) A horse and a pony walk across a field at the same constant speed.

The horse has 4000 joules of kinetic energy.

The pony is **half** the mass of the horse.

What is the kinetic energy of the pony?

Draw a ring around the correct answer

2000 J **4000 J** **8000 J**

Give a reason for your answer.

_____

_____

(2)

(Total 8 marks)

Q2. The figure below shows a rollercoaster.

The rollercoaster car is raised a vertical distance of 35 m to point **A** by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

(a) Calculate the percentage efficiency of the motor.

Gravitational field strength = 9.8 N / kg.

Efficiency = _____ %

(5)

(b) The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

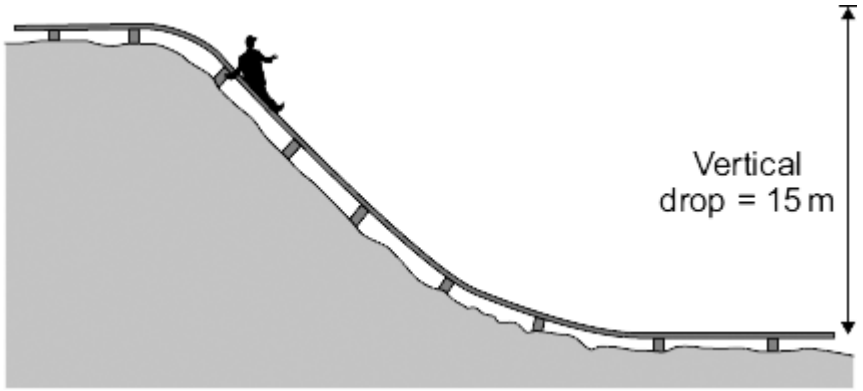
Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

Speed at point **B** = _____ m / s

(6)

(Total 11 marks)

Q3. The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.



(a) A miner of mass 90 kg travels down the slide.

Calculate the change in gravitational potential energy of the miner when he moves 15 m vertically downwards.

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

_____

_____

Change in gravitational potential energy = _____ J

(2)

(b) Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.

Show clearly how you work out your answer.

Give your answer to an appropriate number of significant figures.

_____

_____

_____

Maximum possible speed = _____ m/s

(3)

(c) The speed of the miner at the bottom of the slide is much less than the calculated maximum possible speed.

Explain why.

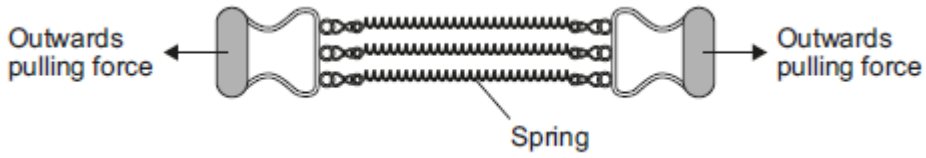
(3)

(Total 8 marks)

Section 2: Forces (https://www.bbc.co.uk/bitesize/topics/ztmttv4)

Q4. **Figure 1** shows an exercise device called a chest expander. The three springs are identical.

Figure 1



A person pulls outwards on the handles and does work to stretch the springs.

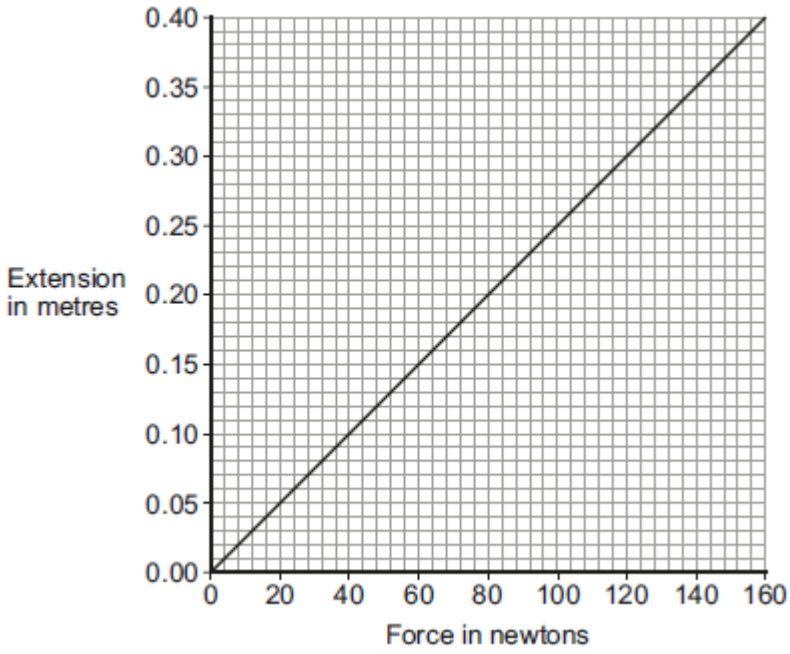
(a) Complete the following sentence.

When the springs are stretched _____ _____ energy is stored in the springs.

(1)

(b) **Figure 2** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 2



(i) How can you tell, from **Figure 2**, that the limit of proportionality of the spring has not been exceeded?

_____

_____

(1)

(ii) Use data from **Figure 2** to calculate the spring constant of the spring.
Give the unit.

_____

_____

Spring constant = _____ Unit _____

(3)

(iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 2** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

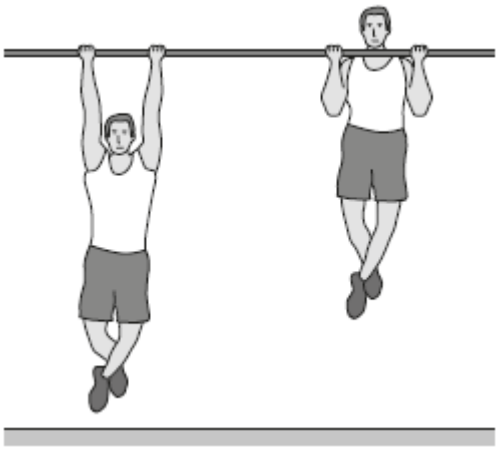
_____

_____

Total force = _____ N

(2)

(c) This student is doing an exercise called a chin-up.



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

_____

_____

Power = _____ W

(3)

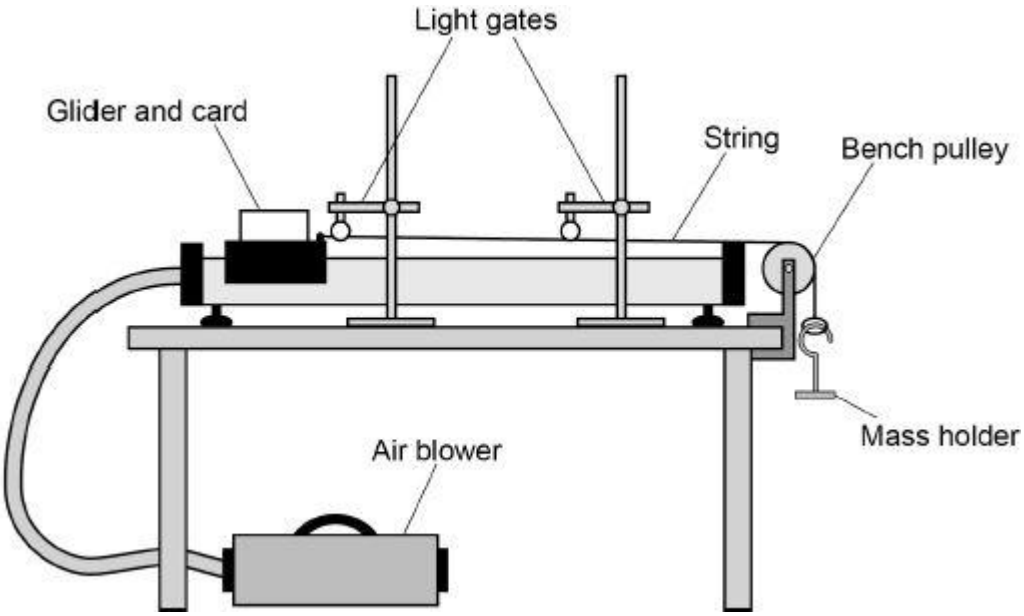
(Total 10 marks)

Q5. A student investigated acceleration using gliders, an air track and light gates.

The air track reduces friction between the glider and the track to zero.

Figure 1 shows the apparatus.

Figure 1



The glider was released from rest and moved along the track.

The mass holder hit the ground before the card passed through the second light gate.

(a) Which **two** statements describe the effect this would have on the glider?

Tick **two** boxes.

Its acceleration would decrease to zero. ☐

Its acceleration would increase. ☐

The resultant force on it would decrease to zero. ☐

The resultant force on it would increase. ☐

Its speed would increase. ☐

(2)

(b) The mass holder should **not** hit the ground before the card passes through the second light gate.

Suggest **one** way that the student could stop this happening.

_____

_____

(1)

The student increased the resultant force acting on the glider by adding more masses to the mass holder.

She calculated the acceleration of the glider for each resultant force.

Each test was done three times.

Table 1 shows the results.

Table 1

Resultant force in N	Acceleration in m/s^2			Mean acceleration in m/s^2
	Test 1	Test 2	Test 3	
0.20	1.3	1.2	1.3	1.26667
0.39	2.6	2.5	2.6	2.6
0.59	3.8	3.8	3.9	3.8
0.78	5.1	5.1	5.1	5.1
0.98	6.4	7.2	6.4	6.7

(c) The student made **two** mistakes in the mean acceleration column.

Identify the mistakes the student made.

Suggest how each mistake can be corrected.

Mistake _____

_____

Correction _____

_____

Mistake _____

_____

Correction _____

_____

(4)

(d) Write a conclusion for this investigation.

Use the data in **Table 1**

_____

_____

(1)

(e) The student used a constant resultant force to accelerate the glider.

The student changed the mass of the glider and calculated the new acceleration.

She repeated this for different masses of the glider, keeping the resultant force constant.

The results are shown in **Table 2**

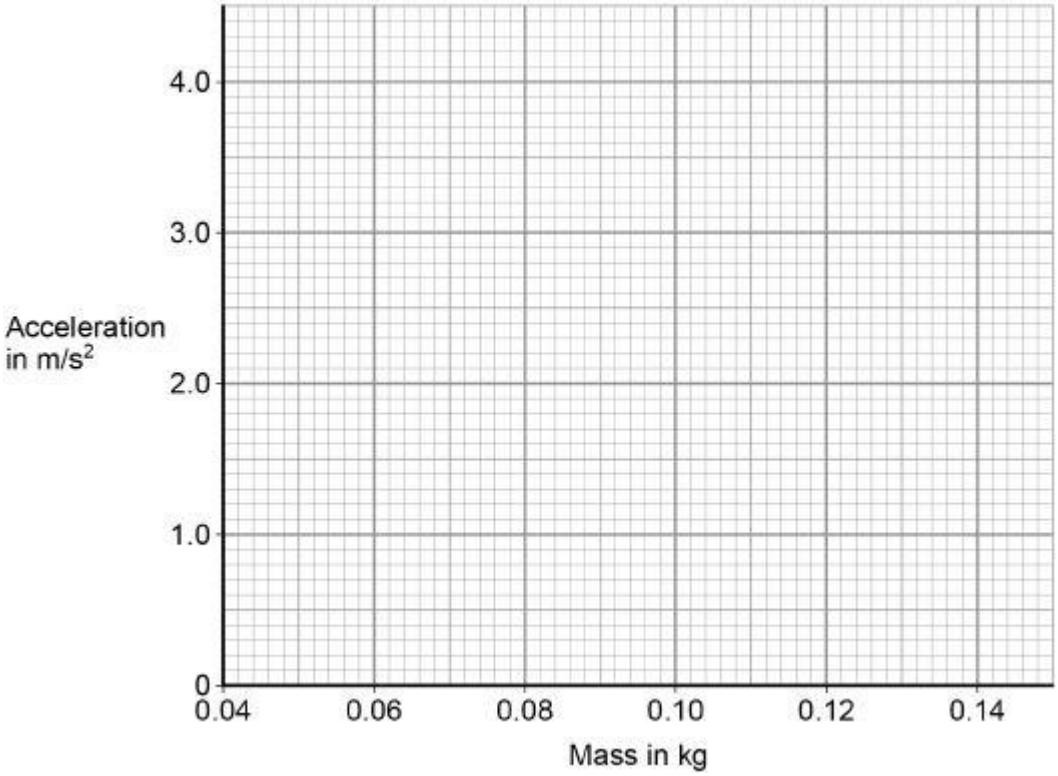
Table 2

Mass of the glider in kg	**Acceleration in m/s^2**
0.060	3.5
0.080	2.6
0.10	2.0
0.12	1.7
0.14	1.4

Plot the results on **Figure 2**

Draw a line of best fit.

Figure 2



(3)

(f) Describe the relationship between mass and acceleration.

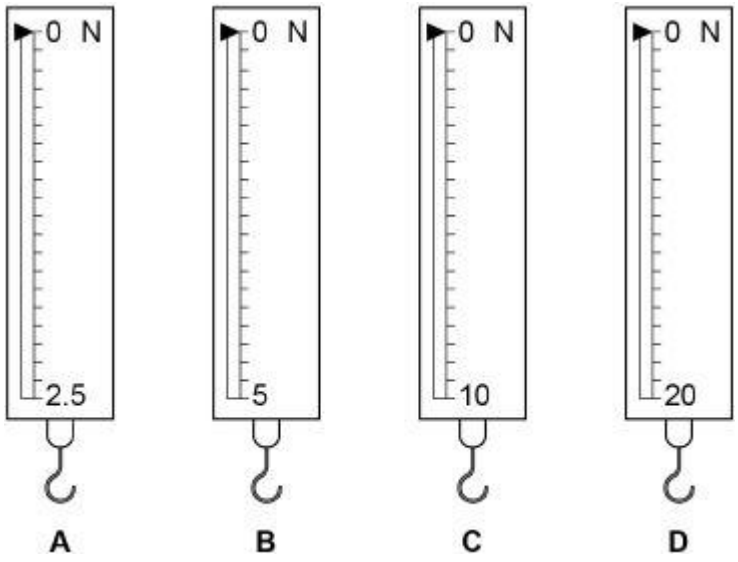
_____

_____

(1)

(Total 12 marks)

Q6. (a) Each of these four newtonmeter contains a spring.



Which newtonmeter has the spring with the greatest spring constant?

Give a reason for your answer.

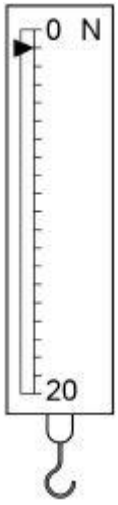
Newtonmeter _____

Reason _____

_____

(2)

(b) The newtonmeter below will give an error when used to make a measurement.



Name the type of error and describe how this error can be corrected.

Type of error _____

Correction _____

_____

(2)

(c) A student hangs a weight on a newtonmeter.

The energy now stored in the spring in the newtonmeter is 4.5×10^{-2} J

The student then increases the weight on the newtonmeter by 2.0 N

Calculate the total extension of the spring.

Spring constant = 400 N/m

Total extension = _____ m

(6)

(Total 10 marks)

Q7. The diagram below shows an ice skater, Skater A.

(a) Write down the equation that links mass, momentum and velocity.

_____

(1)

(b) Skater **A** travels with a velocity of 3.2 m/s and has a momentum of 200 kg m/s

Calculate the mass of Skater **A**.

_____

_____

Mass = _____ kg

(3)

(c) Skater **A** bumps into another skater, Skater **B**. Skater **B** is stationary.

The skaters move off together in a straight line.

Explain what happens to the velocity of each of the skaters.

Use the idea of conservation of momentum.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Section 3: Electricity (https://www.bbc.co.uk/bitesize/guides/zgvq4qt/revision/1)

Q8. A light dependent resistor (LDR) is connected in a circuit.

(a) Draw the circuit symbol for an LDR.

(1)

(b) A student investigated the relationship between current and potential difference for an LDR.

How should the student have connected the ammeter and voltmeter in the circuit?

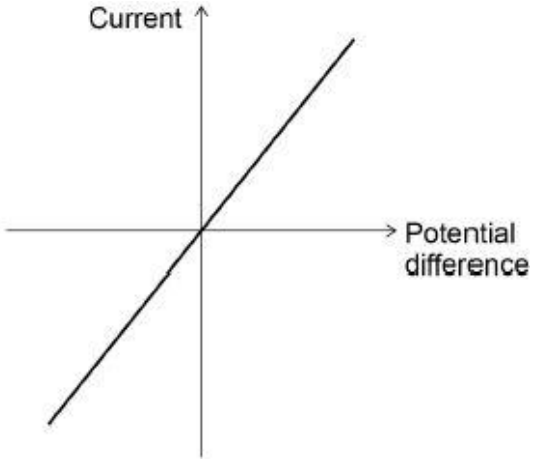
Tick **one** box.

Ammeter	Voltmeter	
in parallel with LDR	in parallel with LDR	☐
in parallel with LDR	in series with LDR	☐
in series with LDR	in parallel with LDR	☐
in series with LDR	in series with LDR	☐

(1)

The diagram below shows a sketch graph of the student's results.

The LDR was in a constant bright light.



(c) The student concluded that the current in the LDR is inversely proportional to the potential difference across the LDR.

Explain why the student's conclusion is incorrect.

_____

_____

_____

_____

(2)

(d) The student repeated the investigation with the LDR in constant dark conditions.

Sketch on the diagram above the graph for the LDR in constant dark conditions.

(2)

The LDR was placed near a light source.

The following results were recorded:

potential difference = 5.50 V

current = 12.5 mA

(e) Write down the equation that links current, potential difference and resistance.

_____

(1)

(f) Calculate the resistance of the LDR.

_____

_____

_____

_____

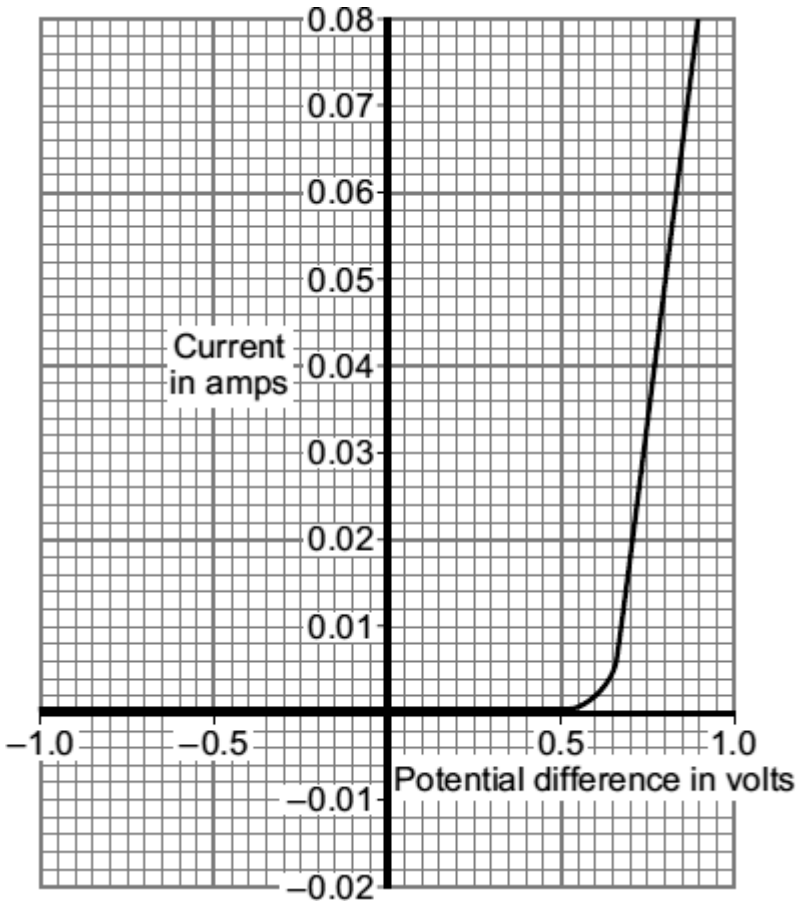
_____

Resistance = _____ Ω

(4)

(Total 11 marks)

Q9. The current-potential difference graph for one type of electrical component is drawn below.

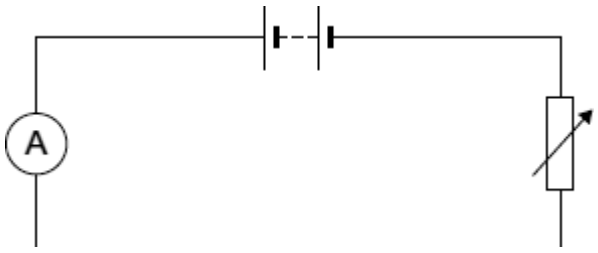


(a) What is the component?

_____

(1)

(b) Complete the diagram to show a circuit that can be used to obtain the data needed to plot the graph. Use the correct circuit symbol for each component that you add to the diagram.



(2)

(c) (i) What is the current through the component when the potential difference across the component is 0.8 volts?

Current _____ amps

(1)

(ii) Calculate the resistance of the component when the potential difference across it is 0.8 volts.

Show clearly how you work out your answer.

_____

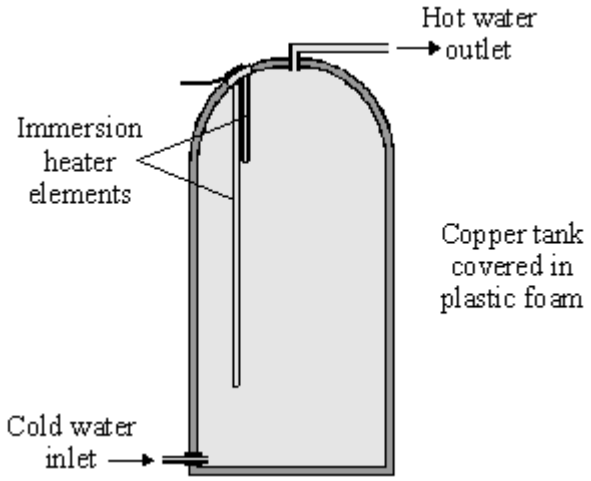
_____

Resistance = _____ Ω

(2)

(Total 6 marks)

Q10. The diagram shows a type of electric immersion heater in a hot water tank. These hot water tanks are normally found in airing cupboards.



Information on the immersion heater states:

230 V
10 A

(a) (i) What is the equation which shows the relationship between power, current and voltage?

_____

(1)

(ii) Calculate the power of the heater. Show clearly how you get to your answer and give the units.

_____

Power = _____

(2)

(b) (i) What rating of fuse should be in the immersion heater circuit?

_____

(1)

(ii) There are three wires in the cable to the immersion heater. Two of the wires are connected to the immersion heater. The third wire is connected to the copper tank.

Explain the function of this third wire and the fuse in the circuit.

_____

_____

_____

_____

(3)

(c) (i) What is the equation which shows the relationship between resistance, current and voltage?

_____

(1)

(ii) Calculate the resistance of the heater. Show clearly how you get to your answer and give the units.

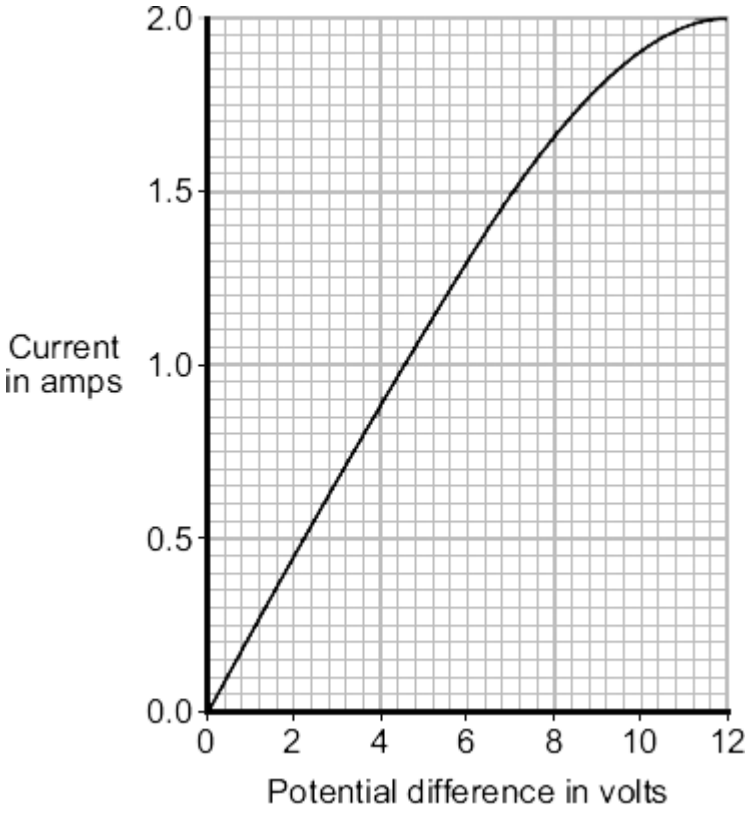
_____

Resistance = _____

(2)

(Total 10 marks)

Q11. The graph shows how the electric current through a 12 V filament bulb varies with the potential difference across the bulb.



(a) What is the meaning of the following terms?

electric current

_____

_____

potential difference

_____

_____

(2)

(b) The resistance of the metal filament inside the bulb increases as the potential difference across the bulb increases.

Explain why.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Use data from the graph to calculate the rate at which the filament bulb transfers energy, when the potential difference across the bulb is 6 V.

Show clearly how you work out your answer.

_____

_____

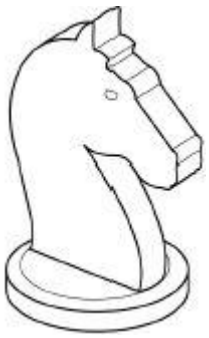
Rate of energy transfer = _____ W

(2)

(Total 7 marks)

Section 4: Atoms (https://www.bbc.co.uk/bitesize/guides/zqjy6yc/revision/1) (https://www.bbc.co.uk/bitesize/guides/z964y4j/revision/1)

Q12. A student wanted to determine the density of the irregular shaped object shown.



(a) Plan an experiment that would allow the student to determine the density of the object.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(b) Another student did a similar experiment.

He determined the density of five common plastic materials.

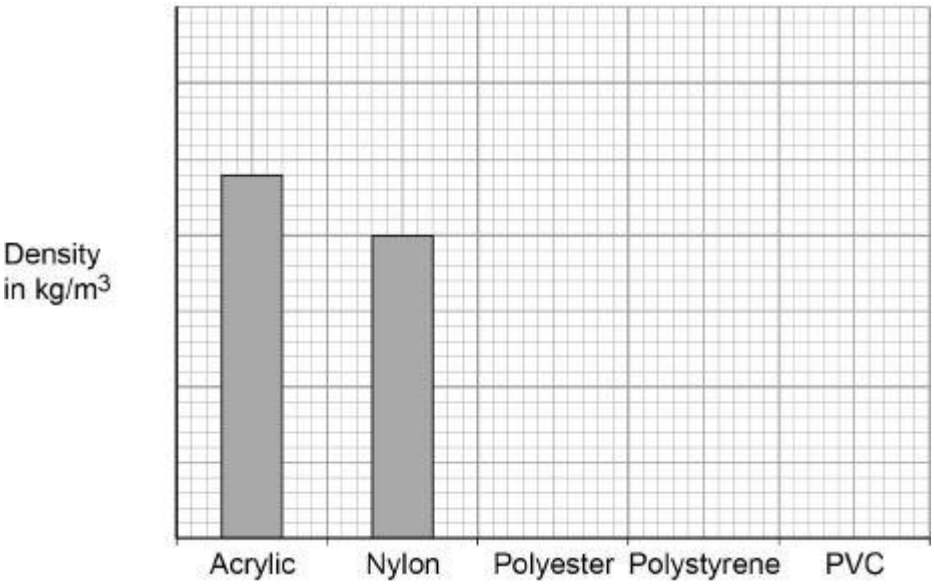
Table 1 shows the results.

Table 1

Plastic material	**Density in kg/m^3**
Acrylic	1200
Nylon	1000
Polyester	1380
Polystyrene	1040
PVC	1100

Figure 2 shows the results plotted in a bar chart.

Figure 2



Complete **Figure 2**

You should:

- Write the correct scale on the y-axis.
- Draw the bars for polyester, polystyrene and PVC.

(4)

(c) The student is given a piece of a different plastic material.

The student determined the density of the material three times.

Table 2 shows the results.

Table 2

	Density in kg/m^3
1	960
2	1120
3	1040

Determine the uncertainty in the student's results.

_____

_____

Uncertainty = _____ kg/m^3

(2)

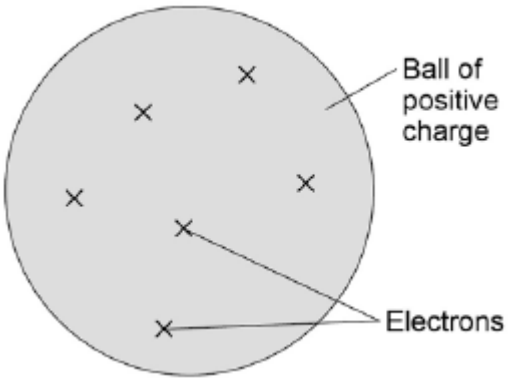
(Total 12 marks)

Q13. **Figure 1** shows the plum pudding model of the atom.

This model was used by some scientists after the discovery of electrons in 1897.

Figure 1

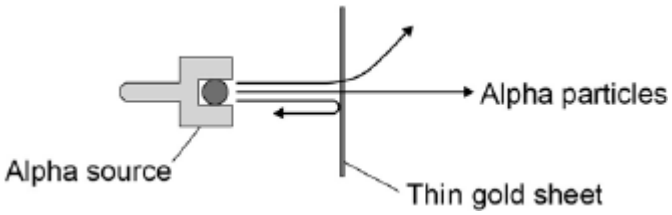
Plum-pudding model



In 1911 the scientists Geiger and Marsden investigated the effect of firing alpha particles at very thin sheets of gold foil.

Their experiment is shown in **Figure 2**. The arrows show the paths taken by alpha particles in the experiment.

Figure 2



(a) Explain why scientists replaced the plum pudding model of the atom with the nuclear model of the atom as a result of the experiment.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) According to modern measurements:

- the radius of an atom is about 1×10^{-10}m
- the radius of an atomic nucleus is about 1×10^{-14}m

Show that these values fit with the nuclear model of the atom.

(2)

(c) In 1931 a scientist discovered that there are hydrogen atoms with mass number 2 as well as hydrogen atoms with mass number 1.

A year later, another scientist discovered neutrons.

Explain why the discovery of neutrons could explain the presence of hydrogen atoms with different mass numbers.

(3)

(d) How would the results of the experiment shown in **Figure 2** change if neutrons were used instead of alpha particles to bombard a thin sheet of gold?

(2)

(Total 11 marks)

Q14. (a) Complete the sentences about atoms.

In an atom, the number of electrons is equal to the number of _____ .

All atoms of an element have the same number of _____ .

Isotopes of the same element have different numbers of _____ .

(3)

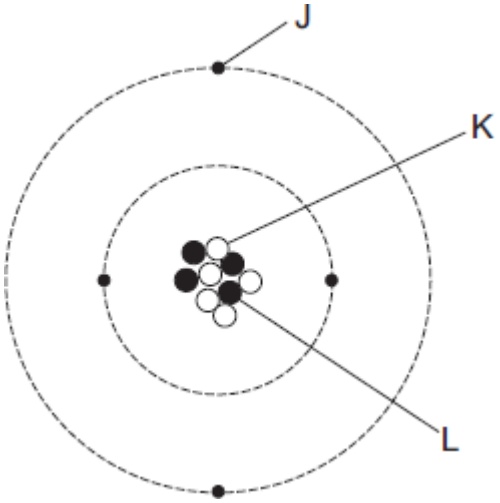
(b) Complete the sentence.

When an atom of a radioactive element emits alpha radiation, an atom of a different element is formed. A different element is formed because the radioactive element has lost _____ .

(1)

(Total 4 marks)

Q15. The diagram represents an atom of beryllium.



(a) Complete the following statements by writing one of the letters, **J**, **K** or **L**, in each box.

Each letter should be used only **once**.

The particle with a positive charge is ☐

The particle with the smallest mass is ☐

The particle with no charge is ☐

(2)

(b) Give the reason why all atoms have a total charge of zero.

_____

_____

(1)

(c) Complete the following sentence.

There are several isotopes of beryllium. Atoms of different beryllium isotopes will have different numbers of _____

(1)

(d) What happens to the structure of an atom to change it into an ion?

_____

_____

(1)

(Total 5 marks)

Q16. (a) The diagram represents 3 atoms, **K**, **L** and **M**.

(i) Which **two** of the atoms are isotopes of the same element?

_____ and _____

(1)

(ii) Give a reason why the **two** atoms that you chose in part (a)(i) are:

(1) atoms of the same element _____

_____

(2) different isotopes of the same element. _____

_____

_____

(2)

(b) The table gives some information about the radioactive isotope thorium-230.

mass number	230
atomic number	90

(i) How many electrons are there in an atom of thorium-230?

_____

(1)

(ii) How many neutrons are there in an atom of thorium-230?

_____

(1)

(c) When a thorium-230 nucleus decays, it emits radiation and changes into radium-226.

$$^{230}_{90}\text{Th} \longrightarrow {}^{226}_{88}\text{Ra} + \boxed{\text{Radiation}}$$

What type of radiation, alpha, beta or gamma, is emitted by thorium-230?

_____

Explain the reason for your answer.

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q17. Neon is an element. Neon is used in advertising signs.

(a) Explain why the atoms of neon give out electromagnetic radiation when the tube is connected to an electricity supply.

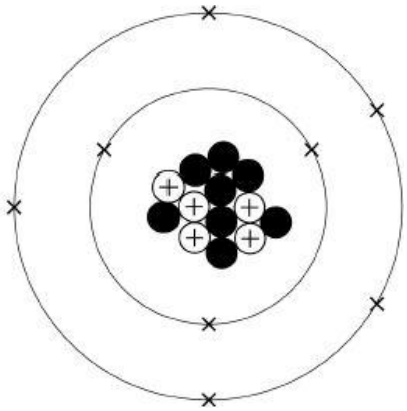
(4)

Some elements can have different isotopes.

(b) An isotope of carbon can be shown as $^{13}_{6}C$

Figure 2 shows an **incorrect** diagram of the structure of an atom of $^{13}_{6}C$

Figure 2



Explain why the diagram of the atomic structure shown in **Figure 2** is incorrect.

Give a reason for your answer.

(4)

Carbon-14 ($^{14}_{6}C$) is a radioactive isotope of carbon. Carbon-14 undergoes **beta** decay.

Figure 3 shows an incomplete nuclear equation for the radioactive decay of carbon-14.

Figure 3

$$^{14}_{6}C \longrightarrow {}^{14}_{7}N + \_\_\_\_$$

(c) Which of the following correctly completes the nuclear equation in **Figure 3**?

Tick **one** box.

- $^{0}_{-1}e$ ☐
- $^{-1}_{0}e$ ☐
- $^{1}_{0}e$ ☐
- $^{0}_{1}e$ ☐

(1)

(d) Explain the change in atomic number in the nuclear equation shown in **Figure 3**.

(2)

(e) The half-life of carbon-14 is 5730 years.

Carbon-14 is used for carbon dating. Carbon dating can tell us how old some objects are.

A skeleton was carbon dated. The results showed that there was only 12.5% of the original amount of carbon-14 left in the skeleton.

Calculate the age of the skeleton.

_____

_____

_____

_____

Age of skeleton = _____ years old

(2)

(Total 13 marks)

Q18. (a) Atoms of the isotope bismuth-212 decay by emitting either an alpha particle or a beta particle.
The equation represents what happens when an atom of bismuth-212 decays by beta emission into an atom of polonium-212.

$$^{212}_{83}\text{Bi} \longrightarrow {}^{212}_{84}\text{Po} + \text{beta particle}$$

(i) The bismuth atom and the polonium atom have the same mass number (212).

What is the *mass number* of an atom?

_____

(1)

(ii) Beta decay does **not** cause the mass number of an atom to change.

Explain why not.

_____

_____

_____

_____

(2)

(b) When an atom of bismuth-212 emits an alpha particle, the atom decays into an atom of thallium.

An alpha particle is the same as a helium nucleus.
The symbol below represents an alpha particle.

$$^{4}_{2}He$$

(i) The equation below represents the alpha decay of bismuth-212.

Complete the equation by writing the correct number in each of the two boxes.

$$^{212}_{83}Bi \longrightarrow \square \quad \square \; Tl + {}^{4}_{2}He$$

(2)

(ii) It is impossible for the alpha decay of bismuth-212 to produce the same element as the beta decay of bismuth-212.

Explain why.

_____

_____

_____

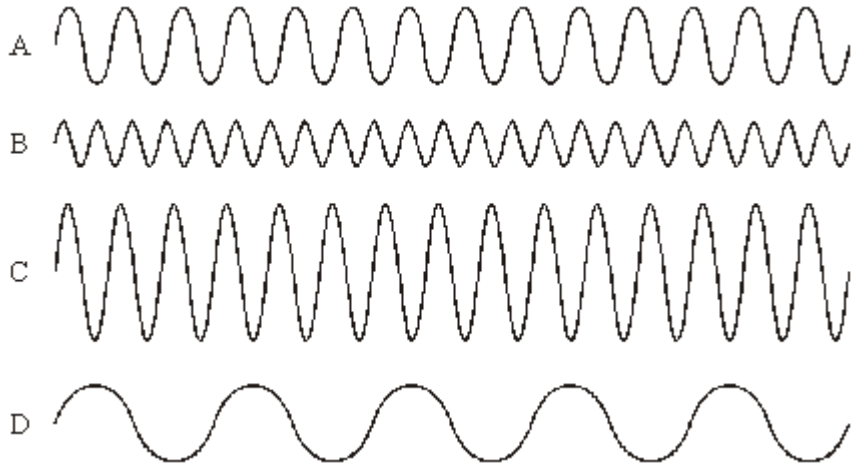
_____

(2)

(Total 7 marks)

Section 5: Waves (https://www.bbc.co.uk/bitesize/topics/z2j22nb)

Q19. The diagram shows oscilloscope traces of four waves, **A**, **B**, **C** and **D**. All four waves are drawn to the same scale.



Which wave has:

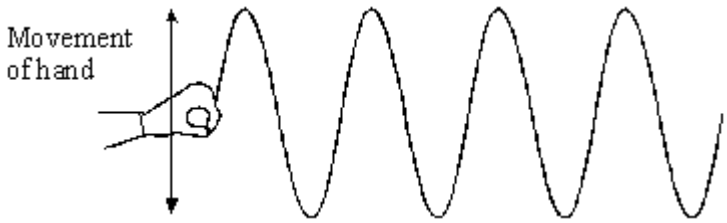
(a) the longest wavelength; _____

(b) the greatest amplitude; _____

(c) the highest frequency? _____

(Total 3 marks)

Q20. The diagram shows a wave travelling along a rope.



(a) On the diagram:

(i) show the wavelength and label it **W**;

(ii) show the amplitude and label it **A**.

(2)

(b) The wavelength of the wave is 0. I m. Its frequency is 2 Hz.

Calculate the speed of the wave. Show clearly how you work out your answer and give the unit.

Speed of wave _____

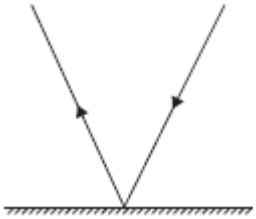
(3)

(Total 5 marks)

Q21. Light rays can be reflected and refracted.

Figure 1 shows how a plane mirror reflects a ray of light.

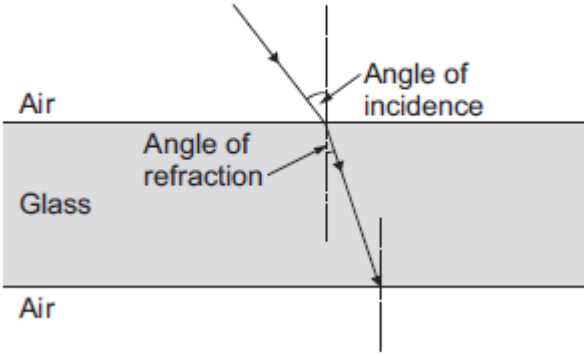
Figure 1



(a) Light is refracted when passing from air into glass.

Figure 2 shows a ray of light as it passes from air into a glass block.

Figure 2



(i) Draw a line on **Figure 2** to show the path of the ray as it leaves the glass block.

(1)

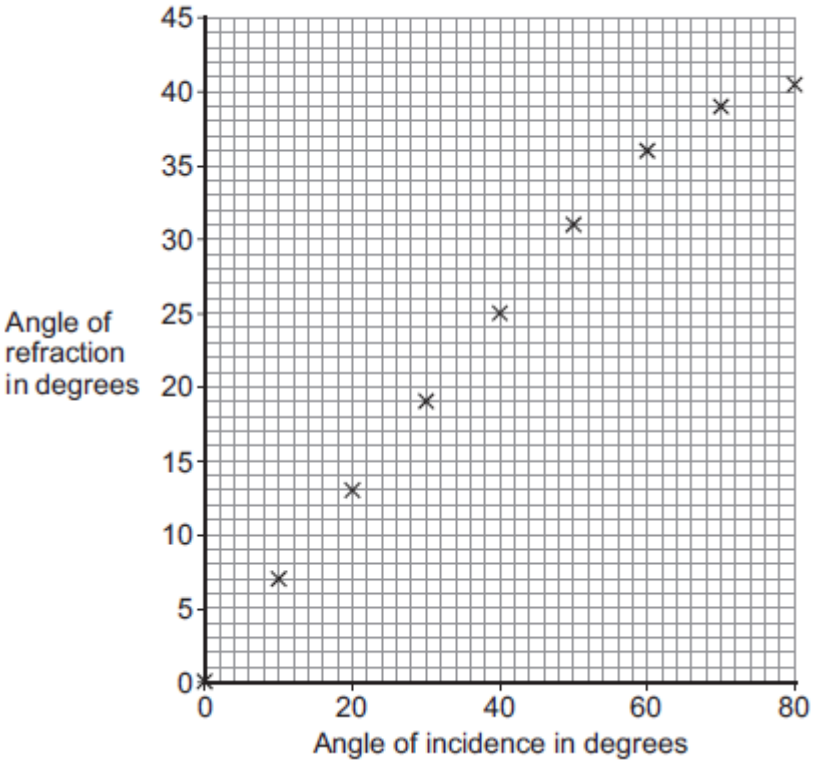
(ii) Name the dashed lines drawn at 90° to the glass in **Figure 2**.

_____

(1)

(b) A student investigated the relationship between the angle of incidence and the angle of refraction as light passes from air into glass. Her results are shown in **Figure 3**.

Figure 3



(i) Draw a line of best fit on **Figure 3**.

(1)

(ii) Use **Figure 3** to describe the relationship between the angle of incidence and the angle of refraction.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q22. (a) Microwaves are one type of electromagnetic wave.

(i) Which type of electromagnetic wave has a lower frequency than microwaves?

_____

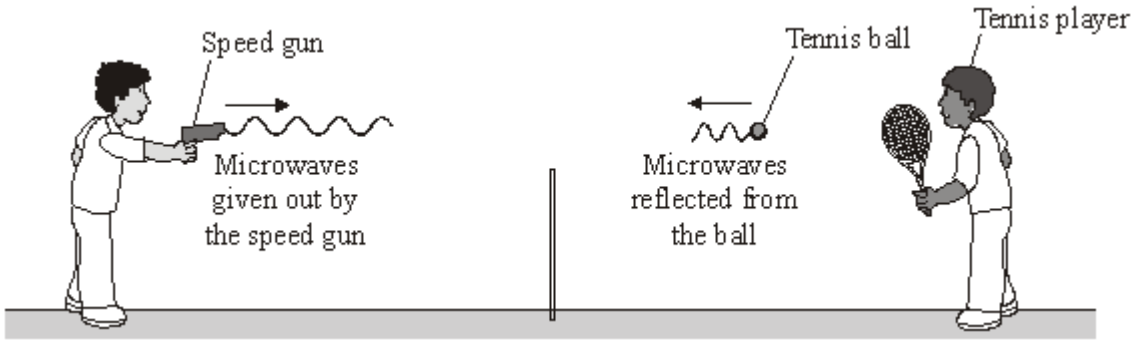
(1)

(ii) What do all types of electromagnetic wave transfer from one place to another?

_____

(1)

(b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



(i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun.

Show clearly how you work out your answer.

_____

_____

Wavelength = _____ m

(2)

(ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

_____

_____

(1)

(Total 5 marks)

Q23. Radio waves, ultra-violet, visible light and X-rays are all types of electromagnetic radiation.

(a) Choose wavelengths from the list below to complete the table.

3×10^{-8} m 1×10^{-11} m 5×10^{-7} m 1500 m

TYPE OF RADIATION	WAVELENGTH (m)
Radio waves	
Ultra-violet	
Visible light	
X-rays	

(4)

(b) Microwaves are another type of electromagnetic radiation.

Calculate the frequency of microwaves of wavelength 3 cm.
(The velocity of electromagnetic waves is 3 × 10^8 m/s.)

_____

_____

_____

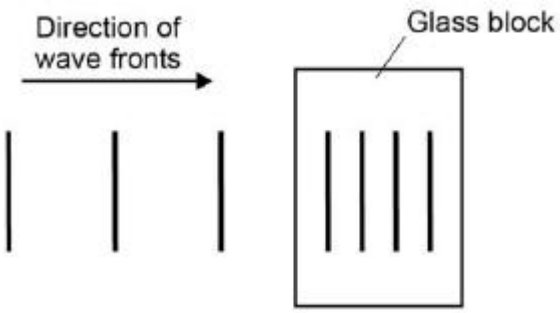
_____

(4)

(Total 8 marks)

Q24. **Figure 1** is a wave front diagram showing light travelling through the air and into a glass block.

Figure 1

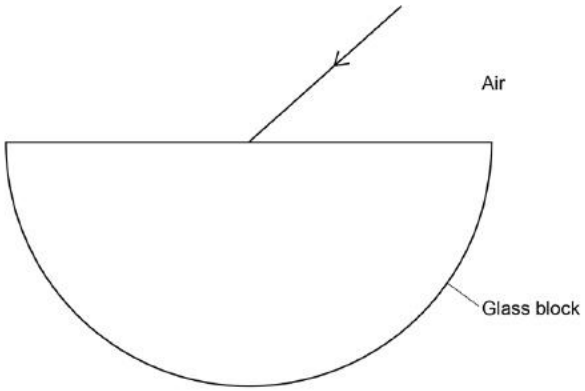


(a) Complete **Figure 1** by drawing wave fronts after they have left the glass block.

(1)

(b) **Figure 2** shows a ray of light incident on a semi-circular glass block.

Figure 2



Complete the ray diagram in **Figure 2**.

- Draw the ray of light passing through and leaving the glass block.
- Label the angle of refraction.

(4)

(c) Explain why the light is refracted.

_____

_____

_____

_____

(2)

(d) A student investigated how different coloured light was refracted by glass.

The student aimed rays of different coloured light at a glass block.

She measured the angle of refraction for each colour.

Give **two** variables that the student should control.

1. _____

2. _____

(2)

The table shows the student's results.

Colour of light	**Angle of refraction in degrees**
Red	27.94
Orange	27.90
Yellow	27.82
Green	27.78
Blue	27.70

(e) Explain why these results could **not** have been obtained with a normal protractor.

_____

_____

_____

_____

(2)

(Total 11 marks)