MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2015 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	23rd May 2015
TIME:	9:00 a.m. to 11:00 a.m.

Answer all Questions.
You are requested to show your working and to write the units where necessary.
When necessary, take g, acceleration due to gravity, as 10 m/s^2.

Density	$m = \rho V$		
Pressure	$F = p A$	$p = \rho g h$	
Moments	$\text{Moment} = F \times \text{perpendicular distance}$		
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$
	$\text{Work Done} = \text{energy converted}$		$E = P t$
Force and Motion	$m a = \text{unbalanced force}$	$W = m g$	$v = u + a t$
	$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$		$s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$	$\text{momentum} = m v$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$		$v = f \lambda$
	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$	$\text{Magnification} = \frac{\text{image distance}}{\text{object distance}}$	
	$\text{Magnification} = \frac{\text{image height}}{\text{object height}}$		$T = \frac{1}{f}$
Electricity	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{1}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$	$V_p I_p = V_s I_s$	
Heat	$Q = m c \Delta\theta$		
Radioactivity	$A = Z + N$		
Other equations	$\text{Area of a triangle} = \frac{1}{2} b h$	$\text{Area of a trapezium} = \frac{1}{2}(a + b) h$	
	$\text{Area of a circle} = \pi r^2$		

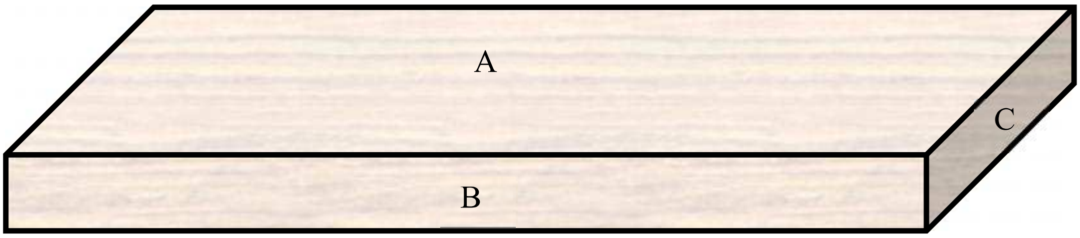
1. a. Complete the following:

i. Mass is the ____.

ii. Weight is the ____.

(2 marks)

b. A long wooden plank has a mass of 450 g.



i. Calculate the weight of the plank.

____

____

[2 marks]

ii. On the diagram above, mark with a letter W the point where all this weight seems to act.

[1 mark]

iii. What is this point called?

____

[1 mark]

iv. When this plank rests on the ground, its area of contact with the ground is 1.4 m^2. Calculate the pressure that the beam exerts on the ground.

____

____

[2 marks]

v. On which face does one have to place the wooden plank in order to exert maximum pressure? Explain.

____

____

[2 marks]

10

2. A dog sees a ball moving and starts running after it.

a. If the velocity of the dog after 4 s changes from rest to 8 m/s, what is the acceleration of the dog?

____

____

[2 marks]

b. Calculate the distance which the dog runs in this time.

____

____

____

[2 marks]

c. After running these 4 s, the dog sees that the ball has stopped moving 12 m in front of him. How long will the dog take to catch the ball, assuming it continues running with the same velocity.

____

____

____

[2 marks]

d. Sketch a velocity-time graph to show the motion of the dog in parts (a) and (c).

[2 marks]

e. Hence use the graph to describe the momentum of the dog during this time.

____

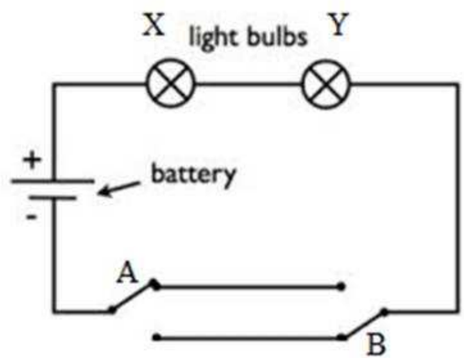
____

____

[2 marks]

10

3. The diagram shows two switches connected to two light bulbs and a 12 V battery. Currently switch A is up and switch B is down.



a. Will the light bulbs light in this way? Explain.

____

____ [2 marks]

b. Complete the following table:

A	B	BULB X ON / OFF	BULB Y ON / OFF
A DOWN	B DOWN		
A DOWN	B UP		

[2 marks]

c. State a practical use of the above set-up.

____ [1 mark]

d. Draw on the circuit, how a wire should be connected such that a short circuit is produced and no current passes through bulbs X and Y. [1 mark]

e. Underline the correct word from the options in the brackets. :

When a short circuit is created, the amount of current passing through the circuit (**increases, decreases, stays the same**) because the total resistance of the circuit (**increases, decreases, stays the same**). [1 mark]

f. The table gives information about three sets of bulbs A, B, and C. In each case, fill in the blank cells.

	Power Source	Bulbs Connected	Voltage across each bulb	Series or Parallel	Effect of removing one bulb
i	240 V mains	3 ceiling bulbs	240 V		
ii	240 V mains	20 Christmas tree bulbs		series	
iii	12V battery	2 headlamp bulbs	12V		

[3 marks]

10

4. In the first few days of 2015, Malta was hit by a cold storm. People had to heat their homes using either renewable or non-renewable sources of energy.

a. Explain what is a renewable source of energy.

____

____

[1 mark]

b. What is a non-renewable source of energy?

____

____

[1 mark]

c. Give an example of each source of energy which may be used for heating homes.

Renewable : ____

Non Renewable :____

[2 marks]

d. Give and explain one **disadvantage** of a renewable source of energy and an **advantage** of a non-renewable source mentioned in part (c).

____

____

____

[2 marks]

e. Suggest and explain **one** other action that can be done so that the house remains warmer during the cold months.

____

____

[2 marks]

f. An electric heater is rated at 1500 W. If the heater is rated as 80 % efficient, calculate the output rate of energy.

____

____

[2 marks]

10

5. Robert Boyle was an Anglo Irish physicist and inventor. During the 17th century he studied the behaviour of gases.

In one of his experiments he used a fixed mass of gas and started to apply pressure to decrease its volume. He observed what happened to the gas pressure and noted the values obtained in the following table.

Pressure, P (kPa)	20	30	40	50	60
Volume, V (cm^3)	250	166.67	125	100	83.33
1/Volume, 1/V ($1/cm^3$)	0.04				

i. Complete the table above. [2 marks]

ii. Draw a graph of **1/Volume** on the x-axis against **Pressure** on the y-axis. [4 marks]

iii. What is the relation between Pressure and 1/Volume?

____

[1 mark]

iv. Explain what would happen to the Pressure when the Volume is halved.

____

[1 mark]

v. Explain in terms of molecular motion the cause for this change in pressure when the volume of a fixed mass of gas is halved.

____

[1 mark]

vi. What should be assumed in part (v)?

____

[1 mark]

10

DO NOT WRITE ABOVE THIS LINE

6. The hair drier shown has a plastic casing and a heating element of rating 900 W, 240 V.

a. Calculate the current flowing through the heating coil when it is being used.

____

____

[2 marks]

b. Calculate the cost of running the drier for 30 minutes if 1 kWh costs 17c.

____

____

____

____

[3 marks]

c. Suggest a possible fuse value for the hairdryer. Support your answer with a calculation.

____

____

[2 marks]

d. The components below are all safety features found in Maltese homes. Explain the function of them.

Component	**Function**
Earth wire	
circuit breaker	
fuse	

[3 marks]

10

7. Hot air balloons rise up once the air inside them is heated. A balloon which has a volume of 2800 m^3 may be used to lift up two or three people.

a. What happens to the volume of the air when it is heated?

[2 marks]

b. Explain why the balloon rises.

[2 marks]

c. Explain one possible way of returning the balloon back to the ground.

[2 marks]

d. Another way of lifting the balloon requires filling it with helium. If the density of helium is 0.164 kg/m^3, calculate the mass of helium that needs to be used.

[2 marks]

e. If the balloon goes down at constant velocity, explain in terms of Newton's laws. the forces acting on the balloon.

[2 marks]

10

8. a. Lisa thinks that when Northern Europe is in winter, South Africa is in summer.

i. Is Lisa correct? Explain.

[2 marks]

John thinks that when Europe is experiencing daylight, South Africa is experiencing night.

ii. Is John correct? Explain.

[2 marks]

b. Proxima Centauri is the closest star to Sun. The Andromeda galaxy is the closest galaxy to Earth. Venus is the closest planet to Earth.

i. Name one difference between a star and a planet.

[1 mark]

ii. Is Proxima Centauri or the Andromeda Galaxy closest to planet Earth? Explain.

[2 marks]

iii A space probe is at a point where the gravitational pull of the Earth on it is equal to the gravitational pull of the Moon on it. Compare and explain the distance of the probe from the Earth and of the probe from the Moon.

[3 marks]

9. The count rate of different radioactive sources was measured when different objects were placed between the source and an instrument used to read the activity.

a. Mention an instrument used to measure the level of radioactivity.

____

[1 mark]

b. The following count rates were obtained.

Source	**Directly in front of instrument**	**With thick sheet of paper in between instrument and source**	**With a thin sheet of aluminium in between instrument and source**	**With a thick sheet of lead in between instrument and source**
Source A	1500	1500	38	38
Source B	3900	3900	3884	38
Source C	4547	2356	2355	38

i. Deduce the radiation/s that Source A might emit. Give reason/s for your answer.

____

____

[2 marks]

ii. Why does the radiation never fall to zero?

____

[1 mark]

iii. Write down possible count rates when a different alpha source is placed at different distances from the instrument. Explain your reasoning.

Source	Directly in front of instrument	10 cm away from source	10 m away from source	10 km away from source
Alpha Source	8555			

[2 marks]

c. Name two safety precautions one needs to take when handling radioactive sources.

____

____

[2 marks]

d. Name **two** practical uses for alpha radioactive sources.

____

____

[2 marks]

10

10. Peter found a metal bar. He marked its ends A and B.

a. Peter suspends a magnet so that it can rotate freely. Explain in which direction the magnet will align itself.

[2 marks]

b. When he brought the North pole of the magnet next to end B of the bar, it was attracted. Explain the **two** possible conclusions of this observation.

[2 marks]

c. Jane wants to make a small bar magnet to hold paper clips.

i. What type of metal should she use?

[1 mark]

ii. Explain your choice of metal.

[1 mark]

iii. Briefly describe how she can make a bar magnet.

[3 marks]

iv. State why she should avoid dropping the magnet on the ground.

[1 mark]

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UNIVERSITY OF MALTA, MSIDA

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2015 SESSION

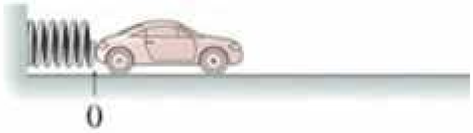
SUBJECT:	**Physics**
PAPER NUMBER:	IIA
DATE:	23rd May 2015
TIME:	4:00 p.m. to 6:00 p.m.

Answer all Questions.
You are requested to show your working and to write the units where necessary.
When necessary, take g, acceleration due to gravity, as 10m/s^2.

Density	$m = \rho V$		
Pressure	$F = p A$	$p = \rho g h$	
Moments	Moment = F × perpendicular distance		
Energy and Work	$PE = m g h$	$KE = \frac{1}{2} m v^2$	$W = F s$
	Work Done = energy converted		$E = P t$
Force and Motion	$m a =$ unbalanced force	$W = m g$	$v = u + a t$
	average speed $= \frac{\text{total distance}}{\text{total time}}$		$s = (u + v)\frac{t}{2}$
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$	momentum $= m v$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$		$v = f \lambda$
	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$	Magnification $= \frac{\text{image distance}}{\text{object distance}}$	
	Magnification $= \frac{\text{image height}}{\text{object height}}$		$T = \frac{1}{f}$
Electricity	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{1}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$	$V_p I_p = V_s I_s$	
Heat	$Q = m c \Delta\theta$		
Radioactivity	$A = Z + N$		
Other equations	Area of a triangle $= \frac{1}{2} b h$	Area of a trapezium $= \frac{1}{2}(a + b) h$	
	Area of a circle $= \pi r^2$		

1. ***This question is about energy in a spring.***

A toy car of mass 150 g is propelled forward on a smooth surface by means of a compressed spring. The energy stored in the spring is 5 J.



a. For energy to be stored in the spring, work had to be done. What is meant by the term work done?

____

____

[2 marks]

b. Write the energy conversion that results once the spring is released.

____

____

[2 marks]

c. Calculate the maximum speed of the car.

____

____

[2 marks]

d. What assumption have you made to calculate this value?

____

____

[1 mark]

e. Describe the motion of the car once it leaves the spring.

____

____

[2 marks]

f. What should be done for the speed of the car to be higher, if the same set-up is to be used?

____

____

[1 mark]

g. Calculate the momentum of the car. (Neglect air resistance.)

[2 marks]

h. The car collides with a car of mass 100 g moving in the opposite direction at a speed of 2 m/s. On collision the two cars stick and move together. Calculate their common velocity after collision.

[3 marks]

i. If the cars hit a wall with a force of 2 N, predict the size of the force on the cars at the time of collision.

[1 mark]

j. Explain how you arrived at your answer.

[1 mark]

k. The cars come to a halt immediately after they hit the wall. Calculate the time of impact.

[2 marks]

l. Would it make a difference to the estimated force if on crashing the wall collapses? Explain.

[1 mark]

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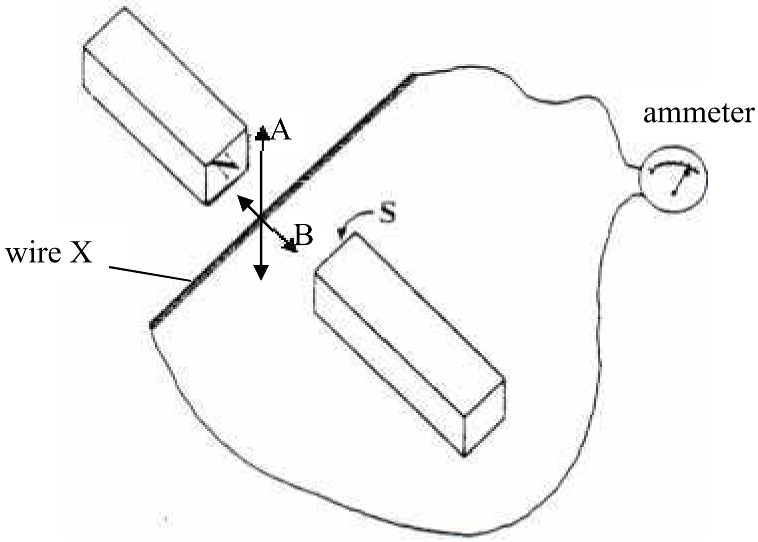
2. ***This question is about induced currents.***

A piece of thick copper wire is placed in a magnetic field as shown in the diagram. The ends of the wire are connected to an ammeter as shown.



a. State the effect, if any, of the following actions. Justify your answer by giving reasons.

i. The length of wire X is moved up and down between the poles in the direction indicated by A.

[3 marks]

ii. The length of wire X is moved sideways between the poles in the direction indicated by B.

[3 marks]

iii. The wire is moved in the direction shown by A, but now the motion is faster.

[2 marks]

iv. State the name of the law which you used to give the above answers.

[1 mark]

b. A student wanted to use a solenoid with an iron core to attract some nails.

i. Draw a diagram of the solenoid, including the type of power supply to be used and the polarity of the ends. [3 marks]

ii. Draw the magnetic field pattern of the solenoid. [2 marks]

iii. The student found that the solenoid was not strong enough to attract the nails. Suggest two ways how the strength of the solenoid may be increased.

[2 marks]

iv. Mention one everyday situation in which an electromagnet is used and state the advantage of using, in this case, an electromagnet instead of a permanent magnet.

[2 marks]

v. Explain whether connecting the solenoid to an a.c supply instead of a d.c. supply would result in a change in the magnetic field.

[2 marks]

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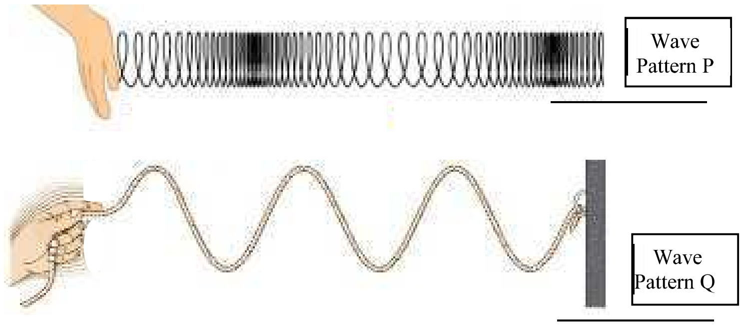
3. ***This question is about wave motion***.

a. Ms Grech was demonstrating wave motion in the lab using a slinky spring and a length of rope. She obtained the following wave patterns.



i. Name the wave patterns being produced:

P: ______________________________ Q:_________________________

[2 marks]

ii. What is being transferred when waves go from one side to the other?

____

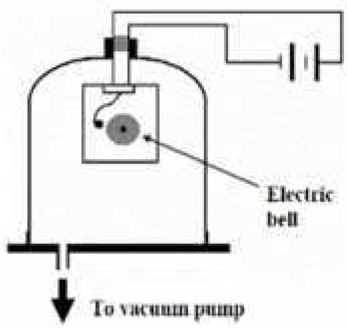
[1 mark]

iii. State which pattern represents:

a. A sound wave: __________________. b. An X-ray: __________________.

[2 marks]

b. The following lesson, Ms Grech prepared the following apparatus to discuss an important characteristic of sound.



i. The electric bell is switched on. Describe two important observations that can be made after the vacuum pump has also been switched on and all the air was removed from the jar.

1. ____

2. ____

[2 marks]

ii. What can be concluded from this experiment, about:

- Sound waves: ____
- Light waves: ____

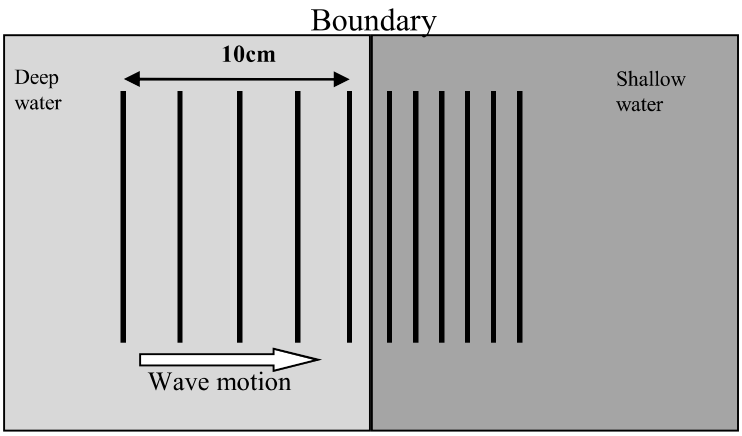
[2 marks]

iii. Ms Grech hangs the electric bell by using a string. Explain why.

____

[1 mark]

c. The following diagram represents the motion of water waves, produced by a vibrating long bar, from deep water to shallow water. (**Diagram not to scale**)



i. What is the wavelength of the water wave in the deep water?

____

[1 mark]

ii. The long bar makes 40 vibrations in 8s. Calculate the frequency of the waves produced.

____

____

[2 marks]

iii. Calculate the speed of the water wave in the deep water.

____

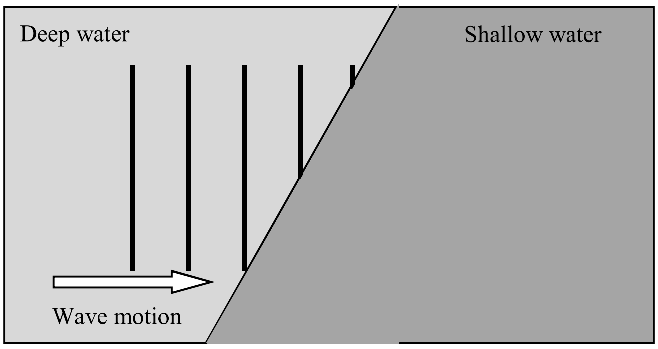
____

[3 marks]

d. The direction of the boundary is now changed as shown below.

i. Complete the diagram to show the water wave in the shallow water.

[2 marks]



ii. Which phenomenon does the change in direction of the water wave represent?

____

[1 mark]

iii. What causes this change in direction?

____

[1 mark]

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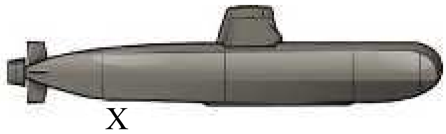
4. ***This question is about pressure***.



A submarine X is travelling at depth of 64 m below the surface of the sea. The density of seawater is 1050 kg/m^3 and the atmospheric pressure is 100,000 Pa.

a. Calculate:

i. the pressure on the submarine due to the seawater at a depth of 64 m.

[2 marks]

ii. The total pressure exerted on the submarine at this same depth.

[1 mark]

iii. Two other submarines Y and Z are travelling at a depth of 50 m and 110 m respectively. Compare the pressure exerted by the seawater on submarine X with that of submarines Y and Z.

[2 marks]

b. The figure shows the hatch found at the top of the submarine. The hatch has a diameter of 0.85 m. Assuming that the hatch is 64 m below sea level:

i. calculate the downward force acting on the horizontal hatch.

[3 marks]

ii. state two reasons why the force needed to lift the hatch is different from the value calculated in b (i).

[2 marks]

c. The submarine uses ultrasound waves to detect obstacles.

i. Give two characteristics of ultrasound waves.

[2 marks]

ii. These waves are produced by a vibrating source. Describe how these waves are transmitted through the seawater.

[3 marks]

d. The submarine sends an ultrasound pulse which hits an obstacle. This is reflected back and detected by the submarine's receiver. The time taken for the pulse to come back to the submarine is **t**.

i. Which other quantity is needed to determine the distance between the obstacle and the submarine?

[1 mark]

ii. How can the distance between the submarine and the obstacle be calculated?

[2 marks]

iii. Give one other use of ultrasound.

[1 mark]

iv. On a particular occasion, the submarine received two different pulses. Suggest a possible explanation for this.

[1 mark]

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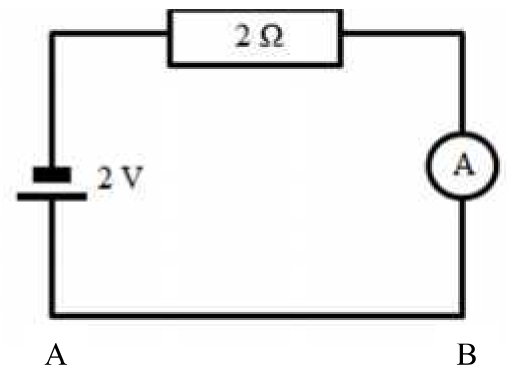
5. ***This question is about circuits***.

The circuit shows a wire AB which is 2 m long. It is connected with a 2 V battery and a resistor of resistance of 2 Ohms.



a. The ammeter reads 0.4 A. Calculate the resistance of wire AB.

[3 marks]

b. Another identical wire CD is placed in parallel with wire AB.
   i. Draw in the circuit above, how you would connect the wire CD. [1 mark]

   ii. Calculate the new total resistance in the circuit.

[3 marks]

c. State and explain how the resistance of the wire AB changes if it is replaced by:
   i. a wire of the same thickness which is only 1 m long;

[2 marks]

   ii. a wire of the same thickness and length but of a different metal;

[1 mark]

   iii. a wire of the same length but which has a larger diameter than the wire mentioned in part c(ii) above.

[2 marks]

d. Anemometers are measuring instruments used to measure wind speed. Hot wire anemometers use a very fine wire electrically heated up to some temperature above room temperature. Air flowing past the wire has a cooling effect on the wire. As the electrical resistance is dependent upon the temperature of the metal, a relationship can be obtained between the resistance of the wire and the flow speed.

i. What is the relationship between Resistance and Temperature?

[1 mark]

ii. Hence, deduce the relationship between Wind Speed and Resistance of wire.

[1 mark]

In each of the circuits in this experiment, the wind speed detector is the tungsten filament of an ordinary torch bulb, from which the glass cover has been removed.

You are provided with the tungsten filament, a fan with three variable settings, and a power supply.

iii. What additional apparatus would you require to be able to do an experiment to verify the relationship between Wind speed and Resistance of a wire?

[2 marks]

iv. Draw a circuit diagram with the power supply and the tungsten filament. Include the tungsten filament as a small **rectangular box** marked with a letter T. [2 marks]

v. Briefly write down the method of this experiment.

[2 marks]

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SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2015 SESSION

SUBJECT:	**Physics**
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Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$		$v = f \lambda$
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	$P = I V$	$R \propto \frac{1}{A}$	$E = I V t$
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Electromagnetism	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$	$V_p I_p = V_s I_s$	
Heat	$Q = m c \Delta\theta$		
Radioactivity	$A = Z + N$		
Other equations	$\text{Area of a triangle} = \frac{1}{2} b h$	$\text{Area of a trapezium} = \frac{1}{2}(a + b) h$	
	$\text{Area of a circle} = \pi r^2$		

1. ***This question is about energy in a spring.***

a. A toy car of mass 150 g is pushed forward by means of a compressed spring on a smooth surface. Fill in the blanks with the following words. Each word may be used once only.

potential	Joule	conservation	movement	direction	force

Work is defined as the product of a ________________________ and the distance moved in the ________________________ of the force. The unit of work is the ________________________.The work done is converted into ________________________energy in the spring which is converted into energy of ________________________ when the spring is released because of the principle of ________________________ of energy.

[3 marks]

b. If the speed of the car is 1.2 m/s, how much is the energy stored in the spring?

____

____

____

[3 marks]

c. What must be done for the speed of the car to be higher?

____

____

[2 marks]

d. Calculate the momentum of the car. (Neglect air resistance.)

____

____

[2 marks]

e. The car collides with Car B of mass 0.1 kg which is moving in the opposite direction at a speed of 2 m/s. On collision the two cars stick and move together.

i. What is the momentum of the Car B before collision?

[2 marks]

ii. What is the total momentum after the collision?

[2 marks]

iii. Hence find the speed of the two cars after the collision.

[2 marks]

f. If the cars hit a wall with a force of 2 N, what would be the size of the force the wall exerts on the cars?

[2 marks]

g. Which of Newton's laws of motion applies in this case?

[1 mark]

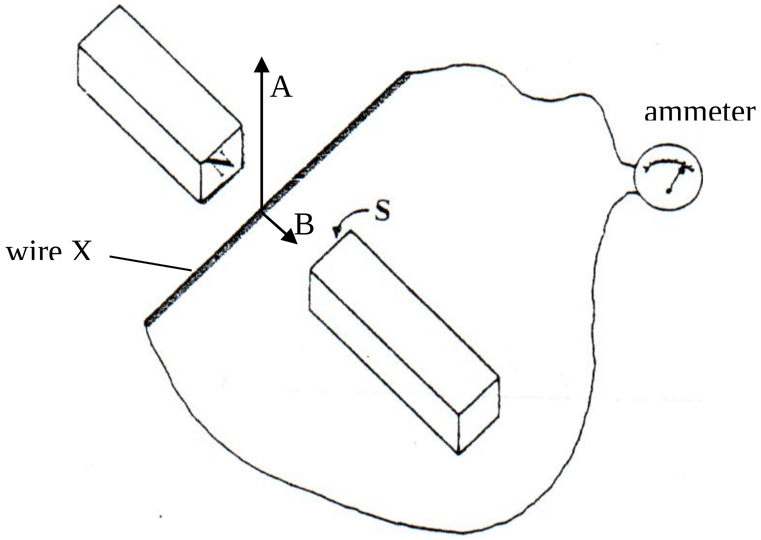
h. Would it make a difference to the estimated force if the wall is covered with a soft material? Explain.

[1 mark]

20

2. ***This question is about induced currents.***

A piece of thick copper wire is placed in a magnetic field as shown in the diagram. The ends of the wire are connected to an ammeter as shown.



a. Complete the sentences by using the following phrases:

the wire is moved along B	*the wire X is moved faster*	*stronger magnets are used*	*the wire is moved along A*

i. A current is produced if:

____

[1 mark]

ii. Zero current is produced if:

____

[1 mark]

iii. More current is produced if:

- ____
- ____

[2 marks]

b. State the law which you applied to give the above answers.

____

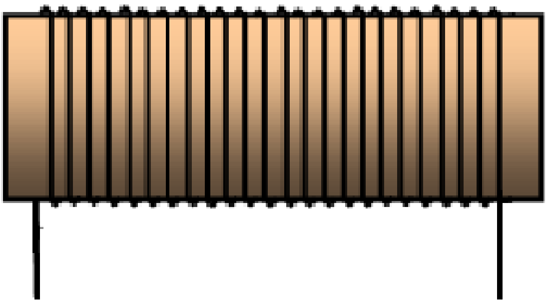
____

[2 marks]

c. The ammeter is now replaced with a battery. Explain what will happen to the wire X.

[2 marks]

d. The following is a diagram of a solenoid with an iron core used by a student to attract some iron nails.



i. Include in the diagram the type of power supply you would use to produce a direct current. [2 marks]

ii. Label the induced poles of the solenoid. [2 marks]

iii. Draw the magnetic field pattern produced when a current is passing through the solenoid. [2 marks]

e. The student found that the solenoid was not strong enough to attract the nails. Suggest two ways how the strength of the solenoid may be increased.

[2 marks]

f. Explain whether connecting the power supply to an a.c supply would affect the magnetic field of the solenoid.

[2 marks]

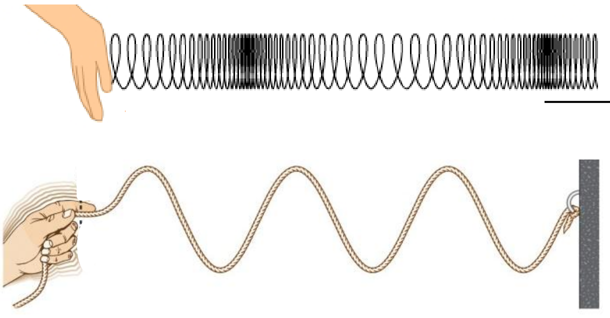
g. Give TWO everyday uses of electromagnets.

[2 marks]

20

3. ***This question is about wave motion.***

a. Ms Grech was demonstrating wave motion in the laboratory using a slinky spring and a length of rope and obtained the following wave patterns.



i. Name the wave patterns being produced:

P: ______________________ Q: ______________________

[2 marks]

ii. What is being transferred when waves go from one side to the other?

____

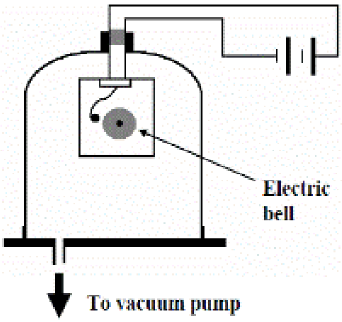
(2 marks)

iii. State which pattern represents:

- A sound wave: ______________________.
- An X-ray: ______________________.

[2 marks]

b. The following lesson, Ms Grech prepared the apparatus shown in the diagram to discuss an important characteristic of sound.
She first switched on the electric bell. After she turned on the vacuum pump so that all the air is removed from the jar.



i. What can the students hear after all the air is removed from the jar?

____

ii. Can the students still see the bell?

____

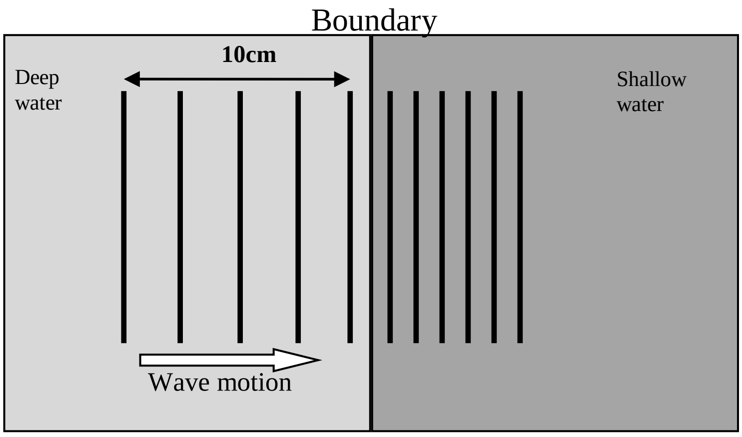
[2 marks]

iii. State if the following statements are **True** or **False.**

- Sound waves do not need a medium to travel. ______________________
- Light waves can travel through a vacuum. ______________________
- The electric bell is hung by a string so that it does not fall. ______________________

[3 marks]

c. The following diagram represents the motion of water waves, produced by a vibrating long bar passing, from deep water to shallow water. (Diagram not to scale)



i. What is the wavelength of the water wave in the deep water? Give your answer in metres.

______

______

[2 marks]

ii. The long bar makes 40 vibrations in 8 s. Calculate the frequency of the waves produced.

______

[1 mark]

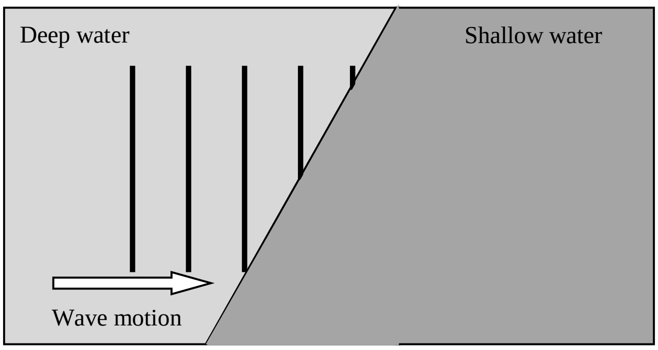
iii. Calculate the speed of the water wave in the deep water.

______

______

[2 marks]

d. The direction of the boundary is now changed as shown below.



i. Complete the diagram to show the water wave in the shallow water. [2 marks]

ii. Underline the correct word.

- This phenomenon is called *reflection* / *refraction*.
- This change of direction is caused because the speed of the wave *decreases* / *increases*.

[2 marks]

20

4. ***This question is about pressure***.

A submarine X is travelling at a depth of 64 m below the surface of the sea. The density of seawater is 1050 kg/m^3 and atmospheric pressure is 100,000 Pa.

a. Calculate:
   i. the pressure on the submarine due to the seawater only at a depth of 64 m;

[3 marks]

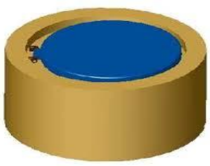
   ii. the total pressure exerted on the submarine at the same depth.

[2 marks]

   iii. Two other submarines Y and Z are travelling at a depth of 50 m and 110 m respectively. Compare the pressure exerted by the seawater on submarine X with that of submarines Y and Z?

[2 marks]

b. The figure shows the hatch found at the top of the submarine. The hatch has an area of 0.6 m^2. Assuming that the hatch is also at a depth of 64 m calculate the downward force exerted by the seawater on the horizontal hatch.



[2 marks]

c. The submarine uses ultrasound waves to detect obstacles.
   i. Give two characteristics of ultrasound waves.

[2 marks]

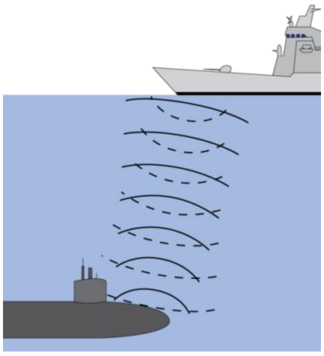
ii. These waves are produced by a vibrating source and transmitted through the seawater. Indicate the correct sequence of events which explain how these waves are transmitted by writing the numbers **2**, **3** or **4** in the space provided.

- ___ vibrating molecules hit other molecules
- ___ a longitudinal wave is formed and energy can flow
- 1 vibrating source makes the molecules in water vibrate
- ___ the vibrations are passed on from one molecule to many others

[3 marks]

d. The submarine sends an ultrasound pulse. When it hits an obstacle, it is reflected back and detected by the submarine's equipment. The time taken for the pulse to come back to the submarine is 0.07 s.

i. If the speed of sound in water is 1,480 m/s, calculate the distance between the submarine and the obstacle.



____

____

[2 marks]

ii. Give one other use of ultrasound.

____

[1 mark]

iii. On a particular occasion, the submarine received two different pulses. Suggest a possible explanation for this.

____

____

[1 mark]

iv. State **one** advantage and **one** disadvantage of ultrasound over X-rays.

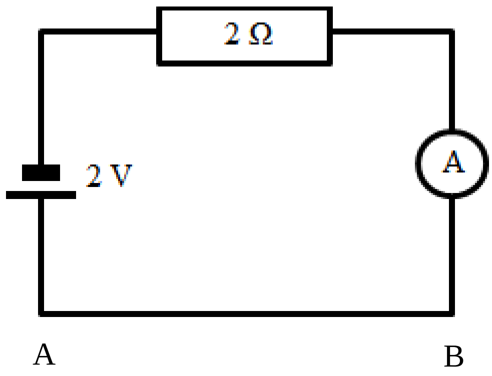
____

____

[2 marks]

20

5. ***This question is about circuits*.**



The circuit shows a wire AB 2 m long. It is connected in series with a 2 V battery and a resistor of resistance of 2 Ohms.

a. The resistance of the wire is 4 Ohms. Calculate the total resistance in the circuit.

____

[1 mark]

b. Calculate the reading on the ammeter.

____

____

[2 marks]

c. Another identical wire CD is placed in parallel with wire AB.

i. Draw in the circuit above, how you would connect the wire CD. [1 mark]

ii. Calculate the combined resistance of the two wires.

____

____

[1 mark]

iii. Calculate the total resistance of the circuit.

____

____

[1 mark]

d. State and explain if the resistance of the wire AB will *increase, decrease* or *remain the same*, when it is replaced by:

i. a longer wire of the same cross-sectional area;

____

[2 marks]

ii. a thicker wire of the same length.

____

[2 marks]

iii. a wire of same thickness and length but of a different metal.

____

[1 mark]

e. Anemometers are measuring instruments used to measure wind speed. Hot wire anemometers use a very fine wire electrically heated up to some temperature above room temperature. Air flowing past the wire has a cooling effect on the wire. As the electrical resistance is dependent upon the temperature of the metal, a relationship can be obtained between the resistance of the wire and the flow speed.

i. State the relationship between Resistance and Temperature.

____

[1 mark]

ii. Deduce the relationship between Wind Speed and Resistance of wire.

____

[1 mark]

In each of the circuits in this experiment, the wind speed detector is the tungsten filament of an ordinary torch bulb, from which the glass cover has been removed.

You are provided with the tungsten filament, an Ammeter, a Voltmeter and a power supply.

iii. Draw a circuit diagram of the above apparatus and include the tungsten filament as a small rectangular box marked with a letter **T**. [3 marks]

iv. Number the following steps used in order to investigate the relationship between wind speed and the resistance of the wire. The first one has been done for you. [4 marks]

The Resistance of the tungsten filament is found using the formula R=V/I when the fan is not yet switched on.	
The above step is repeated in turn with the fan setting 2 and 3.	
A power supply is connected in series with an Ammeter and the tungsten filament.	**1**
The fan is placed in front of the tungsten filament and set on the first wind setting and the Resistance is found.	
A Voltmeter is connected in parallel with the tungsten filament.	

20

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