Index No:________________ SEC24/1.17m

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2017 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	29th April 2017
TIME:	9:00 a.m. to 11:05 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	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. In 1589, the Italian scientist Galileo Galilei is said to have dropped two spheres of different masses from the Leaning Tower of Pisa. As they fell, the spheres accelerated under the force of gravity.

a. Explain the term the ‘force of gravity’.

____

____

____(2)

b. Explain how this force of gravity is responsible for the moon’s motion around Earth.

____

____(2)

c. Match the following statements: (the first one has been done for you)

i.	A light year is a measure		which has not cleared the neighbourhood around the orbit
ii.	Pluto is a dwarf planet		of very long distances in space.
iii.	Our solar system forms part of the Milky Way galaxy		which result in days and nights.
iv.	Earth is one of the eight planets		which is a very small part of the universe.
v.	Earth spins on its own axis		which orbit around the sun.

(4)

d. A number of scientists think that the “Universe is expanding”. Explain this claim by referring to one particular theory?

____

____(2)

(Total: 10 marks)

10

2. The mass of air in a room can be estimated from its volume and the density of air. A room has sides of 4.5 m, 3.5 m and 4 m. The density of air is 1.1 kg/m^3.

a. Define the term density.

____

____ (2)

b. What is the volume of the room in m^3?

____ (1)

c. Calculate the mass of air in the room.

____

____ (2)

d. A heater is placed in the room. Explain, in terms of particles, what happens to the air in the room when the air above the heater heats up.

____

____

____

____ (4)

e. Animals exhale carbon dioxide. In a closed room, carbon dioxide collects at the bottom of the room. What does this show about the density of carbon dioxide?

____

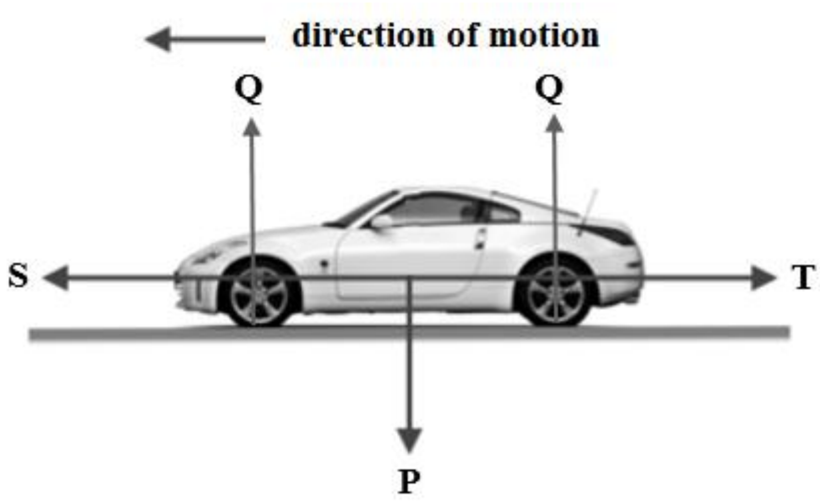
____ (1)

(Total: 10 marks)

10

3. A car has a number of forces acting on it.

a. Some of the forces acting on a moving car are shown in the diagram below.



i. Name the forces labelled as P, Q, S and T in the spaces provided. (Assume that the mass of the car is uniform.)

P: ____________________ Q: ____________________

S: ____________________ T: ____________________ (4)

ii. How are S and T related when the car is moving at constant velocity?

____ (1)

iii. How are S and T related when the car is accelerating forward?

____ (1)

iv. Name and state the law that you have used for your answers in parts (ii) and (iii).

____

____(2)

b. Force S acting on the car of mass 1815 kg is 677 kN. Calculate the acceleration of the car, when force T is 676 kN.

____

____(2)

(Total: 10 marks)

10

4. Electrical resistors are components found in most circuits.

a. In the space below, draw the symbol of a resistor. (1)

b. Complete the following statement with the correct word.

A resistor ______________________ current and converts the electrical energy in a circuit into

______________________ energy. (2)

c. A resistor of 400 Ω is connected in series to another resistor of 0.25 kΩ.

i. Calculate the total resistance.

____

____(2)

ii. If the voltage across the 400 Ω resistor is 20 V, find the voltage across the 0.25 kΩ resistor.

____

____

____(3)

d. The 400 Ω resistor and the 0.25 kΩ resistor are now connected in parallel.

i. Will the total resistance increase, decrease or remain the same as in part c?

____ (1)

ii. If the voltage across the 0.25 kΩ resistor in this set up is 32 V, what is the voltage across the 400 Ω resistor?

____ (1)

(Total: 10 marks)

10

5. In an experiment to estimate the specific heat capacity of brass, a thermometer and a 450 W heater were placed in a 1.4 kg block of brass with an initial temperature of 20 ^{o}C. The table below shows part of the results obtained.

Temperature, T (^{o}C)	25	30	35	40	45
Change in Temperature, ΔT (^{o}C)	5	10	15		25
Time, t (s)	6	12	18	24	30
Total Heat Energy Supplied, H (J)	2700	5400	8100		13500

a. Fill in the **TWO** missing values in the above table. Show your working below.

____

____

____

____

____ (3)

b. Plot a graph of Total Heat Energy Supplied, H (J) on the y-axis against Change in Temperature, ΔT (^{o}C) on the x-axis. (4)

c. Calculate the gradient of the graph.

____

____ (2)

d. Give **ONE** precaution taken in this experiment

____

____ (1)

(Total: 10 marks)

10

10

6. Justin needed to buy an electric kettle. He came across two models A and B with the specifications described below.

a. State the energy conversion that takes place when an electric kettle is switched on.

____(1)

b. Complete the table below. Show your working in the space provided.

Kettle	**A**	**B**
Voltage	220 V	220 V
Current		6.4 A
Power	1980 W	
Outer Case	Metal	Plastic

____

____

____(2)

c. Justin calculates that a kettle is approximately used for 12 minutes a day. Which of the two kettles will use the highest amount of electrical energy per day? Calculate this amount of energy.

____

____

____(3)

d. Suggest a fuse rating for:

Kettle A: ____________________ Kettle B: _____________________

(2)

e. When Justin compared the plugs of Kettle A and Kettle B, he found one wire missing in one of the plugs. State which kettle is likely to have this missing wire in the plug. Explain.

____

____(2)

(Total: 10 marks)

10

7. In April 2016, Ukraine commemorated the 30th anniversary of the nuclear disaster at Chernobyl where after an explosion a lot of radioactive material was released.

a. Name the **THREE** types of nuclear/radioactive radiation and indicate how their penetration can be stopped.

Source: www.usnews.com

____

____

____ (3)

b. Radiation is usually emitted from an unstable nucleus like that of Chlorine–37, $^{37}_{17}Cl$.

i. What do the numbers 37 and 17 represent?

____

____(2)

ii. What does the term unstable nucleus mean?

____

____(2)

c. Radioactive materials can be dangerous, even in small amounts. Mention **ONE** way how to handle such materials.

____ (1)

d. "We do not live in a radiation-free environment." Explain.

____

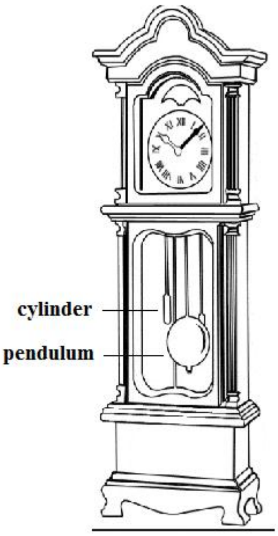
____(2)

(Total: 10 marks)

10

8. A falling object possesses both gravitational potential energy and kinetic energy.

a. A grandfather clock works by having gravitational potential energy stored in a 4.8 kg cylinder. As it descends 1.20 m every seven days, this energy is transferred to kinetic energy and the pendulum keeps swinging.



i. State the law of conservation of energy.

____

____ (2)

ii. Calculate the gravitational potential energy stored in the cylinder when it is at maximum height.

____

____ (2)

iii. Calculate the power transfer as the cylinder moves downwards.

____

____(2)

b. The transfer of gravitational potential energy into kinetic energy is also used in the hydroelectric process.

i. Briefly describe how energy is generated through the hydroelectric process.

____

____

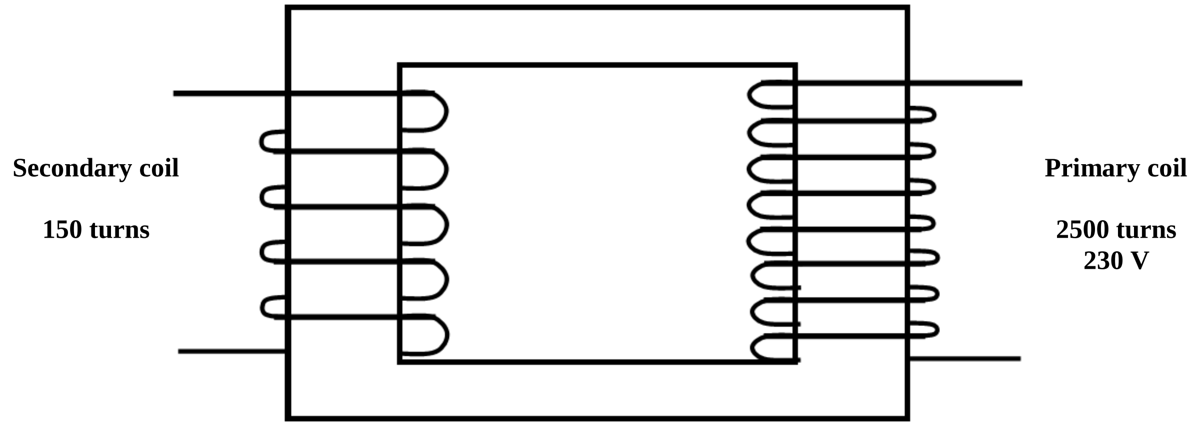
____(3)

ii. State **ONE** main advantage of this form of energy.

____ (1)

(Total: 10 marks)

9. One electronic device uses a step-down transformer. The step-down transformer has 2500 turns in its primary coil and 150 turns in its secondary coil. The primary voltage is of 230 V.



a. What is meant by the term step-down transformer?

____ (1)

b. Explain why a transformer only works with an AC current.

____

____

____ (2)

c. Calculate the voltage in the secondary coil.

____

____ (2)

d. If the current in the primary coil is 0.20 A, assuming this is an ideal transformer, calculate:

i. the power in the primary coil;

____

____ (2)

ii. the current in the secondary coil.

____

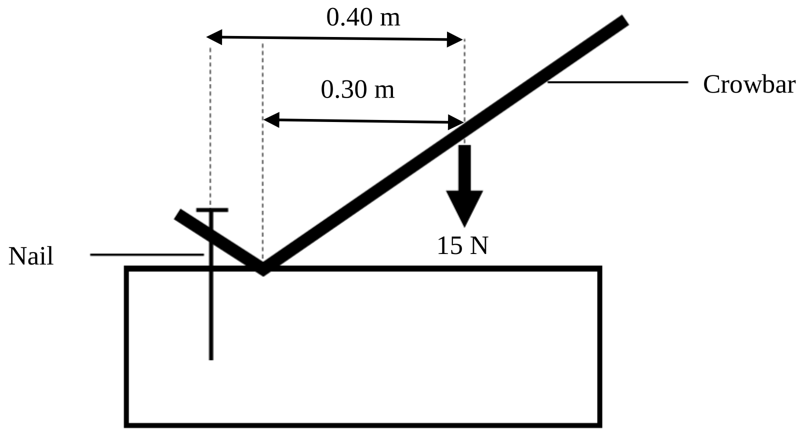
____ (3)

(Total: 10 marks)

10

10. Joseph is teaching his two grandchildren about the use of some tools.

a. Joseph explains how nails can be removed by using a crowbar. One of his grandchildren gives it a try and applies a force of 15 N on the crowbar as shown in the diagram.



i. Which **TWO** quantities determine the magnitude of a moment?

____

____ (2)

ii. Calculate the clockwise moment exerted by Joseph's grandchild.

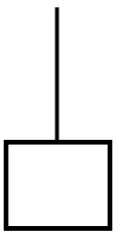
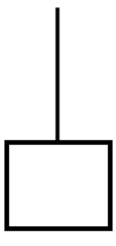
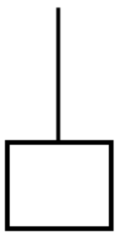
____

____ (2)

iii. Joseph notes that his grandchild is not using the crowbar efficiently. Explain why.

____ (1)

b. Joseph lifts an object using a rope. Draw arrows to indicate the nature and size of the forces acting on the object being lifted **AND** the direction of the resultant force (if any) when:

i. the object is stationary;	ii. the object is starting to be lifted;	iii. the object is being lifted at constant speed.
		

(5)

(Total: 10 marks)

10

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2017 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIA
DATE:	29th April 2017
TIME:	4:00 p.m. to 6:05 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 $10 m/s^2$.

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. This question is about momentum.

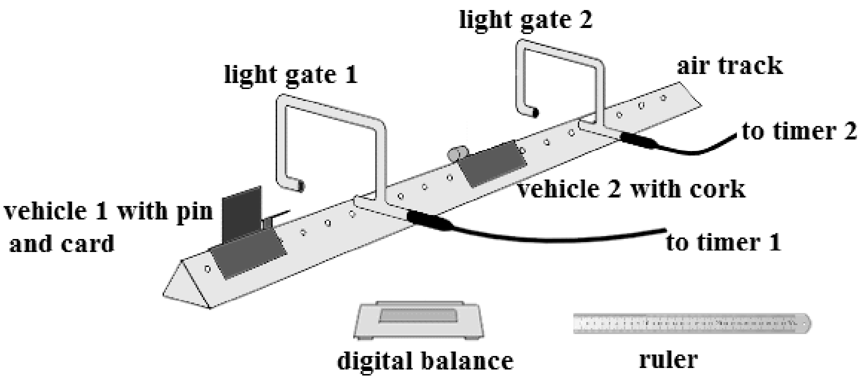
a. State the law of conservation of momentum.

____

____(2)

b. A student wants to investigate if this law is valid and decides to use the air track available at the school laboratory. The diagram below shows the equipment he has available.

Vehicle 1 has a card that can interrupt the signal of the light gates, and a pin which can stick to the cork of vehicle 2.



i. List the main steps required to conduct the experiment and investigate the law stated in part (a).

____

____

____

____(5)

ii. State clearly which equation is used to verify the law.

____

____(2)

iii. Give **ONE** main precaution necessary while setting up the air track, to ensure that this experiment is performed accurately.

____ (1)

c. A student stacks some tins, each of mass 50 g, as shown in the diagram.

i. He throws a 30 g ball with a velocity of 6 m/s towards the tins. Calmentum of the ball as it approaches the tins.

____

____

____(2)

ii. The ball hits Tin 1 and both move together with a velocity v as the tin moves away from the stack. Calculate the final velocity with which the ball and Tin 1 move off together.

____

____

____(3)

iii. He now throws a larger ball of mass 70 g with a velocity u m/s towards Tins 2 and 3 as shown.

Both Tins 2 and 3 move off together with the ball at a velocity of 3.5 m/s. Calculate the initial velocity, u, of the ball.

____

____

____(3)

iv. The student then throws the 70 g ball with a velocity of 1.5 m/s, aiming only at Tin 4. The tin remains at rest, while the ball rebounds back with 1 m/s, in 0.4 s. Calculate the force acting on the ball at the moment of impact.

____

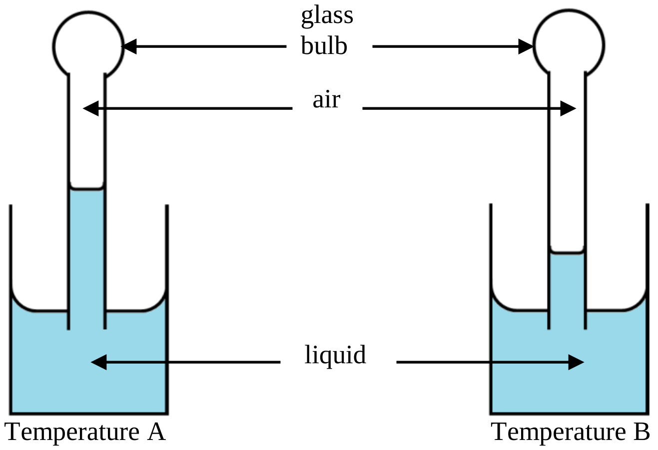
____(2)

(Total: 20 marks)

20

2. The question is about pressure.

a. The thermoscope was a device built in approximately the year 1593 to indicate temperature. Two diagrams of a thermoscope at different temperatures are shown below.



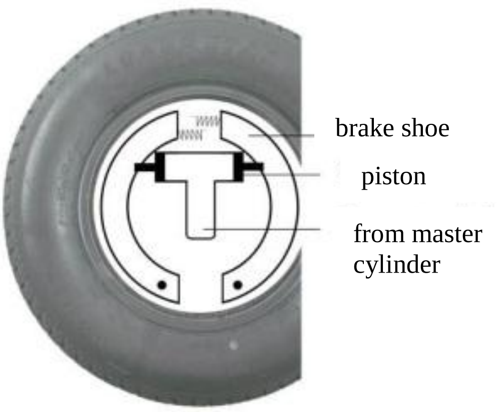
By referring to the theory of particles, explain which of the temperatures, Temperature A or Temperature B, if any, is higher.

____

____

____ (3)

b. In a car drum-brake, a master cylinder of area of 5 cm^2 leads to two pistons each with an area of 0.0031 m^2.



i. If a force of 10 N is applied on the master cylinder, calculate the pressure in the hydraulic fluid in Pa.

____

____ (2)

ii. What is the pressure in the hydraulic fluid leading to one of the two pistons?

____ (1)

iii. Calculate the total force exerted by the two pistons.

____

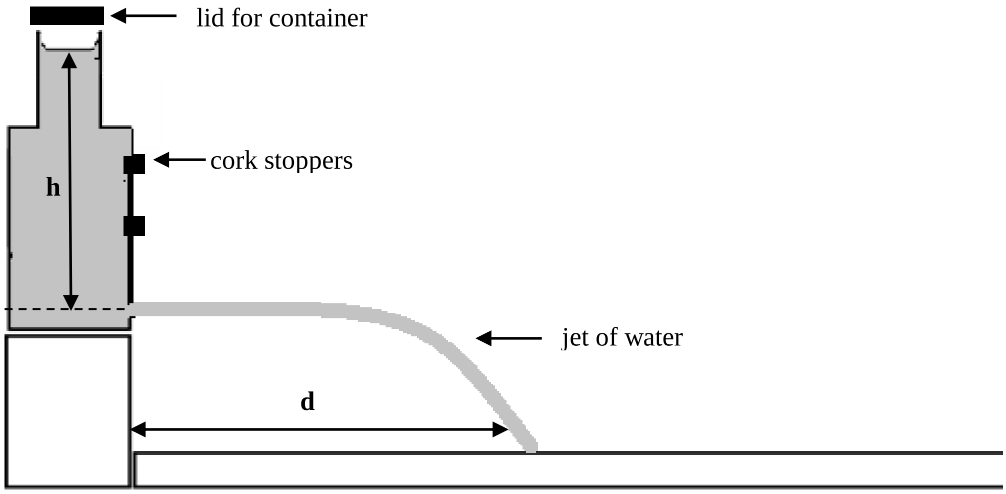
____ (2)

iv. If the master cylinder is connected to two pistons for each of the car's four wheels (a total of eight pistons), how does this affect the value of the force calculated in part b(iii)?

____

____ (2)

c. A group of students investigate how the pressure of water varies with height by measuring the maximum distance reached by the water, d, on changing the height occupied by the water, h, in the apparatus shown below.



i. Predict, giving reason/s, what would happen to the distance, d, reached by the water if:

- the height, h, is increased;

____

- ethanol, with a density of 0.8 g/cm^3, is used instead of water;

____

- the container is sealed with a lid.

____ (6)

ii. If water has a density of 1,000 kg/m^3 and the hole has an area of 2 x 10^{-5} m^2, calculate the force by which the water shoots out of the hole when the height, h, is 0.15 m.

____

____

____

____ (4)

(Total: 20 marks)

20

DO NOT WRITE ABOVE THIS LINE

3. This question is about waves.

a. Energy can be transferred from one point to another using transverse or longitudinal waves. Explain how particles move in these two types of waves.

Transverse:

____

____(1)

Longitudinal:

____

____(1)

b. While playing football, sunlight is reflected from the window of a nearby building into the footballer's eyes.

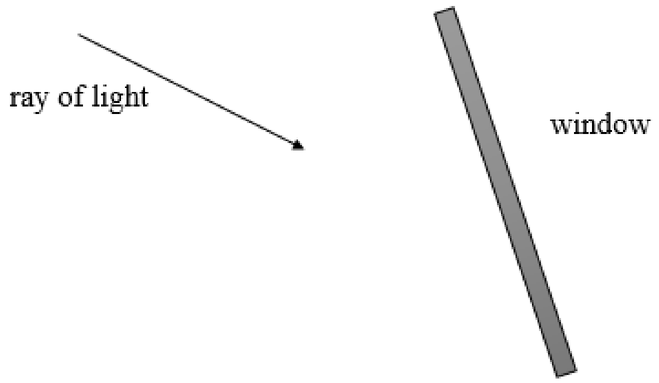
i. Are light waves transverse or longitudinal? ______________________________ (1)

ii. State the law of reflection.

____

____(1)

iii. Complete the diagram below to show the reflection of the ray from the window. Include the normal in your diagram and label clearly the two angles involved. (2)



iv. What could be done to stop sunlight being reflected into the footballer's eyes from this window?

____(1)

c. Light is part of the electromagnetic spectrum.

i. State **ONE** factor that all parts of this spectrum have in common, apart from being of the same type of wave mentioned in part b(i).

____(1)

ii. Which part of this spectrum has the highest frequency?

____(1)

iii. Given that this frequency can be as high as 3.000×10^{19} Hz, calculate the wavelength if the velocity of this wave in air is 2.997×10^{8} m/s.

____

____(2)

d. During an investigation about the properties of water waves, the following wavefronts are seen.

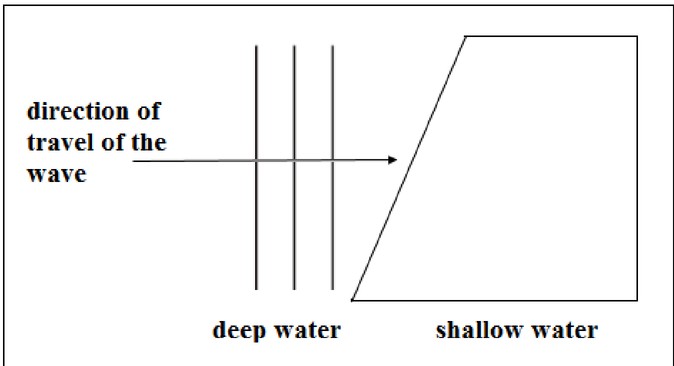


Figure 1

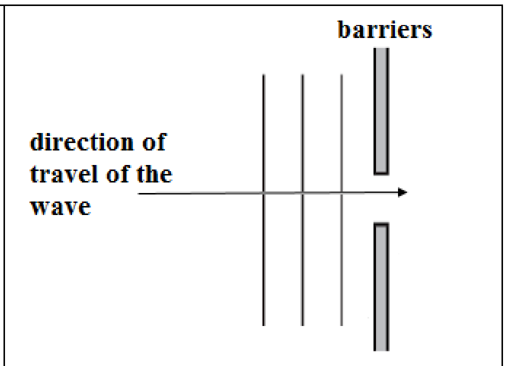


Figure 2

i. Complete Figure 1 to show how water travels from the deep to the shallow water. You should include both the wavefronts and the direction of travel of the wave. (3)

ii. State the name of the phenomenon occurring in Figure 1. ______________________ (1)

iii. Complete Figure 2 to show how water travels as it reaches the barriers. You should include both the wavefronts and the direction of travel of the wave. (2)

iv. State the name of the phenomenon occurring in Figure 2. ______________________ (1)

v. State what happens to the frequency and velocity of the wave when it enters the shallow area in Figure 1.

____

____ (2)

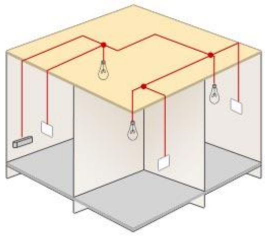
(Total: 20 marks)

20

4. This question is about electricity.

a. Complete the following:

The inside of a wires is made up of ________________, which is a very good ________________ of electricity. __________________ are materials which do not allow electricity to flow through them. (3)



b. Joanne was giving a helping hand to her father in their new house. The electrician asked Joanne's father to buy wires of different thicknesses. While at school Joanne asked her Physics teacher, Ms Vella, why the electrician asked for wires of different thickness. During one of her lessons, Ms Vella, gave her students the following apparatus: battery, ammeter, bulb, connecting wires, crocodile clips and four pieces of wire of different thickness.

i. In the following space, draw and label the set-up required to investigate whether wires of different thicknesses have any effect on a circuit.

(4)

ii. Apart from the thickness of the wire, what is the other quantity that will be measured?

____ (1)

iii. List **THREE** steps to describe how one can check the effect of wire-thickness on a circuit.

____

____

____ (3)

iv. State **ONE** necessary precaution.

____ (1)

c. The experiment can be done with thicker wires.

i. How would the quantity mentioned in part b(ii) vary?

____ (1)

ii. What other observation should Joanne have made?

____ (1)

d. Following this experiment, what conclusion should Joanne make?

____ (1)

e. Apart from thickness, give **ONE** other property which can effect an electrical circuit and explain how.

____

____ (2)

f. Joanne's father was not aware that the wires come in different colours: Brown, Blue and Green/yellow. What are these wires called and what is their main purpose in a three pin plug?

Brown: ________________ - ______________________________________(1)

Blue: ________________ - ______________________________________(1)

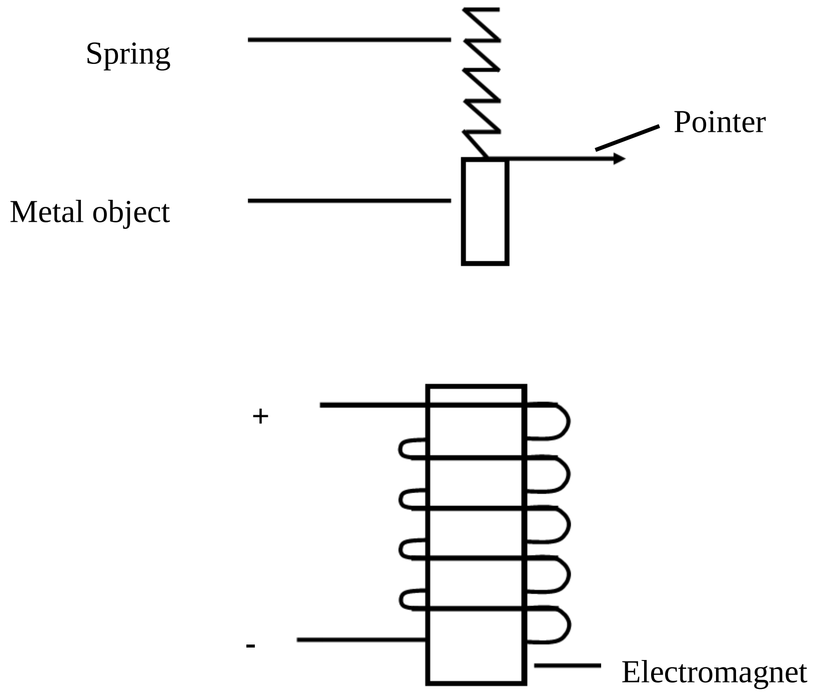
Green/yellow: ________________ - ______________________________________(1)

(Total: 20 marks)

20

5. This question is about electromagnets.

Diandra and Jake are investigating the relationship between the strength of an electromagnet and the current flowing through it. The electromagnet is connected to a variable power supply. They set up the following apparatus and work out the extension of the spring for each value of current.



a. Diandra attaches a pointer to the spring. Why is this piece of apparatus used?

____

____ (1)

b. On the diagram above, draw the position of a ruler that can measure the extension of the spring. (1)

c. Briefly suggest how the experiment can be carried out.

____

____

____

____

____

____ (4)

d. Suggest a suitable material for the electromagnet. Explain your answer.

____

____ (2)

e. On the diagram, include:
   i. the conventional current flowing through the coil; (1)
   ii. the induced magnetic poles on the metal object; (2)
   iii. the magnetic field around the electromagnet. (1)

f. Diandra argues that if the direction of the current flowing through the coil is changed, the metal object will be repelled by the electromagnet. Discuss.

____

____ (2)

g. On carrying out the experiment, Diandra and Jake note that the extension is too small to be measured accurately with a ruler. They decide to increase the extension by using a permanent magnet instead of the metal object.
   i. Explain how a piece of steel can be made into a magnet.

____

____ (2)

   ii. Suggest another change in the equipment to increase the attraction between the electromagnet and the object.

____ (1)

h. For the experiment, the spring used must obey Hooke's Law and not exceed its elastic limit. Explain:
   i. what happens if the elastic limit of the spring is exceeded;

____

____ (1)

   ii. why is it important for this experiment that the spring obeys Hooke's Law.

____

____ (2)

(Total: 20 marks)

20

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2017 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIB
DATE:	29th April 2017
TIME:	4:00 p.m. to 6:05 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 $10 m/s^2$.

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	$\text{Area of a triangle} = \frac{1}{2} b h$	$\text{Area of a trapezium} = \frac{1}{2}(a + b) h$	
	$\text{Area of a circle} = \pi r^2$		

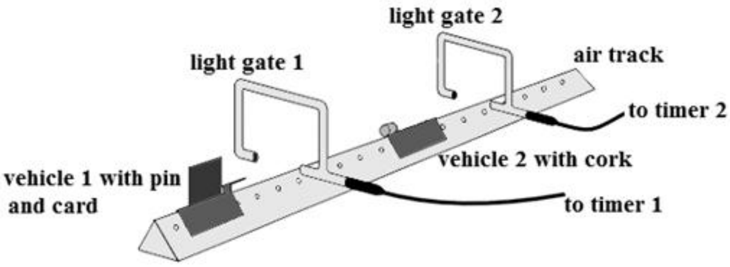
1. This question is about momentum.

a. The law of conservation of momentum states that ____

____ provided that

____ (2)

b. A student wants to investigate if this law is valid and decides to use the air track available at the school laboratory. The diagram on the right shows the equipment he has available. Vehicle 1 has a card that can interrupt the signal of the light gates, and a pin which can stick to the cork of vehicle 2.



i. State which instrument is used to measure the following quantities:

Quantity	Instrument
Length, L, of card on vehicle 1	
Mass, m_1 and m_2, of vehicle 1 and vehicle 2 respectively	
Time, t_1 and t_2, taken by card to pass through light gates 1 and 2 respectively.	

(3)

ii. Vehicle 1 is given an initial push and passes through light gate 1. Give the total initial momentum of the system, in terms of the symbols (m_1, t_1, L) listed in the table above.

____ (1)

iii. Vehicle 1 then collides and sticks to vehicle 2, due to their pin and cork system. They pass through light gate 2 together. Give the total final momentum of the system in terms of the symbols listed in the table above.

____

____ (2)

iv. How should your answers to parts (ii) and (iii) be related to conclude that the law is valid?

____ (1)

v. Give **ONE** main precaution necessary while setting up the air track, to ensure that this experiment is performed accurately.

____ (1)

c. A student stacks some tins, each of mass 0.05 kg, as shown in the diagram.

i. He throws a 0.03 kg ball with a velocity of 6 m/s towards the tins. Calculate the momentum of the ball as it approaches the tins.

____

____ (2)

ii. The ball hits Tin 1 and they move together with a velocity, v as the tin moves away from the stack. Calculate the final velocity with which the ball and Tin 1 move off together.

____

____

____ (3)

iii. He now throws a larger ball of mass 0.07 kg with a velocity u m/s towards Tins 2 and 3 as shown.

Both Tins 2 and 3 move off together with the ball at a velocity of 3.5 m /s. Calculate the initial velocity, u, of the ball.

____

____

____ (3)

iv. The student then throws the 0.07 kg ball with a velocity u of 1.5 m/s, aiming only at Tin 4. The tin remains at rest, while the ball rebounds back with a velocity v of -1 m/s, in 0.4 s. Calculate the force acting on the ball.

____

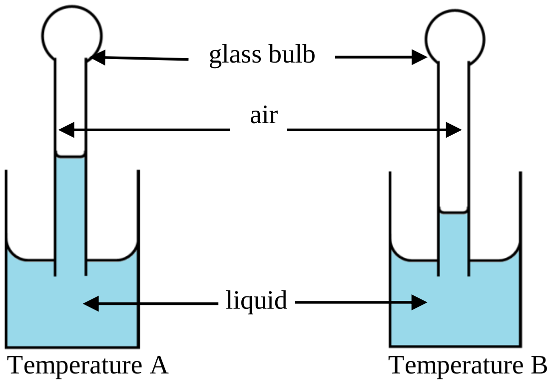
____ (2)

(Total: 20 marks)

20

2. The question is about pressure.

a. The thermoscope was a device built in approximately the year 1593 to indicate temperature. Two diagrams of a thermoscope at different temperatures are shown below.



i. What happens to the pressure and the volume of the air inside the bulb when the temperature rises?

____

____ (2)

ii. Hence, predict whether Temperature A is higher, lower or equal to Temperature B.

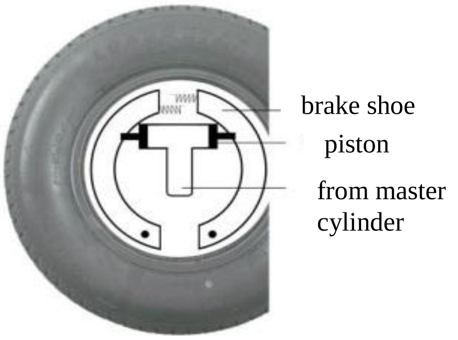
____ (1)

b. In a car drum-brakes, a master cylinder of area of 5 cm^2 leads to two pistons each with an area of 0.0031 m^2.

i. Convert the area of the master cylinder to m^2.

____

____ (1)



ii. If a force of 10 N is applied on the master cylinder (of area 5 cm^2), calculate the pressure in the hydraulic fluid.

____

____ (2)

iii. What is the pressure in the hydraulic fluid leading to one of the two pistons?

____ (1)

iv. Calculate the total force exerted by the two pistons (each of area 0.0031 m^2).

____

____

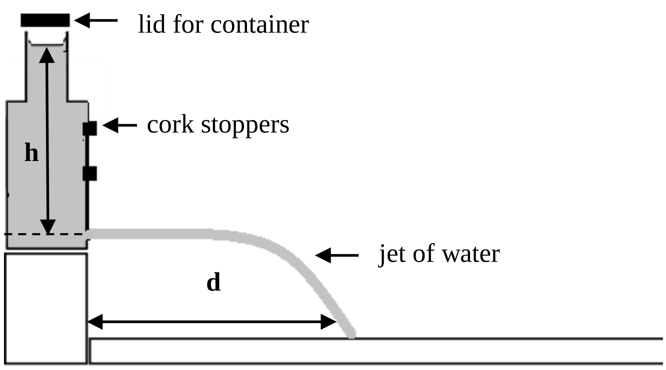
____ (3)

v. If the master cylinder is not just connected to two pistons, but with two pistons for each of the car's four wheels (a total of eight pistons), how does this affect the value of the force calculated in part b(iv)? Explain your answer.

____

____ (2)

c. A group of students investigate how the pressure of water varies with height by measuring the maximum distance reached by a jet of water shooting out of a perforated:



i. If the density of water is 1,000 kg/m^3, calculate the pressure in the fluid when the height, h, is 0.15 m.

____

____ (2)

ii. Explain what happens to the distance, d, reached by the shooting water if:

- the height, h, of fluid in the container is increased?

____

____ (2)

- the water in the container is replaced by cooking oil? (oil has a lower density than water)

____

____ (2)

- the size of the hole is decreased?

____

____ (2)

(Total: 20 marks)

20

3. This question is about waves.

a. Energy can be transferred from one point to another using transverse or longitudinal waves. Circle the correct term in the brackets to show how the particles travel in these waves.

In a transverse wave, the particles vibrate (parallel / perpendicular) to the direction of travel of the wave.
In a longitudinal wave, the particles vibrate (parallel / perpendicular) to the direction of travel of the wave. (2)

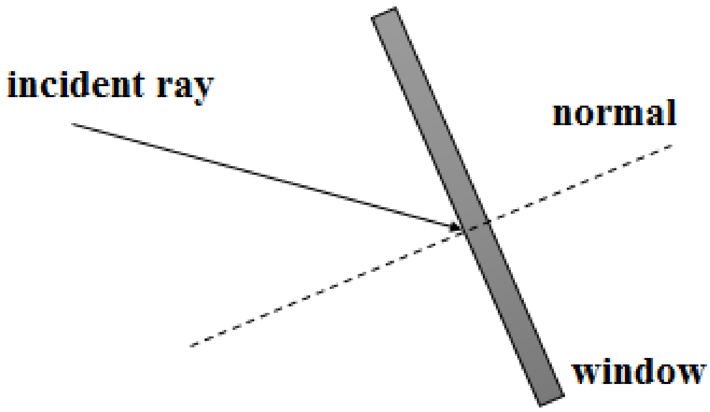
b. A football player is playing a match. When the window of a nearby building is opened, it reflects sunlight into his eyes.

i. Are light waves transverse or longitudinal? ________________________ (1)

ii. State the law of reflection.

____ (1)

iii. Complete the diagram below to show the reflection of the ray from the window. Label clearly the main angles involved. (2)



iv. What could be done to stop sunlight being reflected into the footballer's eyes from this window?

____ (1)

c. Light is part of the electromagnetic spectrum.

i. State **ONE** factor that all parts of this spectrum have in common, apart from being of the same type of wave mentioned in part b(i).

____ (1)

ii. Which part of this spectrum has the highest frequency?

____ (1)

iii. Given that an electromagnetic wave of frequency 3×10^{19} Hz has a wavelength of 1×10^{-11} m, calculate the velocity of this wave.

____

____ (2)

d. During an investigation about the properties of water waves, the following wavefronts are seen.

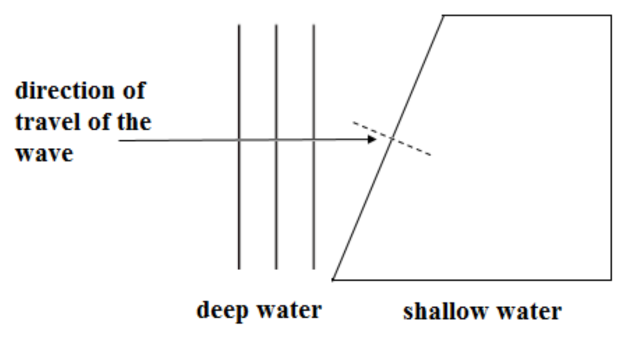


Figure 1

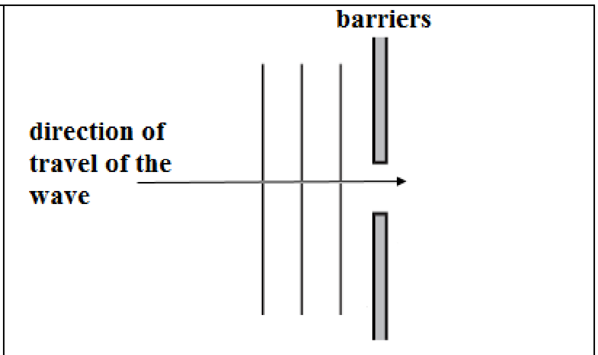


Figure 2

i. In which figure will diffraction of water waves occur? ____________________ (1)

ii. In which figure will refraction of water waves occur? ____________________ (1)

iii. Complete Figure 1 to show how water travels from the deep to the shallow water. You should include both the wavefronts and the direction of travel of the wave. The normal at the boundary has been drawn for you. (3)

iv. Complete Figure 2 to show how water travels as it reaches the barriers. You should include both the wavefronts and the direction of travel of the wave. (2)

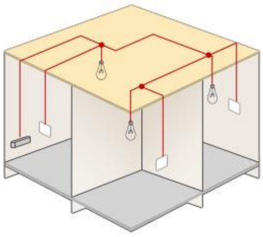
v. Circle the correct word.

In Figure 1, the wavefronts are travelling from a deep to a shallow section. The frequency of the waves will (decrease / increase / remain the same), while the wavelength will (decrease / increase / remain the same). (2)

(Total: 20 marks)

20

4. This question is about electricity.
Joanne was giving a helping hand to her father in their new house. The electrician asked Joanne's father to buy wires of different thicknesses. While at school Joanne asked her Physics teacher, Ms Vella, why the electrician asked for wires of different thickness.



a. Complete the following by choosing the correct word from the list below. Each word may be used, once, more than once or none at all.

insulators ***electrons*** ***conductor*** ***copper***

Wires are made up of _______________, which is a very good ________________ of electrictity.

____________________ are materials which do not allow electricity to flow through them. (3)

b. During one of her lessons, Ms Vella, gave her students the following apparatus: battery, ammeter, bulb, connecting wires, crocodile clips and four pieces of wire of different thickness.

i. In the following space, draw the set-up required to investigate whether wires of different thicknesses have any effect on a circuit.

(3)

ii. Why is the ammeter required?

____ (1)

iii. In the table below write the name of the variables Joanne will measure during the experiment? (2)

iv. State **ONE** necessary precaution required when doing the experiment.

____ (1)

c. Circle the correct answer.

When wires of increasing thickness were used:

i. The bulb's brightness increased / decreased / remained the same.

ii. The voltage of the battery increased / decreased / remained the same.

iii. The resistance in the circuit increased / decreased / remained the same. (3)

d. Apart from thickness, give **ONE** other property which can affect an electrical circuit.

____ (1)

e. Joanne was not aware that the wires in a three pin plug have different colours: Brown, Blue and Green/Yellow. Complete the following table:

Wire Colour	Wire name	Purpose
Brown	Live	
Blue		Completes the circuit
Green/yellow		

(4)

f. While looking for a screwdriver in her father's toolbox, Joanne found a fuse with 13 A written on it. What does 13 A indicate?

____

____ (2)

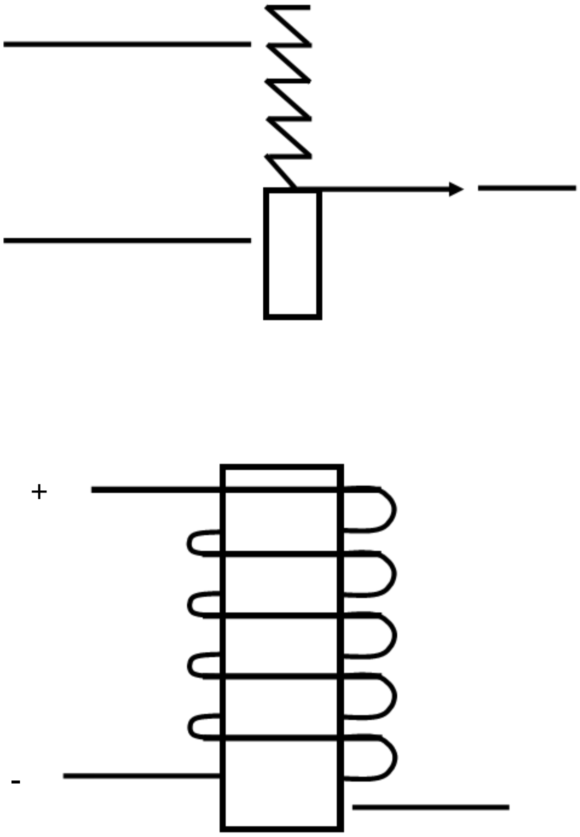
(Total: 20 marks)

20

5. This question is about electromagnets.

Diandra and Jake are investigating the relationship between the strength of an **electromagnet** and the current flowing through it. The electromagnet is connected to a variable power supply. The **metal object** is connected to a **spring** with a **pointer**. The extension of the spring is worked out for different currents flowing through the electromagnet.

a. Label the diagram below using the words in bold from the above passage. (4)



b. On the diagram above, draw the position in which a ruler is to be placed to measure the extension of the spring. (1)

c. Of the two variables that will be measured and recorded, which one:

i. will be changed by the students? ____ (1)

ii. will change only because of a change in the other variable? ________________________ (1)

d. Should the electromagnet be made of iron or steel? Explain your answer.

____

____ (2)

e. On the diagram, include:
   i. the conventional current flowing through the coil; (1)
   ii. the induced magnetic poles on the metal object; (1)
   iii. the magnetic field around the electromagnet. (3)

f. Diandra argues that if the direction of the current flowing through the coil is changed, the metal object will be repelled by the electromagnet. Discuss.

____

____ (2)

g. On carrying out the experiment, Diandra and Jake note that the extension is too small to be measured accurately with a ruler. They decide to increase the extension by using a permanent magnet instead of the metal object.
   i. Explain how a piece of steel can be made into a magnet.

____

____ (2)

   ii. Suggest another change in the equipment to increase the attraction between the electromagnet and the object.

____ (1)

h. After a run of the experiment, Jake measures the spring and finds that it has exceeded its elastic limit during the experiment. How can Jake note that the spring has exceeded its elastic limit?

____

____ (1)

(Total: 20 marks)

20

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