Index Number:________________ SEC24/1.18m

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

L-Università ta' Malta

SECONDARY EDUCATION CERTIFICATE LEVEL
2018 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	28^{th} April 2018
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	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$V_p I_p = V_s I_s$	
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. On the last day of 2016, a 'leap second' was added before midnight. It turns out that a number of factors such as tides and melting glaciers caused the rate of the Earth's rotation to decrease slightly.

a. State how long does the Earth take to:

i. rotate once on its own axis; ______________________ (1)

ii. complete one orbit around the sun. ______________________ (1)

b. 'Today, the Earth's axis is tilted 23.5 degrees from the plane of its orbit around the sun.'

http://earthobservatory.nasa.gov/Features/Milankovitch/milankovitch_2.php

Explain, with the aid of a diagram, how this tilt gives rise to summer and winter at a particular point on Earth.

____

____

____

____

____ (5)

c. Earth is one of the eight planets of the solar system.

i. Name **ONE** other planet which is larger than Earth.

____ (1)

ii. Orbiting the sun is one characteristic of a planet. Give another **TWO** characteristics.

____

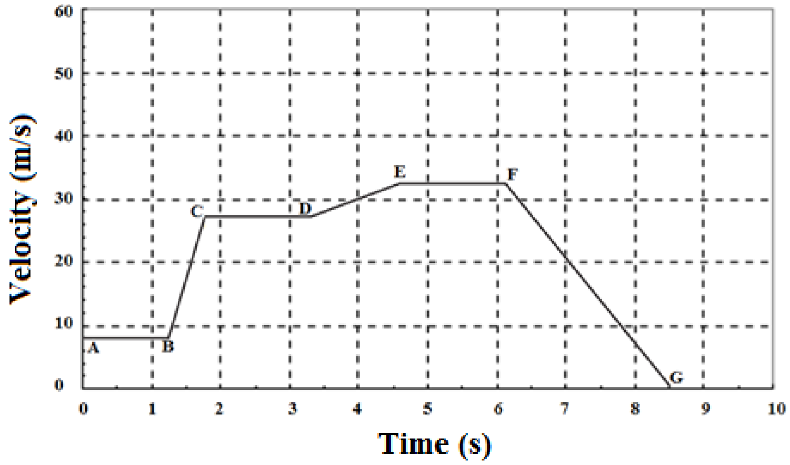
____ (2)

(Total: 10 marks)

10

2. This question is about motion.

a. The graph below shows how the velocity of a car travelling on a straight road changes with time.



i. Calculate the distance travelled by the car from C to D, given that it takes 1.7 s to do so.

____

____ (2)

ii. State which section shows the largest acceleration. Explain your answer.

____ (2)

iii. At point F, the driver uses the brakes to bring the car to rest. What is the distance covered from F to G called?

____ (1)

iv. State and explain **ONE** factor affecting the value of the distance mentioned in part (iii).

____

____ (2)

b. Engineers usually perform crash tests to ensure safe design standards in cars. In one test, a car of mass of 1084 kg was made to crash head-on into a wall at 15.6 m/s.

i. Calculate the initial momentum of the car before hitting the wall.

____ (1)

ii. Calculate the impact force that acts on the driver if the car comes to rest in 0.2 s.

____

____ (2)

(Total: 10 marks)

10

3. A boy throws a piece of wood measuring 3 cm by 4 cm by 6 cm into a swimming pool.

a. Define the term density.

____

____ (2)

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

____

____ (2)

c. If the piece of wood has a mass of 7 g, what is its density in kg/m^3?

____

____

____ (3)

d. The piece of wood is now broken in two pieces. What effect, if any, will this have on the density of each part of the wood?

____

____ (1)

e. Would you expect the wood to float or sink when placed on water? Explain your answer.

____

____

____ (2)

(Total: 10 marks)

10

4. Therese and Karl have just bought a drone. They intend to attach a camera to it so that they can use it for photography. One feature of a drone is that it usually has two green bulbs and two red bulbs.

a. Draw the circuit symbol of a bulb. (1)

b. The four bulbs are connected in series to a battery. Draw a circuit diagram to show the four bulbs connected to the battery. Include a switch in the circuit which can switch ON/OFF all the bulbs together.

(2)

c. If the resistance of one green or red bulb is 24 Ω, what is the total resistance of the four bulbs?

____

____ (2)

d. Therese connected a camera, of resistance 44 Ω, parallel to the four bulbs at the centre of the drone. Find the total resistance of the bulbs and the camera.

____

____

____ (3)

e. If the voltage across one of the green bulbs is 0.3V, what is the voltage across the camera?

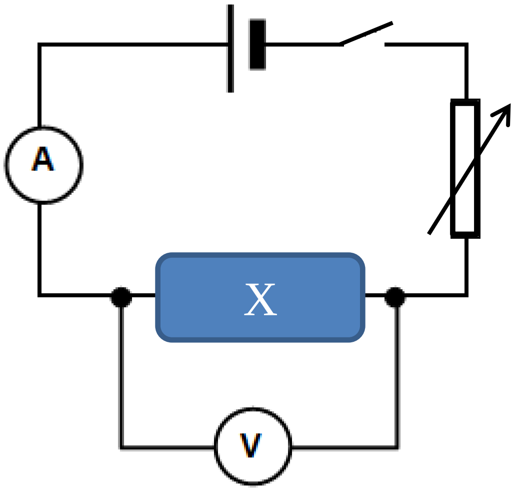
____

____ (2)

(Total: 10 marks)

10

5. The following circuit was connected as shown including an unknown component X.



For different settings of the variable resistor, the following data was recorded:

V/V	1.0	1.5	2.0	2.5	3.0
I/A	0.002	0.003	0.004	0.005	0.006

a. Plot a graph of V/V against I/A. (4)

b. Determine the gradient of the graph.

____

____ (2)

c. What would the value of the current be when the value of V is 2.7 V?

____ (1)

d. State whether component X is ohmic? Explain how you arrived at your answer.

____

____

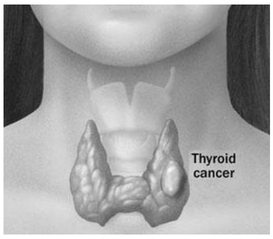
____ (3)

(Total: 10 marks)

10

DO NOT WRITE ABOVE THIS LINE

6. Radioactive Iodine (I-131), is an isotope of Iodine used to treat certain diseases in the thyroid gland such as Thyroid cancer. Beta and gamma radiation emitted from I-131 kill overactive thyroid cells.



a. Give **TWO** properties of:

i. beta radiation:____

____

ii. gamma radiation: ____

____ (4)

b. Name **ONE** other type of radioactive emission.

____ (1)

c. The half-life of I-131 is 8 days. Patients treated with this isotope are asked to isolate themselves for a week. The same treatment can be carried out using Technetium-99, of half-life 6 hours, and patients should isolate themselves for only a day.

i. Explain why the patient has to stay in isolation.

____

____

____ (2)

ii. Explain the reasons for the difference in time of isolation when using Iodine-131 and Technetium-99.

____

____

____ (2)

d. Mention **ONE** other use of radioactive sources.

____ (1)

(Total: 10 marks)

10

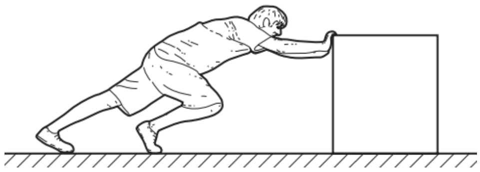
7. This question is about energy.

a. Define the term work.

____

____ (1)

b. A man pushes a box a distance of 3.2 m with a constant force of 700 N along a frictionless surface. Calculate the work done by the man.



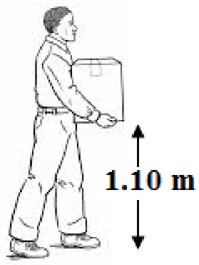
____

____ (1)

c. State the energy changes involved in this process.

____ (1)

d. The box of mass of 45.0 kg is now lifted vertically upwards by 1.10 m as shown in the diagram.



i. Calculate the potential energy gained by the box.

____

____ (1)

ii. What is the power generated by the man when he lifts the box in 3.0 s?

____

____ (2)

iii. If the box had to be released from that height, what would be the kinetic energy with which it would reach the ground? Explain your reasoning by stating the relevant law.

____

____ (2)

e. The power obtained is enough to light up a small bulb for a few seconds if it could be converted into electrical energy. State **ONE** renewable and **ONE** non-renewable source of electrical energy.

Renewable:____________________ Non-Renewable:______________________ (2)

(Total: 10 marks)

10

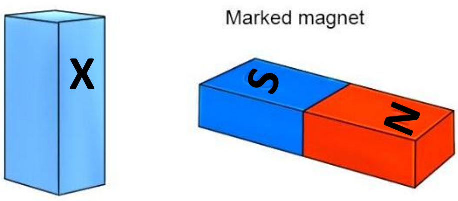
8. This question is about magnets.

a. Fill in the missing words.

Materials which can be made into magnets are called ____________________ materials. To make temporary magnets, ____________________ is used while to make permanent magnets, ____________________ is used. (3)

b. Draw a diagram to show how a magnet can be made using the stroking method. (2)

c. The north pole of a magnet is brought close to a body X as shown which is thought to be a magnet.



https://www.wonkeedonkeetools.co.uk/

i. A force of attraction is experienced between the magnet and body X. What can you conclude about X?

____

____ (2)

ii. How can you confirm what body X is?

____

____

____ (3)

(Total: 10 marks)

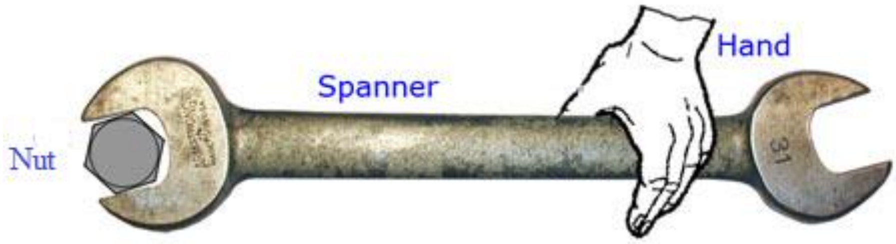
10

9. The concept of moments features in a number of everyday uses.
a. Define the moment of a force.

____

____ (2)

b. A mechanic uses a spanner to undo a tight nut as shown. He places his hand 9 cm from the pivot and applies a force of 10 N.



Taken from: http://www.learneasy.info/

i. On the diagram indicate how the force is applied and the distance from the pivot. (2)

ii. Calculate the moment of the force.

____

____

____ (2)

c. One day, the mechanic hurt his hand and could only exert half the usual force.
i. What can he do to produce the same effect?

____

____ (2)

ii. Using a calculation, show that your answer to part (i) is correct.

____

____ (2)

(Total: 10 marks)

10

10. The electromagnetic spectrum consists of seven different types of radiation.

a. The diagram below shows some of the regions of the electromagnetic spectrum. Complete the diagram by labelling regions A, B and C in the spaces below.

Gamma	A ________	B ________	Visible light	C ________	Microwaves	Radio waves

(3)

b. State **TWO** common properties of all electromagnetic waves.

____

____ (2)

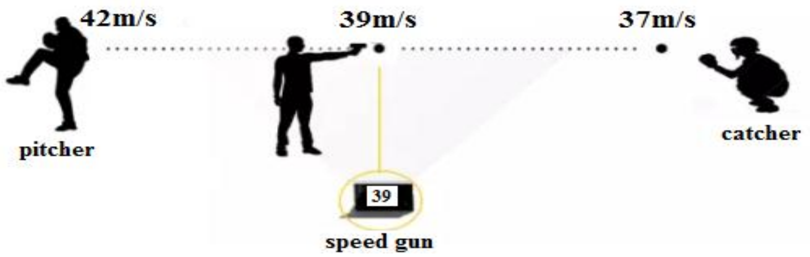
c. Which of the electromagnetic waves has the lowest frequency?

____ (1)

d. State **ONE** main use of gamma radiation.

____ (1)

e. Microwaves are used in speed guns which are devices used in sports to detect the speed with which balls are being launched. The diagram below shows one similar example from baseball, where the speed gun monitors the speed of the ball as it travels from the pitcher to the catcher.



i. One wavelength of microwaves is 0.0125 m. Calculate the corresponding frequency given that the velocity of infrared rays is 3×10^8 m/s.

____

____ (2)

ii. Some of the microwaves transmitted might be absorbed by the ball. What effect would this have on the ball?

____ (1)

(Total: 10 marks)

10

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2018 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIA
DATE:	28th April 2018
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	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	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$V_p I_p = V_s I_s$	
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 heat energy.

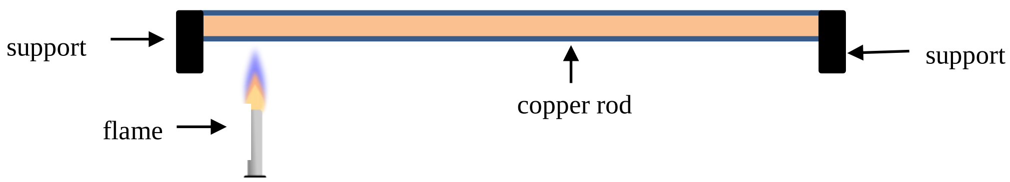
a. The kinetic theory of matter explains the structure of matter. Fill in the missing words:

i. In a solid, the particles are __________________ to each other and __________________ about a mean position. (2)

ii. In a liquid, the particles can __________________ around and are further away from each other from the particles in __________________. (2)

iii. In a gas, the particles are very __________________ from each other. (1)

b. A copper rod fixed between two rigid supports is heated uniformly.



i. Describe why the support will experience a force when the copper rod is heated?

____

____ (2)

ii. With reference to particles, explain the effect of the rod in part (i).

____

____ (2)

iii. What can happen to the rod if it cannot move the supports?

____

____ (1)

c. The temperature of the copper rod was raised by 50 °C while heating. If the mass of the copper rod is 750 g and the specific heat capacity of copper is 385 J/Kg°C, calculate how much heat was given to the rod.

____

____

____

____ (3)

d. The three main methods of heat transfer are conduction, convection and radiation. Complete the following table:

Type of Heat Transfer	Can take place in:	Method of how heat is transferred:
Conduction		
	Liquids or gases	
		Electromagnetic waves

(3)

e. When birds are about to sleep they often flutter their feathers giving the appearance of a ball of feathers. Explain in terms of physics why they do this.

____

____

____ (3)

f. Give **ONE** method of how we can insulate our homes.

____ (1)

(Total: 20 marks)

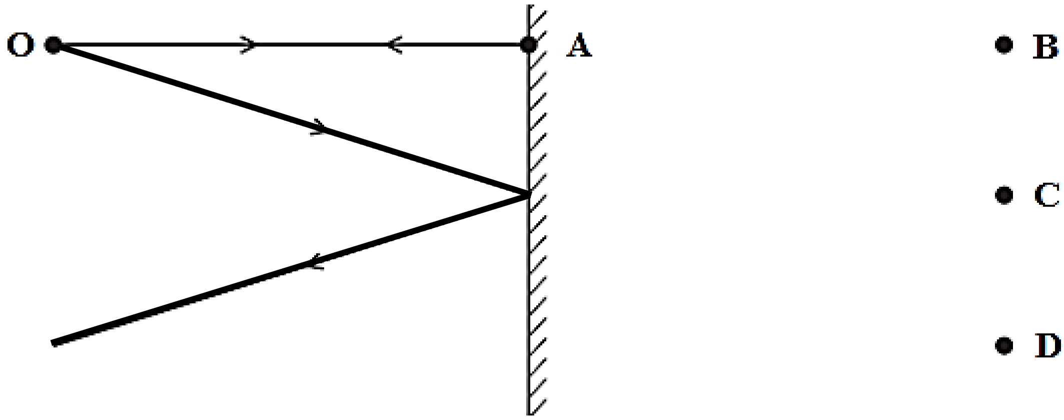
20

2. This question is about Optics.

a. State the law of reflection of waves.

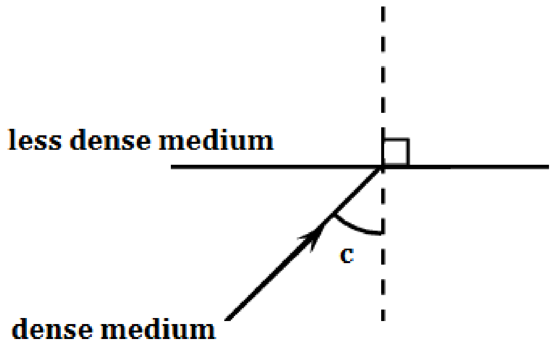
____ (1)

b. The diagram shows two rays of light from an object O being reflected from a plane mirror. Complete the diagram to show whether the image will be formed in position B, C or D.



(2)

c. The ray of light shown in the diagram below reaches the boundary between two media at the critical angle.



i. Complete the diagram to show how the ray will behave at the boundary. (1)

ii. What will happen to the ray of light if the angle of incidence had to be increased further?

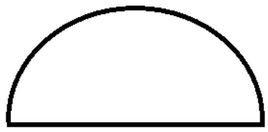
____ (1)

iii. Give an application in which the situation in c(ii) is used.

____ (1)

d. An experiment is carried out to investigate refraction of light through a glass block, for angles smaller than the critical angle. You are provided with a ray box connected to a power supply, a semi-circular glass block, plain paper, protractor, pencil and a ruler.

i. Draw a labelled diagram in the space below to show how you would set up the apparatus for the investigation. The block is already drawn for you.



(2)

ii. Give a brief explanation of the method you would use.

____

____

____

____ (3)

iii. On your diagram, mark clearly the normal at the block and the path the ray of light would follow as it enters and emerges from the block, indicating clearly the angle of incidence with an 'i' and the angle of refraction with an 'r'. (3)

iv. What happens to the speed of light when it enters the block?

____ (1)

v. The speed of light in air is 3.0×10^8 m/s and the refractive index of the glass block used is 1.495. Calculate the speed of light inside the block.

____

____ (2)

vi. Refraction of light occurs also as light passes through lenses to form an image. A converging lens of magnification 3 forms an image 12 cm away from its centre. Calculate the distance in metres between the object and the lens.

____

____ (3)

(Total: 20 marks)

20

3. This question is about the thermistor.

Ella found a thermistor in her father's toolbox. From her Physics lessons, she knew that current flowing through it can vary. Ella was wondering how the thermistor can be used.

a. Complete the following:

The symbol for a thermistor is ________________. The thermistor is sensitive to ________________. It is made from a special material called a ______ __________________. (3)

b. Ella took the thermistor to school and her teacher helped her understand how the thermistor works. In the Physics lab, Ella was given a power supply, an ammeter and a bulb. She was also given a hair dryer with three power levels.

i. Draw a diagram to show how the thermistor and the other circuit components can be connected to show how the thermistor works. (3)

ii. List **THREE** steps Ella must follow to find how the thermistor works.

____

____

____ (3)

iii. State the variables she should investigate.

____ (1)

iv. What should Ella conclude after following the steps mentioned in part b (ii)?

____

____ (2)

c. Back home, Ella's father told her that he was planning to use the thermistor in the cat's room in the backyard. He wanted to install a fan so that it switches on when the cat's room is too hot.

i. Suggest the changes he should make to the circuit in part b(i) for the fan to work. Explain how the fan will go on automatically.

____

____ (2)

ii. Ella suggested that her father could have used a timer with set times for the fan to go on. Which is the most efficient, the thermistor or the timer? Explain.

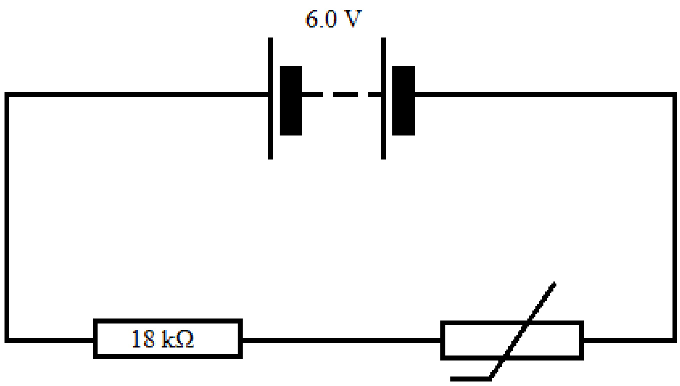
____

____ (2)

d. Give **ONE** other situation where the thermistor might be useful.

____ (1)

e. A battery of emf 6.0 V is connected to a resistor of resistance 18 kΩ and a thermistor. At a temperature of 20 °C the thermistor's resistance is 22 kΩ.



Find the energy produced in the circuit, in 2 hours, when the temperature is 20 °C.

____

____

____ (3)

(Total: 20 marks)

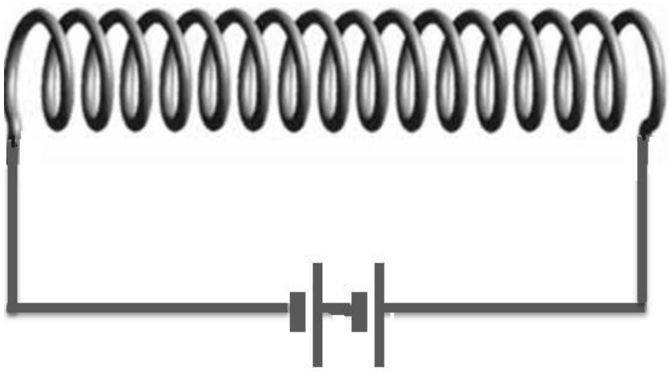
20

4. This question is about magnetic fields.

a. A magnetic field is formed around a magnet. Draw the magnetic field pattern around a bar magnet. (2)

b. When an electric current passes through a conductor, a magnetic field is created.

i. Draw the magnetic field pattern around the coil. (2)



ii. State **ONE** difference between the magnetic field pattern of a permanent magnet and the one produced by the coil.

____

____ (2)

iii. If a piece of iron is introduced in the coil, an electromagnet is produced. State **TWO** advantages of using the electromagnet to produce a magnetic field over a permanent magnet.

____

____ (2)

iv. State **TWO** ways how the advantages you mentioned in part (iii) can be achieved.

____

____ (2)

c. The battery in the circuit shown in part (b) is replaced with a galvanometer.

i. Explain the observation if the north pole of a magnet is pushed into the coil.

____

____ (2)

ii. What happens if the magnet is left inside the coil? Explain.

____

____ (2)

iii. Describe and explain what happens as the magnet is being taken out of the coil.

____

____

____ (2)

iv. What can be concluded from your answers to parts c(i), c(ii) and c(iii)?

____

____ (2)

v. Name the laws related to these observations.

____

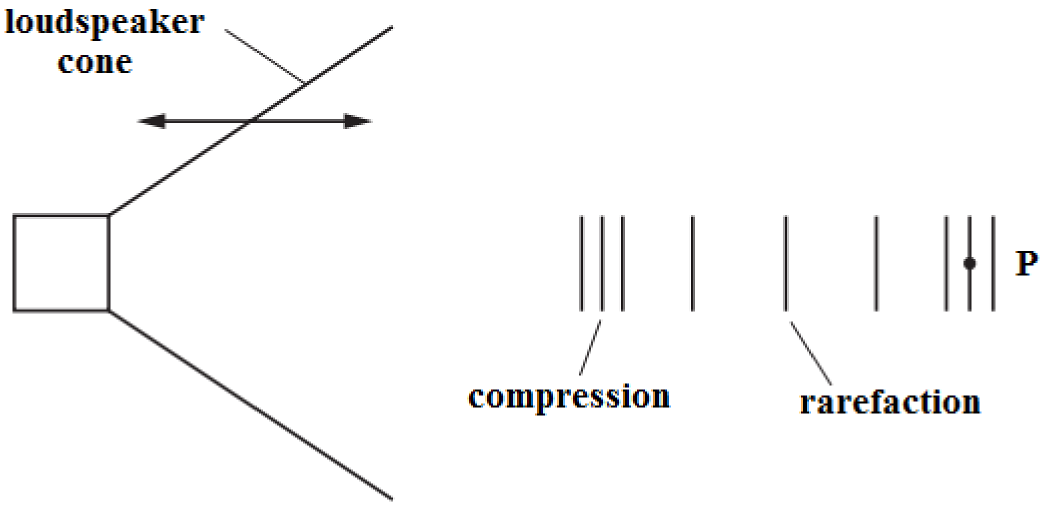
____ (2)

(Total: 20 marks)

20

5. This question is about Waves.

a. Waves carry energy from one location to another. In the diagram below, compressions and rarefactions are sent out from a loudspeaker cone as it vibrates backwards and forwards with a frequency of 50 Hz.



i. Is the wave shown in the diagram longitudinal or transverse? Explain your answer in terms of the particles' motion.

___

___ (2)

ii. What information does the phrase 'the frequency of vibration is 50 Hz' give us about the vibration?

___

___ (1)

iii. P is a compression point. How much time passes before the next rarefaction arrives at P?

___

___ (2)

b. Water waves spread out when passing through a gap.

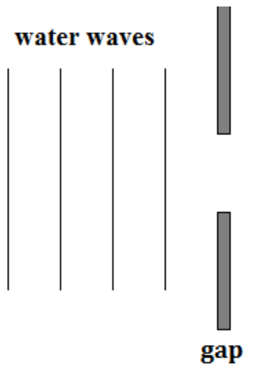
i. What type of waves are water waves?

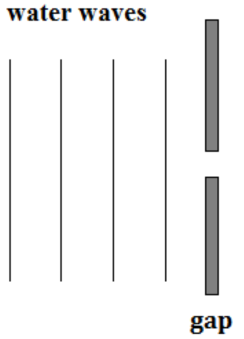
___ (1)

ii. What is the phenomenon observed when a wave passes through a gap called?

___ (1)

iii. Continue the diagrams below, showing the behaviour of waves as they pass through these two gaps. The diagrams should include the wavefronts and the wave direction. (2)





c. Water waves are also refracted at a boundary when passing from a deep to a shallow region. State the effect, if any, this has on their:

i. frequency ______________________________ (1)

ii. wavelength ______________________________ (1)

iii. speed ______________________________ (1)

d. X-rays and Radio waves form part of a group of waves that can travel through vacuum.

i. What is the name of this group of waves?

______________________________ (1)

ii. List **TWO** other properties that these waves have in common.

____

______________________________ (2)

iii. What is name of the wave with the shortest wavelength from this group of waves?

______________________________ (1)

iv. Infrared waves are thermal waves. In fact, we experience this type of heat from a fire or a radiator amongst others. Given that the speed of infrared radiation is 3.0×10^{8} m/s in air and its periodic time is 2.5×10^{-15} s, calculate the wavelength of infrared radiation.

____

____

____

______________________________ (4)

(Total: 20 marks)

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L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2018 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIB
DATE:	28th April 2018
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	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	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$V_p I_p = V_s I_s$	
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 heat energy.

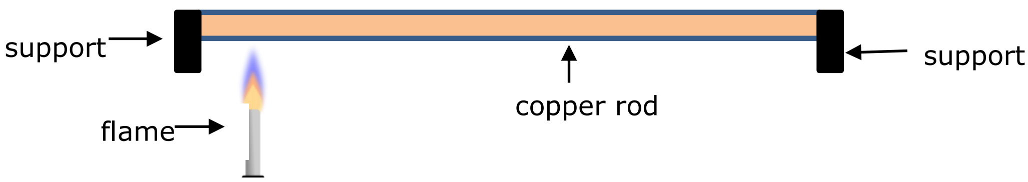
a. The kinetic theory of matter explains the structure of matter. Fill in the missing words.

i. In a solid, the particles ________________ from side to side and occupy a ________________ space. (2)

ii. In a liquid, the particles can move around and are ________________ away from each other than those in ________________. (2)

iii. In a gas, the particles are very ________________ from each other. (1)

b. A copper rod is fixed between two supports which cannot move. The rod is heated uniformly.



i. What happens to the length of the copper rod when it is heated? Explain.

____

____ (2)

ii. What do we call this behaviour?

____ (1)

iii. What can happen to the shape of the rod because the ends of the rod cannot move? Explain.

____

____ (2)

c. The temperature of the copper rod was raised by 50 °C while heating. If the mass of the copper rod is 0.75 kg and the specific heat capacity of copper is 385 J/Kg°C, calculate how much heat was given to the rod.

____

____

____

____ (3)

d. The three main methods of heat transfer are conduction, convection and radiation. Complete the following table:

Type of Heat Transfer	**Can take place in**	**Method of how heat is transferred**
Conduction	Solids	
	Liquids or gases	
	Vacuum	Electromagnetic waves

(4)

e. When birds are about to sleep they often flutter their feathers giving the appearance of a ball of feathers. Explain in terms of physics why they do this.

____

____

____ (3)

(Total: 20 marks)

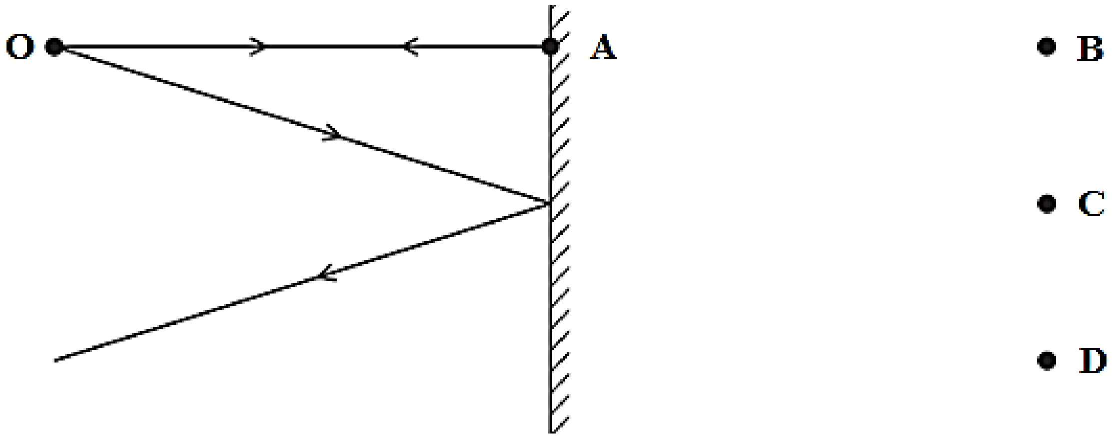
20

2. This question is about Optics.

a. Circle the correct word from each bracket to complete the following:

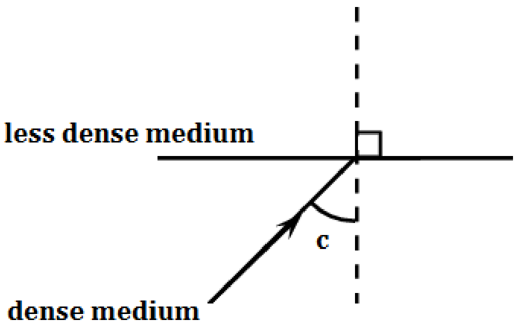
The law of reflection of waves states that the angle of (reflection, incidence, refraction) is equal to the angle of (incidence, refraction, reflection). (1)

b. The diagram shows two divergent rays of light from an object O being reflected from a plane mirror. Complete the diagram to show whether the image will be formed in position B, C or D.



(2)

c. The ray of light shown in the diagram below reaches the boundary between two media at the critical angle.



i. Complete the diagram to show how the ray will behave at the boundary. (1)

ii. What will happen to the ray of light if the angle of incidence had to be increased further?

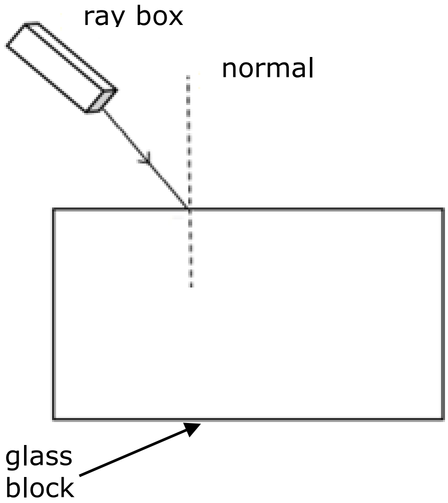
____ (1)

iii. Give an application in which the situation in c(ii) is used.

____ (1)

d. An experiment is carried out to investigate refraction of light through a glass block, for angles smaller than the critical angle. You are provided with a ray box connected to a power supply, a rectangular glass block, plain paper, protractor, a pencil and a ruler.
The diagram on the right shows the setup of the apparatus for the investigation. The incident ray and the normal are already drawn for you.

i. Put the following statements in order by using the numbers **1** to **5**, to describe the method that should be followed to carry out the investigation. The first one is done for you.



Use a protractor to measure the angles of incidence and refraction.	
Mark the ray of light as it enters and emerges the block using the pencil.	
Trace the outline of the block on the plain paper using the pencil.	**1**
Remove the block and draw the normal to the block and the rays of light.	
Use the ray box to pass a light ray through the glass block.	

(4)

ii. On your diagram, mark clearly the path that the ray of light would follow as it enters and emerges from the block, indicating clearly the angle of incidence with an 'i' and the angle of refraction with an 'r'. (4)

iii. What happens to the speed of light when it enters the block?

______________________________ (1)

iv. The speed of light in air is 3.0×10^8 m/s and the refractive index of the glass block used is 1.495. Calculate the speed of light inside the block.

____

______________________________ (2)

v. Refraction of light occurs also as light passes through lenses to form an image. A converging lens of magnification 3 forms an image 12 cm away from its centre. Calculate the distance in metres between the object and the lens.

____

____

______________________________ (3)

(Total: 20 marks)

20

3. This question is about the thermistor.

Ella found a thermistor in her father's toolbox. From her Physics lessons, she knew that current flowing through it can vary. Ella was wondering how the thermistor can be used.

a. Draw the circuit symbol for the thermistor. (1)

b. State whether the following statements are True or False.

   i. The thermistor is sensitive to temperature. ____________________ (1)

   ii. The thermistor is not sensitive to visible light. ____________________ (1)

c. Ella took the thermistor to school and her teacher helped her understand how the thermistor works. In the Physics lab, Ella was given a power supply, an ammeter and a bulb. She was also given a hair dryer with three power levels.

   i. Draw a diagram to show how the thermistor and the other circuit components can be connected to show how it works. (3)

   ii. Insert the correct word from the list below to complete the method used by Ella. Each word may be used once, more than once or none at all.

on, ammeter, first, third, off, reading

When all the components are connected as shown in the diagram in part (i), the hairdryer is switched on the ________________ level of heating power and the ________________ and the bulb are observed. The hairdryer is then switched on the second and ________________ level of heating power, each time taking a reading of the ammeter. (3)

   iii. What should have Ella observed on the ammeter and the bulb when the hairdryer was switched on higher power levels?

____ (1)

iv. What should Ella conclude about thermistor's resistance after following the steps in part c (ii)?

____

____ (2)

d. Back home, Ella's father told her that he was planning to use the thermistor in the dog's kennel in the backyard. He wanted to install a fan so that it goes on when the kennel is too hot.

i. Instead of which component listed in part (c) should the fan be installed?

____ (1)

ii. Which of the components listed in part (c) will not be necessary for the fan to go on?

____ (1)

iii. Ella suggested that her father could have used a timer with set times for the fan to go on because it is more efficient. Explain whether this is a better way to keep the kennel cool.

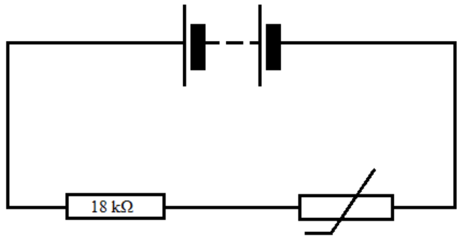
____

____ (2)

e. Give **ONE** other practical situation where the thermistor might be useful.

____ (1)

f. A battery of unknown emf, is connected to a resistor of resistance 18 kΩ and a thermistor. At a temperature of 20 °C, the thermistor's resistance is 22 kΩ. The current flowing in the circuit is 0.015 A.



i. Find the value of the emf of the battery when the circuit is working in a temperature of 20 °C.

____

____ (2)

ii. Would the current flowing in the circuit be smaller when the circuit is working at a temperature 10^{o}C? Explain.

____ (1)

(Total: 20 marks)

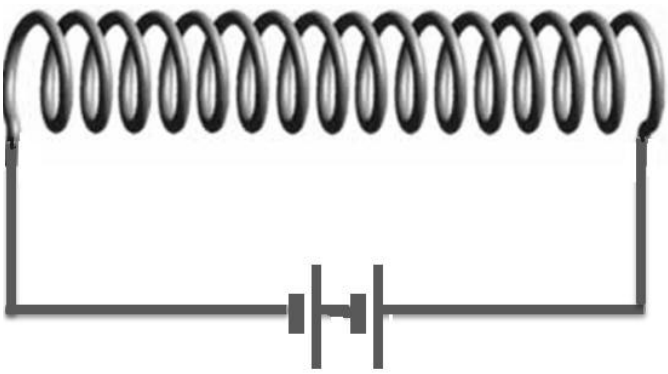
20

4. This question is about magnetic fields.

a. A magnetic field is formed around a magnet. Draw the magnetic field pattern around a bar magnet. (2)

b. When an electric current passes through a conductor, a magnetic field is created.

i. Draw the magnetic field pattern around the coil. (2)



ii. State **ONE** difference between the magnetic field pattern of a permanent magnet and one produced by the coil.

____

____ (2)

c. Indicate with an **X** whether the size of the magnetic field will increase or decrease by: (3)

	Increases	**Decreases**
Increasing the size of the current		
Decreasing the number of turns		
Putting a soft iron core inside the coil		

d. The battery in the circuit shown in part (b) is replaced with a galvanometer.

i. If the north of a magnet is pushed into the coil, the electric meter gives a reading. What does this show?

____

____ (2)

ii. What happens if the magnet is left inside the coil? Explain.

____

____ (2)

iii. Describe and explain what happens as the magnet is being taken out of the coil?

____

____ (2)

iv. From parts d(i), (ii) and (iii) it can be concluded that:

An electric current can only be _________________ when there is relative _________________

between the _________________ and the coil. (3)

v. Name **ONE** applicable law related to these observations.

____

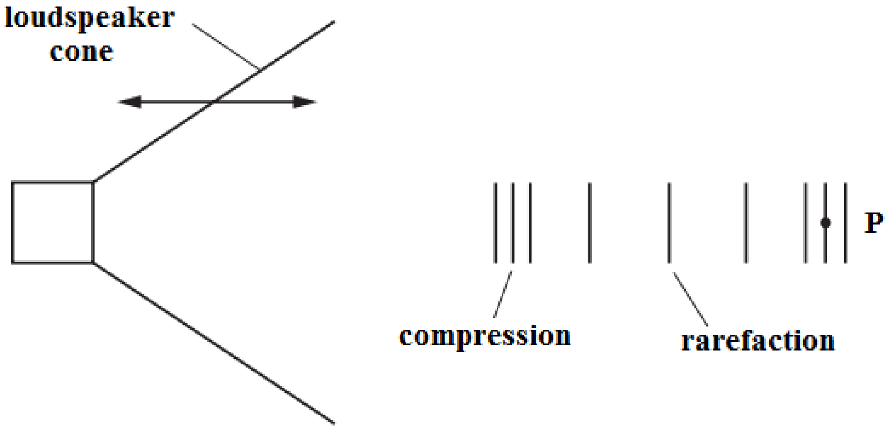
____ (2)

(Total: 20 marks)

20

5. This question is about Waves.

a. Waves carry energy from one location to another. In the diagram below compressions and rarefactions are sent out from a loudspeaker cone as it vibrates backwards and forwards with a frequency of 50 Hz.



i. Circle the correct word from each bracket: (2)

Sound waves are (longitudinal/transverse) waves as the particles vibrate (parallel/ perpendicular) to the direction of travel of the wave.

ii. What information does the phrase 'the frequency of vibration is 50 Hz' give us about the vibration?

____

____ (1)

iii. P is a compression point. How much time passes before the next compression arrives at P?

____

____ (2)

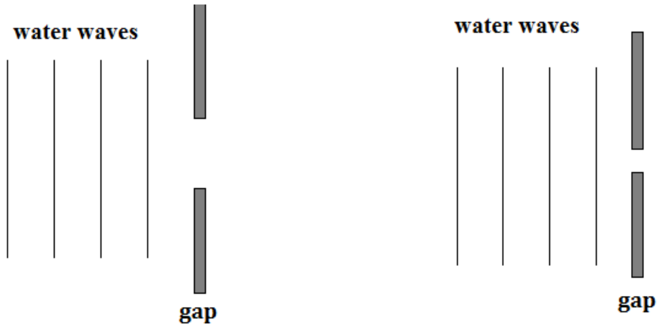
b. Water waves spread out when passing through a gap in a breakwater.

i. Are water waves transverse or longitudinal?

____ (1)

ii. When waves pass through a gap they are said to undergo (reflection / refraction / diffraction / dispersion). Circle the correct word. (1)

iii. Continue the diagrams, showing the behaviour of waves as they pass through these two gaps. The diagrams should include the wavefronts and the wave direction. (2)



c. Water waves are also refracted at a boundary when passing from a deep to a shallow region. State if the quantities listed below will increase, decrease or stay the same in such a situation:

i. Frequency ______________________________ (1)

ii. Wavelength ______________________________ (1)

iii. Speed ______________________________ (1)

d. X-rays and Radio waves form part of the electromagnetic spectrum.

i. List **TWO** other properties that these waves have in common.

____

______________________________ (2)

ii. State **ONE** use of X-Rays.

______________________________ (1)

iii. What is the name of the electromagnetic wave with the shortest wavelength from the electromagnetic spectrum?

______________________________ (1)

iv. Infrared waves are thermal waves. In fact, we experience this type of heat from a fire or a radiator amongst others. Given that the speed of infrared radiation is 3.0×10^{8} m/s in air and its periodic time is 2.5×10^{-15} s, calculate the frequency of the wave and hence calculate the wavelength of infrared radiation.

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______________________________ (4)

(Total: 20 marks)

20

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