SEC Preventive Classes

Secondary Education Certificate

Examination Papers – **2018**

Physics

Operational Programme II - European Structural and Investment Funds 2014-2020
"Investing in human capital to create more opportunities and promote the well-being of society"
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Index Number:_____ SEC24/1.18m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2018 MAIN SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	28th 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 = πr^2		

1. On the last day of 2016, a 'leap second' was added before midnight. 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)

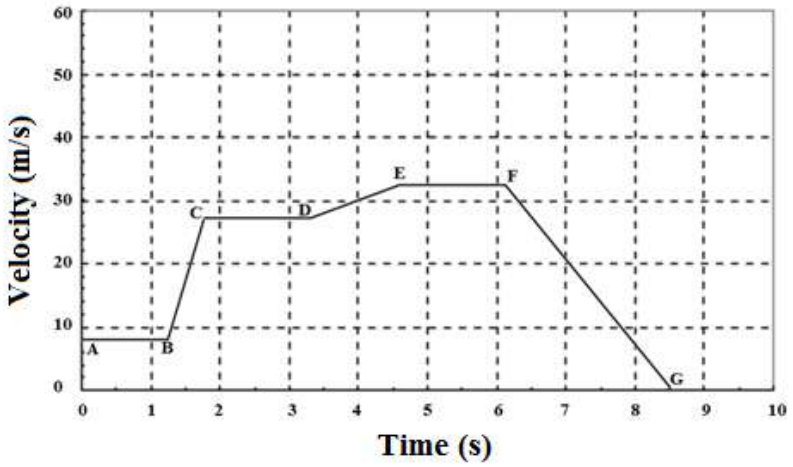
ii. Orbiting the sun is one characteristic of a planet. Give another **TWO** characteristics.

(2)

(Total: 10 marks)

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)

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)

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.

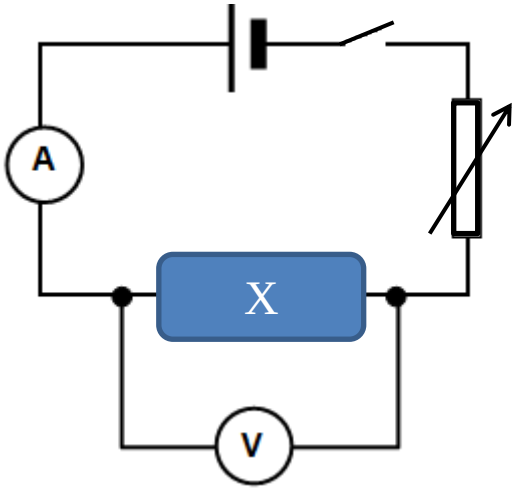
(3)

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

(2)

(Total: 10 marks)

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)

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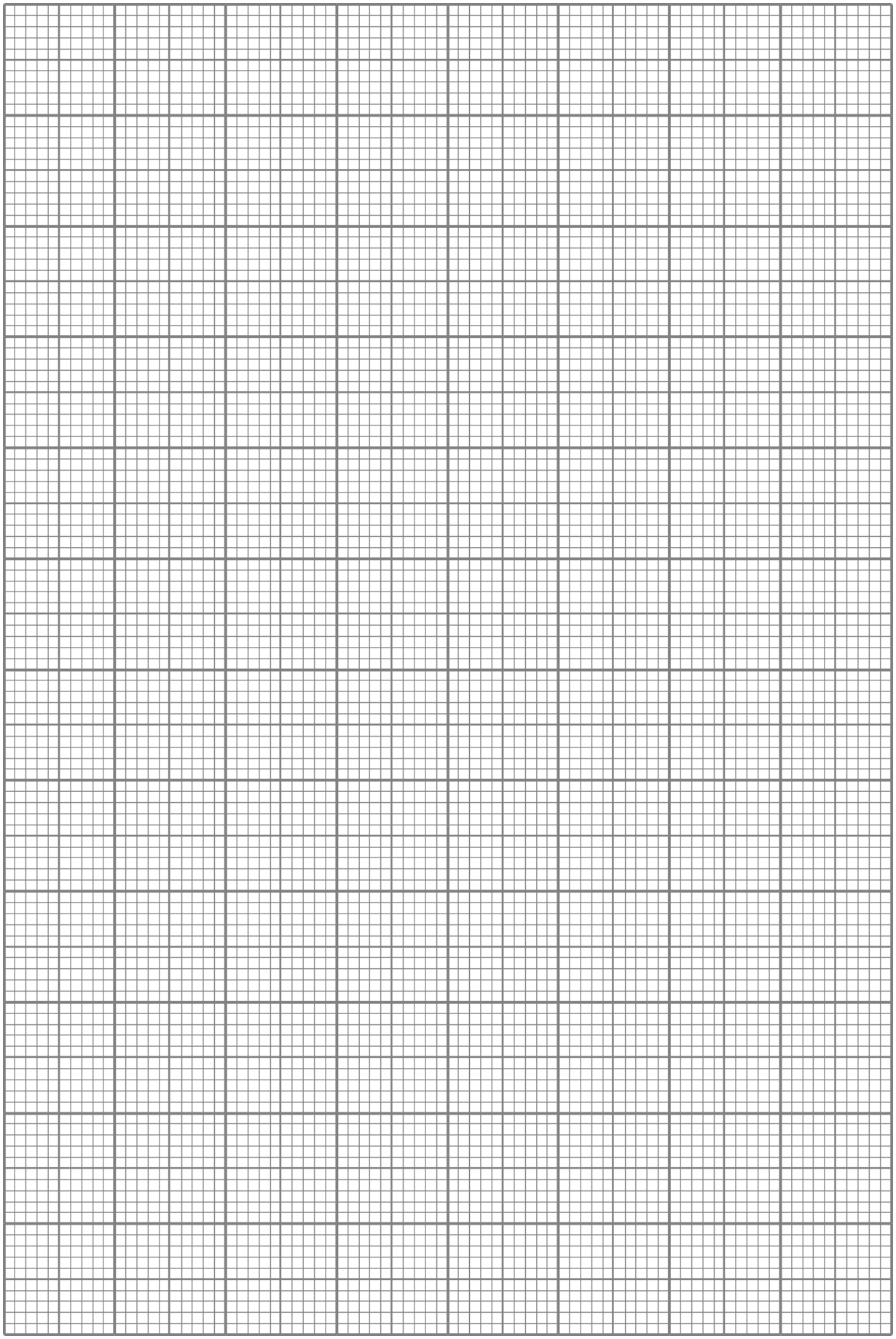
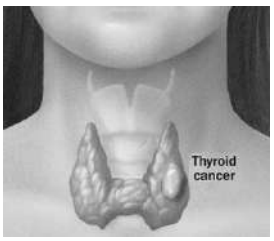


6. Radioactive Iodine (I-131), is an isotope of Iodine used to treat certain diseases in the thyroid gland such as Thyroid cancer. Beta and gamma radiation emitted from I-131 kill overactive thyroid cells.



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)

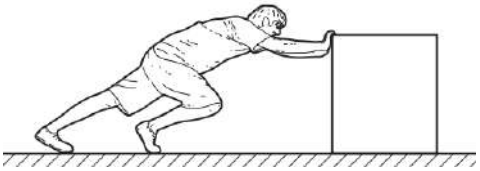
(Total: 10 marks)

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.



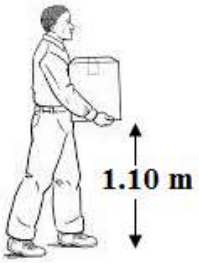
(1)

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)

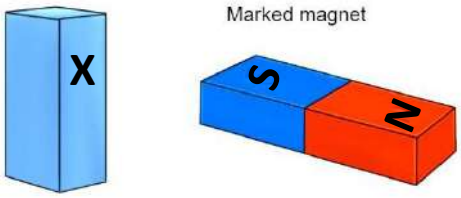
8. This question is about magnets.

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)

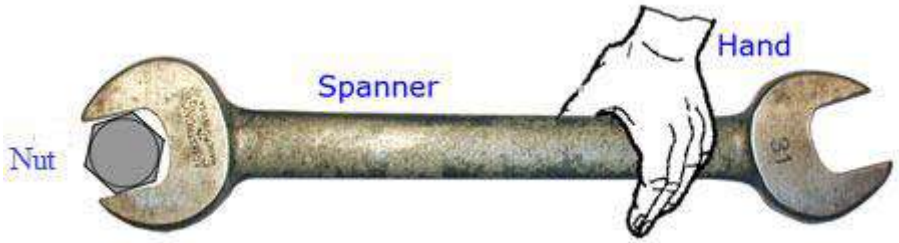
(Total: 10 marks)

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. 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)

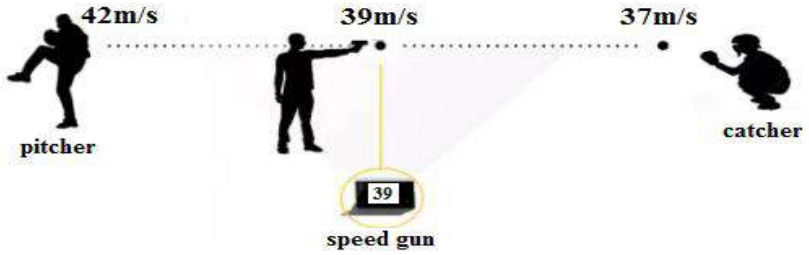
c. Which of the electromagnetic waves has the lowest frequency?

(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)

Index Number:_____ SEC24/2A.18m

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 = πr^2		

1. This question is about heat energy.

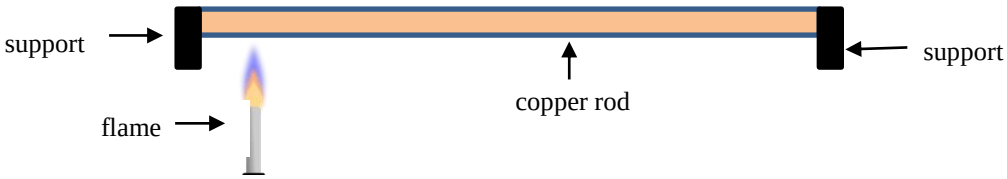
a. The kinetic theory of matter explains the structure of matter. Fill in the missing words:

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)

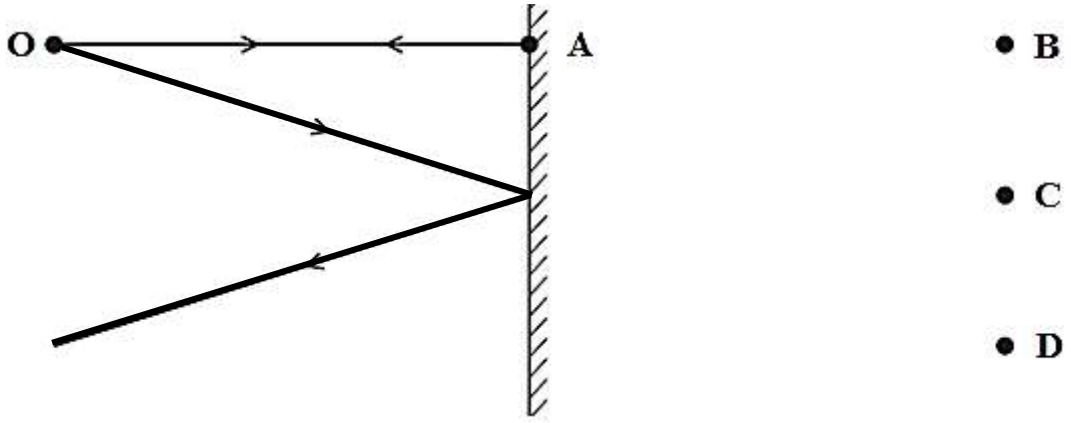
(Total: 20 marks)

2. This question is about Optics.

a. State the law of reflection of waves.

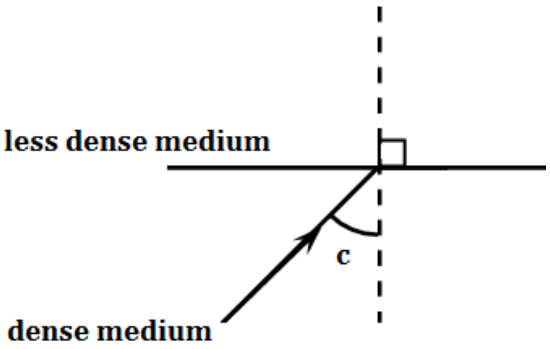
(1)

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)

3. This question is about the thermistor.

Ella found a thermistor in her father's toolbox. From her Physics lessons, she ew 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)

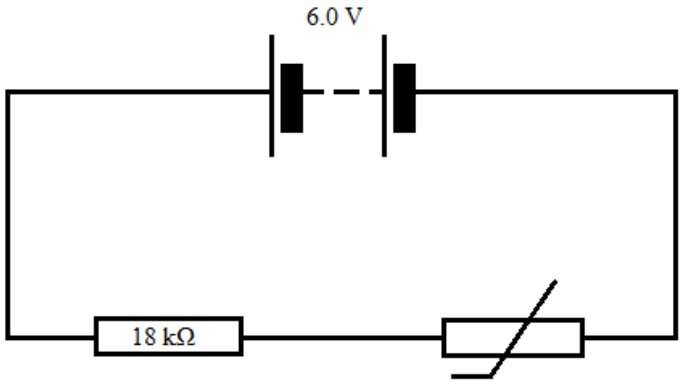
ii. Ella suggested that her father could have used a timer with set times for the fan to go on. Which is the most efficient, the thermistor or the timer? Explain.

(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 18kΩ and a thermistor. At a temperature of 20 °C the thermistor's resistance is 22kΩ.



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

(3)

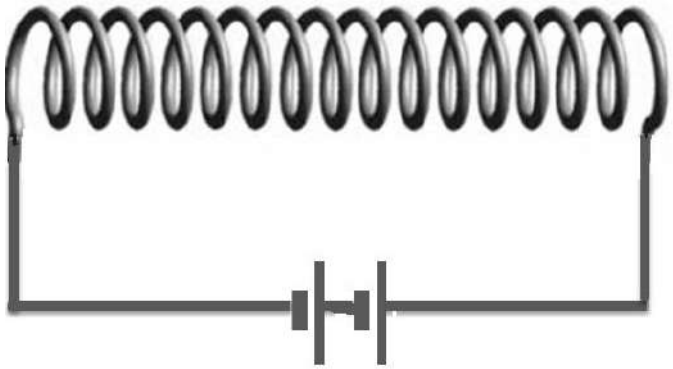
(Total: 20 marks)

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)

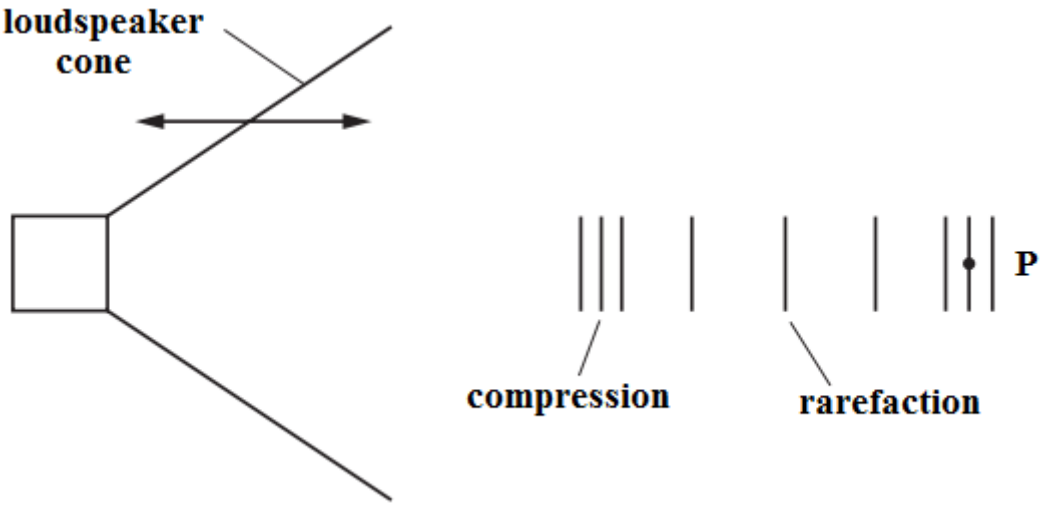
v. Name the laws related to these observations.

(2)

(Total: 20 marks)

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.

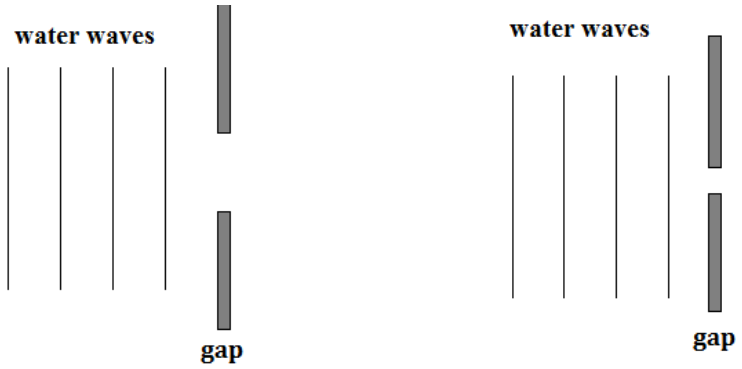
i. What type of waves are water waves?

(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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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.

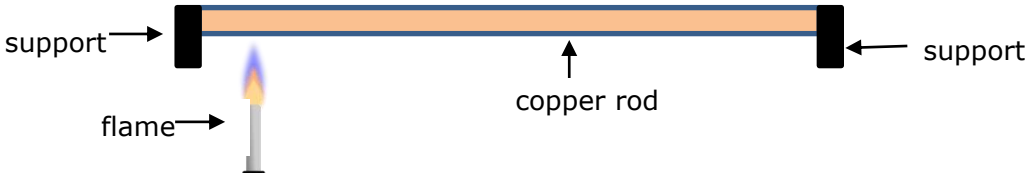
a. The kinetic theory of matter explains the structure of matter. Fill in the missing words.

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)

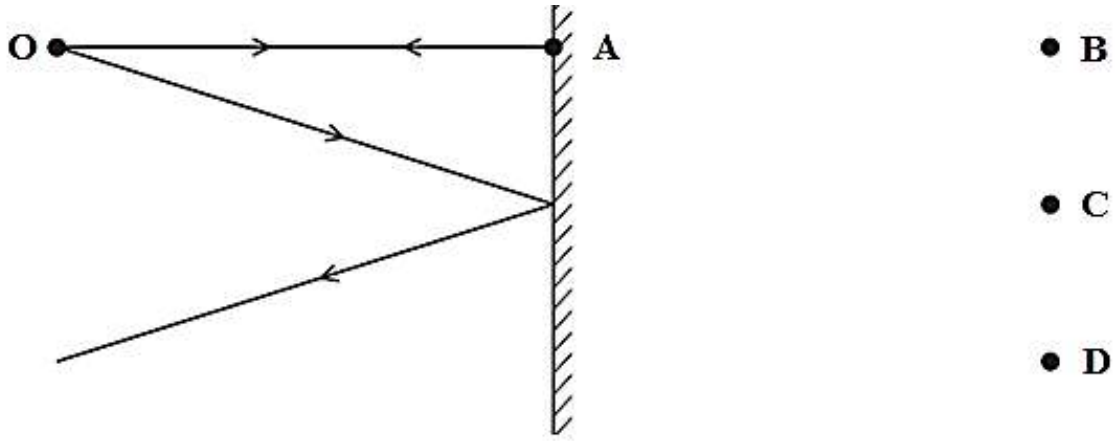
(Total: 20 marks)

2. This question is about Optics.

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

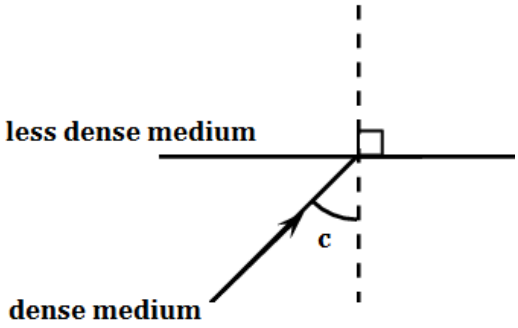
The law of reflection of waves states that the angle of (reflection, incidence, refraction) is equal to the angle of (incidence, refraction, reflection). (1)

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)

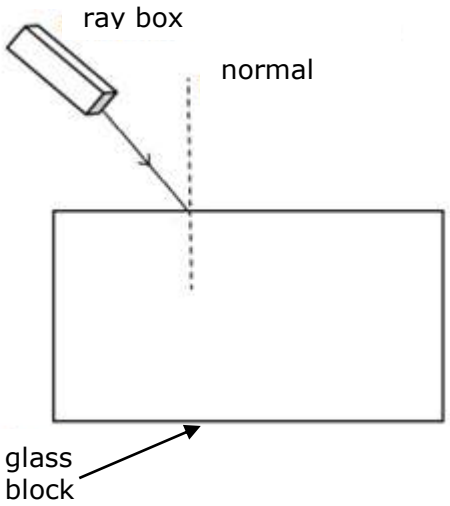
ii. What will happen to the ray of light if the angle of incidence had to be increased further?

(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 '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)

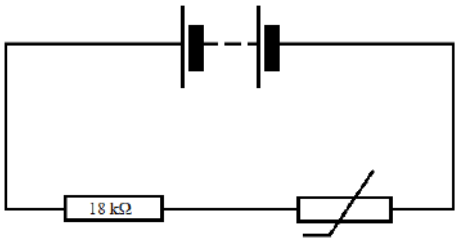
iii. Ella suggested that her father could have used a timer with set times for the fan to go on because it is more efficient. Explain whether this is a better way to keep the kennel cool.

(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 18kΩ and a thermistor. At a temperature of 20 °C the thermistor's resistance is 22kΩ. 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°C? Explain.

(1)

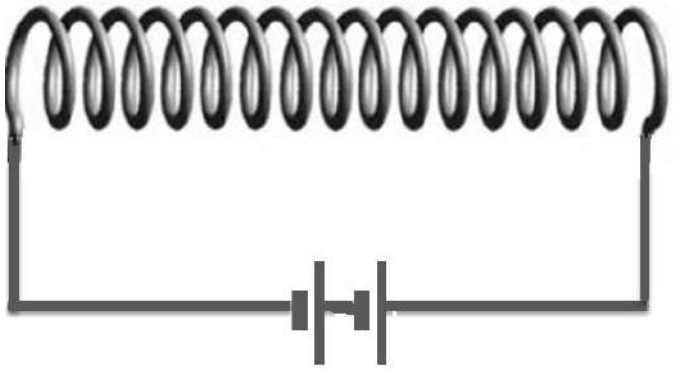
(Total: 20 marks)

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.

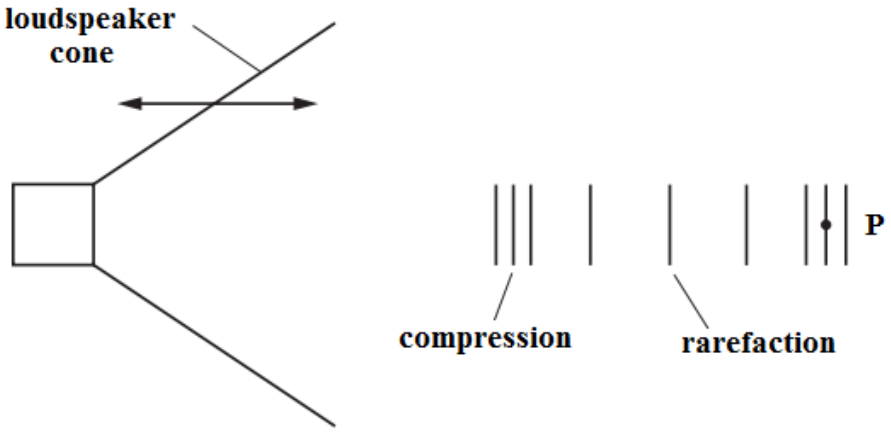
(2)

(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)

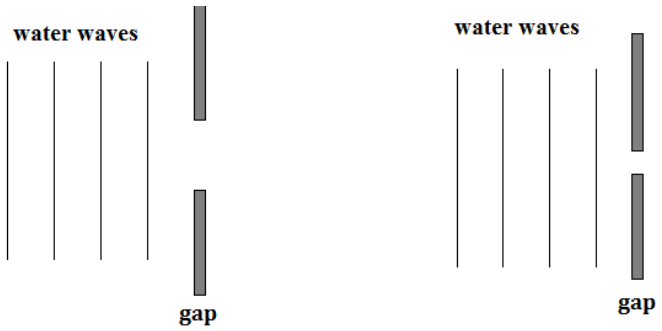
b. Water waves spread out when passing through a gap in a breakwater.

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.

(4)

(Total: 20 marks)

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L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2018 SUPPLEMENTARY SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	30th August 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 = πr^2		

1. In February 2018, Spacex's Falcon Heavy rocket launched a car in space, marking this first ever event in history.

a. This rocket had a total initial mass of 1.421×10^6 kg, and the upward force exerted during lift from the ground was 2.28×10^7 N.
Calculate:

i. the weight of the rocket;

(1)

ii. the resultant force acting on the rocket;

(1)

iii. the upward acceleration at lift-off, assuming the object kept moving upward in a vertical straight line.

(2)

b. Name and state which of Newton's laws of motion supports your calculation in que

(a)iii.

(2)

c. State the size of the force acting on the ground at the time of launch.

(1)

d. State the law that supports your answer in part (c).

(1)

e. When the rocket reached a particular position in space, the car carrying a human size dummy driver was launched from it at a speed of approximately 29 000 km/h. Convert this velocity into m/s, and state under which circumstance this velocity would change in outer space.

(2)

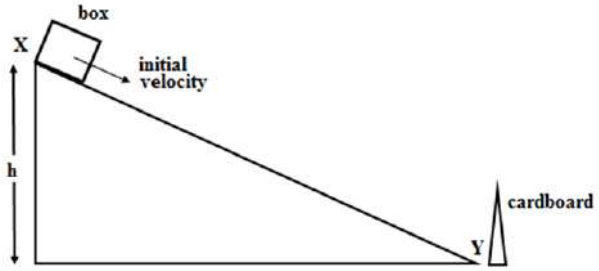
(Total: 10 marks)

2. This question is about momentum.

a. Define momentum.

(1)

b. Two boxes A and B, having the same size are released from the same point X, and travel down the frictionless slope to point Y, where a cardboard is positioned, as shown in the diagram. Box A has a larger mass than box B.



Explain, in terms of momentum, which box has a higher probability of knocking the cardboard down.

(2)

c. Box A has a mass of 1.60 kg and when held at X, it is at a vertical height of 0.80 m. Calculate the gravitational potential energy at this point.

(1)

d. Using your answer to part (c), calculate the final velocity with which box A reaches point Y, at the bottom of the slope.

(2)

e. Hence calculate the momentum of box A at point Y.

(2)

f. The cardboard was replaced by another object of mass 0.50 kg and was held at rest at point Y. Calculate the common velocity with which box A and the object would move together after they collide.

(2)

(Total: 10 marks)

3. The electromagnetic (EM) spectrum consists of seven types of radiation, travelling in the form of transverse waves.

a. Describe the particle movement in transverse waves.

(2)

b. State **TWO** properties that are identical for the seven forms of radiation in the E.M. spectrum, apart from their transverse nature.

(2)

c. Which of the types of radiation in the EM spectrum has the shortest wavelengt

(1)

d. Give a use for the type of radiation stated in part (c).

(1)

e. Which of the EM waves may be used to detect fake banknotes?

(1)

f. T.V. remote controls use infrared radiation of frequency 3×10^{14} Hz, travelling at 3×10^{8} m/s to send signals to a T.V. set placed 3.50 m away.
Calculate the number of complete waves in this distance.

(3)

(Total: 10 marks)

4. Sound is a form of longitudinal wave and it requires a medium in which to travel.

a. Complete the following paragraph by inserting correct words, to explain how energy is transferred in a longitudinal sound wave.

vibrate to the of travel

of the wave. This forms a series of and . The

distance between these two, is equal to half a complete . (3)

b. Ultrasound is also a longitudinal wave, with different frequencies than the audible range. State the approximate frequency above which a sound wave is then considered to be an ultrasound wave.

(1)

c. Bats use ultrasound to form images of their environment by producing waves and then detecting the reflected waves. Consider a bat at rest, producing ultrasound waves at a frequency of 100 000 Hz, that travel with a speed of 330 m/s. These waves hit a nearby rock and are reflected with practically no changes in frequency. The bat detects them 0.0091 s after emission.

i. What does 'a frequency of 100 000 Hz' mean?

(1)

ii. What is the periodic time of this wave?

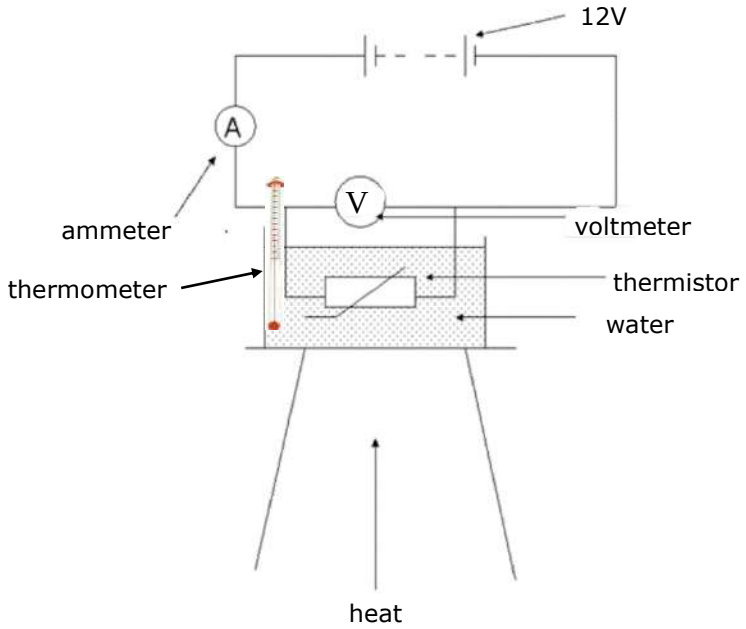
(2)

iii. How far is the rock from the bat?

(3)

(Total: 10 marks)

5. One day Petra and Matteo were investigating how temperature affects the resistance of a thermistor in a circuit. They used the setup below.



a. Petra and Matteo recorded the current flowing in the circuit when the water was being heated. Complete the following table:

Temperature / ^{o}C	10	20	30	40	50	60
Current / A	0.08	0.11	0.15	0.20	0.30	0.40
Resistance / Ω	160		80	60		30

(2)

b. Plot a graph of Resistance (Ω) on the y-axis against Temperature (^{o}C.) on the x-axis. (4)

c. Petra wanted to know the value of the thermistor resistance when the temperature was 35^{o}C. Using the graph, find the value of the resistance.

(1)

d. Suggest a suitable precaution necessary to obtain more reliable results.

(1)

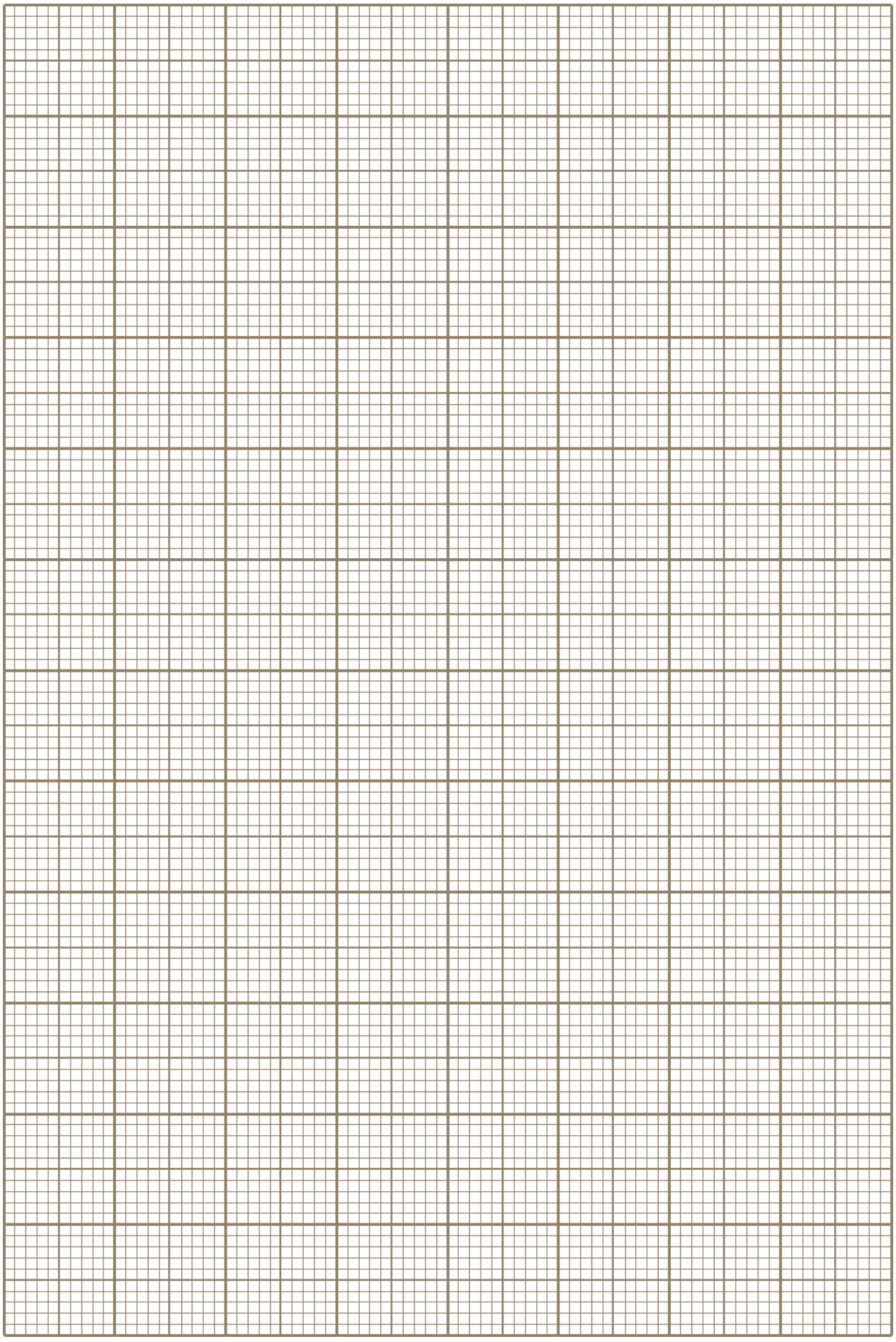
e. Predict a value for the resistance of the thermistor if the water is at 0 ^{o}C.

(1)

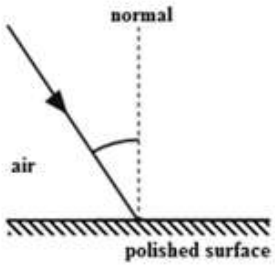
f. How does the resistance of the thermistor vary with temperature?

(1)

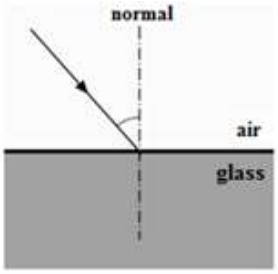
(Total: 10 marks)



6a. A ray of light is travelling in air as shown in the diagrams below. Continue the diagrams to show the path of the ray of light in each situation. (2)



Situation 1



Situation 2

b. Emma's sunglasses fell into shallow area of a swimming pool. She inserted her hand into the water to pick them up, but realised that they were at a water level much deeper than she thought.

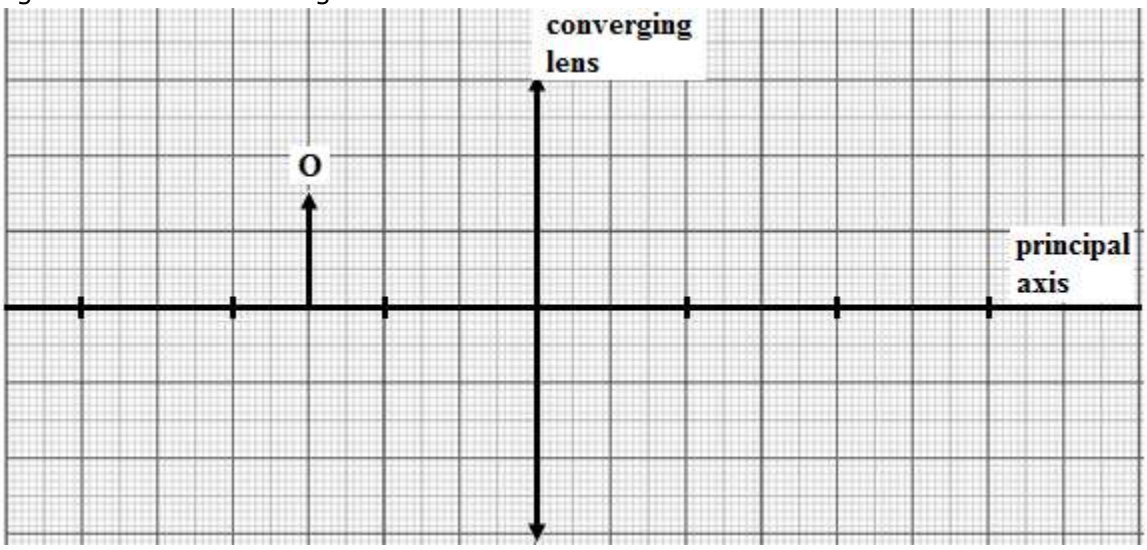
i. When light enters from air into water, its velocity changes. Which ONE of frequency and wavelength will change as well?

(1)

ii. The refractive index of the water used in the swimming pool is 1.33. If the sunglasses appear at a depth of 0.80 m, what is the actual depth of the pool?

(2)

c. The diagram below shows an object, O placed at 3.0 cm from a converging lens, of focal length of 2.0cm. The diagram is to scale.



i. Draw **TWO** rays of light coming out of the object O, to show how the image is formed in this case. Use an arrow to represent the image, and label it with an I. (3)

ii. Use accurate measurements to calculate the magnification of the lens.

(2)

(Total: 10 marks)

10

7. This question is about radioactivity.

a. Define the term half-life.

(2)

b. When a radioactive sample decays, it may emit alpha, beta and gamma radiation. Which of these can be blocked by:

i. a few mm of aluminium? (1)

ii. a piece of paper? (1)

c. Calculate the half-life of a radioactive sample if 200 grams of it decays to 25 grams in 42.6 minutes.

(2)

d. A scientist was asked to use carbon dating to indicate the age of a very old tree. List **THREE** steps the scientist should follow.

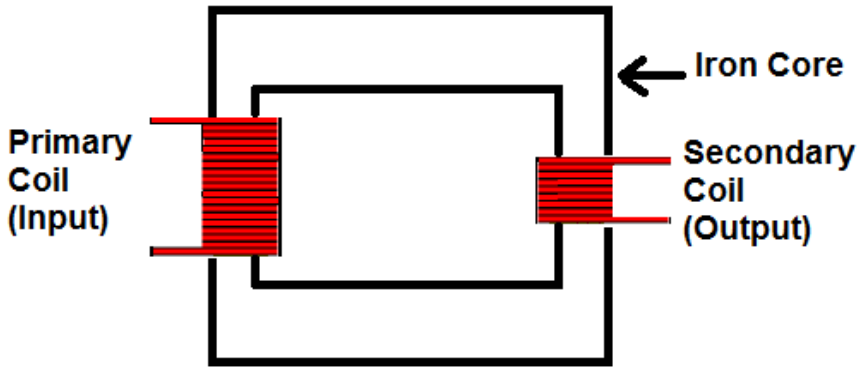
3) 

e. Give **ONE** other beneficial use of radioactivity.

(1)

(Total: 10 marks)

8. A step down transformer is to be used as part of a charging unit of an electronic device.



source: *http://www.learningaboutelectronics.com*

a. What is the principle on which the transformer is based?

(1)

b. Explain how the transformer works.

(3)

c. What kind of output is produced from the secondary coil?

(1)

d. What is the purpose of the laminated soft iron core?

(2)

e. The number of turns in the primary coil is 4000 and the input p.d. is 240 V, while the output needs to be of 3 V. What should be the number of turns in the secondary?

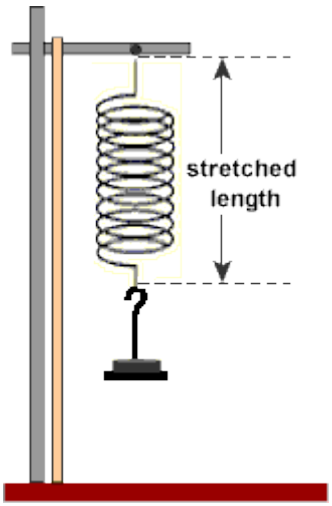
(2)

f. The transformer cannot be 100% efficient in its operation. Suggest one reason for this.

(1)

(Total: 10 marks)

9. Theresa was carrying out an experiment investigating the stiffness of a spring.



a. Give the name of the law that she needs to use.

(1)

b. What does the law state?

(2)

c. Theresa suspended a 10 cm long spring vertically downwards and attached a 100 g mass to it. Calculate the force applied to the spring.

(2)

d. When Theresa measured the length of the spring, she found that it was 16 cm long. What is the value of the spring constant?

(3)

e. What would the new length of the spring be if a 150 g mass was suspended from the spring?

(2)

(Total: 10 marks)

10. A small iron wheel is to be fitted with an iron ring around it. The mass of the ring is 500 g and the volume is 64 cm^3.

source: *https://www.ekshiksha.org.in*

a. One way how this can be done is by first heating the ring. Explain how the ring ends up fitted tightly around the wheel.

(2)

b. Would the density of the ring change when it is heated? Explain your answer.

(2)

c. One way to cool down the wheel with the hot ring is to spray it with water which fizzles off. Explain how this brings about cooling.

(2)

d. What is the density of the ring in g /cm^3?

(2)

e. If the wheel and ring are dropped into a container of water, they sink. Explain.

(2)

(Total: 10 marks)

Index Number: _____ SEC24/2B.18s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2018 SUPPLEMENTARY SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIB
DATE:	30th August 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 electricity.

a. You are given the following apparatus:
- a 6V battery;
- two identical bulbs X and Y;
- connecting wires.

In the space below draw two separate labelled diagrams showing the two bulbs in a series set up and in a parallel set up. (3)

b. An identical bulb, Z, is added in each circuit. The bulb's connection is the same as that of the other bulbs in the circuit.

i. Underline the correct answers to describe the following observations.

The brightness of the bulbs X and Y in the series circuit (increases, decreases, remains the same). In the parallel circuit the brightness of X and Y (increases, decreases, remains the same). (2)

ii. In which circuit is it possible to control the two bulbs separately?

(1)

iii. In the circuit chosen in part (b)ii, indicate with the letter "S", the point where a switch or switches should be inserted to be able to switch on/off the two bulbs separately. (1)

c. Suggest a common use for both circuits:

Series circuit: (1)

Parallel circuit: (1)

d. The resistance of each bulb is 3.5 Ω.
   i. Find the combined resistance in the series circuit with bulbs X and Y only.

(1)

   ii. Find the combined resistance in the parallel circuit with bulbs X and Y only.

(2)

e. Calculate the current flowing across the bulbs in the series circuit.

(2)

f. What is the voltage across each bulb in the series circuit? Explain.

(2)

g. Appliances may be fitted with a fuse as a means of protection.
   i. Explain why some appliances should be supplied with a fuse.

(2)

   ii. Draw the circuit symbol of a fuse.

(1)

   iii. Suggest a suitable fuse value for the series circuit in this circuit.

(1)

(Total: 20 marks)

20

2. This question is about the Earth and the Universe

a. Fill in the blanks, by using the correct word from the following:

Sun	Pluto	Neptune	Mercury

i. Planet farthest from sun:

ii. The brightest body in the sky:

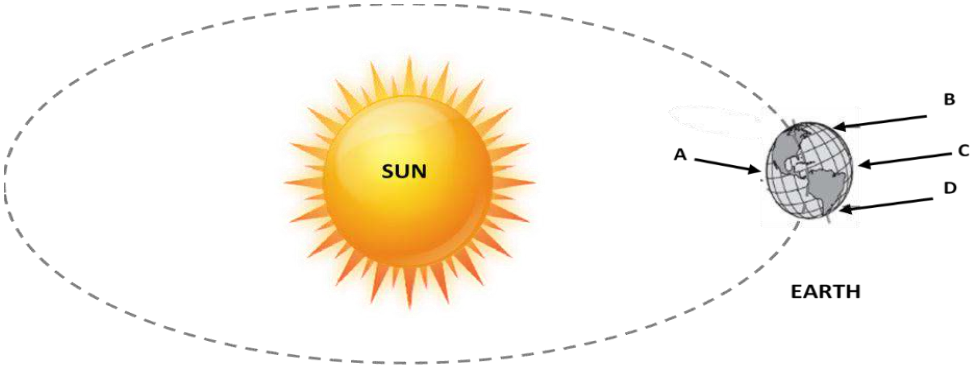
iii. Planet closest to the sun:

iv. The name of a dwarf planet: (4)

b. State **ONE** difference between a planet and a dwarf planet.

(1)

c. Consider the following diagram.



i. State whether the following statements are True or False. (4)

	TRUE/FALSE
It is Summer at point B.	
It is night at points C and D only.	
It is day at points A and C.	
After 12 hours, it will be day at point C.	

ii. On the above diagram, mark with an "X" the point where planet Earth would be after 6 months. (1)

iii. What would happen if the Earth does not spin on its own axis?

(2)

d. i. Explain the term "force of gravity"

(2)

ii. With the aid of a labelled diagram explain how this force is responsible for the moon's motion around Earth.

(3)

iii. How would this force be affected if instead of the moon there is another body of larger mass?

(1)

e. Give **TWO** benefits of space exploration.

(2)

(Total: 20 marks)

20

3. This question is about motion.

Every morning John drives his son to school. On a particular day, he accelerates from rest and reaches a velocity of 20 m/s in 100 s. He continues travelling at this speed for 6 minutes, and then decelerates uniformly for 50 s, to come to rest in front of the school.

a. Calculate the acceleration of the car during the first 100 s.

(2)

b. Sketch a graph of velocity (in m/s) against time (in s), to show the whole journey of the car. Include any known values. (3)

c. Using your graph, or otherwise, calculate the total distance travelled.

(2)

d. Calculate the average speed with which the car performed the journey.

(1)

e. Given that the average engine power used to complete this journey is 19 000 W, what is the work done by the car's engine?

(2)

f. On another day, John drives exactly through the same path however he stops for a few minutes during the journey to pick up a friend of his son. State with reasons, what effect, if any, will this have on the:

i. work done;

(2)

ii. average power developed.

(2)

g. The main form of energy possessed by the moving car is kinetic energy. Calculate this energy when the car is moving with a velocity of 20m/s, given that its mass is 1300 kg.

(2)

h. John's car can achieve this kinetic energy due to the transfer from chemical potential energy. List a main source of this energy in this case.

(1)

i. Is this source of energy renewable or non-renewable? Why?

(2)

j. List a main disadvantage of using this source of energy.

(1)

(Total: 20 marks)

20

4. This question is about specific heat capacity.

Katrina and Bjorn wanted to determine the specific heat capacity of water and cooking oil. The equipment available was a small plastic container, a mass balance, an electric heater, a thermometer and a joule meter.

a. Draw a diagram of how this equipment maybe set up. (3)

b. Katrina and Bjorn used the equipment to carry out the experiment and presented the following report of the method used. Indicate the correct order of the method they used.

The final temperature and the reading of the joule meter were taken.	
The heater was switched off.	
The mass of the liquid and container was measured using the balance.	
The initial temperature was measured using the thermometer.	
The electric heater was switched on.	
The mass of the container was measured using the balance.	

(6)

c. Mention **ONE** important precaution that needs to be taken.

(1)

d. If during the experiment, the temperature of 50 g of water was raised by 2 ^{o}C, what reading did the joule meter give if the specific heat capacity of water is 4200 J /Kg ^{o}C

(2)

e. On a different day, Katrina and Bjorn went for a day at the beach. During the day, they noticed a cool breeze coming from the sea. Katrina gave the following explanation to Bjorn about the formation of this breeze. Fill in the missing words. (4)

During the day, the land warms up _____ than the sea because it has a smaller _____. As a result, hot air _____ over land which has to be replaced by air coming from the _____. This moving air is the sea breeze Katrina and Bjorn feel.

f. In the evening, after sunset, Katrina and Bjorn noticed that the breeze had changed direction. Fill in the missing words. (4) In the evening, the land _____ heat faster than the sea. The air over the sea is therefore _____ and moves _____. This air has to be replaced by air from land which explains the change in direction of the .

(Total: 20 marks)

5. This question is about magnets.

a. A student bought a bar magnet to use it at home.

i. From what material is the bar magnet most likely to be made of?

(1)

ii. Explain how you arrived at your conclusion.

(2)

iii. What is special about the poles of a magnet?

(1)

iv. Fill in the missing words in the following sentence: (2)

The magnetic field is the _____ around a magnet where a _____ can be felt.

v. Draw the magnetic field pattern around a bar magnet. (3)

vi. What happens when two magnets are brought next to each other?

(2)

vii. What happens to the bar magnet if it is suspended freely in air?

(2)

b. The magnet may be replaced by an electromagnet.

i. What is an electromagnet?

1)

ii. Mention **TWO** ways how the strength of the electromagnet may be increased.

(2)

iii. The electromagnet may be used to make magnets. Explain how this can be done.

(4)

(Total: 20 marks)

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