Index Number: _____ SEC24/1.18s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

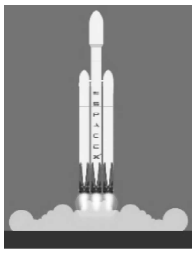
SECONDARY EDUCATION CERTIFICATE LEVEL
2018 SUPPLEMENTARY SESSION

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 question (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)

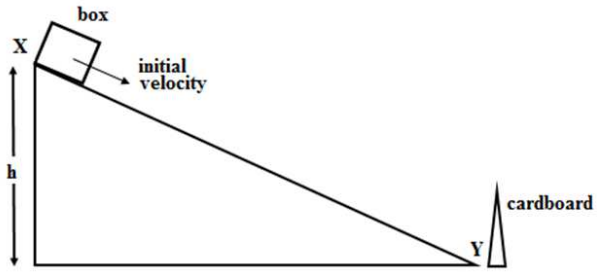
10

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 wavelength?

_____ (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)

10

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?

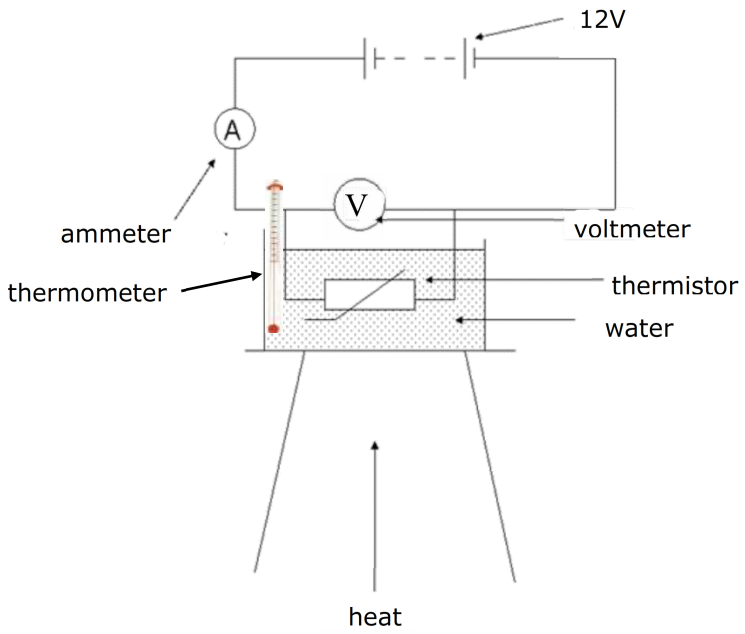
_____

_____

_____ (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 / °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 (°C) on the x-axis. (4)

c. Petra wanted to know the value of the thermistor resistance when the temperature was 35°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 °C.

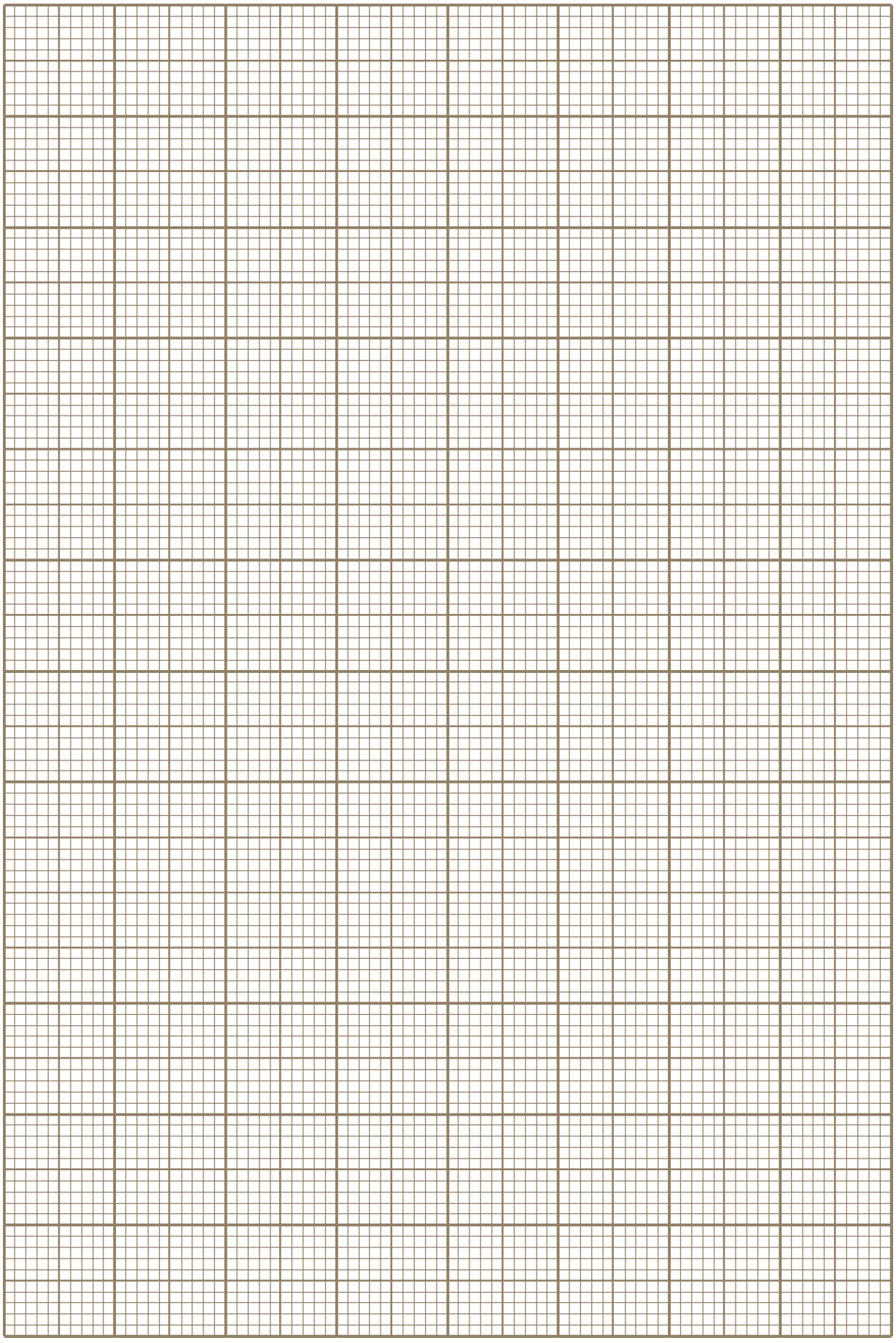
_____ (1)

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

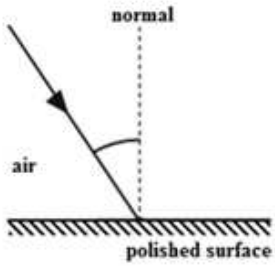
_____ (1)

(Total: 10 marks)

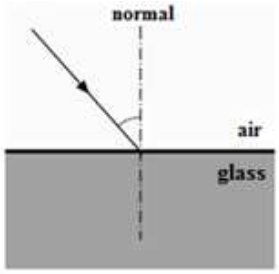
10



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 a 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.

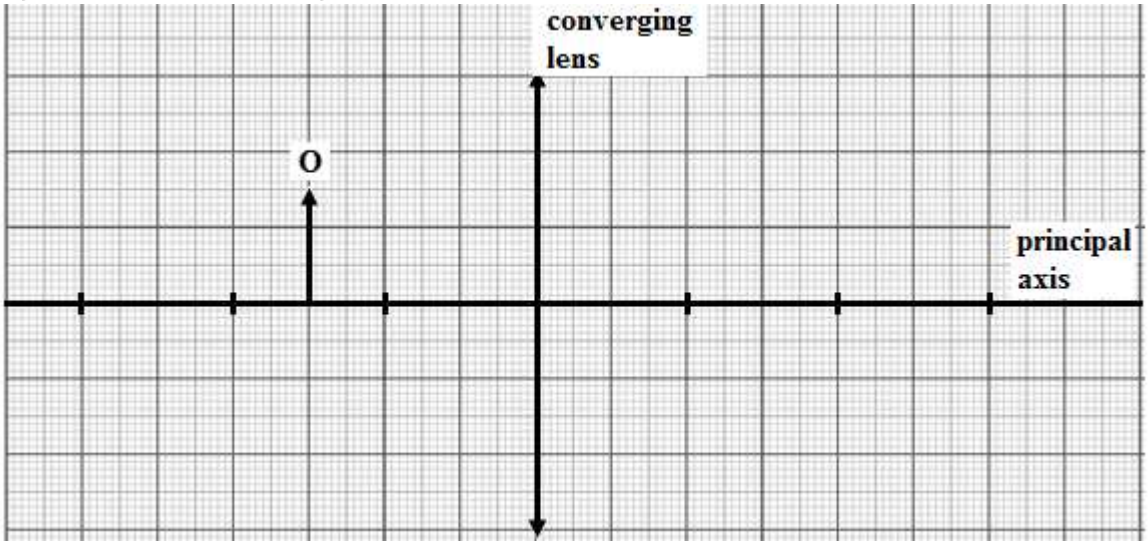
i. When light enters from air into water, its velocity changes. Which **ONE** of frequency and wavelength will change as well?

_____ (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)

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)

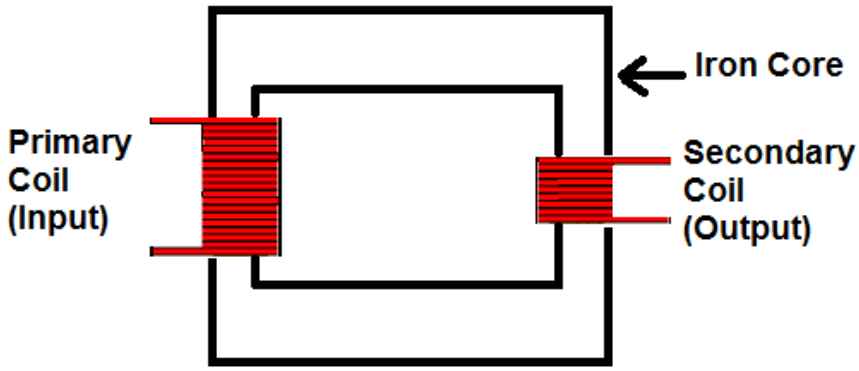
e. Give **ONE** other beneficial use of radioactivity.

_____

_____ (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?

_____

_____

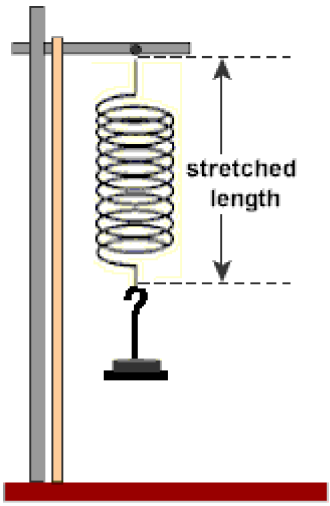
_____ (2)

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)

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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:	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: _____

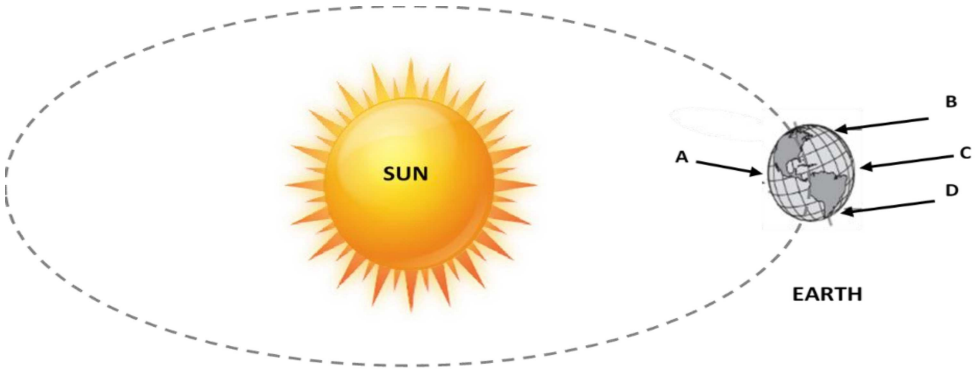
iv. The name of a dwarf planet: _____ (4)

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.

_____

_____

_____

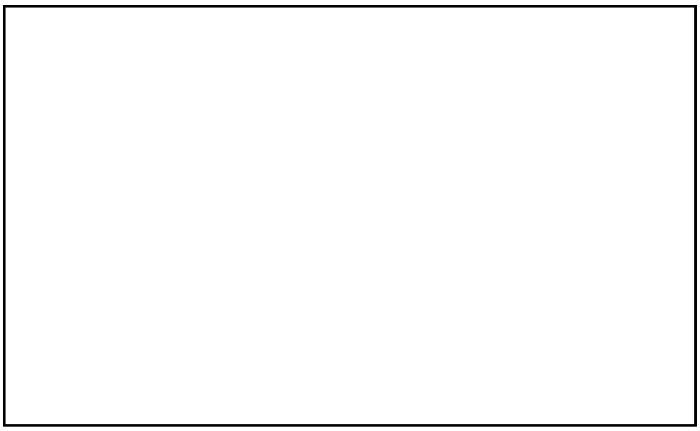
_____

_____

_____

_____

_____ (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)

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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