Index Number: _____ SEC24/1.13m

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

SECONDARY EDUCATION CERTIFICATE LEVEL

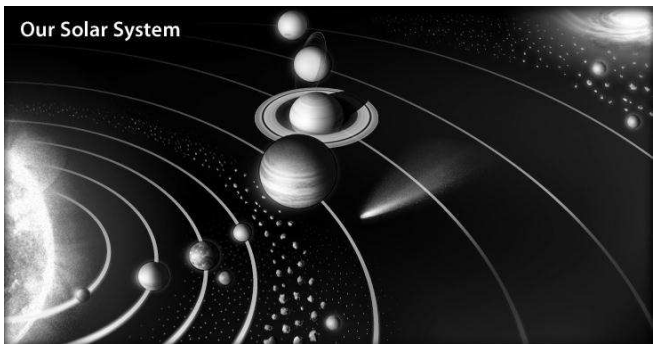
MAY 2013 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	30th April 2013
TIME:	4:00 p.m. to 6:00 p.m.

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

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

1. Our Solar System is made up of a central star (the sun) and eight planets orbiting around it. Pluto which was considered as the furthest planet from the sun is now classified as a `dwarf planet'.



a. Name the **eight** major planets of the solar system starting with the planet closest to the sun.

i._____ ii._____ iii._____

iv._____ v._____ vi._____

vii._____ vii._____ [4]

b. Which force is keeping the planets in orbit round the sun?

_____

[1]

c. What is meant by the term `dwarf planet'?

_____

[1]

d. Define the term planet.

_____

_____

_____

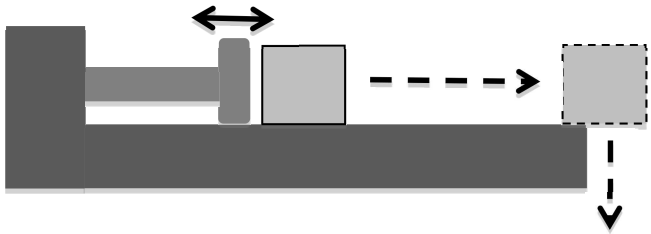
[3]

e. Name an instrument which can be used to observe the sky.

_____

[1]

2. A machine functions in the following way:



- An arm moves forwards and backwards horizontally.
- During its forward movement, the arm pushes boxes with a force of 25 N along a smooth horizontal surface, till the edge, for a total distance of 50 cm and a total time of 2.5 s.
- Once at the edge of the horizontal surface, the box falls off the edge through a vertical distance of 0.8 m into a bigger box placed underneath.
- The arm then goes back to position and would be ready to push the next box.

a. Calculate the work done until the box is pushed to the edge of the horizontal surface.

[2]

b. Calculate the output power of the machine in pushing the box to the edge of the horizontal surface.

[2]

c. If the input power of the machine is 8 W, calculate the efficiency of this machine.

[2]

d. Calculate the gravitational potential energy of the box, of mass 200 g, at the edge just before falling into the box underneath.

[2]

e. Calculate the maximum velocity that the box reaches during its vertical fall.

[2]

3. A plastic ruler is rubbed with a piece of cloth. The plastic ruler is found to have a negative charge.

a. What charge does the cloth carry?

[1]

b. Explain how you arrived at your conclusion.

[2]

c. Explain what happens when a positively charged body is brought:

i. near the charged cloth;

[1]

ii. near the ruler.

[1]

d. What can you conclude from your answer to part (c)?

[2]

e. While spraying refrigerators in a factory, both the spray and the outer body of the refrigerators is given a charge. Give three reasons why this is done.

[3]

4. Michael filled a glass with ice cubes and left it on his kitchen table. He went to play with his console game and returned to the kitchen. By that time, most of the ice cubes in the glass had melted.

a. Michael noted that the remaining ice cubes were floating at the surface. Explain briefly why the ice cubes float rather than sink to the bottom.

[2]

b. Eventually all the ice melted and the total volume of the water in the glass was 100 cm^3. Michael measured the temperature of the water and found it to be 10 ^oC. Then he immersed an electric water heater into the water for a few minutes and the temperature of the water increased to 50 ^oC.

i. Mention an instrument that Michael can use to measure the temperature of the water.

[1]

ii. Given that the density of water is 1 g/cm^3, calculate the mass of water in the glass in grammes.

[1]

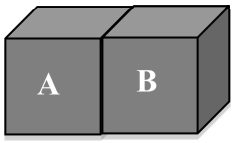
iii. If the specific heat capacity of water is 4200 J/kg^oC, calculate the amount of heat absorbed by the water from the heater.

[3]

iv. Assuming no heat losses, and given that the power of the heater is 80 W, after how many minutes does the water reach the required temperature of 50 ^oC.

[3]

5. Two identical blocks of metal, indicated as block A and block B in the diagram, are placed next to each other (with one face of block A touching one face of block B) on a wooden table in a room.



a. Block A is at room temperature (25 ^{o}C) and the temperature of block B is 60 ^{o}C.

i. Considering the first twenty minutes after the two blocks are placed next to each other, state how the temperature of each block varies with time?

Block A: _____

Block B: _____

[2]

ii. Predict a temperature for each of the two blocks after they are left over three hours left touching each other on the table.

Block A: _____ Block B: _____

[2]

iii. Explain briefly your conclusions in part (ii).

_____

_____

_____

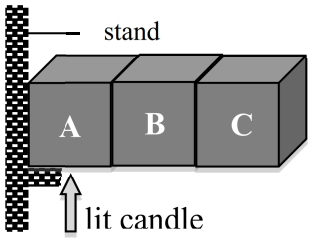
[2]

iv. Briefly explain any difference in the process if the blocks were made of glass.

_____

[1]

b. Three identical metal blocks (indicated as block A, block B and block C in the diagram) are stuck together by sandwiching wax between the adjacent faces of the blocks. After the wax solidified and the three blocks were stuck firmly to each other, the free end of A is attached firmly to a stand. A lit candle was placed underneath the free edge of block A.



i. What is expected to happen?

_____

_____

[2]

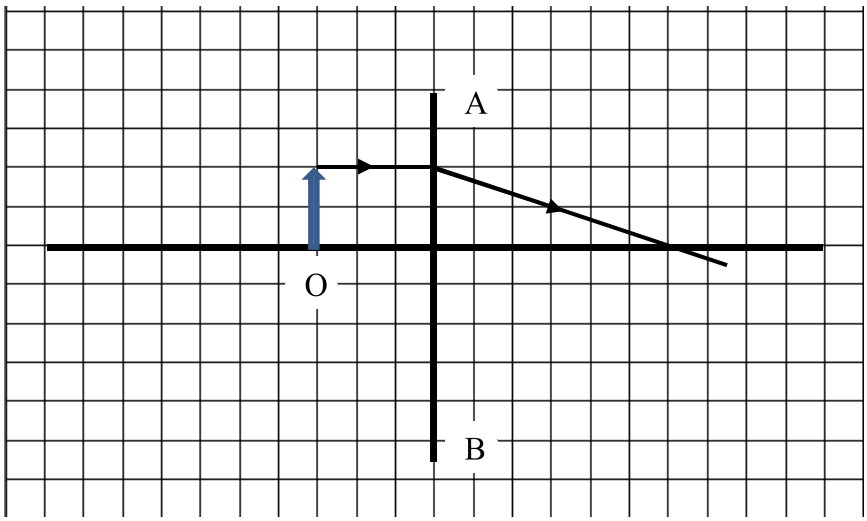
ii. Mention the physical process that is taking place.

_____

[1]

6. Lenses are used, amongst other things to enlarge small prints in books.

a. The diagram below is **drawn to scale [1:1]**. Lens AB is placed in front of the printed page O.



i. State the type of lens used.

[1]

ii. On the ray diagram above, mark with a letter **F**, the position of the principal focus. [1]

iii. Measure the focal length and record it in metres.

[2]

iv. Complete the diagram above to locate the position of the image **I**. Draw the image in the form of an arrow. [3]

v. Calculate the magnification produced by the lens.

[2]

vi. Mention **one** practical use of this type of lens **as used in the above arrangement** besides that of a magnifying glass.

[1]

7. While a new submarine was being tested, a pressure gauge recorded the following sea water pressure values on it as it dived deeper.

Depth [h / m]	5	10	15	20	25
Pressure [P/ kPa]	52.5	105.0	157.5	210.0	262.5

a. Plot a graph of pressure [P/kPa] on the y-axis against depth [h/m] on the x axis from the table above. [4]

b. It is known that the pressure (P) varies with depth (h) according to the following equation:

$$P = h \rho g$$

where ρ is the density of sea water and g is the acceleration due to gravity.

i. What can you conclude from the equation about the relationship between P and h? Explain your reasoning.

[2]

ii. Calculate the gradient of the graph.

[2]

iii. If the gradient is equal to ρg, estimate a value for the density (ρ) of sea water

[2]

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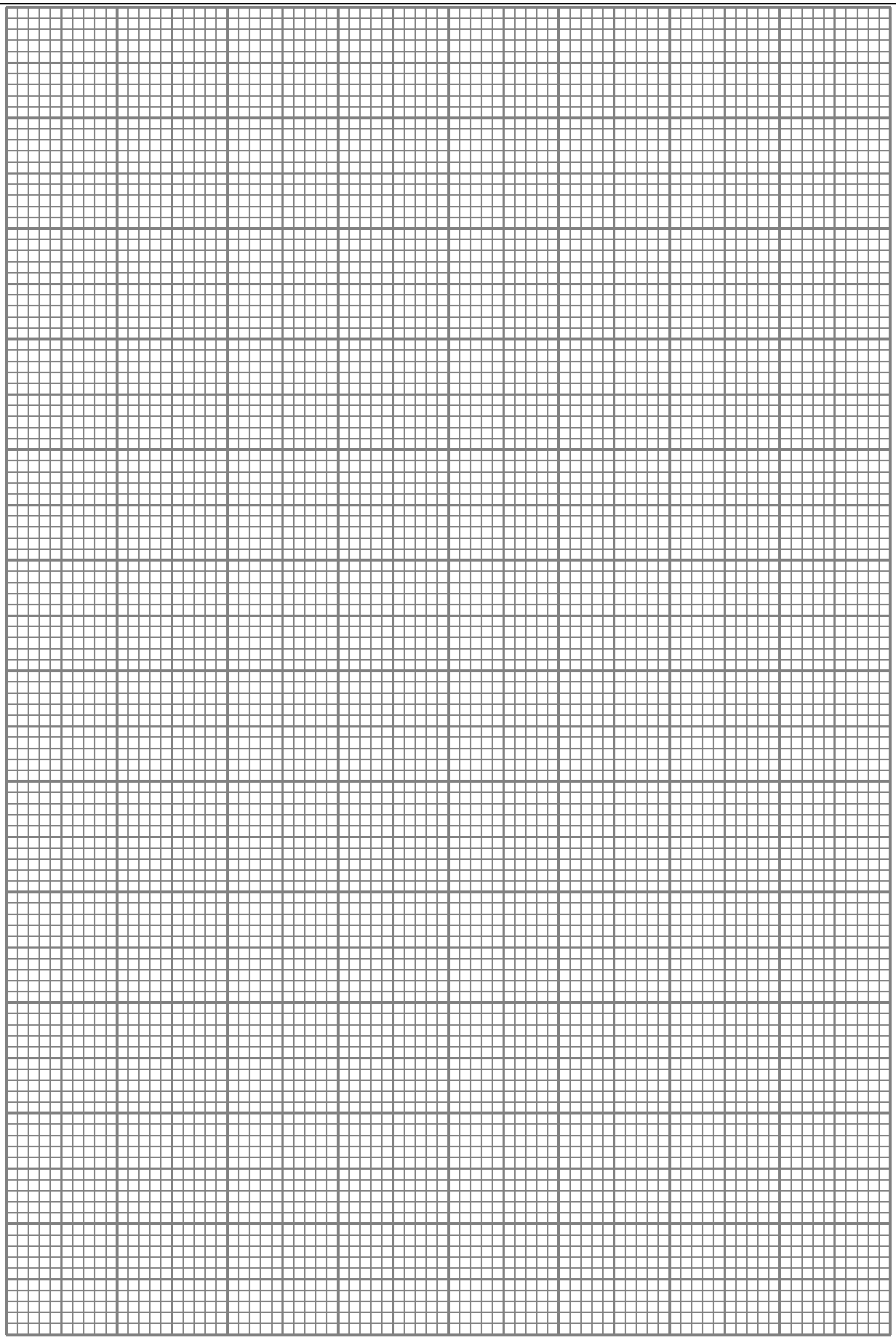
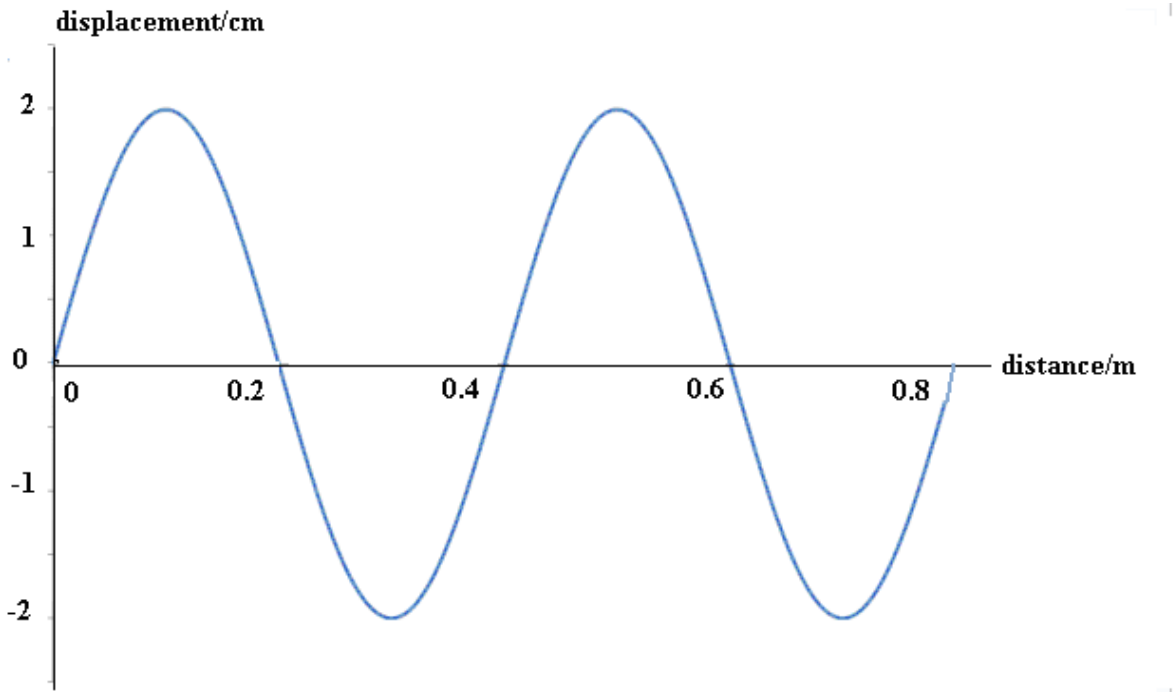


8. The plot below represents a displacement distance graph for a sound wave.



a. How many wavelengths are shown? _____ [1]

b. What is the amplitude in metres? _____ [2]

c. What is the value of the wavelength? _____ [1]

d. If the source produces 60 waves per second, calculate the velocity of the wave.

_____

_____

[2]

e. Work out the periodic time.

_____

_____

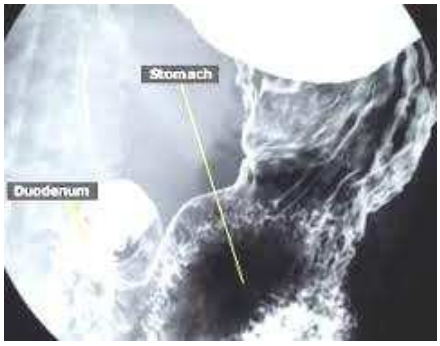
[2]

f. If the graph above represents a sound wave, on the same graph sketch a graph to represent a wave:

i. with the same pitch and a louder sound and label it A; [1]

ii. with the same amplitude and double the frequency. [1]

9. A barium meal is given to a patient before X-rays of the gut, stomach and small intestines. The chemical in the barium meal has a chalky taste, is non-toxic and is radioactive.



a. An atom of barium (Ba) has 56 protons and 81 neutrons in its nucleus.

i. How many nucleons are there in the nucleus?

_____ [1]

ii. Write down the symbol of barium indicating the nucleon number and proton number.

_____ [1]

b. Barium is formed from caesium-137 ($^{137}_{55}Cs$). In the process, a β-particle is liberated.

i. What is a β-particle?

_____ [1]

ii. State two properties of β radiation.

_____

_____ [2]

c. Barium exists in different forms known as **isotopes.** Define the term isotope.

_____

_____ [2]

d. Other radioactive substances like polonium liberate α-particles when it disintegrates while substances like uranium liberate γ-rays. State which radiation is the:

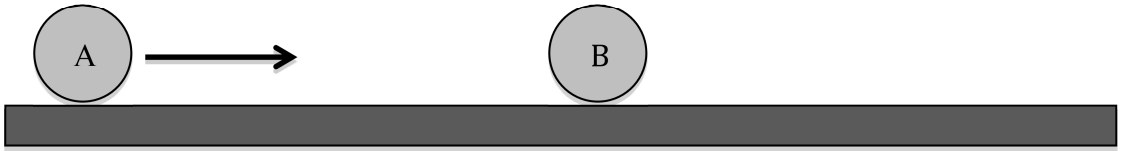
i. most penetrating radiation; _____ [1]

ii. stopped by paper. _____ [1]

e. Name one use (**not medical**) of radioactive substances.

_____ [1]

10. Two bowling balls, marked A and B in the diagram below, have different masses. Bowling ball A has a mass of 800 g while bowling ball B has a mass of 1.2 kg. They are placed on a smooth surface.



a. Bowling ball A is given a velocity of 12 m/s and collides into bowling ball B, which is initially at rest.

i. What is the SI unit of momentum?

[1]

ii. Calculate the momentum of bowling ball A before collision.

[2]

iii. Calculate the total momentum of the two bowling balls before the collision occurs.

[2]

b. On collision, bowling ball A and bowling ball B move together as one object and move forward in the direction in which bowling ball A was initially moving.

i. What is the total momentum after collision occurs?

[1]

ii. Calculate the velocity of the two balls (stuck together) after collision occurs.

[2]

iii. Mention the principle that has been used in the above calculation.

[1]

iv. Mention **one** assumption that is being taken into consideration in carrying out the above calculation.

[1]

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

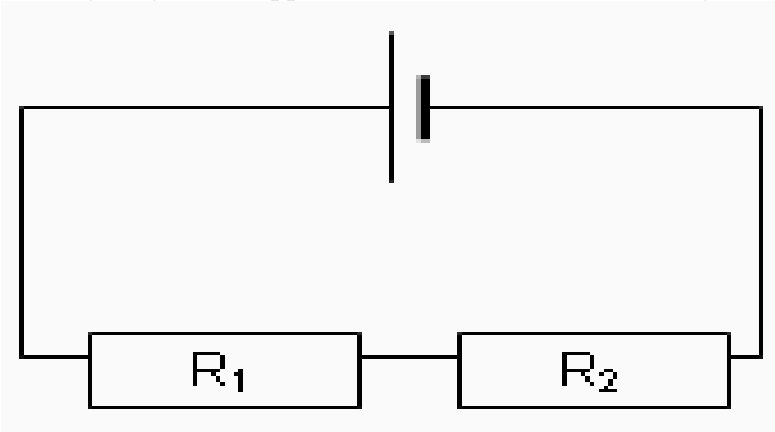
SUBJECT:	**Physics**
PAPER NUMBER:	IIA
DATE:	2nd May 2013
TIME:	4:00 p.m. to 6:00 p.m.

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

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	$W = m g$	$v = u + a t$
	$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$		$s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$	$s = u t + \frac{1}{2} a t^2$	momentum = m v
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$		$v = f \lambda$
	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$	$\text{Magnification} = \frac{\text{image distance}}{\text{object distance}}$	
	$\text{Magnification} = \frac{\text{image height}}{\text{object height}}$		$T = \frac{1}{f}$
Electricity	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto \frac{1}{A}$	$E = I V t$
	$R_{total} = R_1 + R_2 + R_3$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$	$V_p I_p = V_s I_s$	
Heat	$Q = m c \Delta\theta$		
Radioactivity	$A = Z + N$		
Other equations	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 the resistance of electrical conductor***s.

Kim and Lisa were investigating what happens to the current and the voltage in the circuit shown.



a. i. What is an 'electric current'?

[2]

ii. Mention an instrument used to measure current.

[1]

iii. How should it be connected in the circuit?

[1]

b. The battery is marked 3V, R_1 has a value of 50 Ω and R_2 has a value of 150 Ω.

i. Calculate the total resistance in the circuit.

[2]

ii. What is the current in the circuit?

[2]

iii. Calculate the p.d. across R_1.

[2]

iv. Calculate the p.d. across R_2.

[2]

c. Kim decided to connect another resistor R_3 of 25 Ω in parallel with R_1.

i. Calculate the total resistance of the parallel branch.

[2]

ii. Comment on the current in the parallel branch. Explain.

[2]

d. Lisa wanted to connect a three pin plug to an electrical appliance.

i. What is the purpose of the fuse in the three pin plug?

[2]

ii. The appliance is rated at 200 W. If the mains supply is 240 V, calculate the current in the appliance. Suggest a suitable fuse value from the following: 1 A; 0.5 A and 13 A.

[2]

2. ***This question is about forces and moments.***

a. Elena suspends a 30 cm spring from a retort stand. She loads the spring and observes what happens to the spring.

i. State Hooke's Law.

[2]

ii. Explain a practical precaution she needs to take when loading the spring in order not to damage it.

[1]

iii. How can she be sure that in the end the spring was not damaged?

[2]

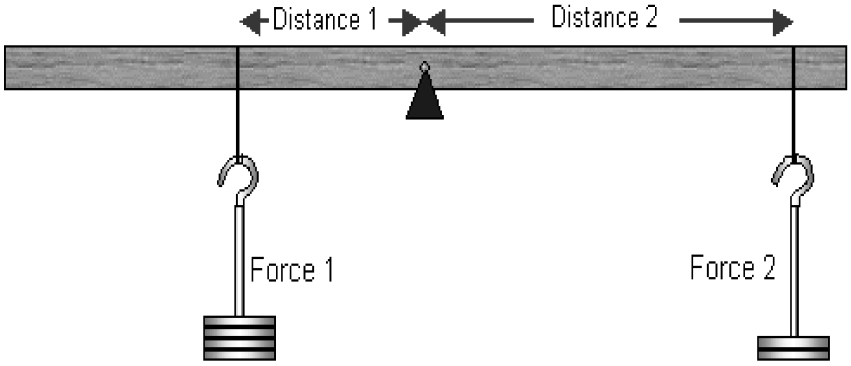
iv. When a mass of 100 g is loaded, the spring has a length of 36 cm. If $F=kx$, where F stands for the force on spring, x is the extension and k is the spring constant, calculate a value for the spring constant.

[3]

v. Why is the force considered to be a vector quantity?

[2]

b. Elena then went on to investigate the turning effect of a force using a uniform ruler pivoted at the centre. She sets it up in *equilibrium* as shown.



i. What is meant by the term equilibrium?

[2]

ii. If F_1 is 20 N and distance d_1 is 15 cm, where should the force F_2 of 10 N be placed in order for the system to remain in equilibrium.

[3]

iii. In the above calculation, the weight of the ruler was ignored. Why?

[1]

iv. If F_2 is doubled while F_1 remains the same, suggest two ways how to keep the system in equilibrium.

[2]

c. While helping her mother to paint, explain why Elena used a screw driver to open the can of paint rather than opening it with her fingers.

[2]

3. ***This question is about falling objects.***

While browsing on the net, Giorgio came across this passage: " . . . *debate had started up on one of Aristotle's "laws" of nature, that heavier objects fell faster than lighter objects . . . According to legend, Galileo decided . . . to drop the objects from . . . the Tower of Pisa, 54 meters tall. Galileo climbed up to the top of the building carrying a variety of balls of varying size and weight . . . They all landed at the base of the building at the same time (legend says that the demonstration was witnessed by a huge crowd of students and professors) . . .* "

(http://inventors.about.com/od/gstartinventors/a/Galileo_Galilei.htm)

a. Giorgio kept thinking about these experiments supposedly carried out by Galileo Galilei, and wanted to investigate the case further. He worked out the time taken for a 20 kg metal sphere to reach the ground, and the highest velocity it would reach. He assumed that there was **no air resistance**.

i. What is the acceleration of the 20 kg sphere during its free fall?

[1]

ii. With reference to Newton' laws of motion and assuming no air resistance, state and explain if the sphere will eventually reach terminal velocity.

[2]

iii. Calculate the time that the sphere takes to reach the ground from the top of the Tower. Give your answer to **three** decimal places.

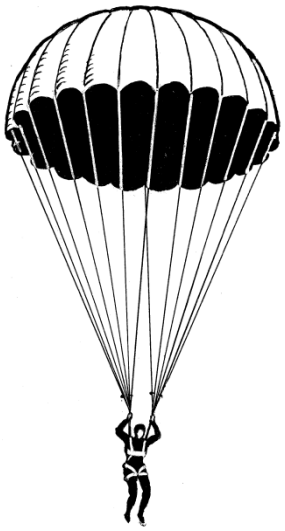
[3]

iv. Without using the formulae for gravitational potential and kinetic energy, calculate the velocity of the sphere just before it touches the ground.

[2]

v. Calculate the sphere's maximum kinetic energy.

[2]



b. Giorgio wanted to work out the values regarding the possibility of a person jumping from the top of the Tower of Pisa using a parachute. He thought that in order to carry out the investigation, it would not have been wise to perform eventual experiments with a person but with an object having the same weight. So, in his calculations, he condidered an object having his own weight, i.e. an object of mass 60 kg.

i. Without doing any calculations, or otherwise state the time taken for the 60 kg object to reach the ground after being released from the top of the tower without a parachute. Explain briefly your conclusion.

[2]

ii. Giorgio knew that if a parachute is used, the time taken to reach the ground would be longer. He thought that if the time taken were to be 20 s, it would be a good compromise. Under these conditions, calculate the acceleration of the object falling with a parachute. [Assume that the parachute underwent constant acceleration during this time.]

[2]

iii. Calculate the maximum velocity reached by the object falling with a parachute.

[2]

iv. Under these conditions, calculate the resultant (unbalanced) force that would be pulling the object with the parachute downwards.

[2]

v. Under these conditions, calculate the upward force (air resistance) due to the presence of the parachute.

[2]

20

4. ***This question is about dispersion.***

a. Adrian was writing a paragraph on why the sky appears blue. You are requested to answer the following questions in order to help him.

i. Which colours form white light? List them in order starting from the red end of the spectrum.

_____

_____

_____

[3]

ii. State if the velocity of light waves is higher, lower or equal to the velocity of sound in air.

_____

[1]

iii. State which colour has the longest wavelength.

_____

[1]

iv. Which colour has the highest frequency?

_____

[1]

He finished his paragraph as follows:

When white light passes through the atmosphere, air molecules and tiny dust particles in the air scatter the light. Blue light is mostly scattered and thus more blue light enters our eyes. As a result the sky appears blue.

b. Adrian and Peter were given the following apparatus to investigate further about white light: a ray box with a narrow slit, a convex lens, a 60^{o} light prism and a white screen.

i. Describe, including a **ray diagram** how they would set up the experiment to see the visible spectrum. Indicate clearly which colours are obtained at the edges of the spectrum.

[6]

ii. On your diagram indicate with (UV) and (IR) where you would expect to find ultra violet radiation and the infra-red radiation respectively. [2]

iii. What is the purpose of the convex lens?

[1]

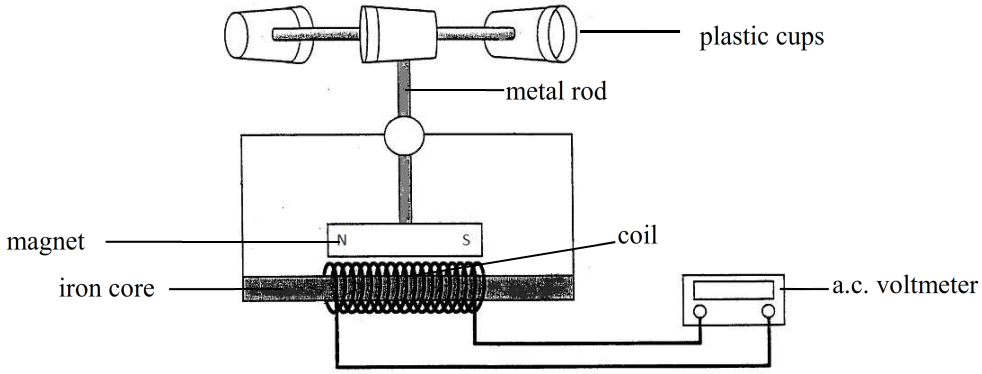
iv. Name the two phenomena that take place when the light rays enter the prism.

[2]

c. Peter would like to recombine the seven colours to form white light again. Explain briefly how he can do this?

[3]

5. ***This question is about magnets and electromagnetism.***



a. A student designed a device to measure the speed of moving air. The student attached a magnet to a metal rod which in turn has a fan with a number of plastic cups attached to it.

i. The student put this device facing a fan which was producing constant wind. State which reading the student needs to take to check that his device is working properly.

[1]

ii. Briefly explain how the device works.

[4]

iii. What will happen to the reading when the speed of air increases? Explain.

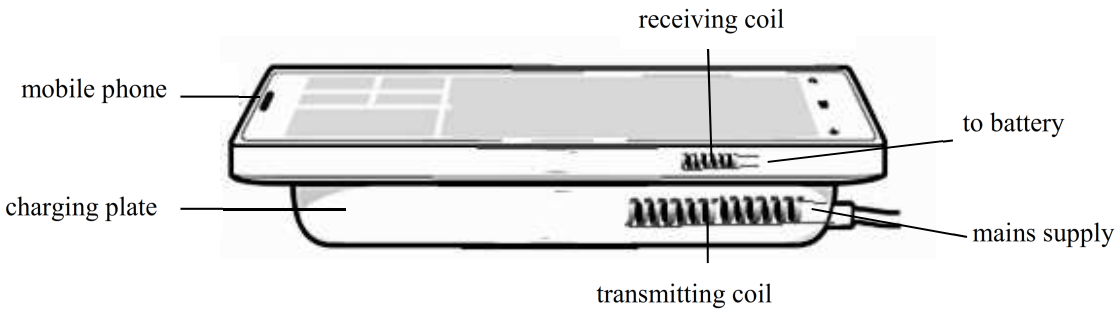
[2]

iv. The student wants to investigate whether the amount of cups attached will make a difference in the setup. Indicate the readings the student should take in the table below. [2]

v. Suggest two ways of making the apparatus more efficient.

[2]

b.



Wireless charging is a popular new feature included on some mobile phones. The phone is placed on the charging plate and the phone charges wirelessly. The diagram above shows a charging plate which has a transmitting coil connected to a mains supply and a mobile phone. Inside the mobile phone there is a receiving coil which is connected to a battery.

i. Briefly explain how the battery is charged.

[3]

ii. Explain why it is important for the charging plate to be connected to an a.c. supply.

[2]

iii. A typical charging plate runs on a 240 V mains and has a current of 0.02A. If the voltage of the battery is 5 V calculate the current in the receiving coil.

[2]

iv. It is suggested that the charged plate is plugged off from the mains supply once charging has been completed. Explain why.

[2]

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

SECONDARY EDUCATION CERTIFICATE LEVEL

MAY 2013 SESSION

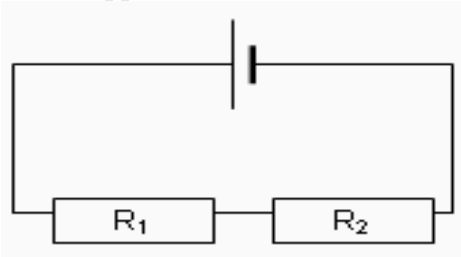
SUBJECT:	**Physics**
PAPER NUMBER:	IIB
DATE:	2nd May 2013
TIME:	4:00 p.m. to 6:00 p.m.

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

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

Kim and Lisa were investigating what happens to the current and the voltage in the circuit shown.



a. An electric current is defined as the _____ of flow of _____.

[2]

b. Kim and Lisa found an ammeter and a voltmeter in the laboratory. Redraw the circuit to show how these can be connected in the circuit above to find the current in the circuit and the p.d. provided by the battery.

[4]

c. The battery is marked 3 V, R_1 has a value of 50 Ω and R_2 has a value of 150 Ω.

i. Calculate the total resistance in the circuit.

[2]

ii. What is the current in the circuit?

[2]

iii. Calculate the p.d. across R_1.

[2]

d. Kim decides to connect another resistor R_3 of 50 Ω in parallel with R_1. What happens to the total resistance in the circuit? Choose the correct statement by writing an **x** in the box. [1]

Resistance remains the same	
Resistance increases	
Resistance decreases	

e. If the current through R_2 is 0.02 A, what is the current passing through each resistor in the parallel branch?

[2]

f. Lisa wanted to connect a three pin plug to an electrical appliance.

i. State the colour of the insulation of each wire in the table below. [3]

Wire	**Colour**
Live	
Neutral	
Earth	

ii. What is the purpose of the fuse in the three pin plug?

[2]

2. ***This question is about forces and moments.***.

a. Elena suspends a 30 cm spring from a retort stand. She loads the spring and observes what happens to the spring. Fill in the missing words.

Hooke's Law states that the _____ of a material is directly proportional to the

applied _____ provided the elastic limit is not exceeded. [2]

b. When a weight of 1 N is loaded on the spring, it has a length of 36 cm.
   i. Calculate the extension of the spring.

_____

[1]

   ii. If $F=kx$ where F stands for force on a spring, x is the extension and k is the spring constant, calculate a value for the spring constant.

_____

_____

[2]

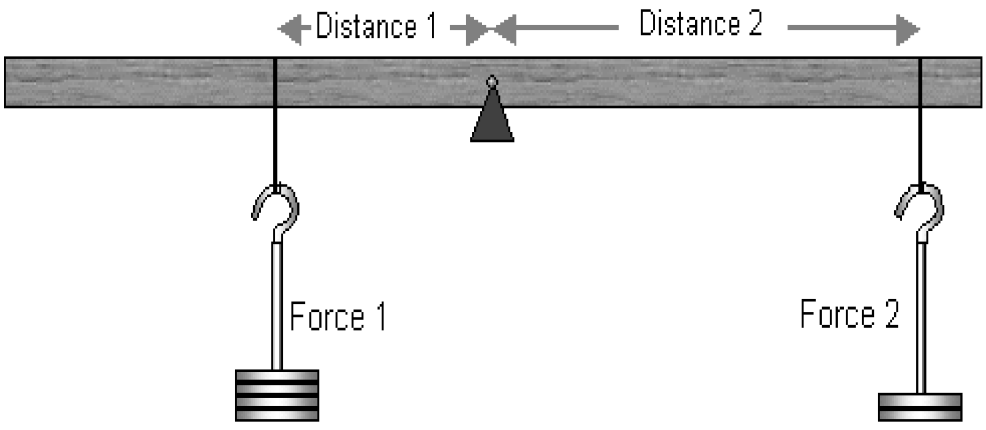
c. Fill in the missing words:

Vectors are physical quantities which have _____ and _____

while _____ quantities have size only.

[3]

d. Elena then went on to investigate the turning effect of a force using a uniform ruler pivoted at the centre. She sets it up in *equilibrium* as shown.



i. The ruler is in equilibrium because the resultant _____ and the resultant_____ in any direction is _____. [3]

ii. If the distance d_1 is 0.15 m, F_1 is equal to 20 N and F_2 is equal to 15 N, calculate the moment due to the force F_1.

[2]

iii. What is the moment due to the force F_2?

[1]

iv. Calculate the distance d_2.

[2]

v. If F_2 is doubled while F_1 remains the same, suggest two ways how to keep the system in equilibrium.

[2]

e. While helping her mother to paint, explain why Elena used a screw driver to open a can of paint rather than her fingers.

[2]

3. ***This question is about falling objects.***

Giorgio read this passage: " . . . *debate had started up . . . that heavier objects fell faster than lighter objects . . . According to legend, Galileo decided . . . to drop the objects from . . . the Tower of Pisa, 54 meters tall. Galileo climbed up to the top of the building carrying a variety of balls of varying size and weight . . . They all landed at the base of the building at the same time . . .* "

(http://inventors.about.com/od/gstartinventors/a/Galileo_Galilei.htm)

a. Giorgio wanted to carry out investigations about these experiments carried out by Galileo Galilei. He calculated the time taken for a 20 kg metal sphere to reach the ground, and the highest velocity it would reach. He assumed that there was no air resistance.

i. What is the acceleration of the 20 kg sphere during its free fall?

[1]

ii. State whether the sphere will ever reach terminal velocity. [Hint: Assume there is no air resistance]

[1]

iii. What is the initial velocity of the 20 kg sphere as soon as it is released at the top of the Tower?

[1]

iv. Considering the free fall of the sphere from the top of the Tower of Pisa at 54 m above the ground, calculate the time that the sphere would take to reach the ground from the top of the Tower.

[4]

v. Use one of the equations of motion to calculate the highest velocity that the sphere would reach, that is its velocity just before touching the ground.

[3]

vi. Calculate the sphere's kinetic energy just before touching the ground.

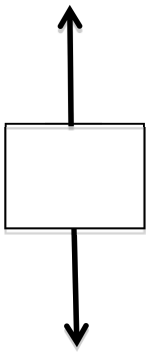
[2]

b. Giorgio wanted to work out the values needed of a person jumping from the top of the Tower of Pisa using a parachute. He thought that in order to carry out the investigation, it would not be wise to perform experiments with a person but with an object having the same weight. So, in his calculations, he considered an object having his own weight, i.e. an object of mass 60 kg.

i. State the time taken for the 60 kg object without parachute to reach the ground after being released from the top of the Tower. (*Hint: you do not need to carry out any calculations to answer this question.*)

[1]

ii. As the 60 kg object is accelerating during its fall, there is a resultant (or unbalanced) force acting downwards on it. This is due to the combined effect of two forces acting on the object. Write the name in full of the two main forces acting on the object next to the arrows in the diagram below. [2]



iii. If the 60 kg object with the parachute takes a total time of 20 s to reach the ground from the top of the Tower, calculate its acceleration.

[3]

iv. Calculate the resultant (or unbalanced) force acting on the 60 kg body.

[2]

4. ***This question is on dispersion.***

a. Adrian spilt some liquid on a book. He noticed that some of the words were no longer legible. The following is the text that now has some illegible words. Fill in the blanks with the most appropriate word.

White light from the sun is made up of seven colours which are _____,

_____, _____, _____,

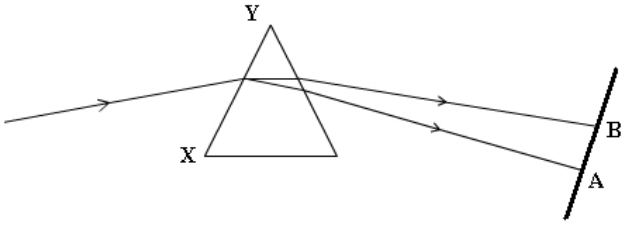
_____, _____ and _____. All of the

waves from the sun travel with the same _____ but have different wavelengths.

Red has the _____ wavelength while violet has the _____

wavelength. [5]

b. Adrian decided to investigate white light further. By using a white light source and placing a prism as shown in the diagram below, he produced the same effect of the rainbow.



i. Besides dispersion name the other phenomenon that occurs as the light ray enters the glass prism.

_____

[1]

ii. Define dispersion.

_____

[1]

iii. Briefly explain why light is dispersed.

_____

[1]

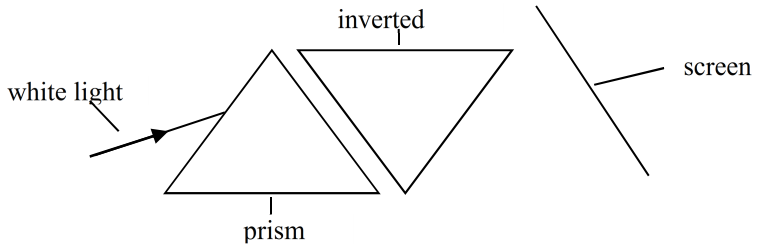
iv. Which colours are found at ends A and B on the screen?

A: _____ B: _____ [2]

v. Two other types of radiation exist. One above B and the other below A. State these radiations.

Above B: _____ Below A: _____ [2]

c. Adrian placed an inverted prism as shown in the diagram.



What is observed on the screen now? Why?

_____

_____

[2]

d. Adrian points a green ray of light to the prism instead of the white one. What is observed on the screen now? Explain.

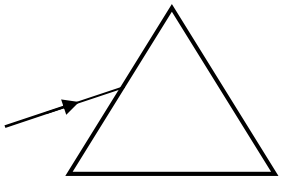
_____

_____

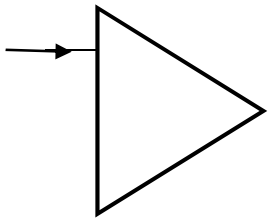
[2]

e. An incident ray is shone onto a prism. In the two cases below draw the path followed by the ray of light through the glass prisms. [2]

i.



ii.



iv. What is the phenomenon taking place in setups as in part e(ii)? Name a piece of apparatus that makes use of such setup.

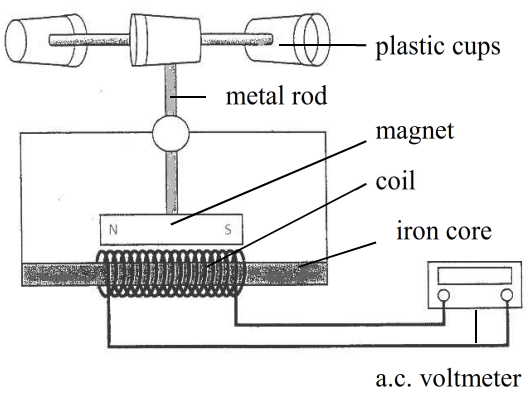
_____

_____

[2]

5. ***This question is about magnets and electromagnetism.***

a. A student designed a device to measure the speed of moving air. The student attached a magnet to a metal rod which in turn has a number of spokes with plastic cups attached to them. The student put this device facing a fan which was producing a constant current of air.



i. State what will the student read from the voltmeter.

_____ [1]

ii. Arrange these statements in order by writing numbers 1 to 5 in the column on the right hand side.

Since there flux change an emf is induced in the coil.	
The reading is measured on the voltmeter.	
The air current from the fan will make the plastic cups turn.	
The magnetic field of the magnet will link with the coil.	
The magnet will turn as well.	

[5]

iii. What will happen to the reading of the voltmeter when the speed of air current increases?

_____ [1]

iv. Briefly explain the need of the iron core.

_____ [1]

v. State two magnetic properties of soft iron.

_____

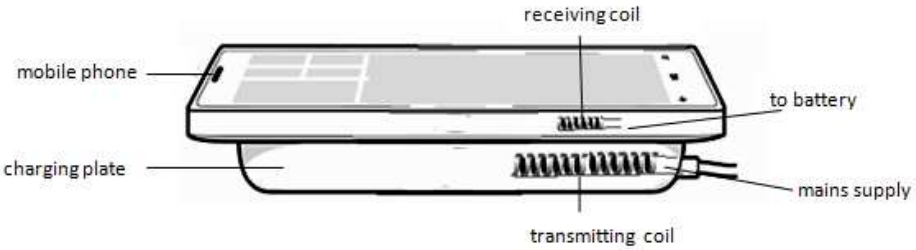
_____ [2]

vi. Suggest **two** ways of making the apparatus more efficient.

_____

_____ [2]

b. Wireless charging is a popular new feature included on some mobile phones. The phone is placed on the charging plate and the phone charges wirelessly. The diagram shows a charging plate which has a transmitting coil connected to a mains supply and the mobile phone. Inside the mobile phone there is a receiving coil which is connected to a battery.



i. State what will be present around the transmitting coil when the charging plate is connected to the mains supply.

[1]

ii. State two conditions required to induce a current in the receiving coil.

[2]

iii. State why it is important for the charging plate to be connected to an a.c. supply.

[1]

iv. A typical charging plate runs on a 240 V mains and produces a current of 0.02 A. Find the power of the charging plate.

[1]

v. If it is assumed that this system is 100% effficient and if the voltage of the battery is 5 V, calculate the current in the receiving coil.

[2]

iv. It is suggested that the charged plate is plugged off from the mains supply once charging has been completed. Explain why.

[1]

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