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

SECONDARY EDUCATION CERTIFICATE LEVEL

SEPTEMBER 2014 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	I
DATE:	1st September 2014
TIME:	9:00 a.m. to 11:00 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 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 = πr^2		

1. The table below shows the tuning dial of a radio. The positions of some Maltese radio stations are shown.

MHz	89.7	92.7	93.7	100.2	101.0	101.8	102.3	103.0	103.7	104.6
Radio station	Bay Radio	One Radio	Radio Malta	Solid FM	Radio 101	Calypso Radio	Radju Marija	RTK	Campus FM	Smash Radio

a. With reference to the table above state which radio station transmits with:

i. the highest frequency ________________________;

ii. the longest wavelength_______________________.

(2 marks)

b. Convert 93.7 MHz to Hz.

___

(1 mark)

c. Give two properties of radio waves which distinguish them from sound waves.

___

___

(2 marks)

d. Calculate the wavelength of Bay Radio waves.

___

___

(2 mark)

e. Complete the following sentences:

Radio waves form part of the ________________________ spectrum. Two other types of radiation

that are part of this spectrum are ________________________, ________________________.

(3 marks)

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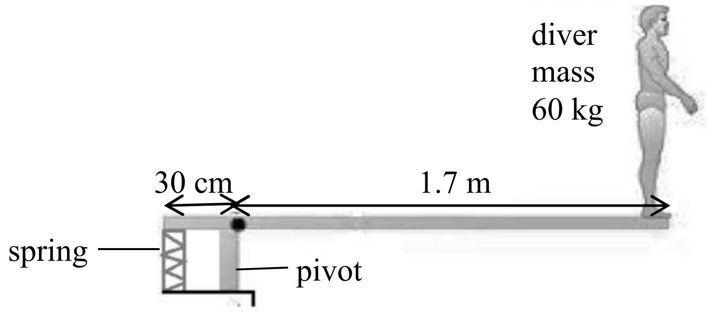
2. A diver of mass 60 kg stands on the end of a diving board of mass 30 kg and length 2 m.



a. Draw, a simple diagram in the space below to show the forces acting on the diving board.

(2 marks)

b. If the diver is 1.7 m away from the pivot calculate the **total** clockwise moment about the pivot.

(4 marks)

c. Hence or otherwise, calculate the force exerted by the spring 30 cm away from the pivot.

(2 marks)

d. Calculate the upward reaction force at the pivot. State the principle you are using.

(2 marks)

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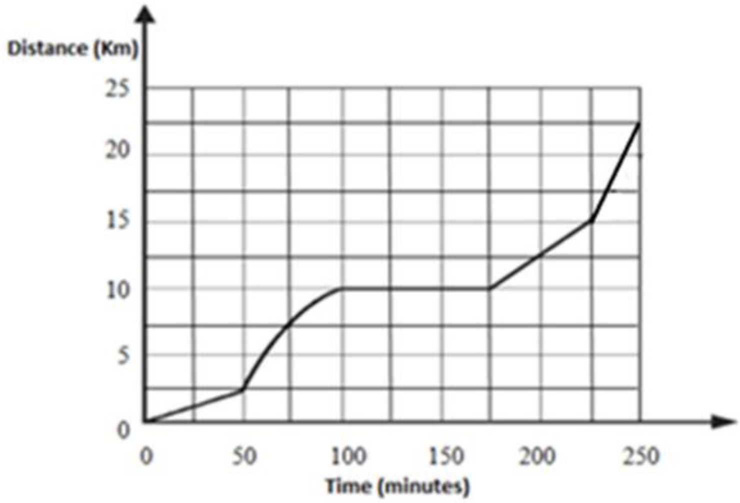
3. Moyra cycles on her bike for 22.5 km as shown in graph below. At one point she has a puncture and repairs it on the spot to continue with her ride. The graph shows the different stages of her journey.



Use the graph to find:

i. how far she travelled in the first 75 minutes; ____________ (1 mark)

ii. how long she took to travel the last 7.5 km of the journey; ____________ (1 mark)

iii. how long did Moyra take to repair the puncture. ____________ (1 mark)

Calculate:

iv. her speed (in m/s) between the 175^{th} and the 225^{th} minute;

____

____

(2 marks)

v. her total average speed (in m/s) for the journey;

____

____

(2 marks)

vi. Moyra looked at the graph of her journey and concluded that she cycled fastest in the last 25 minutes. Do you agree? Explain.

____

____

(2 marks)

vii. Adrian travelled the same distance at a constant speed in 150 minutes. On the same axes sketch a graph to represent his journey. (1 mark)

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4. Planet Earth is one of the eight planets which form part of the Solar System.

a. Give two characteristics which define a planet.

____

____

(2 marks)

b. Name one "dwarf" planet.

____

(1 mark)

c. Name the force which keeps objects orbiting around each other.

____

(1 mark)

d. Would you expect the force mentioned in part (c) to, increase, decrease or remain the same if:

- a 5kg object is moved from the moon to planet Earth? ____________________
-
- a 10kg object is taken on top of a very high mountain? ____________________
-
- a 20kg object is taken from Valletta to Mosta? ____________________

(3 marks)

e. Fill in the blanks with the most appropriate word.

The initial explosion which resulted in the formation and the expansion of the universe is called the ____________________ ____________________. With the use of ____________________ we can observe the skies and understand how great our universe is. Distances in space are measured in ____________________ ____________________.

(3 marks)

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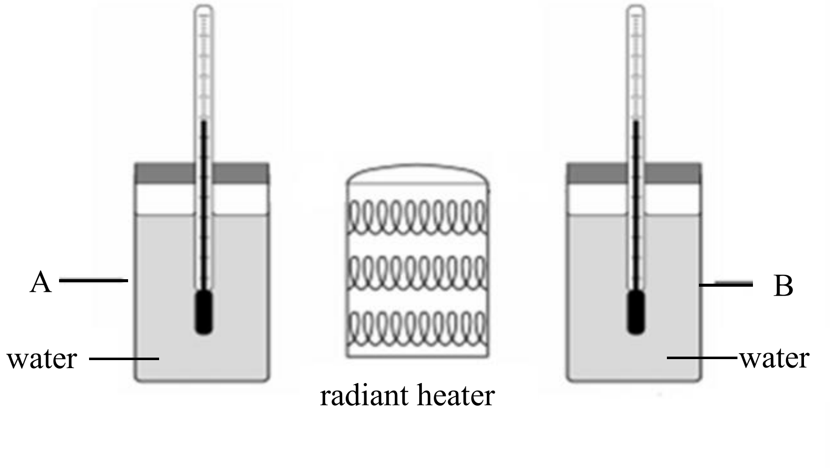
5. Carol and Edward investigate two surfaces A and B, which surround two beakers filled with water as shown below. They design an experiment to find whether surface A or B is the better absorber of heat.



i. Name **one** precaution that they should take to ensure a fair result.

(1 mark)

They tabulate the results obtained as shown below.

Time (min)	0	1	2	3	4	5	6	7
A (^{o}C)	20	22	24	26	28	30	32	34
B (^{o}C)	20	24	28	32	36	40	44	48

ii. Plot a graph of the temperature of A (y-axis) against time (x-axis). On the same graph plot also the temperature of B (y-axis) against time (x-axis).

(5 marks)

iii. Which of the two materials (A or B) is the better absorber of heat? Explain.

(2 marks)

iv. Work out the gradient of graph A.

(2 marks)

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DO NOT WRITE ABOVE THIS LINE

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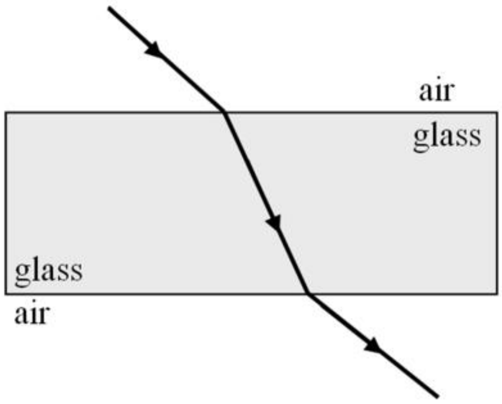
6. A student is studying the relation between the angle of incidence and the angle of refraction of a ray of light as it enters a particular glass block.



a. Mark on the diagram the angle of incidence and the angle of refraction at **each** boundary. Mark also the normal at each boundary (3 marks)

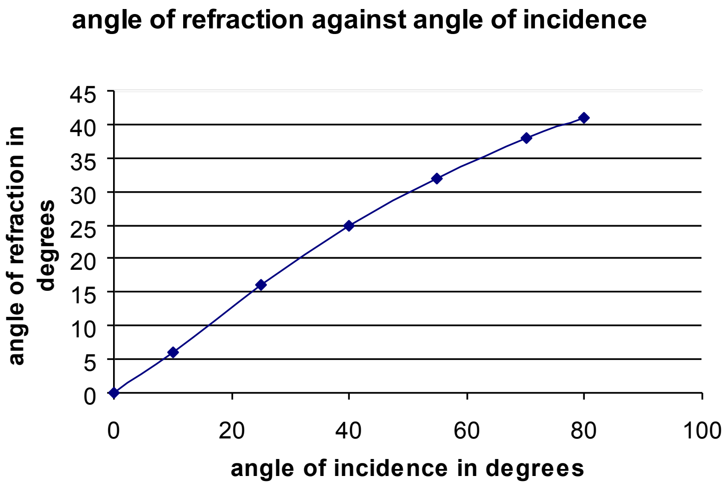
b. List the procedure the student should follow to measure these angles.

(3 marks)

c The speed of light in air is 3×10^8 m/s whilst the speed of light in glass is 2×10^8 m/s. Calculate the refractive index from air to glass.

(2 marks)

d. The table below shows how the angle of refraction, **r** varies with the angle of incidence, **i**.



Draw clearly a second graph for a medium with a much greater refractive index. Explain your reasoning

(2 marks)

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7. The diagram shows a picture of a lamp stand made from solid wood.

a. Define 'Centre of Gravity'.

____

(2 marks)

b. Mark on the diagram with a letter **X** the approximate position of the centre of gravity. (1 mark)

c. State clearly how you would check that the position of the centre of gravity of the lamp stand is correct using only the triangular prism block.

____

____

(2 marks)

d. If a glass shade is fitted on the lamp stand, what will be the effect, if any, on the centre of gravity previously found. Explain

____

____

(2 marks)

e. Describe with the aid of a diagram, how the centre of gravity of an irregular shaped metal sheet can be found.

____

____

____

____

(3 marks)

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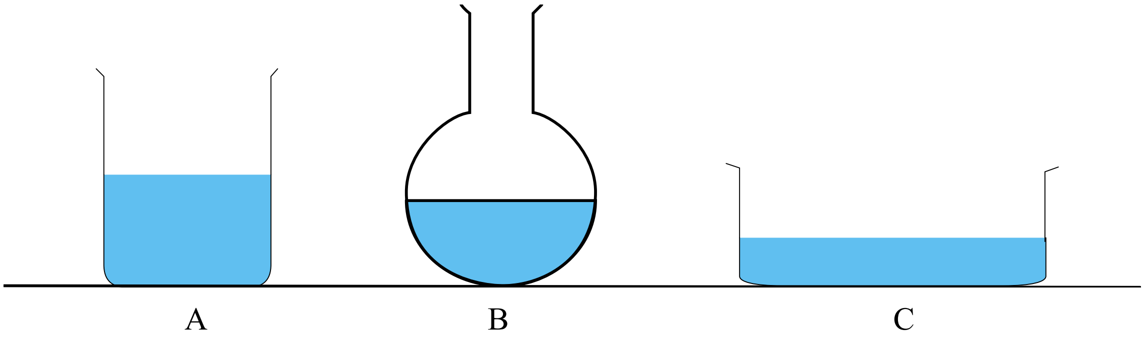
8. Peter places equal volumes of a liquid in each of three containers A, B and C placed on a wooden bench as shown below.



i. Predict in which container A, B or C will the liquid evaporate at the fastest rate. Explain.

(2 marks)

ii. Name **two** other conditions which increase the rate of evaporation.

(2 marks)

iii. Peter calculates that 10 ml of the liquid evaporates in 1 hour. Calculate the rate of evaporation per second.

(2 marks)

iv. Peter observes that as the liquid evaporates, some water droplets between the container and the wooden bench start to freeze. Explain why.

(2 marks)

v. Athletes put on more clothes as soon as they end their race. Explain why.

(2 marks)

10

9.a. State Hooke's law.

____

____

(2 marks)

b. Lisa attached some loads to a spring. Each time she measured the new length of the spring using a ruler. When she attached a load of 5 N the length of the spring extended to 42 cm. She then added another 5 N and the new length was 52 cm.

i. Calculate the original length of the spring.

____

____

(1 mark)

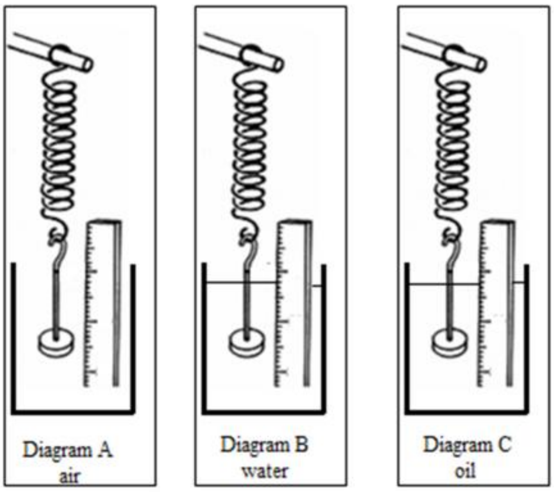
ii. Calculate the force required to produce an extension of 1 cm.

____

____

(2 marks)

c. Now Lisa places the same spring with a load of 5N in a beaker filled with water and then in an identical beaker filled with oil.



i. Mark the forces acting in diagram A.

(2 marks)

ii. The spring will extend most when it is placed in

_______________ whilst it will extend least when

placed in _______________ .

(2 marks)

iii. Give a reason using correct scientific terms for your answer to part (ii).

____

____

(1 mark)

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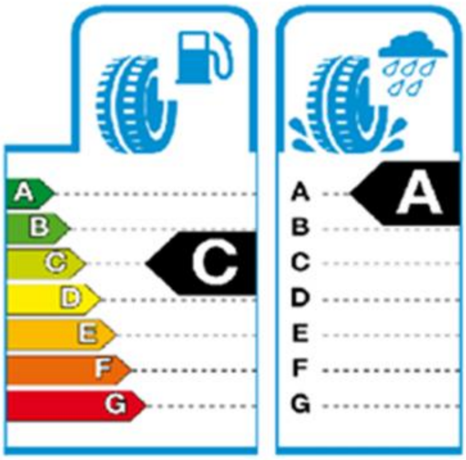
10.a A TV advertisement encourages car drivers to look out for EU Tyre Labels before purchasing a tyre. Tyres are labelled from 'A' to 'G'. It is claimed that tyres labelled 'A' reduce the fuel consumption of the car and increase the car's safety on the road.



i. Explain how car tyres which have a good grip on wet roads affect the braking distance of a car driver applies a sudden brake.

____

____

(2 marks)

ii. Do tyres which have a good grip affect the thinking distance of the driver? Explain.

____

____

(2 marks)

iii. Name **one** other factor which has an effect on the:

- thinking distance; ______________________________
- braking distance. ______________________________

(2 marks)

b. A driver of a car travelling at 10 m/s has a reaction time of 0.5 s before he applies the brake.

i. Calculate the distance covered by the car during this time.

____

____

(2 marks)

ii. The driver brakes and stops the car in 3 s. Calculate the total distance covered by the car during braking.

____

____

(2 marks)

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

SECONDARY EDUCATION CERTIFICATE LEVEL

SEPTEMBER 2014 SESSION

SUBJECT:	**Physics**
PAPER NUMBER:	IIB
DATE:	1st September 2014
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 = πr^2		

1. ***This question is about Radioactivity.***

One method that scientists use to date ancient fossils is called carbon dating. All living things on Earth are made up of a small amount of the element Carbon-14.

a. Carbon-14 ($^{14}_{6}C$) decays by emitting beta particles. The symbol for a beta particle is $^{X}_{Y}e$:

i. State the values of X and Y? X ______________________ Y ______________________.

ii. A beta particle can be stopped by ____.

(3 marks)

b. Carbon-12 ($^{12}_{6}C$) is another atom of the element Carbon. Carbon-12 and Carbon-14 are called isotopes.

i. Isotopes have the same ____________________ number but different __________________ number.

ii. Carbon-14 is said to be radioactive. Its nucleus can be shown as __________________.

(3 marks)

c. Apart from beta particles, radioactive nuclei can also emit:

i. _____________________ particles;

ii. ________________________ radiation.

(2 marks)

d. Compare the ionising power of the radioactive emissions mentioned in c (i) and c (ii).

____

____

____

____

____

(2 marks)

e. Give one way in which radioactive emissions can be beneficial and one way in which they can be harmful.

Beneficial: ______________________________

Harmful: ______________________________

(2 marks)

f. A GM tube connected to a counter is used to measure the radioactivity emitted from a substance. After the substance has been removed, the counter still gives a reading. Explain.

____

____

(2 marks)

g. Carbon-14 has a half-life of 5,730 years.

i. Define the term half-life of a radioactive substance.

____

____

(2 marks)

ii. A fossil was found to be 17,190 years old. Determine what fraction of the element Carbon-14 was found in the fossil after all these years.

____

____

(2 marks)

iii. Another fossil, found to be 11,460 years old, contained 24 atoms of Carbon-14. What was the original amount of atoms of Carbon-14, when the organism died?

____

____

(2 marks)

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2. ***This question is about electric circuits.***

Andrea connected two bulbs, P and Q, each of resistance $4\,\Omega$ and a 6 V cell in two different ways as shown below.

Figure A

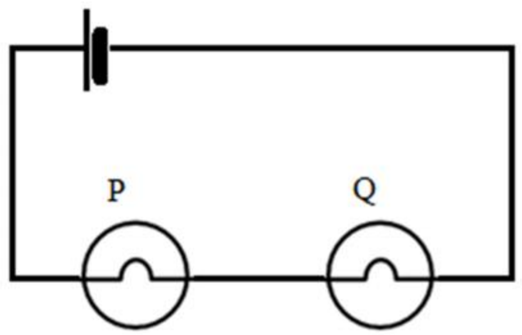
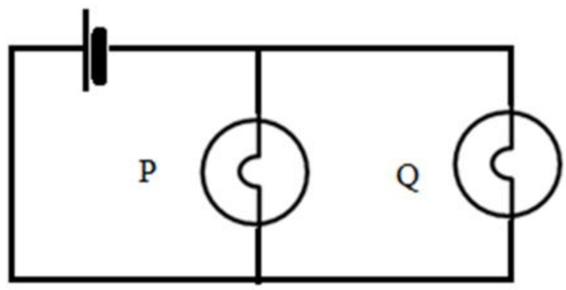


Figure B



a. In Figure A the bulbs are connected in ________________, while in Figure B the bulbs are connected in ________________, (2 marks)

b. Calculate the total resistance of the two bulbs in both figures.

Figure A: ____

____

Figure B: ____

____

(3 marks)

c. Draw on the diagram of Figure A an ammeter which can be used to measure the total current flowing in the circuit. (2 marks)

d. Calculate the total amount of current flowing in Figure A.

____

____

(2 marks)

e. A voltmeter is an instrument to measure potential difference.
   i. Draw the symbol of a voltmeter to show how it should be connected properly in Figure B to find the voltage across bulb Q. (2 marks)

ii. What is the voltage across bulb Q in Figure B? Explain how you arrived to your answer.

____

____

____

(2 marks)

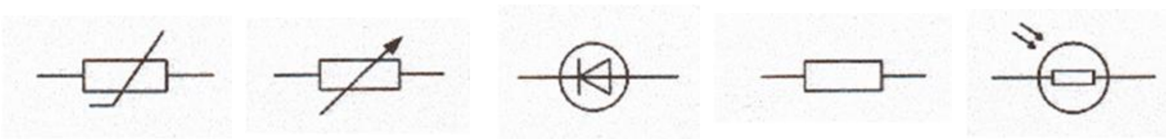
f. Underline the correct term from the suggested words in the brackets.

i. If a third bulb R of resistance 4 Ω, is connected in Figure A similarly to bulbs P and Q, the voltage across bulbs P, Q and R will (increase, decrease, remain the same) and the current through each bulb will (increase, decrease, remain the same).

ii. If a third bulb R of resistance 4 Ω, is connected in Figure B in the same manner as bulb P and Q, the voltage across bulbs P, Q and R will (increase, decrease, remain the same) and the current through each bulb will (increase, decrease, remain the same).

(4 marks)

g. Which of following diagrams represent an electrical component which:



A **B** **C** **D** **E**

i. allows current to flow in one direction only? ____

ii. decreases its resistance when its temperature rises? ____

iii. allows more current to flow when exposed to light? ____

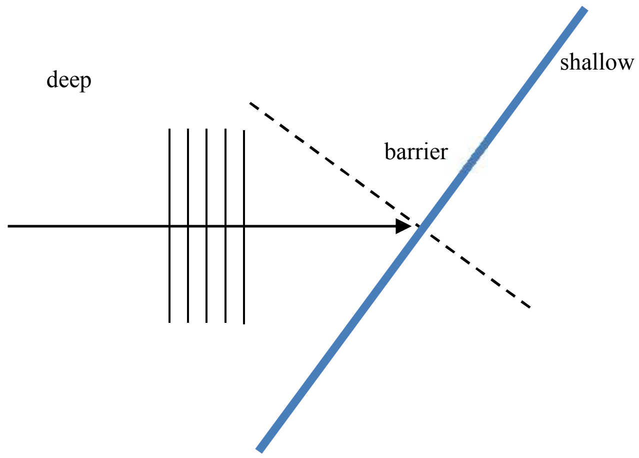
(3 marks)

20

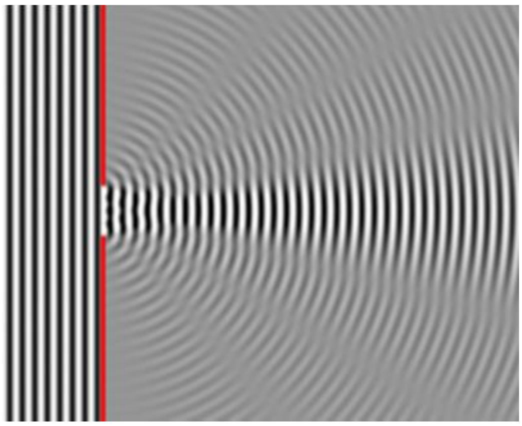
3. *This question is about water waves.*

In a ripple tank experiment, an electric motor causes a bar to vibrate which then produces plane waves.

a. A block of perspex is placed at the bottom of the ripple tank such that there is a deep and a shallow section of water. Continue the path of the water waves in the shallower region. On your diagram show clearly the angle of incidence and the angle of refraction, and the wavelengths of the water waves in the shallower part. (4 marks)



b. The apparatus is rearranged and the water waves in the diagram could be observed.



i. What do we call this phenomenon?

____ (1 mark)

ii. State whether there are any changes, (increase or decrease or no changes) in the following properties of a wave after it passes through the barrier.

- speed of the waves ______________________________
- frequency ______________________________
- wavelength. ______________________________

(3 marks)

c. State and explain the effect if any, on each of the physical quantities below, when doubling the speed of the motor of the ripple tank.

- speed of the waves ______________________________

____

- frequency of waves ______________________________

____

- wavelength of waves ______________________________

____

(3 marks)

d. John and Rita wish to calculate the speed of the water waves at a particular moment.

   i. Describe a simple experiment on how can they find the speed of the water waves.

____

____

____

____

____

(4 marks)

   ii. State any formula they need to use to find the speed.

____

____

(1 mark)

   iii. State two precautions that should be taken.

____

____

____

(2 marks)

   iv. Wavefronts were measured such that the distance between two successive crests was 2 cm. The frequency of the water waves is 0.5 Hz. Calculate the velocity of the water waves.

____

____

(2 marks)

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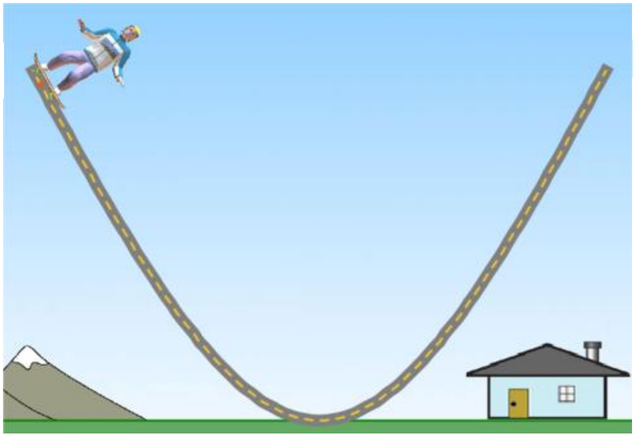
4. ***This question is about energy and momentum.***

a. A skateboarder moves from A to B to C as shown on the diagram below.

A



C

B

i. If the skateboarder is 15 m high above the ground at A and the mass of the skateboarder is 70 kg, calculate the potential energy of the skateboarder at A.

(2 marks)

ii. Assuming that all the energy is conserved, state the kinetic energy of the skateboarder at B.

(1 mark)

iii. The actual velocity of the skateboarder at B is 14 m/s. Calculate the kinetic energy of the skateboarder at B.

(2 marks)

iv. Give **two** reasons why the potential energy of the skateboarder at A is **not** totally converted to kinetic energy at B.

(2 marks)

v. A second skateboarder has a smaller mass than the first skateboarder. If the second skateboarder starts from the same height, how will the velocity at B change with respect to the velocity of the first skateboarder? Explain.

____

____

(2 marks)

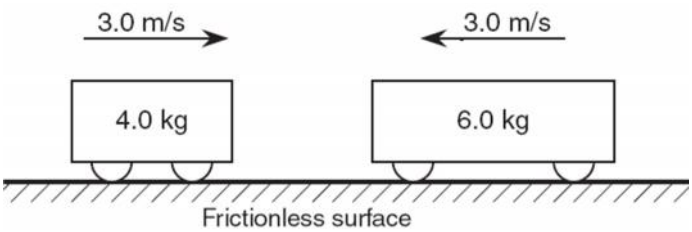
b. Complete the law of conservation of momentum.

The law of conservation of momentum states that total momentum before a collision is ___________

____

(2 marks)

c. Two trolleys moving in opposite directions collide and move together.



i. Give the units of momentum. _____________ (1 mark)

ii. Calculate the **total** momentum of the two trolleys before collision.

____

____

(3 marks)

iii. Draw an arrow on the diagram to show the direction in which the trolleys move after collision. Explain.

____

____

(2 marks)

iv. Calculate the common velocity of the trolleys moving together after collision.

____

____

(2 marks)

v. Explain why the trolleys are made to move on a frictionless surface.

____

(1 mark)

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

a. Jeremy and Charlotte investigate the magnetic field around a bar magnet.

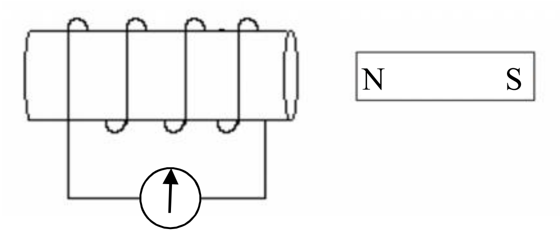
i. Describe a simple experiment to observe the magnetic field pattern around a bar magnet.

(2 marks)

ii. Draw the magnetic field lines around the bar magnet shown below.

(2 marks)

b. The students place the bar magnet close to a solenoid. (The solenoid is wound on a hollow cardboard cylinder)



i. What is observed as soon as they push the magnet into the solenoid?

(1 mark)

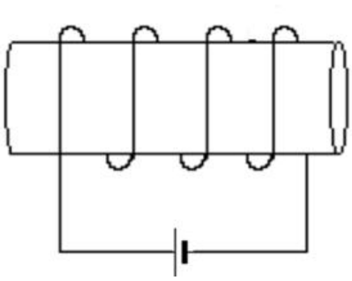
ii. What is observed as soon as they remove the magnet out of the solenoid?

(2 marks)

iii. Name **two** changes that can be done to increase the effect observed.

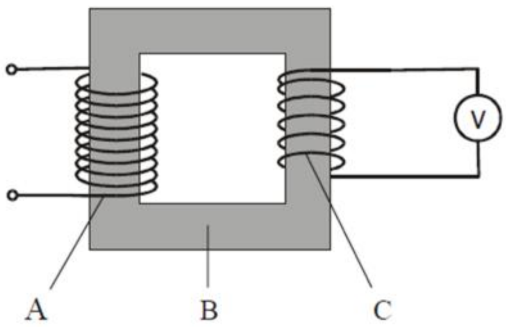
(2 marks)

iv. Draw the magnetic field lines around a current carrying solenoid. Mark also the position of the North pole.



(3 marks)

c. i. Label A, B and C in the transformer below.



A - ____________________________

B - ____________________________

C - ____________________________

(3 marks)

ii. The 240V mains electricity supply is connected to A, which has 400 turns. C has 100 turns. Calculate the voltage across C.

____

____

(2 marks)

iii. The transformer is 90% efficient. What does this mean?

____

____

(2 marks)

iv. Name **one** use of a step-down transformer.

____

(1 mark)

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