



DEPARTMENT OF  
EDUCATION

UPPER SECONDARY  
SCHOOL CERTIFICATE  
EXAMINATIONS

**PHYSICS**

Wednesday

21 October 2015

Time allowed:

2 hours and 30 minutes

(8:00am – 10:30 am)

NO EXTRA TIME

(NO OTHER TIME)

Candidates are advised to  
fully utilize the allocated  
time

**P**

## INSTRUCTIONS TO CANDIDATES

*To be read by the external invigilator to all candidates*

1. The subject code for Physics is **7**.
2. There are **15** printed pages in the question booklet.
3. There are **11** printed pages in the Section B answer booklet and Part A Electronic Answer Sheet. They are inserted in the middle of your Question Booklet.
4. There are two sections in this paper.

### **Section A: Multiple Choice Questions - 30 marks**

This section will be electronically marked. Electronic Answer Sheets will be distributed by your external invigilator. All answers to the Multiple Choice Part **MUST** be answered on this Answer Sheet. Carefully following the instructions, fill in your Candidate Information and Subject Information.

### **Section B: Short Answer Questions -70 marks**

Write down your name, your school name and your 10-digit candidate number on the Part B Answer Sheet provided.

5. You are required to write the correct answer in the space provided.
6. Calculators may be used.
7. Answers written on the question paper will not be marked. Write answers neatly in spaces as allocated on the answer sheet. Answer **ALL** questions.
8. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper **will not be marked**.
9. **ALL** working must be shown step by step to get full marks. Students may lose marks for writing down final answers only.
10. Correctional Fluid is not allowed on the answer sheet. Where you have made an error, cross out all the working and start on a new line.
11. Graphical Calculators are not permitted.
12. Enough spaces have been allocated for answers to every question. Questions must be answered in spaces as allocated. Answers all over the answer booklet may not be marked.

**PENALTY FOR CHEATING OR ASSISTING TO CHEAT IN  
NATIONAL EXAMINATIONS IS NON-CERTIFICATION.**

**DO NOT TURN OVER THE PAGE  
AND DO NOT WRITE  
UNTIL YOU ARE TOLD TO START.**

**PART A: MULTIPLE CHOICE (QUESTIONS 1 to 30)****30 MARKS**

Answer each question by shading in with HB pencil, the circle directly under the correct alternative A or B or C or D. If you make a mistake, rub it out completely using an eraser rubber and shade the correct answer on the ELECTRONIC ANSWER SHEET.

**QUESTION 1**

Which instrument would be appropriate for measuring the thickness of an A4 sheet of paper?

- A. A Vernier Calliper                      B. A meter ruler                      C. A micrometer  
D. A top pan balance                      E. A 30cm ruler

**QUESTION 2**

Which of the following combination of basic SI units is a joule (J)?

- A.  $\text{kg ms}^{-2}$                       B.  $\text{kg m}^2\text{s}^{-2}$                       C.  $\text{kg m}^{-2}\text{s}^{-2}$                       D.  $\text{kg m}^2\text{s}^2$                       E.  $\text{kg m}^2\text{s}^{-1}$

**QUESTION 3**

A ball is thrown up in air and returns to the thrower. During its motion, the acceleration of the ball

- A. remains constant and directed upwards for all times.  
B. remains constant and directed downwards for all times.  
C. changes in magnitude and directed downwards for all times.  
D. changes in magnitude and directed upwards for all times.  
E. remains constant but directed upwards when the ball is moving up and is directed downwards when the ball is moving downwards.

**QUESTION 4**

The area under the velocity-time graph for an object moving with constant acceleration represents

- A. momentum.                      B. initial velocity.                      C. acceleration.                      D. final velocity.                      E. displacement.

**QUESTION 5**

A projectile is launched upwards at an angle less than  $90^\circ$ , relative to the horizontal. During its motion, the velocity in the horizontal direction

- A. changes.  
B. remains constant always.  
C. is zero at maximum height of the projectile.  
D. is always positive on the way up only.  
E. is always negative on the way down only.

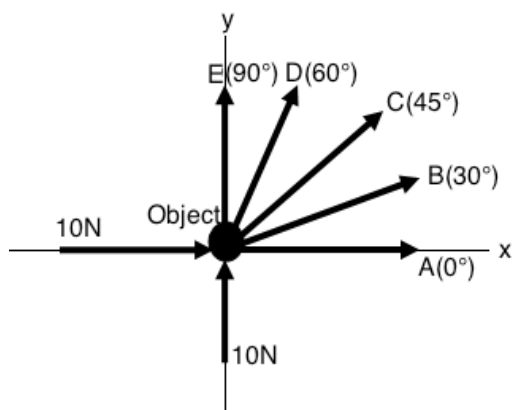
**QUESTION 6**

According to Newton's second law of motion, force is directly proportional to rate of change of

- A. square of linear velocity.      B. square of linear acceleration.      C. linear velocity.  
 D. linear momentum.              E. linear acceleration.

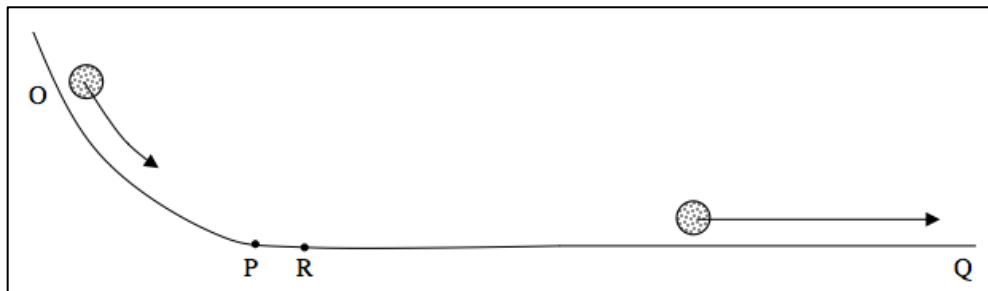
**QUESTION 7**

The diagram shows an object of mass 1 kg placed at the origin of the x-y axes. Two 10N forces are acting on the object at the same time as shown in the figure. The letters A, B, C, D, and E show the possible direction of the acceleration of the object. The direction of the acceleration is shown by the angles. The angles are measured relative to the positive x-axis shown, in the anticlockwise direction.



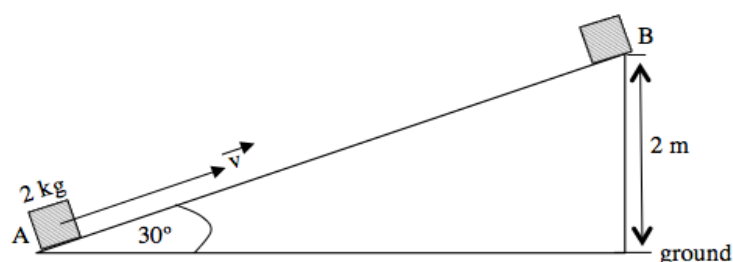
Which option gives the correct angle for the direction of the acceleration?

- A.  $0^\circ$   
 B.  $30^\circ$   
 C.  $45^\circ$   
 D.  $60^\circ$   
 E.  $90^\circ$

**QUESTION 8**

The diagram above shows a marble held at O on the path OPRQ. When the marble is released it moves along the path and its direction is shown by the arrow. The segment of the path PRQ is horizontal. The segment OPRQ is assumed to be smooth. When the marble just passes point P and to R, what can you say about its velocity from R to Q?

- A. It is zero.                              B. It is constant.                              C. Increase at constant rate.  
 D. Decrease at constant rate.        E. It is non-uniform.

**QUESTION 9**

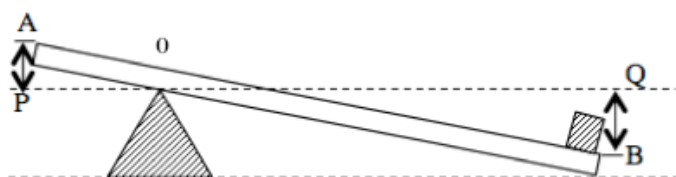
A block of mass 2kg is moved up a smooth inclined plane AB with a constant velocity. When the block reaches point B, two meters above the ground, the work done on the block is

- A. 40 J      B. 20 J      C. 60 J      D. 80 J      E. 50 J

**QUESTION 10**

An athlete of mass 80kg can run from point A to B in one minute at constant speed of 5m/s. What is the average power associated with the speed of the athlete?

- A. 400 W      B. 16.667 W      C. 20 W      D. 40 kW      E. 20 kW

**QUESTION 11**

A simple machine is made up of a uniform massless lever AB that is at rest, supported by a pivot, as shown in the diagram above. It is found that when a force of 50N is applied at end A, the lever moves to the horizontal position PQ. If the weight at end B is 30 N, what is the mechanical advantage of the machine?

- A. 60 %      B. 50%      C. 40%      D. 20 %      E. 30%

**QUESTION 12**

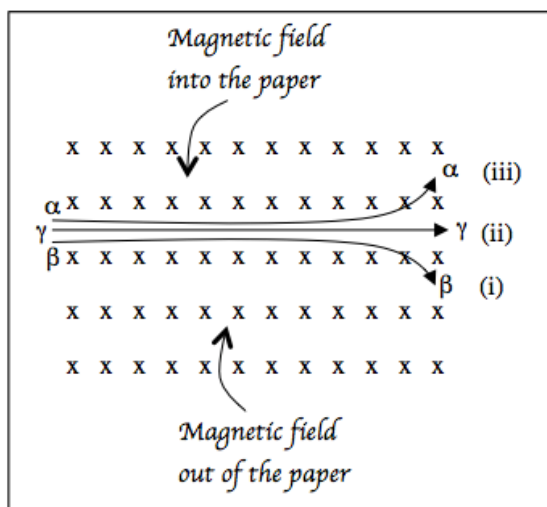
Which of the following description best suits a state of matter in a gaseous form?

- A. Strong bonds between their molecules making them very difficult to break. Have fixed shape and volume
- B. Having a fixed volume, but their shape is determined by the shape of the container holding them. They have weak bonds between their molecules.
- C. Virtually no bonds between their molecules. They have no fixed shapes and volume in the container they occupy.
- D. The bonds between them is weak, but have fixed volume and shape.
- E. Virtually no bonds existing between their molecules. Spread into available space and their volume is determined by the shape and size of the container holding them.



**QUESTION 19**

The diagram below shows the three types of radiation which are affected by the presence of the magnetic field.



Which of the label (s) showing deviation of the rays is a positively charged region or side?

- A. (ii)
- B. (i)
- C. (iii)
- D. (i) and (iii)
- E. (i) and (ii)

**QUESTION 20**

Which statement best explains the main difference between mechanical waves and electromagnetic waves?

- A. Electromagnetic waves travel as fast as mechanical waves.
- B. Electromagnetic waves have a source as mechanical waves do not.
- C. Electromagnetic waves can travel through vacuum as mechanical waves do not.
- D. Electromagnetic waves have a high frequency than mechanical waves.
- E. Mechanical waves travel faster than electromagnetic waves.

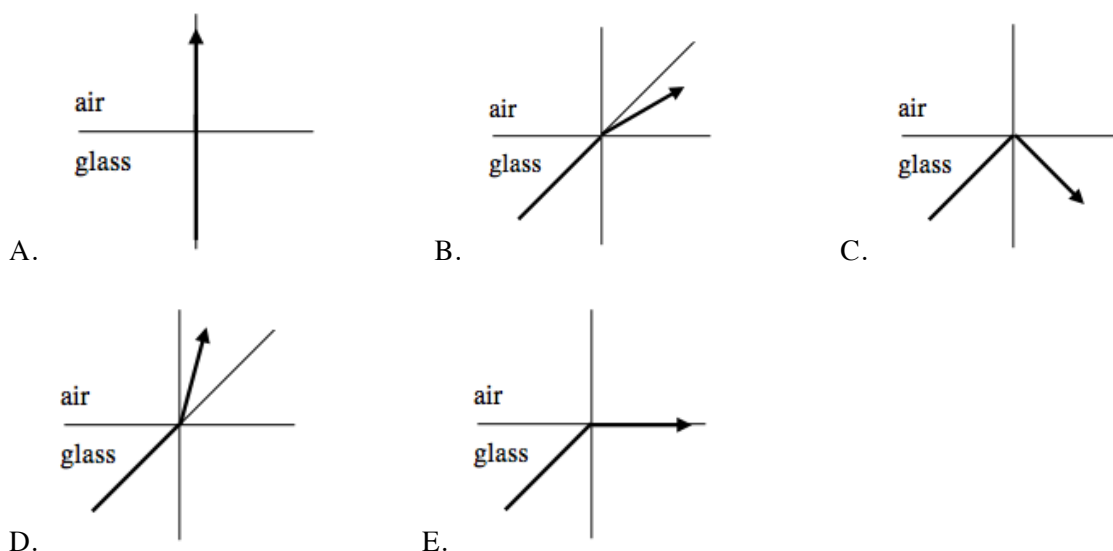
**QUESTION 21**

The bending of waves around obstacles is called \_\_\_\_\_.

- A. reflection
- B. diffraction
- C. refraction
- D. interference
- E. destructive interference

**QUESTION 22**

Which diagram does NOT show the possible path for a light ray going from a glass block into air?

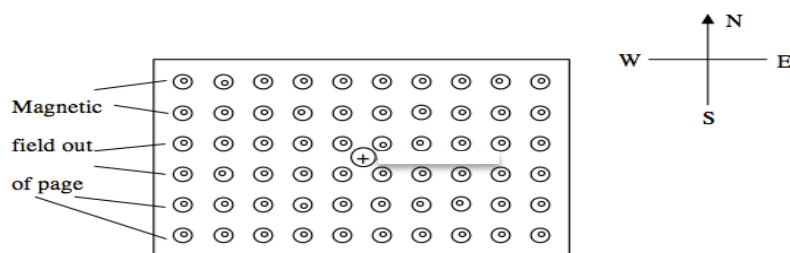


**QUESTION 23**

The magnetic field lines of a wire carrying uniform current is

- A. circular centered about the wire.
- B. rectangular centered about the wire.
- C. square centered about the wire.
- D. straight and parallel to the wire.
- E. straight and perpendicular to the wire.

**QUESTION 24**



A positively charged particle enters a region where the uniform magnetic field is directed out of page as shown in the diagram above.

If the particle is deflected eastwards, the particle is moving

- A. into page.
- B. south.
- C. north.
- D. east.
- E. west.

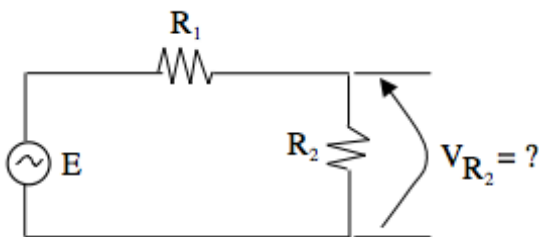
**QUESTION 25**

A power grid line having a resistance of  $2\Omega$  is to be used to transmit  $2000\text{W}$  of power. The power engineer has a choice of using current values from  $1\text{A} - 10\text{A}$ . For minimum power loss which current should be used to transmit power?

- A.  $10\text{A}$       B.  $1\text{A}$       C.  $2\text{A}$       D.  $5\text{A}$       E.  $7\text{A}$

**QUESTION 26**

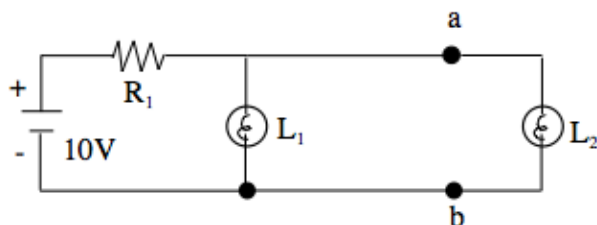
If you have the following circuit where the power supply is given as  $E = 20\sin(377t)$ . Determine the voltage drop across  $R_2$  if  $R_2 = \frac{1}{4}R_1$



- A.  $V_{R_2} = 10\sin(377t)$   
 B.  $V_{R_2} = 5\sin(377t)$   
 C.  $V_{R_2} = 15\sin(377t)$   
 D.  $V_{R_2} = 16\sin(377t)$   
 E.  $V_{R_2} = 4\sin(377t)$

**QUESTION 27**

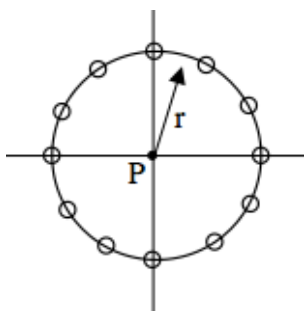
Given the following circuit; if ‘somehow’ a short circuit develops between points  $a$  and  $b$ , what would be the effect of this on the lamps  $L_1$  and  $L_2$ ?



- A. Only lamp  $L_2$  will go off  
 B. Only lamp  $L_1$  will go off  
 C. Lamp  $L_1$  will ‘blow’  
 D. Both lamps  $L_1$  and  $L_2$  will go off.  
 E. Lamp  $L_2$  will “blow”

**QUESTION 28**

Suppose we have a distribution of negative charges, distributed symmetrically in a circular arrangement, as shown as the magnitude of the each charge is  $q$ . What would be the electric field at point P (center of the circle)?

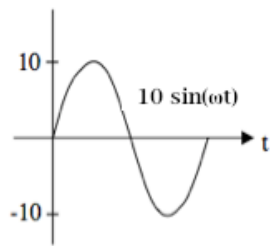
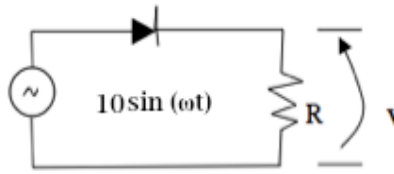


- A.  $E = \frac{k12q}{r^2}$   
 B.  $E = \frac{k16q}{r^2}$   
 C. zero  
 D.  $E = \frac{k12q}{2r^2}$   
 E.  $\infty$

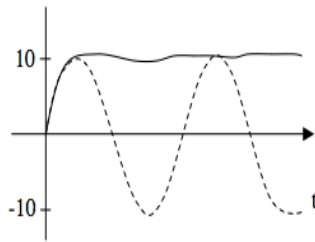


**QUESTION 29**

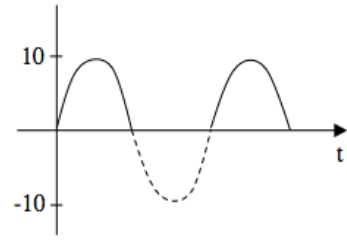
Given the following simple diode circuit, identify the wave form of the voltage drop across the resistor when the power supply is a sine waveform as given.



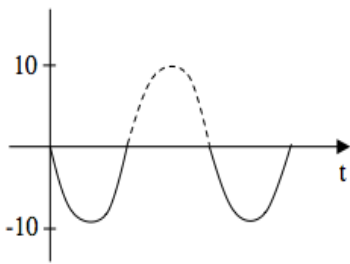
A.



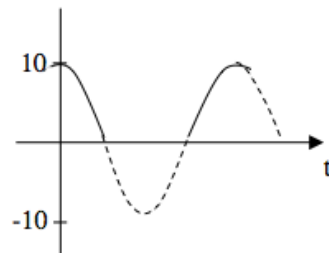
B.



C.



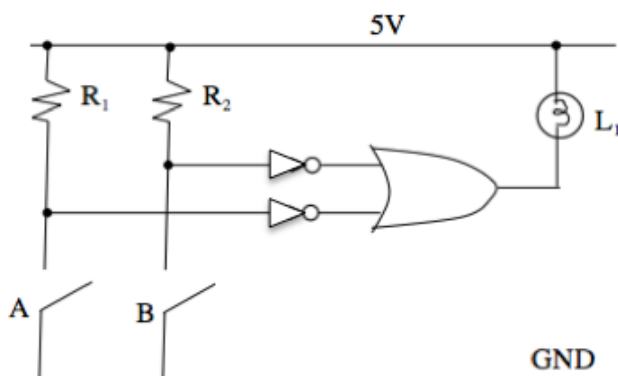
D.



E.

**QUESTION 30**

Given the circuit, determine the combination of position of switches A and B for the lamp  $L_1$  to be off.



- A. Switch A closed and Switch B open
- B. Switch B closed and Switch A open
- C. both switches A and B open
- D. both switches A and B closed
- E. Impossible to turn  $L_1$  off.

**PART B: SHORT ANSWERS**

**(QUESTIONS 31 to 40)**

**For each Question, work out the answers and write the answer in the space provided on the ANSWER BOOKLET.**

**QUESTION 31**

A ball is projected into the air with an initial velocity of 20m/s at angle of  $60^\circ$  above the horizontal. The ball lands at a distance of X meters from the launching point.

- a). What is the horizontal component of the velocity of the ball? (2 marks)
- b). How long was the ball in the air? (3 marks)
- c). What is the horizontal distance X travelled? (2 marks)

**QUESTION 32**



During a snooker competition, a 200 grams ball A moving with velocity  $V_A$  as show in the diagram above, collides head-on with an identical ball B that was at rest. After the collision, ball A remains at rest while ball B moves on with a velocity of 4m/s.

- a). With what speed was ball A moving before the collision? (1 marks)
- b). What is the momentum of the ball B after the collision? (2 marks)
- c). What is the momentum of ball A after the collision? (1mark)
- d). What are the directions of the forces exerted by balls on each other? (2marks)
- e). Which of the three laws of motion (Newton's Laws) is being applied in part a). above? (1 mark)

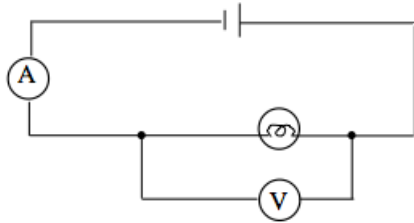
**QUESTION 33**

A boy can carry a 2kg box and walk one meter to the right. Then he raises it by 1m and places it on a shelf.

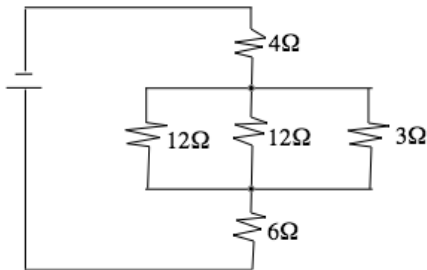
- a). Explain why the boy cannot do any work in carrying the box horizontally. (2 marks)
- b). Calculate the work the boy does in raising the box vertically and placing it on the shelf. (2 marks)
- c). If the boy takes one minute to raise the box vertically, what is the power used in raising the box? (2 marks)
- d). What form of energy does the box have as a result of being raised and placed on the shelf? (1mark)

**QUESTION 34**

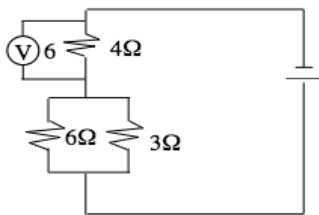
- a). Suppose a current of 3A flows for 60 seconds (1 minute) in a circuit containing a lamp. What is the amount of electric charge that flowed through the lamp? (1 mark)
- b). What current flows through a 240V, 60 watt lamp operating at the correct voltage? (1 mark)
- c). In the following circuit, what is the power of the lamp if the ammeter and voltmeter readings are 4A and 12V respectively? (1 mark)



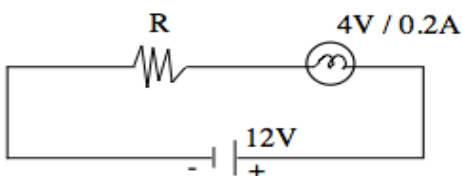
- d). Find the total resistance in the following circuit. (1 mark)



- e). In the circuit below the potential difference across the 4Ω resistor is 6V. What is the potential difference across the 3Ω resistor? (1 mark)



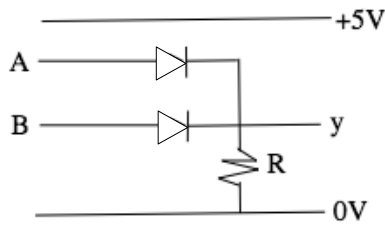
- f). The following circuit could be used to light a 4V bulb from a 12V battery supply.



- i). What should be the voltage drop across the resistor R so that the bulb operates at its normal rating? (1 mark)
- ii). What should be the resistance of R so that the bulb operates at its normal rating? (1 mark)

**QUESTION 35**

a). The following circuit with 2 diodes is given, where Y is the output when A and B are inputs that can be connected to +5V or 0V.



i). Obtain the truth table for the circuit when A and B are inputs that can be connected to +5V or to 0V.

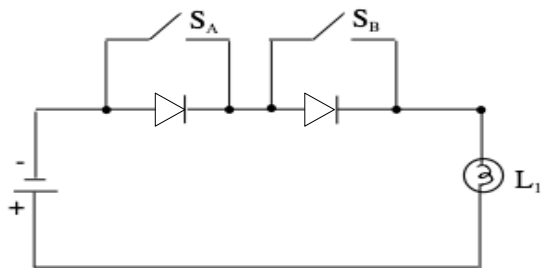
(1 mark)

ii). The behavior of this circuit is equivalent to which logic gate?

(1 mark)

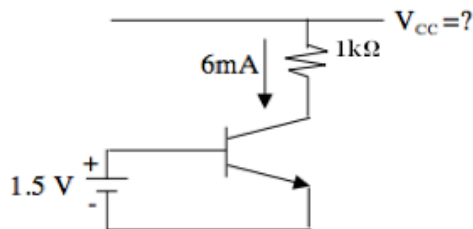
b). Obtain the truth table of the following circuit.

(1 mark)

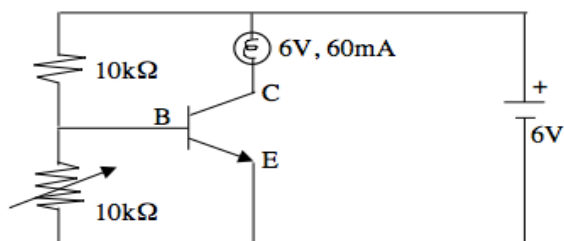


c). In the following circuit, when the transistor is ON with a current of 6mA flowing through it, what is the value of the power supply being used?

(1 mark)



d). In the following circuit,



i). What do the letters E, C, B stand for?

(1 mark)

ii). What is the effect of the variable resistor, (what is it for)?

(1 mark)

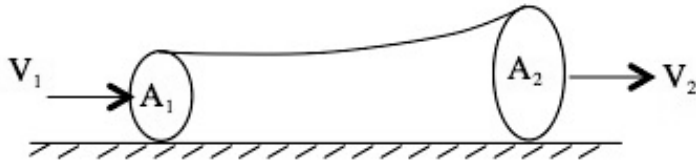
iii). What type of transistor is this?

(1 mark)

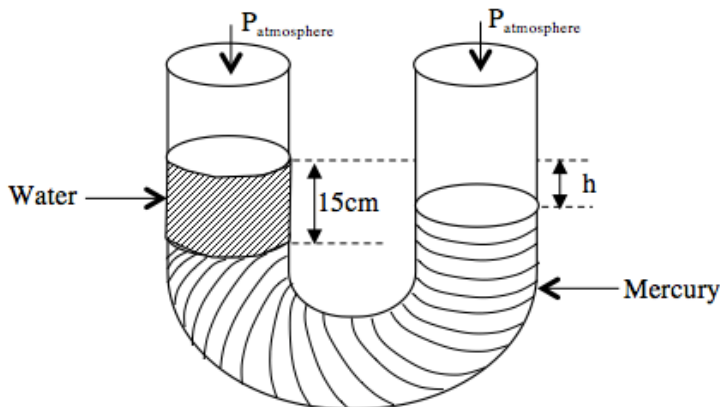
**QUESTION 36**

a). Water is flowing through a pipe of two circular cross- sections area  $A_1$  and  $A_2$  lying horizontally as shown in figure below. The pressure difference between the cross-section  $A_1$  and  $A_2$  is 7500 Pascals. If the velocity of the water through cross-section  $A_1$  is 3.25 m/s, what would be the velocity of the water through cross-section  $A_2$ ?

(3 marks)



b). A U shaped tube open to the air at both ends contains some mercury as shown in figure below. A quantity of water is carefully poured into the left arm of the U shaped tube until the vertical height of the column is 15 cm.



i). Calculate the gauge pressure. (2 marks)

ii). Is there any difference between the gauge pressure and the pressure at the surface of the mercury in the right hand arm? Explain. (2 marks)

**QUESTION 37**

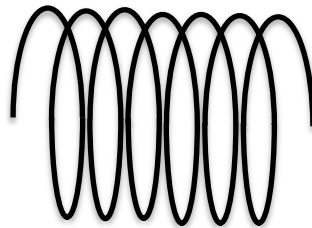
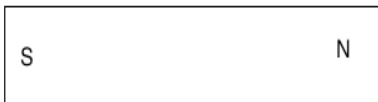
- How many changes in phase are involved in working out the total amount of heat required to raise the temperature of ice at  $-15^{\circ}\text{C}$  to steam at  $115^{\circ}\text{C}$ ? (1 mark)
- In a hot climate, the inhabitants often wear white coloured clothes. Explain why they do that? (1 mark)
- An electric boiler with power rating of 125 kW is used to completely evaporate water at a temperature of  $100^{\circ}\text{C}$  in 2 minutes. If the initial temperature of water is  $20^{\circ}\text{C}$ , how much in kilograms is the mass of the water? (3 marks)
- Explain the difference between heat and temperature. (1 mark)
- You bought two cooking pots with same masses and volumes. One is made of copper which has a specific heat capacity of  $400\text{J/kg}^{\circ}\text{C}$  and the other is made of aluminum whose specific heat capacity is  $900\text{J/kg}^{\circ}\text{C}$ . If the same amount of heat is applied to both cooking pots with equal amount of rice and water in them, in which of the pots will rice cook faster? (1 mark)

**QUESTION 38**

- a) The speed of a wave propagating is 330 m/s in air at 0°C. If the frequency is 440 Hz, what is its wavelength? (1 mark)
- b) A ship sends out a sound wave and receives an echo after 1 second. If the velocity of the sound in water is 1500 m/s, determine how deep is the water. (1 mark)
- c) All AM radio stations are assigned frequencies in the range between 550 and 1600 Hz. The speed of propagation of radio waves is  $3 \times 10^8$  m/s. What wavelengths do these radio waves span? (2 marks)
- d) Waves in a deep region of a ripple tank have a velocity of 6 cm/s and wavelength of 4 cm. They pass into a shallow region where their speed is 4 cm/s.
- i). Calculate the wavelength of the wave in the shallow region. (1 mark)
- ii). Calculate the frequency of the waves in the deep region. (1 mark)
- iii). Calculate the frequency of the waves in the shallow region (1 mark)

**QUESTION 39**

- a). Explain the term Mutual Induction. (1 mark)
- b). In a laboratory demonstration, a bar magnet is moved relative to a fixed circular coil (approaching the coil) having several turns.



Coil

Draw the direction of the current in the coil (clockwise or counterclockwise), when

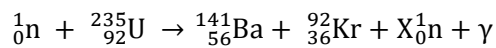
- i). When North pole of the magnet is moved towards the coil. (1 mark)
- ii). The North pole of the magnet is moved away from the coil, after being moved towards the coil. (1 mark)
- iii). Explain your choices of directions in i) and ii) above. (4 marks)

**QUESTION 40**

a). An isotope of an element is a nuclide with same atomic number and different mass number. The table below shows isotopes of hydrogen nuclide. Study the table and give the value of X and Y. (2 marks)

Isotope	${}^1_1\text{H}$	${}^2_1\text{H}$	${}^3_1\text{H}$
Number of electrons	1	1	1
Number of protons	1	1	1
Number of neutrons	X	1	Y

b). The equation below is a fission reaction in a nuclear reactor.



What is the value of X in the equation above? (1 mark)

c). In a nuclear reactor, what particles are produced? (1 mark)

d). In a nuclear reactor, the reaction keeps repeating itself and a chain reaction occurs. The minimum amount of uranium for the reaction to occur is called? (1 mark).

e). In a nuclear reactor, which part of the reactor slows down the neutrons to the correct speed for the fission process to occur? (1 mark)

f). In a nuclear reactor, which part absorbs neutrons to slow or stop the chain reaction? (1 mark)

**END OF EXAMINATION**

# PHYSICS - 2015

## PART B – Answer Booklet

Write your name, province and school codes and your candidate number correctly and clearly in the space provided below.

Year		Province		School			Candidate No		
<b>1</b>	<b>5</b>								

Candidate Name: \_\_\_\_\_

School Name: \_\_\_\_\_

Answers written on the QUESTION paper or any other paper will NOT be marked.

Write answers neatly in the spaces provided in this answer booklet

\*\*\*\*\*

### FOR MARKERS USE ONLY

	Score	Markers' Initials	
		Marker 1	Marker 2
<b>PART B</b>			
QUESTION 31			
QUESTION 32			
QUESTION 33			
QUESTION 34			
QUESTION 35			
QUESTION 36			
QUESTION 37			
QUESTION 38			
QUESTION 39			
QUESTION 40			
<b>FINAL TOTAL</b>	<b>70</b>		

START YOUR WORK ON THE NEXT PAGE





QUESTION 32	Mark/Q	Marker 1	Marker 2
(a). _____	1		
(b). _____	2		
(c). _____	1		
(d). _____	2		
(e). _____	1		
For Markers Use Only	<b>Q 32 Total</b>		



<b>QUESTION 34</b>	<b>Mark/Q</b>	<b>Marker 1</b>	<b>Marker 2</b>
a).  <hr/>	1		
b).  <hr/>	1		
c).  <hr/>	1		
d).  <hr/>	1		
e).  <hr/>	1		
f). i.  <hr/>	1		
ii.  <hr/>	1		
<b>For Markers Use Only</b>	<b>Q 34 Total</b>		

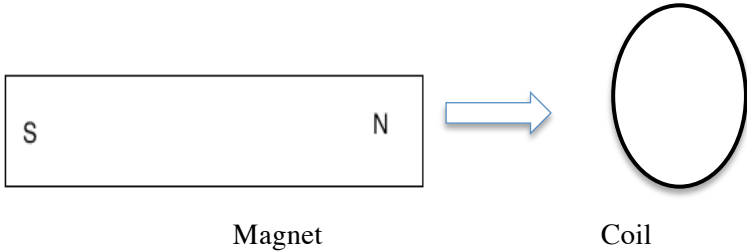
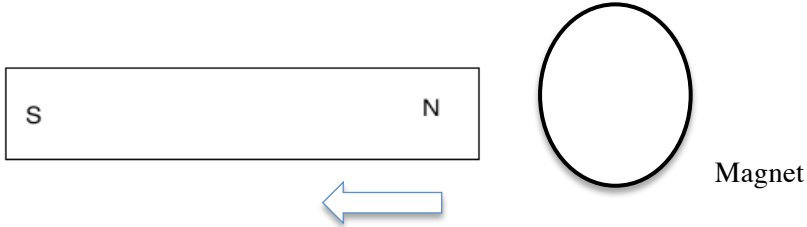
QUESTION 35	Mark/Q	Marker 1	Marker 2
(a) i.	1		
ii. _____	1		
(b).	1		
(c).	1		
_____	1		
(d) i. _____ _____ _____	1		
ii. _____ _____	1		
iii. _____	1		
For Markers Use Only	<b>Q 35 Total</b>		



QUESTION 37	Mark/Q	Marker 1	Marker 2
(a). _____ _____ _____	1		
(b). _____ _____ _____	1		
(c) _____	3		
(d) _____ _____ _____ _____	1		
(e). _____	1		
For Markers Use Only	<b>Q 37 Total</b>		

QUESTION 38	Mark/Q	Marker 1	Marker 2
(a).			
(b).	1		
(c).	1		
(d).	2		
i.	1		
ii.	1		
iii.	1		
	1		
For Markers Use Only	<b>Q 38 Total</b>		



QUESTION 39	Mark/Q	Marker 1	Marker 2
(a). _____ _____ _____ _____	1		
(b). i  <p style="text-align: center;">Magnet                      Coil</p>	1		
ii.  <p style="text-align: center;">Magnet</p>	1		
iii. _____ _____ _____ _____ _____	4		
For Markers Use Only	<b>Q 39 Total</b>		

QUESTION 40	Mark/Q	Marker 1	Marker 2
(a). X: _____ Y : _____	1 1		
(b). X: _____	1		
(c). _____	1		
(d). _____	1		
(e). _____	1		
(f). _____	1		
For Markers Use Only	<b>Q 40 Total</b>		

UPPER SECONDARY SCHOOL CERTIFICATION EXAMINATION

PHYSICS DATA SHEET

CONSTANTS

Acceleration due to gravity ( $g$ ) =  $10\text{ms}^{-2} = 10\text{N kg}^{-1}$   
 $c = 3.0 \times 10^8 \text{ms}^{-1}$ ,  $\mu_0 = 4\pi \times 10^{-7}\text{Tm/A}$   
 Decay constant ( $\lambda$ ) =  $0.6931 \div$  half-life in seconds

FORMULA

$P = \frac{F}{A}$	$P = hPg$	$\rho = \frac{m}{v}$	$v_{av} = \frac{s}{t}$
$a = \frac{v - u}{t}$	$v^2 = u^2 + 2as$	$s = ut + \frac{1}{2}at^2$	$F = ma$
$W = Fs$	$E_p = mgh$	$E_k = \frac{1}{2}mv^2$	$P = \frac{W}{t}$
$v = f\lambda$	$T = \frac{1}{f}$	$n = \frac{\sin \hat{i}}{\sin \hat{r}}$	$n = \frac{1}{\sin \hat{c}}$
$E = mc^2$	$V = IR$	$P = IV$	$E = IVt$
$R = R_1 + R_2 \dots$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$Q = It$	$V = \frac{E}{Q}$
$V_s I_s = V_p I_p$	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	$Q = mc\Delta T$	$Q = mL$
$p = mv$	$F = \frac{kQ_1 Q_2}{d^2}$	$F = BIl \sin \theta$	$F = nBIl \sin \theta$
Surface Tension $\gamma = \frac{F}{L}$	$\Delta L = \alpha L_0 \Delta T$	$T_f = \frac{9}{5}T_c + 32^\circ$	$B_p = \frac{\mu_0 i}{2\pi r}$
$\Delta V = \beta V_0 \Delta T$	$T_c = T - 273.15^\circ$	Bernoulli's Equation $\rho_1 + \rho g h_1 + \frac{1}{2} \rho v_1^2 = \rho_2 + \rho g h_2 + \frac{1}{2} \rho v_2^2$	
Efficiency = $\frac{\text{work output}}{\text{work input}} \times 100$		Specific Heat Capacity of Water = $4200 \text{ J/kg} \cdot ^\circ\text{C}$ Ice $L_f = 340.0 \frac{\text{J}}{\text{g}} = 3.4 \times 10^5 \text{ J/kg}$ Steam $L_v = 2.3 \times 10^6 \text{ J/kg}$	

Unless otherwise stated, the direction of current in electric circuits must be treated from positive terminal to negative terminal (conventional direction of current).