DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

PHYSICS

Wednesday

19 October 2011

Time allowed:

2 hours and 30 minutes

(8:00 am – 10:30 am)

NO EXTRA TIME

(NO OTHER TIME)

Candidates are advised to fully utilise the allocated time

INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates

1. The subject code for **Physics** is **7**
2. There are **16** printed pages in the question booklet and **8 printed** pages in the answer booklet. The formula sheet is in page 8 of the question booklet.
3. There are two sections in this paper. Answer all questions.

   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 Section 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 your10 digit candidate number on the Section B Answer Sheet Provided.
4. You are required to only write the correct answer in the space provided.
5. Calculators may be used.
6. Answers written on the question paper will not be marked. Write answers neatly in spaces as allocated on the answer sheet. Answer **ALL** questions.
7. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper **will not be marked**
8. ALL working must be shown step by step to get full marks. Students may lose marks for writing down final answers only.
9. 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.
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.

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

P

DO NOT TURN OVER THE PAGE

AND DO NOT WRITE

UNTIL YOU ARE TOLD TO START.

SECTION A: MULTIPLE CHOICE (QUESTIONS 1 to 30) 1 MARK EACH

Answer each question by shading in with HB pencil, the circle directly under the correct alternative A, B, C, D or E.

If you make a mistake, rub it out completely using an eraser rubber and shade the correct answer on the Electronic Answer Sheet.

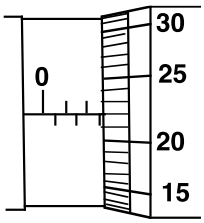
QUESTION 1

Convert 5.3 km into metres (m). Which of the following correctly gives the answer in metres?

A. 53 B. 530 C. 5300 D. 53 000 E. 530 000

QUESTION 2

A micrometer is used to measure the length of a specimen. Which of the following gives the correct reading in millimeters (mm) as shown in the figure below.



A. 1.522 B. 1.750 C. 2.500

D. 2.520 E. 2.522

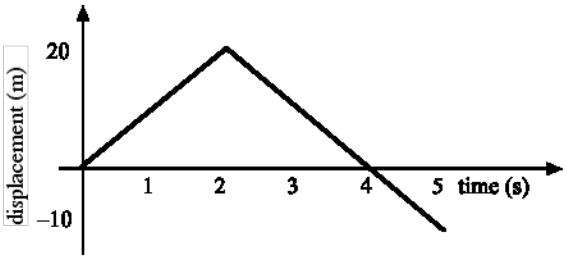
QUESTION 3

Which of the following correctly gives dimensions of force?

A. $M.L.T^{-2}$ B. $M.L.T^{-1}$ C. $M.L^{2}.T^{-2}$ D. $M.L^{-1}.T^{-1}$ E. $M.L^{-2}.T^{-2}$

QUESTION 4

The following diagram shows a displacement-time graph for a particle moving in a straight line. The average velocity for the interval from t=0 to t=5 is



A. 0 B. 6 m/s C. -2 m/s D. 2 m/s E. –4 m/s

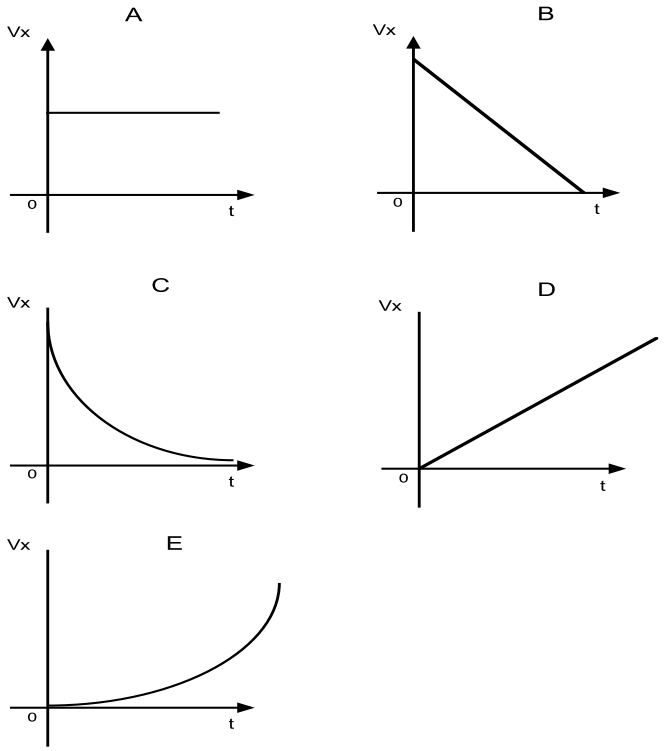
QUESTION 5

A particle moving in a straight line with a constant acceleration of 3 m/s^2 has an initial velocity of –1 m/s. Its velocity 2 seconds later is

A. -7 m/s B. 0 C. 4 m/s D. 5 m/s E. 6 m/s

QUESTION 6

If the acceleration of a particle in the x- direction is increasing with time, which of the following v_x- t graph best represent this information.



QUESTION 7

A particle of mass 5 kg is pulled along a smooth horizontal surface by a horizontal string. The acceleration of the particle is 10 m/s^2. The tension in the string is

A. 2 N B. 5 N C. 10 N D. 15N E. 50 N

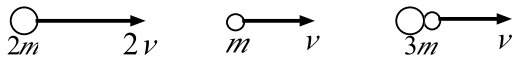
QUESTION 8

A ball of mass 0.4 kg hits a wall at right angles with a speed of 12 m/s and bounces off again at right angles to the wall with a speed of 8 m/s. The impulse exerted by the wall on the ball is

A. 1.2 Ns B. 1.4 Ns C. 1.6 Ns D. 1.8 Ns E. 2.0 Ns

QUESTION 9

Two masses collide and stick together after collision as shown in the following figure. What is the speed of the combined mass just after impact?



A. 3v B. v C. $\frac{5}{3}$v D. $\frac{3}{2}$v E. $\frac{3}{5}$v

QUESTION 10

A car is moving with a constant speed of 20 m/s against a resistance of 100 N. The power exerted by the car is

A. 5 W B. 200 W C. 1 kW D. 2 kW E. 20 kW.

QUESTION 11

Suppose you have the following situation where a block of mass, **m** is moved up an inclined plane a vertical distance, **s**. The work done against gravity is

A. mh B. mgh C. ms^2g D. mgs E. gh

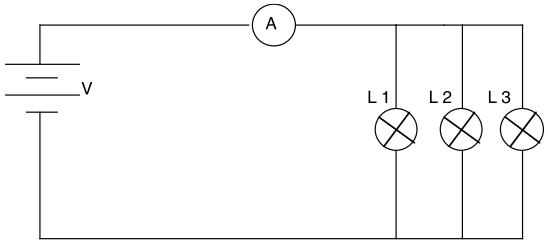
QUESTION 12

A particle falls freely from rest through a distance d. Its speed is then;

A. $\sqrt{gd}$ B. $-\sqrt{2gd}$ C. $-\sqrt{\frac{1}{2}gd}$ D. $\sqrt{2gd}$ E. $\sqrt{\frac{1}{2}gd}$

QUESTION 13

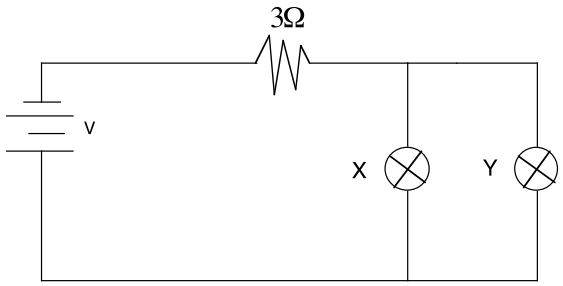
The following diagram shows three identical light bulbs connected to a d.c source. Each bulb operates at normal brightness and the ammeter registers a steady current. Then suddenly the filament of one of the bulb breaks. What happens to the ammeter reading and to the brightness of the two remaining bulbs?



	Ammeter reading	Brightness
A	Increases	Increases
B	Increases	Unchanged
C	Unchanged	Unchanged
D	Decreases	Unchanged
E	Decreases	Decreases

For Questions 14 and 15, refer to the information below.

In the following circuit, the two lamps X and Y are operated at their rated voltage and power. If lamp X is rated 6V, 12W and lamp Y is rated 6V, 24W.



QUESTION 14

What is the current through the 3Ω resistor?

A. 9A B. 6A C. 3A D. $\frac{1}{3}A$ E. $\frac{1}{6}A$

QUESTION 15

What is the potential difference, V across the battery?

A. 24V B. 18V C. 12V D. 9V E. 6V

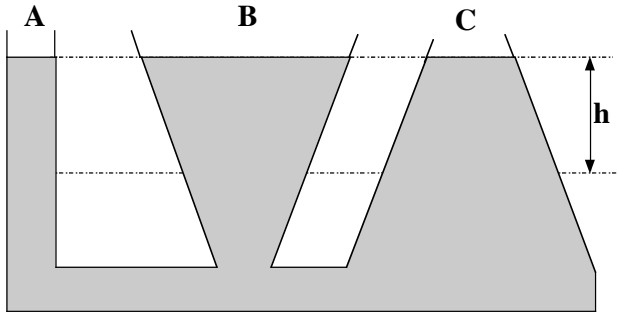
QUESTION 16

If the voltage provided by PNG Power to the houses is 240 (V_{rms} = 240V), then the voltage peak is given by

A. 360V B. 350V C. 339.4V D. 249.0V E. 169.71V

For Question 17, refer to the information below.

Consider three vessels; A, B and C in the figure below of different shapes. They are connected at the bottom by a horizontal pipe.

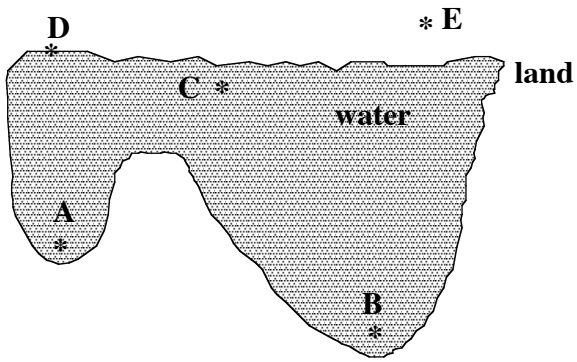


QUESTION 17

Which of the following statements about the liquid pressure at a depth, **h** in the three vessels is true? The liquid pressure in

A. vessel B is twice that in vessel A and three times that in C
B. all three vessels A, B and C is the same
C. vessel A and B are the same and one- half that of C
D. vessel A is one- half that in vessel B and twice smaller than vessel C
E. vessel C is three times that in vessels A and B

For Question 18, refer to the diagram below.



QUESTION 18

At which point, indicated with letters, would the total pressure be the highest?

QUESTION 19

A stone of mass 0.165 kg and relative density 2.22 is gently lowered into a vessel full of water whose density is 1000 kg/m^3. Which of the following gives the correct value of the density in kg/m^3 of the stone?

A. 2.22×10^1 B. 2.22×10^2 C. 2.22×10^3 D. 2.22×10^4 E. 2.22×10^5

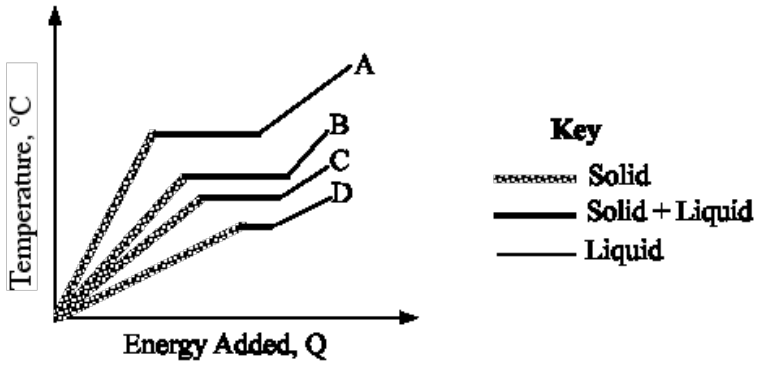
QUESTION 20

A piece of copper is dropped into a beaker of water. If the water temperature rises, what happens to the temperature of copper?

A. Stays the same B. Increases C. Decreases D. Impossible to tell

For Questions 21 and 22, refer to the graph below to answer the questions.

The graph shows the Temperature vs Energy Added for various materials; A B, C and D. The materials have the same mass, warmed in identical conditions and they change phase from solid to liquid.



QUESTION 21

Which material has the highest specific heat capacity as a solid?

QUESTION 22

Which material has the highest latent heat of fusion?

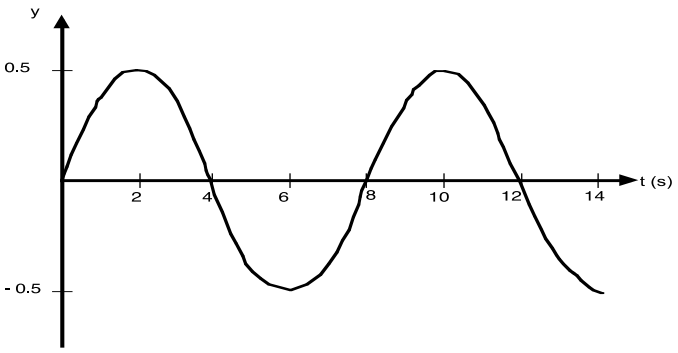
QUESTION 23

Which of the waves below requires a medium to propagate?

A. x- rays B. sound waves C. light waves D. radio waves E. gamma rays

QUESTION 24

What is the frequency of the wave below?



A. 8 s B. 0.0125 Hz C. 0.5 Hz D. 0.012 s E. 8 hz

QUESTION 25

When light propagates from high refractive index material to a low refractive index material, part of the light is transmitted and part of it is reflected. Which of the statements below is true about light that transmits into the second medium.

A. $\theta_t = \theta_i$ B. $\theta_t > \theta_i$

C. $\theta_t < \theta_i$ D. Relationship between θ_t and θ_i does not depend on "n".

QUESTION 26

A long current- carrying wire generates a magnetic field, B. To double the field, 2B, the current should be

A. quadrupled B. doubled C. halved D. cubed

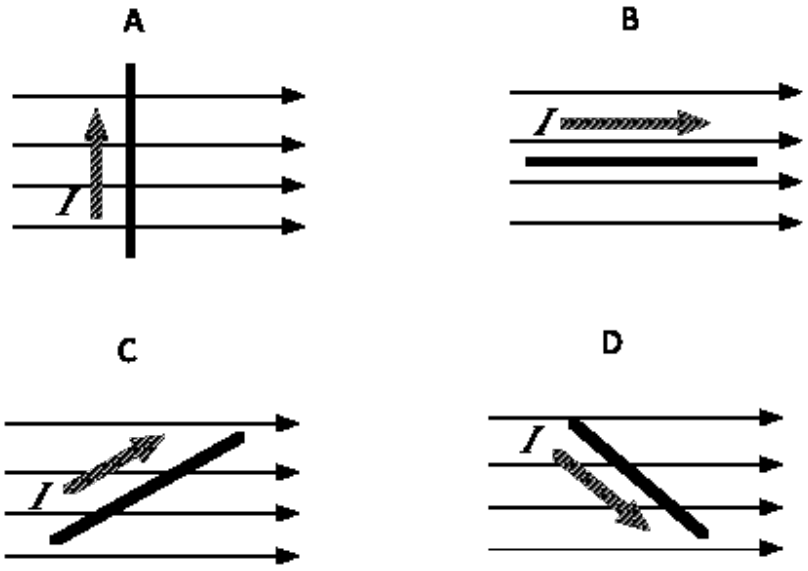
QUESTION 27

A transformer works by field generated from current- carrying primary coil inducing an emf (hence current) in secondary coil. Why does a transformer not work with direct current (d.c) in primary coil?

A. The magnetic field created is weak
B. The magnetic field created is not time- varying
C. Direct current does not generate magnetic field
D. Direct current damages the coils

QUESTION 28

In which of the cases below would you expect the force exerted on the conductor to be the weakest. (Lines with arrow represent magnetic field lines and the thick line represents the current- carrying conductor)



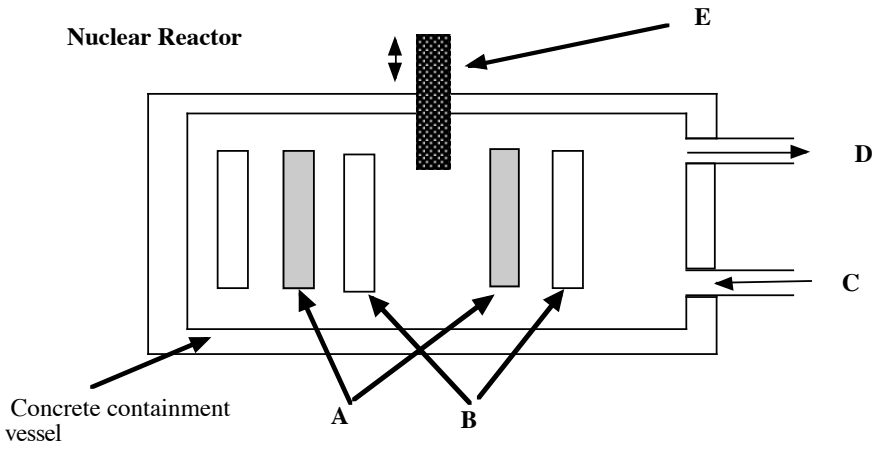
QUESTION 29

Nuclei of radioactive elements with the same atomic number and different mass number is called

A. fission B. fusion C. isotopes D. decay E. collision

For Question 30, refer to the diagram below.

The diagram below shows the core components of a nuclear reactor where a controlled fission reaction took place.



QUESTION 30

Which of the parts, indicated with letters, is the core?

SECTION B (QUESTIONS 31 to 40)

Write your answer to the questions in the spaces provided in your answer booklet.

QUESTION 31

a) The length of two rods were measured and their lengths were recorded as;

Length 1 = 2.000 ± 0.0001 m Length 2 = 0.100 ± 0.0001 m

If the two lengths are added together, what is their sum including the absolute error? (2 marks)

b) How many significant figures are there in the measurement below? (2 marks)

i) 36.00 s ii) 0.00315 s

c) "All measurements are 100% accurate". Is this statement True or False? (1 mark)

d) A motorcycle is traveling at a speed of 10 km/h along a straight road. Express the speed in m/s. (2 marks)

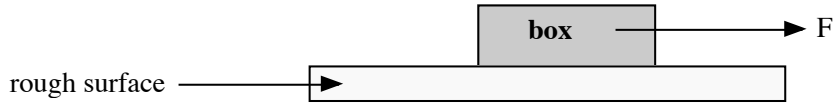
QUESTION 32

A cyclist starting from a point A travels 200 m due North to point B at a constant speed of 5 m/s. He rests at B for 30 seconds and then travels 300 m due South to point C at a constant speed of 10 m/s.

i) Draw a displacement versus time graph of the journey (2 marks)
ii) Determine the time taken for the whole journey (1 mark)
iii) Calculate the average speed of the journey (1 mark)
iv) Determine the increase in displacement from point A after 100 seconds. (1 mark)
v) Calculate the average velocity of the whole journey. (1 mark)
vi) How can you determine graphically from your displacement-time graph, the average velocity for the journey? (1 mark)

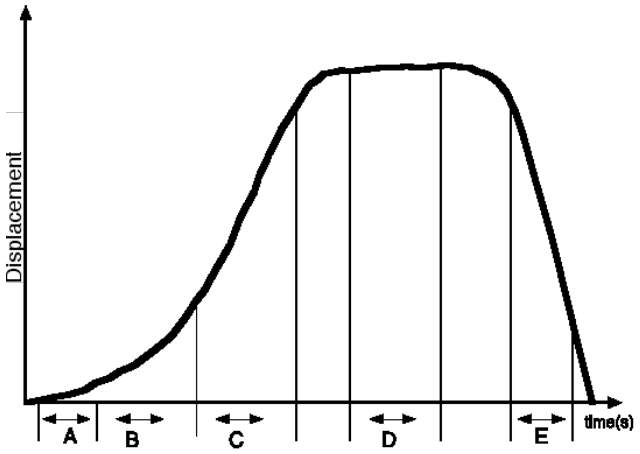
QUESTION 33

a) A box is being dragged across a rough surface by an applied force, F as shown. The other forces acting on the box are not shown.



Ignoring air resistance, how many forces are there altogether acting on the box? (1 mark)

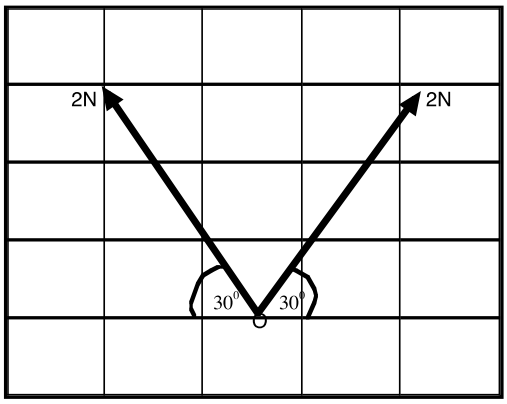
b) The graph below represents the change in displacement with time for a vehicle moving along a straight line.



During which time interval does the acceleration of the vehicle have its greatest numerical value? (1 mark)

c) A person is standing on a log floating in a pond. He notices that when he tries to move forwards, the log moves backwards. Explain why the log will move backward when the person moves forward. (1 mark)

d) Two forces act at a point, O as shown in the diagram.



i) On the diagram (*refer to answer sheet*) sketch and label the resultant of the two forces. (1 mark)
ii) What is the magnitude of the resultant force? (1 mark)

e) Suppose a bullet of mass 0.04 kg is moving with a speed of 90 m/s hits and enters a heavy wooden block and stops after a distance of 60 cm. What is the average resistive force exerted by the block on the bullet? (2 marks)

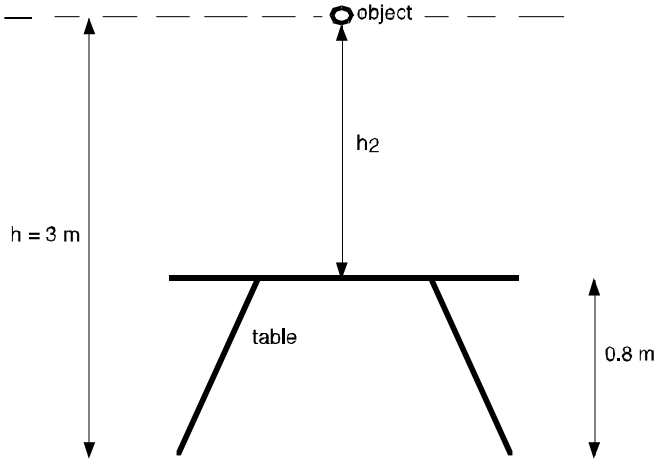
QUESTION 34

a) If the engine of a car is working at constant power, the acceleration of the car must be constant. Is this statement True or False? (1 mark)

b) A train covers a distance of 20 m in two seconds at a constant speed, with the engine exerting a driving force of 2000N. The engine is working at the rate of 20 kW. Is this statement True or False? (1 mark)

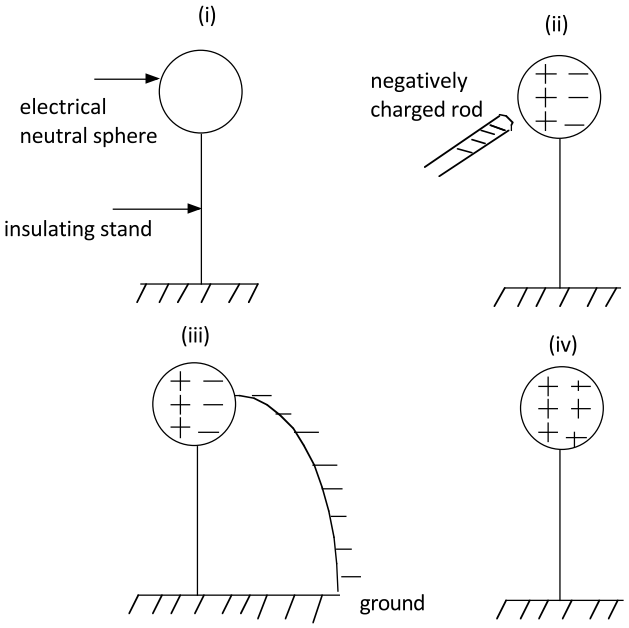
c) Suppose a man lifts 20 boxes each of mass 15 kg to a height of 1.5 m. Determine the work done by the man against gravity. (3 marks)

d) An object of mass 2 kg is held 3 m above the floor of a room. Find the potential energy (PE) of the object relative to a table of height 0.8 m (as shown) and the PE relative to the ground. (2 marks)



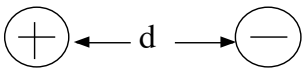
QUESTION 35

a) Identify which method of charging process is illustrated by the following 4 graphical steps? (2 marks)

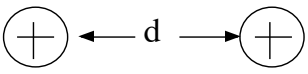


b) For the two cases below, draw the electric field lines when a pair of electric charges interact (*refer to answer sheet*). (d=distance). (2 marks)

(i)

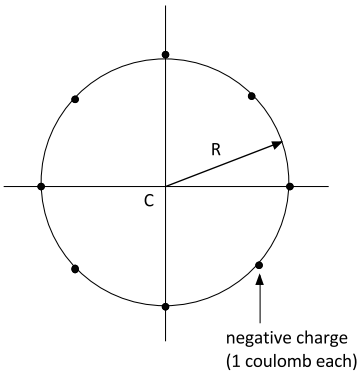


(ii)

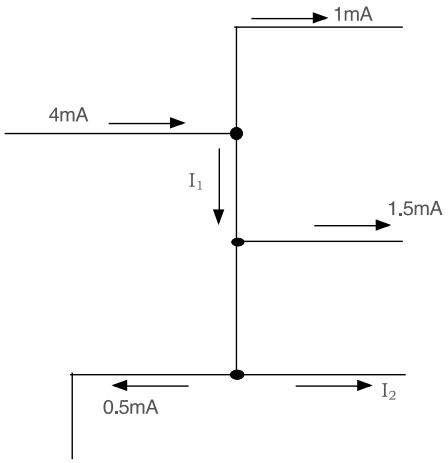


c) Given the following symmetrical distribution of 8 negative charges (charges are 1 Coulomb each). What is the electric field at C? (1 mark)

R= 5 cm

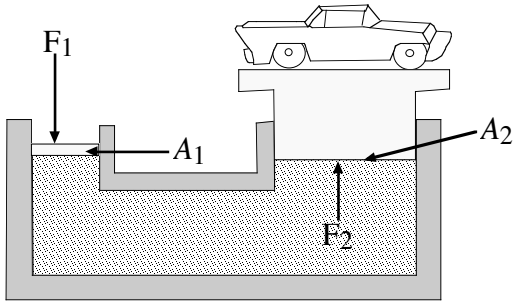


d) Given the following electric circuit "paths" for current to flow, determine the current in paths 1 and 2 (I_1 & I_2). (2 marks)



QUESTION 36

a) In a car lift, compressed air exerts a force, F_1 on a small piston having a radius of 5.0 cm. This pressure is transmitted to a second piston of radius 15 cm as shown in the figure below. The mass of the car is 1350 kg. Acceleration due to gravity g= $10ms^{-2}$



i) Calculate the force on the smaller piston F_1. (2 marks)

ii) What is the required pressure if the force of 1500N is applied on the smaller piston. (2 marks)

b) A cylindrical swimming pool has a radius 2 m and depth 1.3 m. It is filled completely with salt water of specific gravity 1.03. The atmospheric pressure is 1.013×10^5 Pa.

i) Calculate the density of salt water (1 mark)

ii) Calculate the pressure at the bottom of the pool given that the density of salt water is 1.01×10^3 kg/m^3. Given that g= $10ms^{-2}$. (2 marks)

QUESTION 37

a) The temperature of a silver bar rises by 10.0 °C when it absorbs 1.23 kJ of heat. The mass of the bar is 525 g. Determine the specific heat capacity of silver. (2 marks)

b) A metal rod is 40.125 m long at 20°C and 40.148 m long at 45°C. Calculate the average linear expansion coefficient in this temperature range. (2 marks)

c) Complete the following table by converting appropriate temperature scale. (3 marks)

For Water			
Scale	Absolute zero	Freezing point	Boiling point
Celcius °C		0 °C	
Kelvin K	0 K		373 K

QUESTION 38

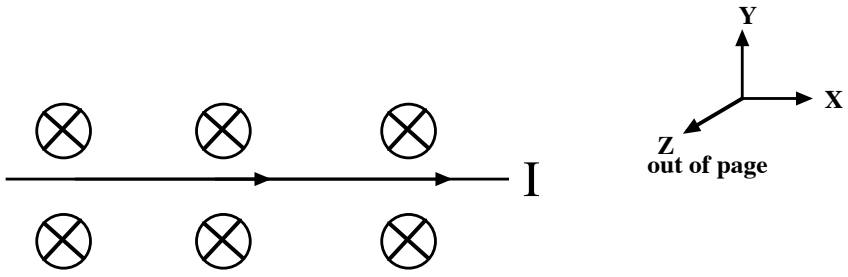
a) For a certain transverse wave, the distance between two successive crests is 1.0 m and eight crests pass a given point along the direction of travel every 10.0 s. Calculate the wave speed. (2 marks)

b) Light propagates through the boundary between air ($n_{air} = 1$) and glass ($n_{glass} = 1.5$) with an angle of incidence of 30° in air. Calculate the angle of refraction or transmission in glass. (2marks)

c) A sinusoidal wave is traveling along a rope. The oscillator that generates the wave completes 40 vibrations in 30.0 s. Also, a given maximum point travels 400 cm along the rope in 10.0 s. What is the wavelength? (3 marks)

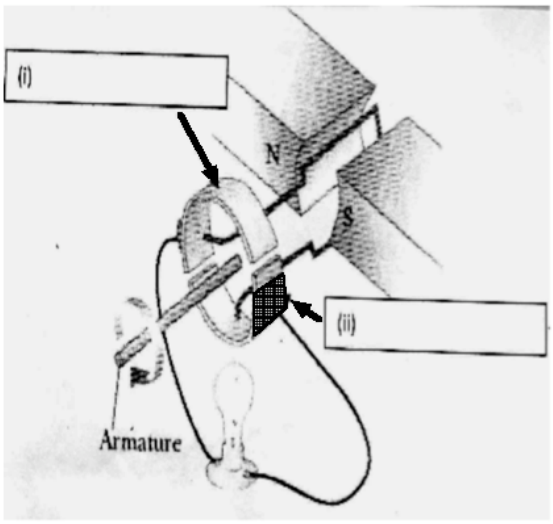
QUESTION 39

a) Indicate the direction of the force exerted on the current-carrying conductor below. The magnetic field is uniform around the wire with direction into this page (cross in circle represent field lines into the page). (1 mark)



b) The magnetic field is 2 x 10^{-3} Tesla at a distance 2 mm (0.002 m) away from the source (long current-carrying wire). What is the current through the wire? (2 marks)

c) Identify the parts (i) and (ii) in the DC generator below. (2 marks)



QUESTION 40

Read the article below which is based on recent Fukushima- Dai Lchi Nuclear disaster in Japan which occurred in March 2011

What is a Nuclear Meltdown?

Japanese officials and nuclear experts have said they cannot rule out the possibility of a nuclear meltdown at a Japanese nuclear power plant that was badly damaged by last week's earthquake and tsunami. Here is a quick guide to the nuclear process, what can go wrong, and how to prevent catastrophe.

Nuclear power is produced by harnessing the heat produced by the splitting of atoms inside uranium- a process known as fission. Rods packed with uranium are submerged into water, and the heat produced by the nuclear reaction creates steam, which is used to power turbines that produce electricity.

The nuclear reaction can be controlled utilizing rods made of neutron-absorbing material, such as boron, essentially shutting down the fission process. But the rods still produce heat, even when control rods are in place, requiring a cooling system to maintain temperatures.

When the cooling system failed at Japan's Fukushima Dai-lchi reactor Number 2, the fuel rods boiled through the available water and were for a period of hours exposed to the air. If the rods get too hot, they can eventually melt, thus the term "meltdown".

In the event of a complete meltdown, the still-burning hot nuclear fuel could drip to the floor of the reactor. If the containment structure around the reactor is not strong enough, the fuel potentially could be exposed to the outside environment, and can have devastating consequences for nearby communities.

The world's worst nuclear power disaster was in Chernobyl, Ukraine in 1986. After an explosion at the plant, a cloud of radioactive dust spread for hundred of kilometers and was blamed for a surge of cancer deaths and birth defects. It has left some nearby towns uninhabitable to this day.

People also can be exposed to radiation poisoning through contaminated food and water. A recent U.N. study estimates the Chernobyl disaster caused 6,000 cases of thyroid cancer in children, largely through contaminated milk.

Workers at the Fukushima plant are pumping sea water, treated with boron, to try to cool the overheating reactor cores. This process, if successful, will completely shut down and destroy the reactor.

After the reactors are brought under control, nuclear technicians will either have to remove the spent fuel, or try to bury the remnants in a concrete "sarcophagus" that will prevent the excess radiation from leaking out, until they can be safely removed.

Answer the following questions which are entirely based on the article.

a) Nuclear Power is produced by harnessing the heat produced by splitting atoms inside Uranium. This process is called_____. (1 mark)
b) If the rods packed with Uranium get too hot, they can eventually melt. This is called_____. (1 mark)
c) Name the three devastating consequences of radiation exposed to outside environment mentioned in this article. (3 marks)
d) What is the best method described in this article for preventing radiation from leaking? (1 mark)
e) The end result of a nuclear process is energy in the form of _____. (1 mark)

END OF EXAMINATION

HIGHER SCHOOL CERTIFICATE EXAMINATIONS

PHYSICS DATA SHEET

CONSTANTS		
Acceleration due to gravity (g) = 10 m s^{-2} = 10 N kg^{-1} c = 3·0 x 10^8 m s^{-1} , $\mu_o = 4\pi$ x 10^{-7} Decay constant $(\lambda) = 0.63 \div$ half-life in seconds		
FORMULAE		
$P = \frac{F}{A}$	$P = hDg$	$D = \frac{m}{V}$
$v_{av} = \frac{s}{t}$	$a = \frac{v - u}{t}$	$v^2 = u^2 + 2as$
$s = ut + \frac{1}{2}at^2$	$F = ma$	$W = Fs$
$E_p = mgh$	$E_k = \frac{1}{2}mv^2$	$P = \frac{W}{t}$
$v = f\lambda$	$T = \frac{1}{f}$	$n = \frac{\sin \hat{i}}{\sin \hat{r}}$
$n = \frac{1}{\sin \hat{c}}$	$E = mc^2$	$V = IR$
$P = IV$	$E = IVt$	$R = R_1 + R_2 + \ldots.$
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots.$	$Q = It$	$V = \frac{E}{Q}$
$V_s I_s = V_p I_p$	$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	$Q = mc\Delta T$
$Q = mL$	$p = mv$	
Efficiency = $\frac{\text{work output}}{\text{work input}} \times 100$		

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

PHYSICS — 2011

SECTION B - ANSWER BOOKLET

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

Year		Province		School			Candidate No		
1	1								

Candidate Name: _____

School Name: _____

Answers written on the QUESTION paper or any other paper will NOT be marked. Write answers in the spaces as provided on this answer booklet.

FOR MARKERS USE ONLY

	Score	Markers Initials	
		M1	**M2**
Section A:Total			
Section B:			
Question 31			
Question 32			
Question 33			
Question 34			
Question 35			
Question 36			
Question 37			
Question 38			
Question 39			
Question 40			
FINAL TOTAL			

SECTION B - S NSWERS

Write your answer in the space provided below. Your answers must be clear and precise.

QUESTION 31

a). _____	2
a) (i) _____	2
(ii)_____	
b) _____	1
c) _____	2
_____	
_____	
For Markers Use Only **Q31 Total**	

QUESTION 32

(i).	2
(ii). _____ _____ _____	1
(iii). _____ _____ _____	1
iv). _____ _____ _____	1
v). _____ _____ _____	1
vi) _____ _____ _____	1
For Markers Use Only **Q32 Total**	

QUESTION 33

a). _____ 1

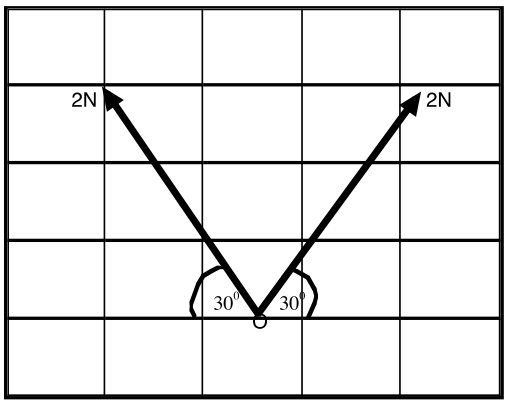
b). _____ 1

c). _____ 1

_____

_____

d). (i) 1



(ii) _____ 1

e). _____

_____ 2

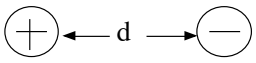
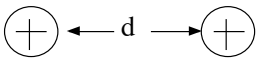
_____

For Markers Use Only **Q33 Total**

QUESTION 34

a). _____	1
b) _____	1
c). _____ _____ _____	3
d). _____ _____ _____	2
For Markers Use Only **Q34 Total**	

QUESTION 35

a). _____	2
b). (i)  (ii) 	2
c). _____	1
d) I_1 = _____mA I_2 = _____mA	2
For Markers Use Only **Q35 Total**	

QUESTION 36

a) (i). _____ _____ _____	2
(ii). _____ _____ _____	2
b) (i). _____ _____ _____	1
(ii). _____ _____ _____	2
For Markers Use Only **Q36 Total**	

QUESTION 37

a). _____ _____ _____	2
b). _____ _____ _____	2

c). 3

For Water			
Scale	Absolute zero	Freezing point	Boiling point
Celcius °C		0 °C	
Kelvin K	0 K		373 K

For Markers Use Only **Q37 Total**

QUESTION 38

a). _____ 2

_____

_____

b). _____ 2

_____

_____

c). _____ 3

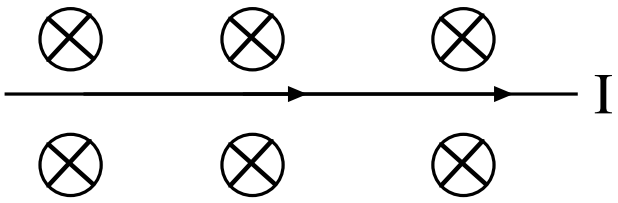
_____

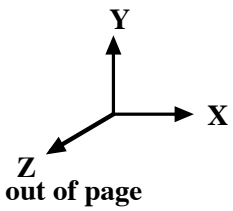
_____

For Markers Use Only **Q38 Total**

QUESTION 39

a)





2

b). _____ _____ _____	3
c) (i) _____ (ii) _____	2
For Markers Use Only **Q39 Total**	

QUESTION 40

a). _____	1
b). _____	1
c). _____ _____ _____	3
d). _____ _____ _____	1
e). _____	1
For Markers Use Only **Q40 Total**	