DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

PHYSICS

Wednesday

17 October 2012

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

P

INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates

1. The subject code Physics is **7**
2. There are **19** printed pages in the question booklet.
3. There are **11** printed pages in the Section B answer booklet and a 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 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.
5. You are required to only 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. 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.
11. 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.
12. Graphical Calculators are not permitted.

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

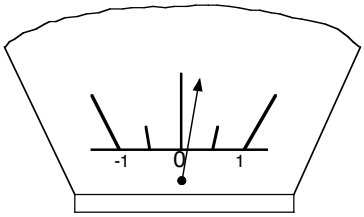
DO NOT TURN OVER THE PAGE
AND DO NOT WRITE
UNTIL YOU ARE TOLD TO START.

SECTION 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, B, C, D or E. If you make a mistake, rub it out completely using an eraser and shade the correct answer on the Electronic Answer Sheet.

QUESTION 1

Before an ammeter was used to measure electric current in an electric circuit, the needle was noted to be on the +0.1mA mark. This kind of error is known as:



A. random error
B. reaction time error
C. parallex error
D. systematic error
E. human error

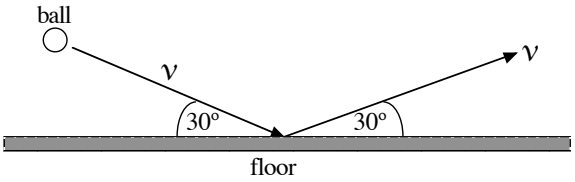
QUESTION 2

Which of the following is NOT a basic SI unit?

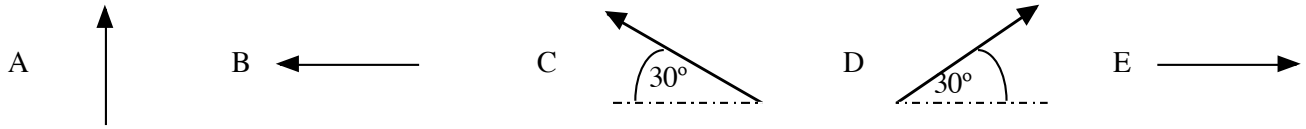
A. ampere B. newton C. meter D. kilogram E. second

QUESTION 3

A ball traveling with a speed v m/s hits a floor and rebounds with the same speed as shown in the diagram.



The direction of the change in velocity of the ball is;



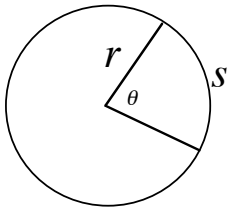
QUESTION 4

A projectile is launched at a given angle above the horizontal with a specified initial velocity. What can you say about the acceleration of the projectile in the horizontal direction? (Assume the launching angle is less than 90°)

A. positive and constant value
B. positive and changes with time
C. negative and remains constant
D. negative and changes with time
E. zero for all times

QUESTION 5

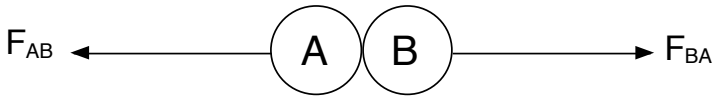
In the diagram, when the arc length s equals the radius r of the circle, the angle θ is equal to;



A. 1 radian B. π radians C. 2π radians D. $\frac{\pi}{2}$ radians E. $\frac{\pi}{4}$ radians

QUESTION 6

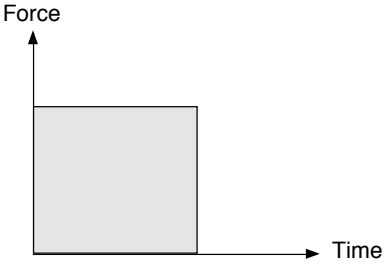
Two spherical balls collide head-on as shown in the diagram. Ball B has twice the mass of ball A. F_{AB} is force exerted by ball A on ball B. Force F_{BA} is force exerted on ball A by ball B. What can you say about the magnitude of the two forces?



A. $F_{BA} = F_{AB}$ B. $F_{BA} = 2F_{AB}$ C. $F_{BA} = \frac{F_{AB}}{2}$ D. $F_{BA} = 4F_{AB}$ E. $F_{BA} = \frac{F_{AB}}{4}$

QUESTION 7

The graph shows how a force acts on a body over a certain time interval.



The area under the graph represents the

A. magnitude of the force.
B. change in linear momentum of the body.
C. acceleration of the body.
D. mass of the body.
E. linear momentum of the body.

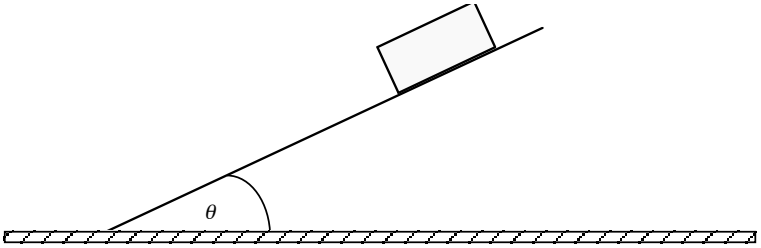
QUESTION 8

The SI unit of Power is watt (W). It is related to the SI units of energy and time in the following way.

A. Js^{-1} B. Js C. Js^{2} D. Js^{-2} E. $J^{-1}s$

QUESTION 9

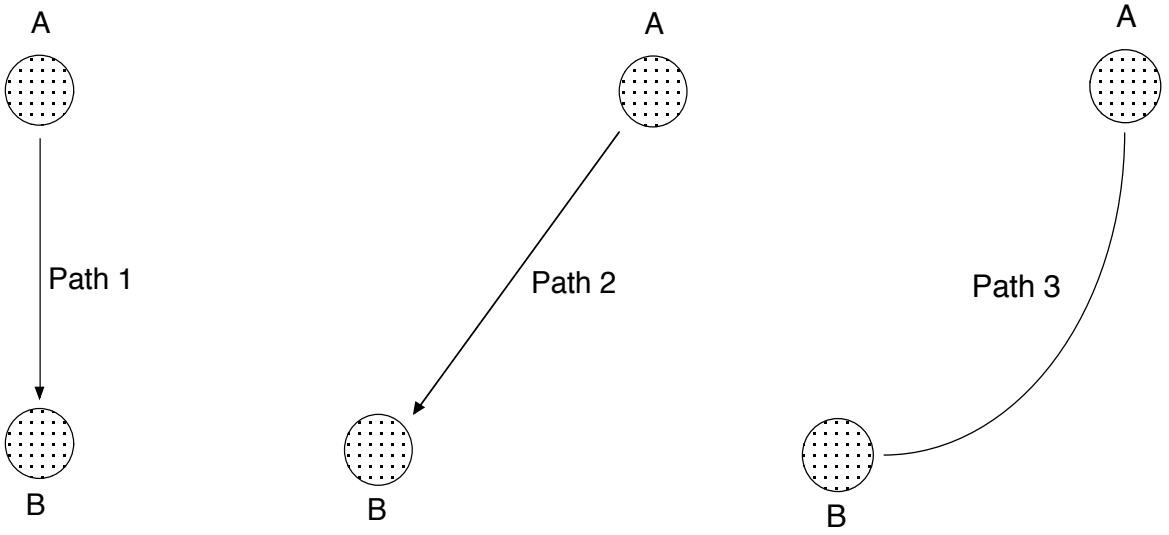
A block is released down a smooth plane inclined at angle θ to the horizontal. The acceleration of the block is;



A. $g\cos\theta$ B. $g\tan\theta$ C. $g\sin\theta$ D. $g\sec\theta$ E. $g\cos ec\theta$

QUESTION 10

Three identical balls are released the same time from the same height along three different paths.
Path 1 is a direct fall.
Path 2 is a smooth straight inclined surface.
Path 3 is a smooth curved surface.



A. Ball 1 has the greatest speed.
B. Ball 2 has the greatest speed.
C. Ball 3 has the greatest speed.
D. All balls have the same speed.
E. Balls 2 and 3 have the same speed.

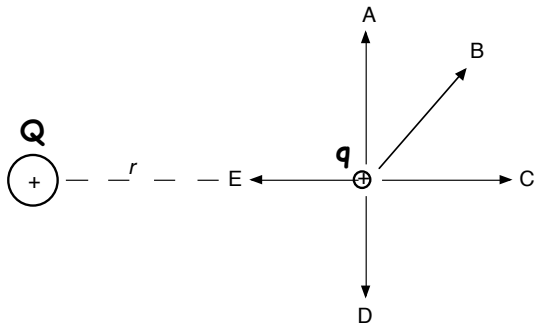
QUESTION 11

Which of the following elements is commonly used as a semi-conductor in the electronics industry?

A. Silicon B. Nitrogen C. Argon D. Chlorine E. Helium

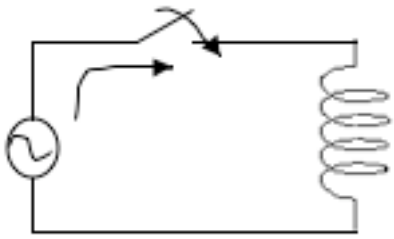
QUESTION 12

In the diagram a small positive test charge ^{+}q is located at a distance r from a positive test charge ^{+}Q. In which direction will q move?



QUESTION 13

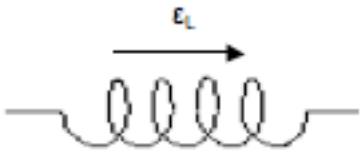
Suppose you increase the frequency of the input signal (voltage supply), to a basic inductive circuit as shown below. The current in the circuit will



A. be zero.
B. increase (but is finite).
C. decrease (but not zero)
D. stay the same.
E. be infinite.

QUESTION 14

The figure shows an emf ε_L induced in a coil. Which of the following can describe the current (conventional) through the coil?



A. constant and rightward
B. constant and leftward
C. increasing and rightward
D. decreasing and rightward
E. decreasing and leftward

QUESTION 15

Air preasure at sea level is equal to _____ centimeters of mercury.

A. 0.076 B. 0.76 C. 7.6 D. 76 E. 760

QUESTION 16

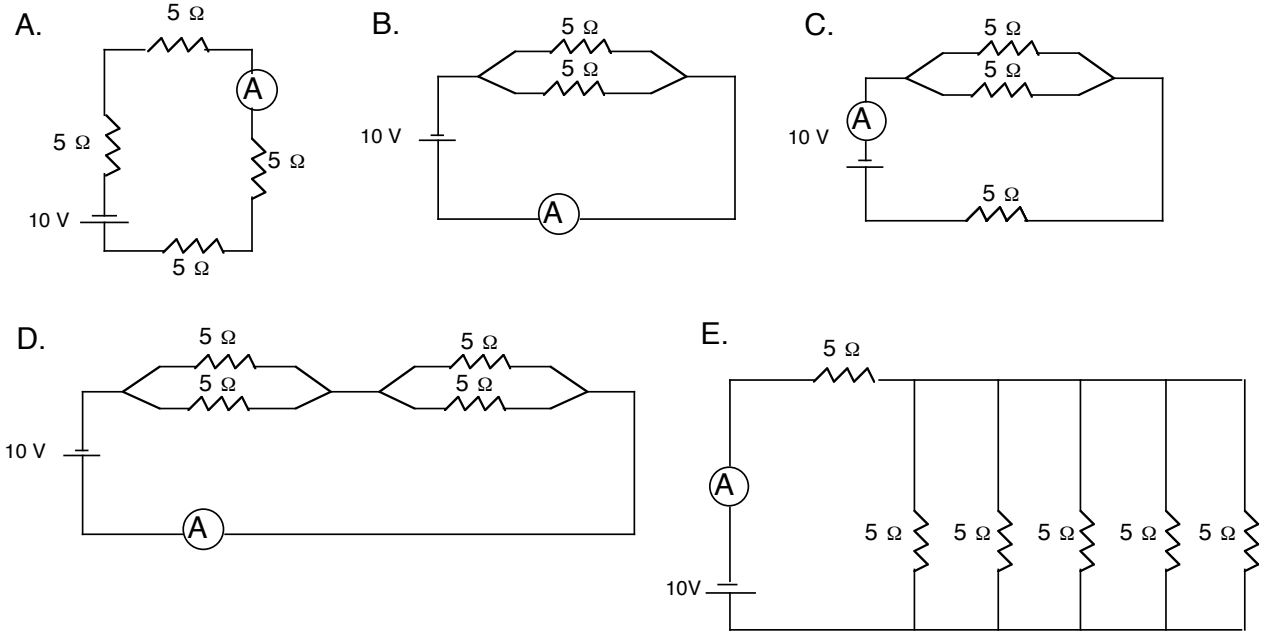
The temperature 50 Kelvin corresponds to which of the following temperatures in degree celcius?

A. -323.15°C B. -223.15°C C. 223.15°C D. 323.15°C E. 473.15°C

QUESTION 17

The circuit diagrams show various combinations of 5Ω resistors connected to a 10V battery and an ammeter. (Neglect resistance of battery and ammeter.)

In which circuit would a 2A reading on the ammeter be read?



QUESTION 18

Which of the following truth tables represent the AND logic in digital electronics?

A.

Input B	Input A	Output
0	0	0
0	1	0
1	0	1
1	1	0

B.

Input B	Input A	Output
0	0	0
0	1	1
1	0	1
1	1	0

C.

Input B	Input A	Output
0	0	0
0	1	0
1	0	0
1	1	1

D.

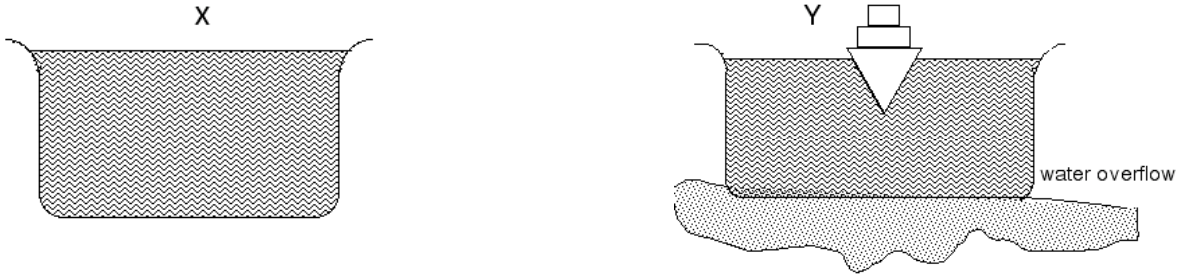
Input B	Input A	Output
0	0	0
0	1	1
1	0	1
1	1	1

E.

Input B	Input A	Output
0	0	1
0	1	0
1	0	1
1	1	0

QUESTION 19

In the diagrams X represents a tub filled with water to the brim. Y represents the same tub filled with water to the brim but has a toy warship floating in it. What can you say about the weight of Y?



The weight of Y will be;

A. greater than X.

B. less than X.

C. equal to X.

D. equal to the weight of water displaced.

E. equal to the weight of water displaced plus weight of X.

QUESTION 20

Which of the following statements about specific gravity is NOT true.

A. It is a dimensionless quantity.

B. It is the ratio of the density of a substance to the density of water.

C. It is a pure number.

D. It applies to all substances.

E. It has the same units as density.

QUESTION 21

Which of the following examples demonstrate heat transfer by the process of convection?

A. Heat from the sun falling heating up the earth.

B. A metal rod being heated over a fire.

C. A saucepan with water heating up inside.

D. Heat given of during nuclear fusion.

E. Black material absorbing heat.

QUESTION 22

2.52×10^3 Joules of heat energy is supplied to 12 grams of water at 21°C. Specific heat capacity of water is 4200J/kg/°C. What is the final temperature of the water?

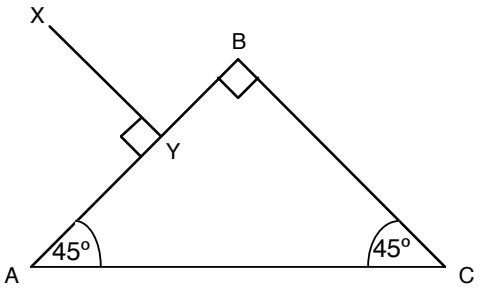
A. 29°C B. 31°C C. 50°C D. 71°C E. 79°C

QUESTION 23

Experienced fisherman when viewing a fish from air at an angle other than 90° do not aim directly at the fish when fishing. This is due to;

A. diffraction B. reflection C. refraction D. mirage E. transmission

QUESTION 24



A ray of monochromatic light XY is incident upon a prism as shown. If the critical angle for the prism-air boundary is 42°, the ray of light will:

A. Make an angle of incidence of 42° at face AC.

B. Emerge from face AC with an angle of refraction greater than 45°.

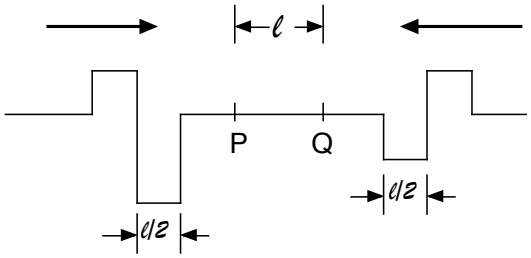
C. Emerge from face BC at an angle of 90° with the prism surface.

D. Be totally internally reflected at the face BC.

E. Partly emerge from the face AC and partly emerge from the face BC.

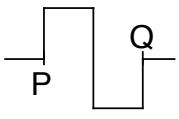
QUESTION 25

Two pulses each of length ℓ travel towards each other along a rope as shown.

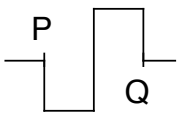


When both pulses are completely in the region between P and Q the shape of the rope is:

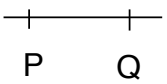
A.



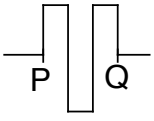
B.



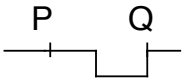
C.



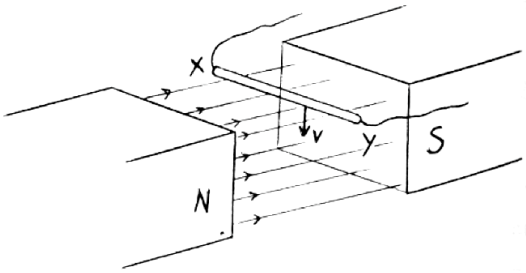
D.



E.



Questions 26 and 27 refer to the following information.



A straight section of a metal conductor XY is moved with a constant velocity *v* through a uniform magnetic field as shown in the diagram.

QUESTION 26

The direction of the force acting on the electrons in the metal conductor is:

A. towards X.

B. towards Y.

C. towards the north pole of the magnet.

D. towards the south pole of the magnet.

E. in the direction of velocity, v.

QUESTION 27

If the two ends of the conductor XY are connected to a sensitive centre-zero galvanometer, there is a reading on the galvanometer when the conductor is moved as shown. What movement of the conductor will not show a reading on the meter?

A. Upwards with a velocity v.

B. Downwards with a velocity smaller than v.

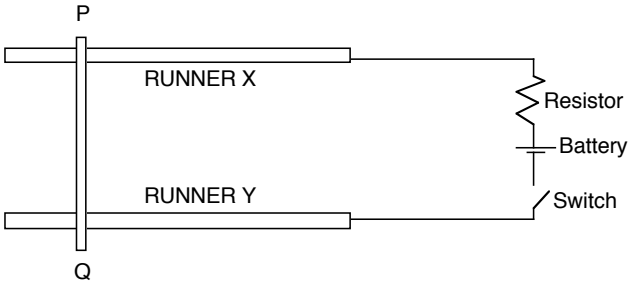
C. At a 45°angle to the magnetic field, with a velocity v.

D. A circular motion within the magnetic field.

E. With a velocity v, parallel to the magnetic field.

QUESTION 28

A vertical uniform magnetic field acts in a direction upwards. (i.e out of the paper) and a conductor PQ which is free to move rests on horizontal conducting runners X and Y as shone.



When the switch is closed, conductor PQ experiences a force that acts:

A. towards the right.

B. towards the left.

C. upwards out of the paper.

D. downwards into the paper.

E. sideways off the runner in the direction from Q to P.

QUESTION 29

Of the three types of radiation, alpha, beta and gamma which of these options lists these radiations in order of decreasing penetrability, with the most penetrating listed first?

A. alpha, beta, gamma

B. beta, gamma, alpha

C. gamma, beta, alpha

D. gamma, alpha, beta

E. alpha, gamma, beta

QUESTION 30

Listed are 5 isotopes of uranium;

A. $^{234}_{92}U$ B. $^{235}_{92}U$ C. $^{236}_{92}U$ D. $^{237}_{92}U$ E. $^{238}_{92}U$

Which of them is X in the nuclear reaction?

$X + {}^{1}_{0}n(neutron) \rightarrow Y \rightarrow {}^{239}_{93}Np + {}^{0}_{-1}e(particle)$?

SECTION B: SHORT ANSWER (QUESTIONS 31 to 40) 70 Marks

Write your answer to the questions in the spaces provided in your Part B Answer Booklet.

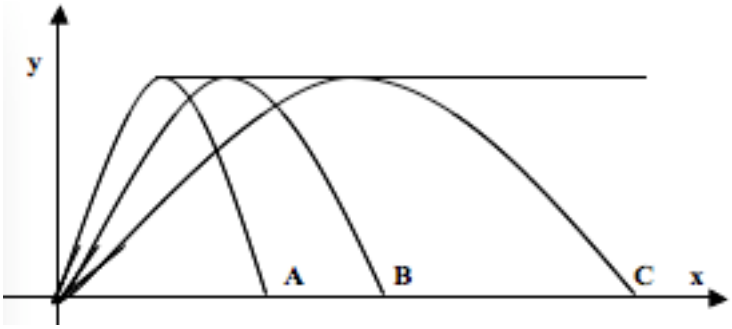
QUESTION 31

(a) Suppose you are by the Sepik River, where your boat can travel 1.20 m/s in still water.

If you steer the boat to head directly across the stream where the velocity of the current is 0.75 m/s, what is the velocity (magnitude and direction) of your boat relative to the shore? (A vector diagram must be shown in your working out) (3 marks)

(b) Suppose a falling stone takes 0.2 seconds to fall past a window that is 1 m above ground level. From how far above the top of the window was the stone dropped? (1 mark)

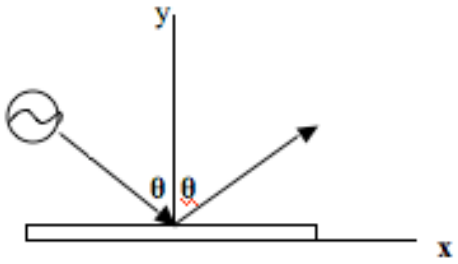
(c) The following figure shows three paths (A, B and C), for a kicked football with equal initial velocities, at different angles. Ignoring the effects of air on the flight, rank the paths in descending order according to initial horizontal velocity components. (1 mark)



(d) Consider a rotating object (for example, centrifuge rotor motor) that is accelerated from rest to 20,000 rpm in 5.0 minutes. You are required to determine its angular acceleration. (2 marks)

QUESTION 32

(a) The following figure shows an overhead view of a tennis ball bouncing from a wall without any change in its speed. Consider the change of momentum in the ball's linear momentum.

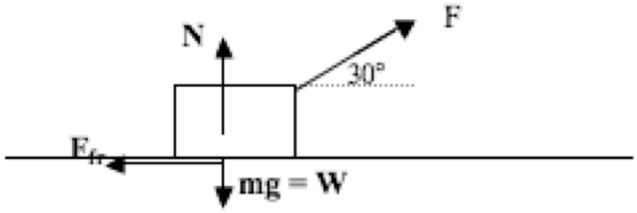


(i) Is the change of momentum in the x component, positive, negative or zero? (1 mark)

(ii) Is the change of momentum in the y component, positive, negative or zero? (1 mark)

(iii) What is the direction of the change of momentum? (1 mark)

(b) The following figure shows a 20kg object that you are dragging along the floor applying a force of 50 Newton. Assume you are applying the force at an angle of 30°.



(i) Determine the magnitude of the Normal force (upward force), exerted by the floor on the object. (2 marks)

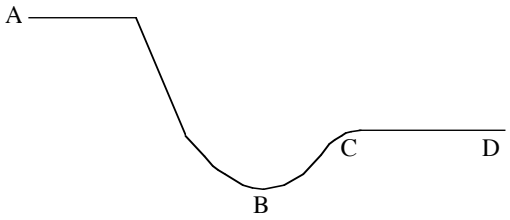
(ii) Calculate the acceleration of the object, assuming a coefficient of kinetic friction equal to 0.20. (2 marks)

QUESTION 33

(a) You are required to calculate the required power of a 1500kg vehicle under the following condition.

The vehicle accelerates from 90 Km/h to 100 Km/h in 5 seconds to pass another vehicle while on a level road. Assuming the frictional force on the vehicle is 700 Newton. (2 marks)

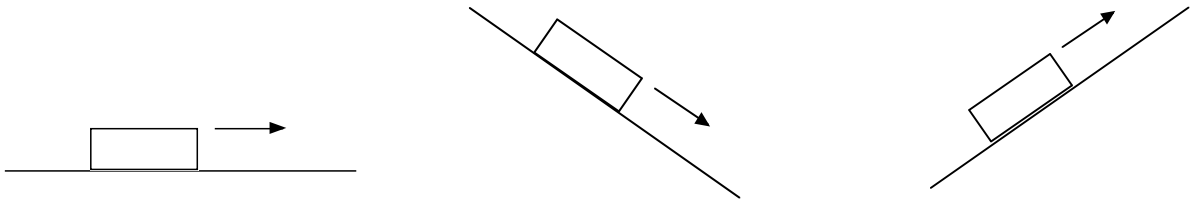
(b) Suppose an object slides from A to C and suppose A to C can be considered frictionless, then it goes through a horizontal portion CD, where a frictional force acts on that object.



State whether the kinetic energy of the object is *increasing*, *decreasing* or *remains constant* in (2 marks)

i) region CD. ii) region BC.

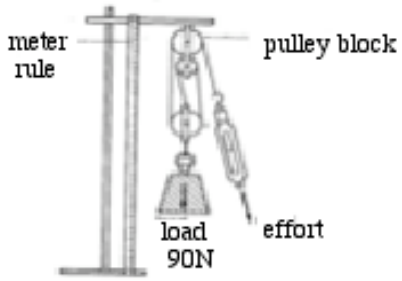
(c) Suppose you have three different situations where an object is sliding on a **rough** floor, and the floor has the orientation as illustrated in the following figures.



Case A Case B Case C

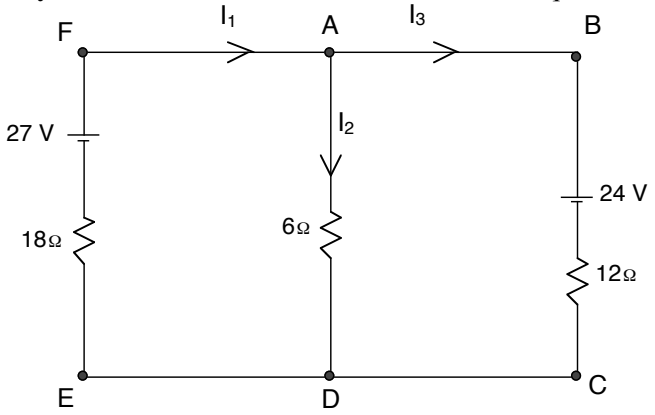
Suppose the object begins with the same speed in all three cases, and slides until the kinetic frictional force between the object and the floor, makes the object stop. In which case, is the amount of mechanical energy dissipated, the maximum? (1 mark)

(d) In the figure shown, a 90 N load is lifted 2 cm by applying an effort measured by a Newton balance. If the effort moves a distance of 6 cm, determine its value. (2 marks)



QUESTION 34

(a) Study the electric circuit shown and answer the questions that follow.

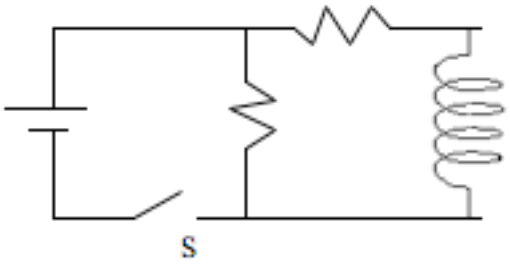


(i) Write down the mathematical expression for current at junction A. (1 mark)

(ii) Write down the voltage equation for (2 marks)

1. loop DEFA.
2. loop DABC.

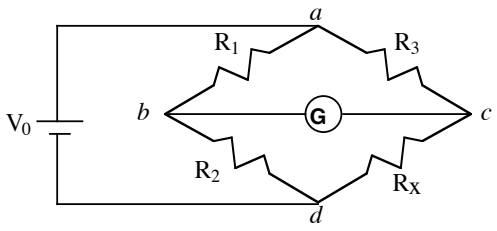
(b) The following figure shows a circuit with 2 identical resistors and an inductor.



Is the current through the central resistor *more than, less than*, or the *same as* that through the other resistor

(i) just after the closing of switch S? ii) a long time after the closing of S? (1 mark each)

(c) In the following Wheatstone bridge configuration, in terms of electric potentials (voltages) at different points in the circuit; when is the balanced condition achieved? (1 mark)

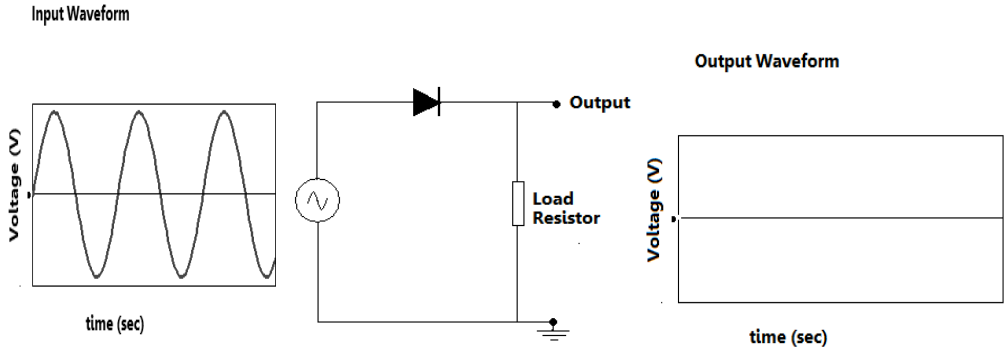


(d) In performing measurements of DC voltages, (emf), potentiometer meters are more accurate than deflection type meters. Is this statement true or false? (1 mark)

QUESTION 35

(a) Sketch the output wave form of the following circuit, if we inject an oscillation voltage as indicated in the diagram below

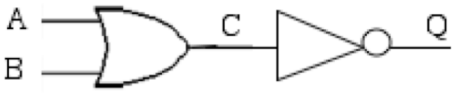
(1 mark)



(b) Explain briefly the difference between intrinsic semiconductors and extrinsic semiconductors. (2 marks)

(c) Transistors can be used in amplifiers to amplify current or voltage. Assume this particular transistor BC547 is used to construct an amplifier circuit giving an amplification power of 100. Calculate the magnitude of the output voltage if the input voltage to the amplifier is 20mV. (1 marks)

(d) (i) Complete the truth table for this combination of gates, showing all the possible states of C and Q. 2 marks)



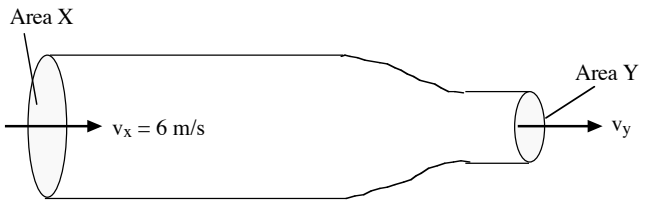
(ii) Name the gate that input A and B go through. (1 mark)

QUESTION 36

(a) Suppose an object is weighed with a spring balance, first in air and then whilst totally immersed in water. The readings on the balance are 0.48N and 0.36N respectively. Calculate the density of the object. (2 marks)

(b) If a pawpaw weighs 8N on land and in the water it weighs 3N, what is the up-thrust acting on the pawpaw? (1mark)

(c) Suppose you have a horizontal section of a pipe as sho wn below, where water is entering on side X that has a diameter of 0.5 m with a speed v = 6 m/s. The water leaves the pipe at the narrower section Y, which has a diameter of 0.25 m. At what speed does water leave? (1 marks)



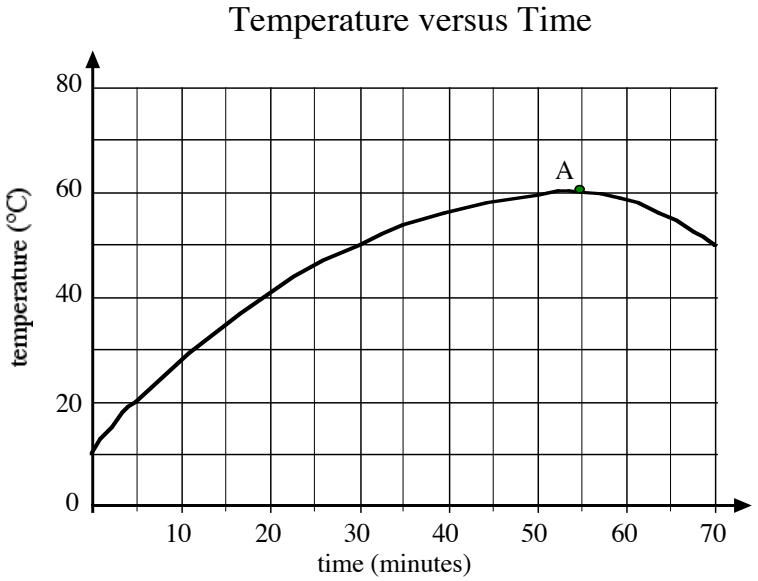
(d) Define surface tension of a fluid. (1 mark)

(e) Suppose a horizontal circular loop of wire has a diameter of 5 cm and is lowered into a sample of crude oil. Suppose the additional force that is required to pull the loop out of the oil is 0.04 N. Calculate the surface tension of the sample of crude oil. (2 marks)

QUESTION 37

(a) Name 2 of the most common way by which heat energy can be transmitted. (2 marks)

(b) The graph below shows temperature versus time for water in a tank after the heater has been switched on. The heater is switched off at point A on the graph.



(i) The mass of water in the tank is 50 kg. What is the amount of heat supplied by the heating coil in the first 20 minutes? (1 mark)

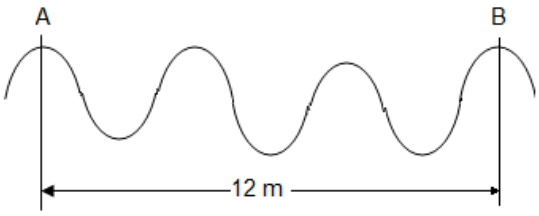
(ii) If the mass was 40 Kg. What would be the power of the heater? (2 mark)

(iii) How could the heat loss from the cylinder be reduced? (1 mark)

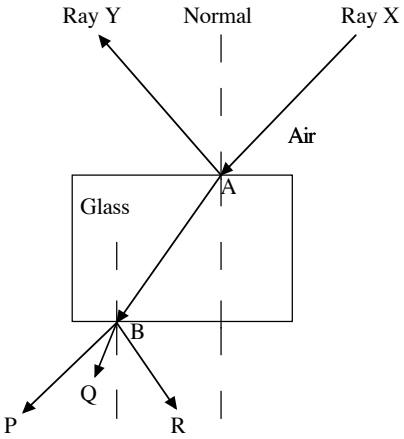
(c) Explain why the Bedouins in the desert wear black robes if as we know, black fabric will absorb heat and in the desert, the objective is to remain cool to increase their survival. (1 mark)

QUESTION 38

(a) The figure shows a side view of a water waves in a glass-walled tank. The crest at point A takes 6 seconds to reach point B. What is the frequency of the wave? (1 mark)



(b) The following diagram shows a ray of light passing through a glass prism.



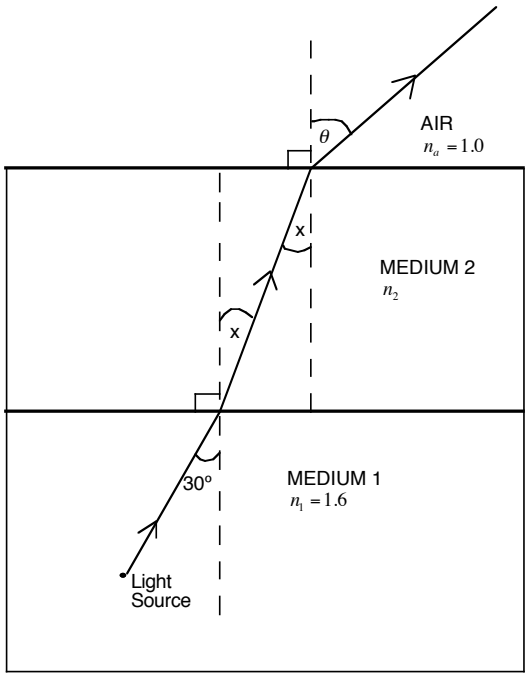
(i) Comment on the speed of ray X when it enters the glass at A, travels through the glass and emerges at B? (1 mark)

(ii) Comment on the comparative brightness of ray X and ray Y. (1 mark)

(iii) Which path labelled (P, Q or R) would ray X follow when emerging from B? (1 mark)

(c) In the diagram is shown the path of a ray of light from a point source in medium 1 (refractive index $n_1 = 1.6$) which enters medium 2 (refractive index n_2) and finally emerges into air (refractive index $n_{air} = 1.0$) at an angle θ with the normal.

Calculate the value of θ. (2 marks)



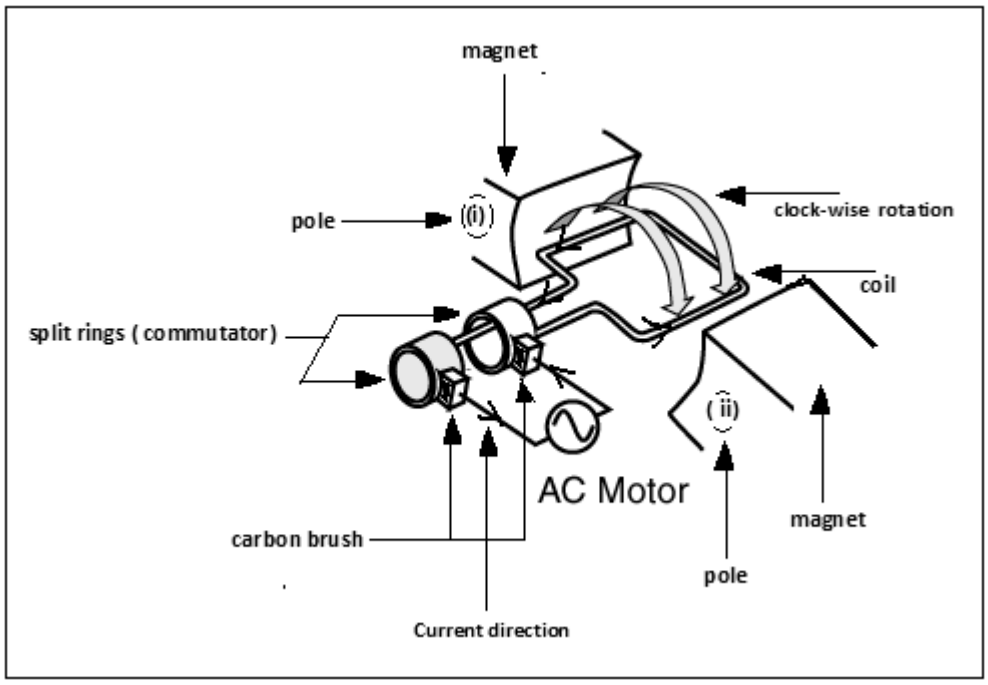
(d) Explain in terms of critical angle how light travels in a fibre optic cable. (1 mark)

QUESTION 39

(a) A distribution line carries power from a power generation plant to a substation in a town 20km away. The transmission line has a resistance of $3 \times 10^{-2} \Omega$ per kilometer. What is the total resistance of the line? (1 mark)

(b) Explain why power must be transmitted at a very high voltage from a power generation plant to towns many kilometers away. (1 mark)

(c) The electric motor in the diagram contains a coil in a magnetic field. The motor spins clockwise when an alternating current passes through it.



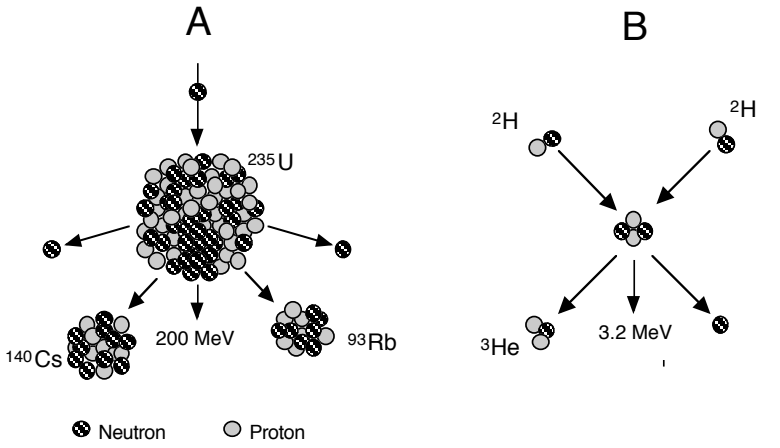
(i) Which of the poles of the magnet, labelled (i) and (ii) is North and which is South? (2 mark)

(ii) Suggest <u>two</u> modifications that would make the motor more powerful. (2 marks)

(d) What is the function of the split ring commutators? (1 mark)

QUESTION 40

(a) The diagrams A and B show the two types of nuclear reactions.



(i) Name the nuclear reaction process in diagram A. (1 mark)

(ii) Briefly describe the nuclear reaction process in diagram B. (1 mark)

(b) In a nuclear reaction, the mass of the reactant is 236.05 atomic units, and the mass of the product is 235.86 atomic units. (1 atomic mass unit = 1.667×10^{-27} Kg).

Calculate the energy released in the process. (2 mark)

(c) The isotope Radium-226 has a half-life of 1600 years and suppose you had 1000grams of radium-226;

(i) How much would be left after 4800 years? (2 mark)

(ii) Why would it be more of a problem to dispose Radium-226 than an isotope of the same mass with a half-life of 10 years? (1 mark)

END OF EXAMINATION

PHYSICS – 2012

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	*2*								

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 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 - ANSWERS

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

QUESTION 31

(a)	
_____	3
(b)	
_____	1
(c) _____	1
(d)	
_____	2
For Markers Use Only **Q31 Total**	

QUESTION 32

a) i. _____ 1

ii. _____ 1

iii. _____ 1

b) i.

_____ 2

ii.

_____ 2

For Markers Use Only **Q32 Total**

QUESTION 33

(a)

_____ 3

(b) i. Region CD _____ 1

ii. Region BC _____ 1

(c) _____ 1

(d)

_____ 2

For Markers Use Only **Q33 Total**

QUESTION 34

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

QUESTION 35

(a)

1

(b) _____ 2

_____

_____

(c) _____ 1

(d) i.

INPUTS			
B	**A**	**C**	**Q**
0	0		
0	1		
1	0		
1	1		

2

ii. _____ 1

For Markers Use Only **Q35 Total**

QUESTION 36

(a)

_____ 2

(b)

_____ 1

(c)

_____ 1

(d) _____ 1

(e)

_____ 2

For Markers Use Only **Q36 Total**

QUESTION 37

(a) 1 _____ 2. _____ 2

(b) i.

_____ 1

ii.

_____ 2

iii. _____

_____ 1

(c) _____

_____ 1

For Markers Use Only **Q37 Total**

QUESTION 38

(a)

_____ 1

(b) (i) _____ 1

(ii) _____ 1

(iii) _____ 1

(c)

_____ 2

(d) _____ 1

_____

For Markers Use Only **Q38 Total**

QUESTION 39

(a)	
_____	1
(b) _____	
_____	1
(c) i. Pole (i) _____	1
Pole (ii) _____	1
ii. 1. _____	1
2. _____	1
(d) _____	1
_____	
For Markers Use Only **Q39 Total**	

QUESTION 40

(a) (i) _____ 1

(ii) 1

_____

_____

(b)

2

_____

(c) (i)

2

_____

(ii)

1

_____

For Markers Use Only **Q40 Total**

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)