FOR ASSESSORS USE ONLY

QUESTIONS	1	2	3	4	5	6	7	8	9	10	Total
Marks											
QUESTIONS	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
Marks											

SOUTHERN PROVINCE GISAGARA DISTRICT
GS STPHILIPPE NERI GISAGARA
CLASS : S1 ALL
HOLIDAY PACKAGE OF SECOND TERM

SECTION A: ATTEMPT ALL QUESTIONS (70 marks)

1) Select the option that best completes the statement or answers the question.

a) Choose a set of renewable energy resources.

i) Solar energy- natural gas ii) solar energy-geothermal energy

iii) Coal- hydroelectric power iv) Uranium/Nuclear energy-wind energy **(1 mark)**

b) Which of the following is a disadvantage of using solar power?

i) It is not reliable in all weather conditions. ii) It emits pollutants.

iii) Maintenance cost of solar energy is very high.

iv) The coating materials used in solar absorber possess low emissivity. **(1mark)**

c) Which of the following energy resources releases greenhouse gases?

i) Hydro-electric power ii) Coal iii) solar energy iv) Geothermal energy

(1 mark)

d) What is the function of the "Control rods" in a nuclear fission reactor?

i) To reflect neutrons back into the core to prevent leakage.

ii) To absorb neutrons and regulate the rate of the chain reaction.

iii) To speed up the neutrons so they can cause more fission.

iv) To circulate the coolant through the secondary loop**.** **(1mark)**

e) Which of the following material is used to construct the control rod in the nuclear reactor?

i) Cadmium ii) Copper iii) Graphite iv) None of the above **(1mark)**

f) What role does 'Moderator' play in a nuclear reactor?

i) It captures neutrons to shut down the reactor quickly

ii) It acts as a lubricant for the turbine bearings.

iii) It slows down fast neutrons to thermal speeds to increase fission probability.

iv) It speeds up neutrons to ensure they have enough energy to split U-238**.** **(1mark)**

2) (a) What occurs when a photon of sufficient energy interacts with an atom such that an electron is ejected and a new photon of lower energy is produced?

i)The Photoelectric Effect. ii) Pair Production.

iii) Compton Scattering. iv) Internal Conversion. **(1 mark)**

b) What is the momentum of a photon with a frequency f?

i) $p = hf$ *ii*) $p = \frac{hf}{C}$ iii) $p = mc$ iv) $p = \frac{h}{f}$ **(1mark)**

c) Which of the following is an accurate statement about a photon?

i) It has a measurable rest mass. (ii) It has a negative electric charge.

iii) Its momentum is independent of its wavelength.

iv) It carries a single quantum of electromagnetic energy**.** **(1mark)**

d) What is the de Broglie wavelength of an electron accelerated by a potential difference V?

i) It is independent of V. ii) It is proportional to V

iii) It is inversely proportional to $\sqrt{V}$. iv) It is proportional to V. **(2marks)**

e) Light of a certain frequency falls on a metal surface, but no photoelectrons are emitted. To cause emission, one should:

i) Increase the intensity of the light. ii) Increase the frequency of the light.

iii) Use a metal with a smaller work function. iv) Either (ii) or (iii). **(1mark)**

3) a) The length of simple pendulum oscillating with period T is quadrupled, what is the new period of oscillations in terms of T?

i) 2T ii) 4T iii) T iv) $\frac{1}{2}T$ v) $\frac{1}{4}T$ **(2marks)**

b) A mass-spring oscillating system undergoes SHM with maximum amplitude, if the amplitude is doubled what effect will it produced on the mechanical energy of the system?

i) The energy is increased by factor two ii) The energy is increased by factor four

iii) The energy is decreased by factor two iv) The energy is decreased by factor four

v) It does not affect the energy **(2marks)**

c) Which of the following orders of damping corresponds to increasing damping strength?

i) Under damped → Critically damped → Over damped

ii) Over damped → Critically damped → Under damped

iii) Critically damped → Over damped → Under damped

iv) Under damped → Over damped → Critically damped **(2marks)**

d) When an outside driving force causes an object to oscillate at certain frequency, the resulting oscillations are called:

i) Resonant oscillations ii) natural oscillations

iii) Damped oscillations iv) Forced oscillations **(1mark)**

e) The "quality factor" Q of a damped oscillator is a measure of:

i) The initial amplitude ii) The degree of damping (how slowly the oscillation decays)
iii) The natural (undamped) frequency iv) The total energy in the system **(1mark)**

4) Fill in the blank with appropriate term from the box. The symbols have their usual meanings. You may use any key word once or not at all.

$U = \frac{KQ_1 Q_2}{r^2}$	$U = \frac{KQ_1 Q_2}{r}$	electric dipole moment	positive	$a = \frac{E}{\|e\|m}$
Straight line	electric dipole	negative	parabola	$a = \frac{\|e\|E}{m}$

a) Electrical potential energy between two electric charges is given by the formula ……..

(1 mark)

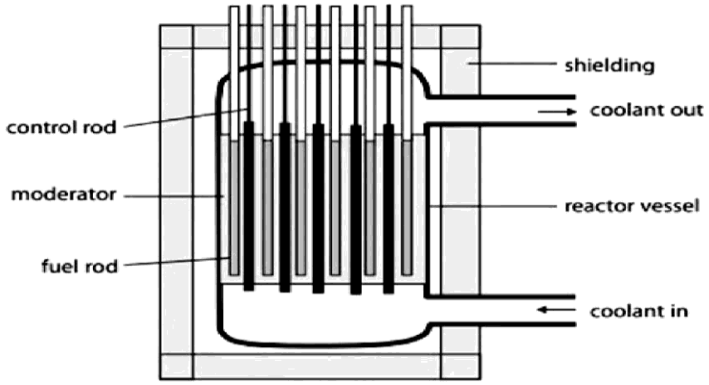
b) The direction of an electric field at any point, by convention, is the direction of the electrical force on a small ……..tests charge, placed at that point. **(1 mark)**

c) The trajectory of an electron in an electric field is a**……..** **(1 mark)**

d) Acceleration of an electron from rest in the electron gun of a cathode ray oscilloscope is given by …… **(1mark)**

e) Electric potential due to a dipole at any point is directly proportional to…… **(1mark)**

5) The diagram below shows the main parts of a nuclear reactor



a) Copy the table below and draw a line linking each part of the reactor with its main function.

Part of reactor	**Main function**
A) Control rod	i)Removes energy from the reactor
B) Coolant	ii)Controls the rate of fission
C)Fuel rod	iii) Absorbs dangerous radiation

D)Shielding	iv) Contains uranium for fission

(4marks)

b) Which of the following is the correct energy change taking place in a nuclear power plant?

i) Nuclear energy -> Heat energy -> Mechanical energy -> Electrical energy

ii) Heat energy -> Nuclear energy -> Mechanical energy ->Electrical energy

iii) Potential energy -> Kinetic energy -> Mechanical energy>Electrical energy

iv) Kinetic energy -> Potential energy -> Mechanical energy -> Electrical energy

(1mark)

6) a) Choose the option that best answers the question or completes the statement.

If the distance between two masses is doubled, the gravitational force between them:

i) Is doubled ii) is reduced to half

iii) Becomes four times iv) is reduced to a quarter **(2marks)**

b) The time period of a satellite orbiting Earth in a circular orbit is independent of:

i) Radius of the orbit ii) The mass of the satellite

iii) Both the mass and radius of the orbit iv) Neither the mass nor the radius of its orbit. **(1 mark)**

c) An object of mass m is projected from the surface of a planet of mass M and radius

R. Which of the following correctly describes the fundamental energy condition required for the object to escape permanently from the planet's gravitational field (ignoring air resistance)?

i) The object's kinetic energy must be greater than its gravitational potential energy at the surface.

ii) The object's total mechanical energy must be zero or positive.

iii) The object's kinetic energy must be equal to the planet's gravitational potential energy at infinity.

iv) The object's momentum must exceed, $m\sqrt{\frac{2GM}{R}}$

(v) The object's kinetic energy must be equal to $\frac{GMm}{R}$ **(1mark)**

d) If you were to go deep into a mine shaft toward the center of the Earth, how would the value of g change (assuming uniform density)?

i) It would decrease linearly toward zero.

ii) It would increase because you are closer to the center.

iii) It would increase exponentially. iv) It would stay exactly the same **(1mark)**

e) How does the escape velocity change if the object being launched is a massive rocket vs. a small pebble

i) It depends on the fuel type. ii) The rocket requires a higher escape velocity

iii) The pebble requires a higher escape velocity. iv) It remains the same **(2 marks)**

7) Write **True** if the statement is correct and **False** if the statement is wrong.

a) The value of gravitational acceleration g is maximum at the equator because the Earth's rotation adds to gravitational pull. **(1mark)**

b) If the Earth stopped rotating but kept the same mass and radius, the value of g at the equator would increase**.** **(1mark)**

c) A rocket can accelerate in outer space even though there is no air to push against.

d) According to Niels Bohr's model, an electron emits radiation continuously while moving in a permitted orbit. **(1mark)**

e) If fuel burns inside a completely sealed rocket without ejecting gases, the rocket will accelerate forward**.** **(1mark)**

f) Doubling both the intensity and frequency of incident light doubles the maximum kinetic energy of emitted electrons**.** **(1mark)**

8) a) In a Compton –scattering experiment using $0.124nm$ X-ray photons , at what scattering angle is the wavelength of the scattered X-rays 1.0% longer than that of incident X-rays(use Planks constant h= 6.63 x10 $^{-34}$ J.s *and* Speed of light in vacuum of air $c = 3 \times 10^8$m /s)

i) 30 ° ii)45.2° iii) 60.7° iv) 90.0° **(2marks)**

b) In the same experiment, at what scattering angle is the wavelength of the scattered X-rays 0.0050% longer than that of the incident X-rays?

i) 6.7° ii)13.0° iii)22.4° iv) 38.9° **(1mark)**

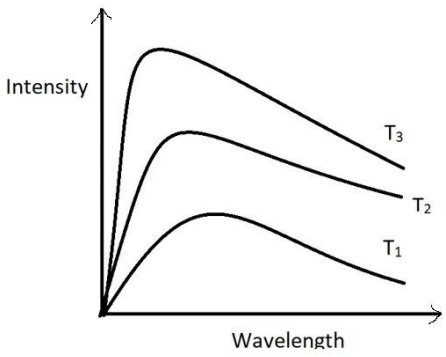
c) In the same Compton –scattering experiment using $0.124nm$ X-ray photons, what is the maximum possible wavelength of the scattered X-rays and at what angle does it occur?

(Use Planks constant h= 6.63 x10 $^{-34}$ J.s *and* Speed of light in vacuum of air $c = 3 \times 10^8$m /s)

i) $0.1264nm$ at 90.0° ii) $0.1289\,nm$ at 180.0°

iii)$0.1312\,nm$ at 180.0° iv) $0.1245nm$ at 45.0° **(1mark)**

9) Analyze the following graph of intensity of black body radiation against its wavelength for different temperatures.



Answer questions related to the graph:

a) Based on the provided graph, which of the following best describes the relationship between intensity and decreasing wavelength?

i) Intensity increases linearly as wavelength decreases.

ii) Intensity decreases continuously as wavelength decreases.

iii) Intensity increases to a maximum peak and then decreases as wavelength continues to decrease.

iv) Intensity remains constant regardless of the wavelength. **(2marks)**

b) According to the physics of blackbody radiation, why does a human being emit radiation?

i) Because humans have a temperature above absolute zero

ii) Because humans reflect light from the sun.

iii) Because humans are made of organic matter.

iv) Humans do not emit radiation; they only absorb it. **(2marks)**

10) An electron is accelerated from rest through a potential difference of 100V. What is the resulting de Broglie wavelength of the electron? (Mass of electron: $9.1 \times 10^{-31}\ g$, Magnitude of the charge of electron e $= 1.6 \times 10^{-19} c$)

a) 1.23nm b) 0.123nm c) 12.3nm d) 0.012m **(2marks)**

11) a) If Rutherford had replaced the gold foil (Z=79) with an aluminum foil (Z=13) in his scattering experiment, what would be the most likely observation?

i) More alpha particles would be deflected at large angles.

ii) The alpha particles would be absorbed by the aluminum nuclei.

iii) The results would remain exactly the same.

iv) Fewer alpha particles would be deflected at large angles **(1mark)**

b) You are designing a test circuit to measure the power dissipated by a specific resistor (R) in a complex network. To achieve this with the least interference to the circuit's total current, how must you insert your meters?

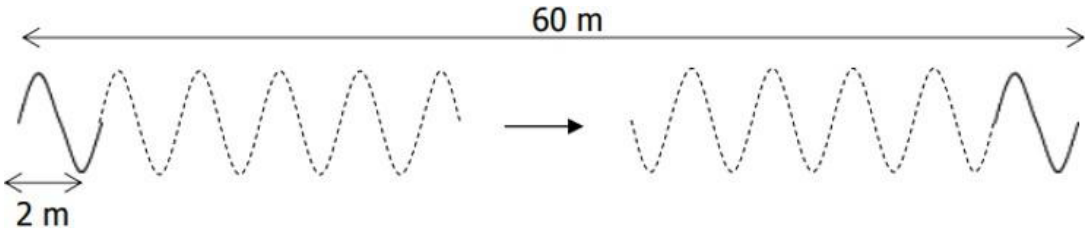
i) Place the ammeter in parallel with R and the voltmeter in series with R

ii) Place the ammeter in series with R and the voltmeter in parallel with R

iii) Place both the ammeter and voltmeter in series with R

iv) Place both the ammeter and voltmeter in parallel with R **(1mark)**

12) A wave of wavelength 2m travels 60 m in 12 seconds.



a) What is the speed of the wave? **(1mark)**

b) How many waves would be produced in 12 seconds? **(2marks)**

c) What is the frequency of the wave? **(1mark)**

13) Two waves traveling in opposite directions produce a standing wave. The individual wave functions are:

$y_1 = (4.0\text{cm})sin(3.0x - 2.0t)$ and $y_2 = (4.0\text{cm})\sin(3.0x + 2.0t)$, where x and y are measured in centimeters.

a) Find the amplitude of the simple harmonic motion of the element of the medium located at x = 2.3 cm. **(2marks)**

b) Find the positions of the nodes and antinodes if one end of the string is at x = 0. **(2marks)**

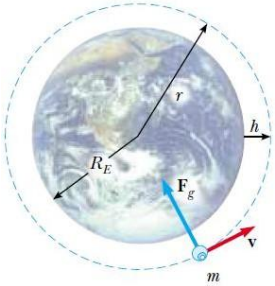
c) What is the maximum value of the position in the simple harmonic motion of an element located at an antinode? **(1mark)**

14) A pendulum of length 1.00 m is released from an initial angle of 15.0°

(a) What is the resonant (angular) frequency of this pendulum?
(Use acceleration due to gravity= $9.81 m/s^2$) **(1mark)**

(b) After 1000. Seconds, its amplitude is reduced by friction to 5.50°. What is the value of b/2m? **(2marks)**

15) Consider a satellite of mass m moving in a circular orbit around the Earth at a constant speed v and at an altitude h above the Earth's surface, as illustrated in figure below:



a) Determine the speed of the satellite in terms of G, h, R_E (the radius of the Earth), and M_E(the mass of the Earth). **(2marks)**

b) If the satellite is to be geosynchronous (that is, appearing to remain over a fixed position on the Earth), how fast is it moving through space? **(2marks)**

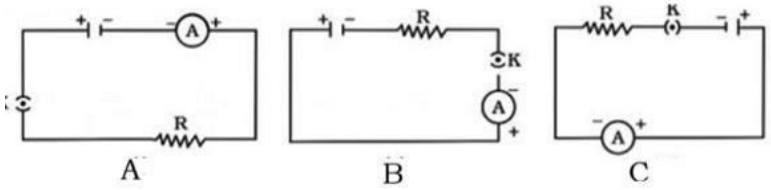
(Use Earth's mass M_E=5.98 x10^{24}kg, the radius of the earth R_E=6400km and Universal gravitational constant G= 6.67 X $10^{-11}$$kg^{-1}m^3s^{-2}$).

Use the Space provided to answer from question 12 to 15

SECTION B: ATTEMPT ALL QUESTIONS FIVE QUESTIONS (50 marks)

16) Consider the following figure and answer related questions.

I) A cell, a resistor, a key and an ammeter are arranged as shown in the circuit diagrams A, B and C of figure below:

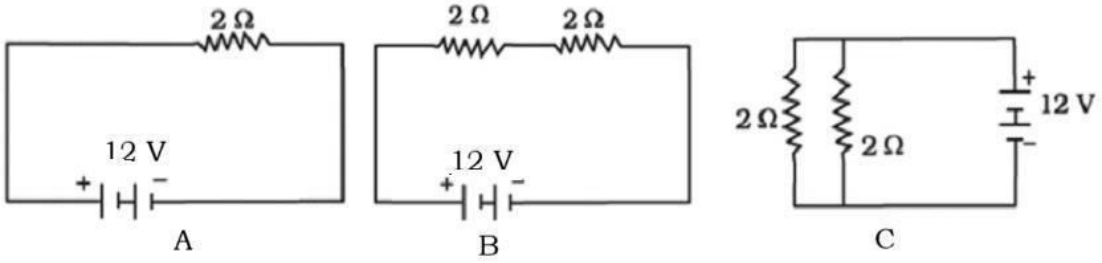


The current recorded in the ammeter will be:

a) Maximum in A b) maximum in B

c) Maximum in C d) the same in all the cases **(1mark)**

II) Three electric circuits A, B and C are given below:



In the above circuits, heat produced per second in the resistor or

Combination of resistors connected to a 12 V battery will be:

a) Maximum in case A b) maximum in case B

c) Maximum in case C d) same in all the case **(2marks)**

III) The factors that influence the resistance of a metallic conductor are:

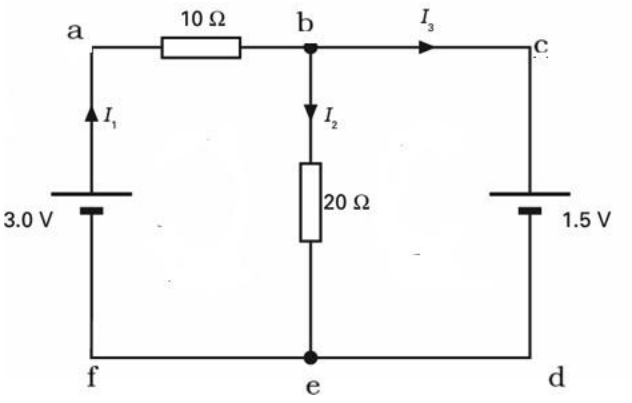
a) The material of which the conductor is made

b) The length of the conductor c) the thickness of the conductor

Choose the option that best answers the question.

A) a) and b) B) b) and c) C) a) and c) D) a), b) and c) **(1 mark)**

IV) Use Kirchhoff's laws to find the three electric currents flowing through the electric circuit shown below:



(6marks)

17) a) The angular momentum of hydrogen electron in n^{th} orbit is given by:

i) nh ii) $\frac{h}{2n\pi}$ iii) $\frac{nh}{2\pi}$ iv) $\frac{n^2 h}{2\pi}$ **(1mark)**

b) An electron in the hydrogen atom is in the n = 4 energy level when this electron makes a transition to a lower energy level, the wavelength of the photon emitted:

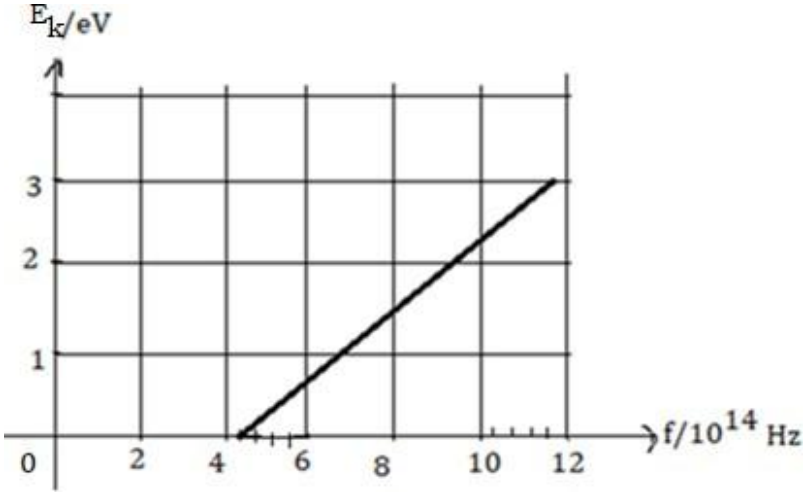
i) is in the Lyman series only, (ii) is in the Balmer series only,

iii) is in the Paschen series only (iv) Could be in the Lyman, Balmer, or the Paschen series

(1mark)

c) The graph in the figure below shows how the energy E_k of photoelectrons emitted from the

surface of sodium metal varies with frequency f of the incident radiation. Planck constant ($h=6.62\times10^{-34}m^2kg/s$)



1) Find the threshold frequency **(1mark)**

2) Calculate the work function of sodium in **J** or eV **(1mark)**

d) The lowest energy of a hydrogen atom are shown below

First excited state _____ -3.4 eV

Ground level _____ -13.6 eV

(i)Determine the energy of level n=3(second excited state) of the hydrogen atom $E_n = \frac{-13.6eV}{n^2}$

(2 marks)

(ii)A free electron with kinetic energy $12eV$ collides with an atom of hydrogen and causes it to be raised to its first excited state (n=2).

1) Determine the energy absorbed when electron jumps from ground level n=1 to n=2

(3 marks)

2) Calculate the kinetic energy of the free electron in eV after the collision **(1 mark)**

18) a) A stationary charge in a uniform field possesses electric potential energy. If the charge is moved perpendicular to the field lines, what happens to this energy?

(i) It becomes kinetic energy. (ii) It decreases.

(iii) It increases. (iv) It remains constant **(2marks)**

b) A beam of electrons enters a uniform electric field directed vertically upward. The beam is moving horizontally.

In which direction will the electrons be deflected?

(i)They will not be deflected (ii) Horizontal to the right

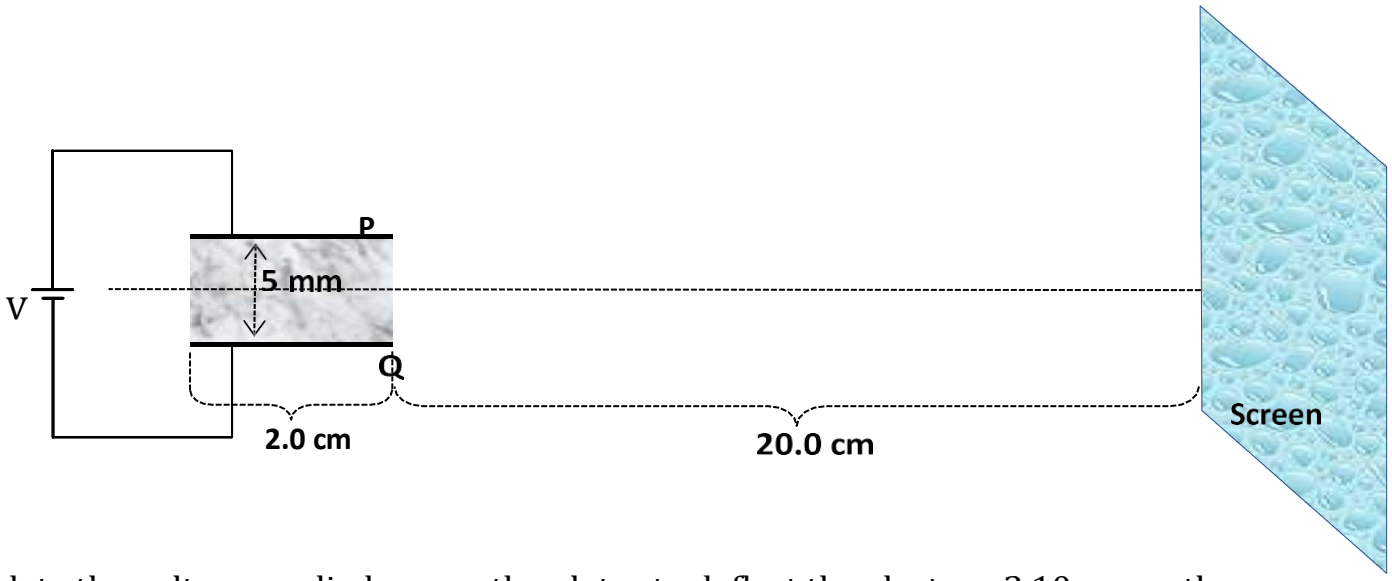
(iii) Vertically downward (iv) Vertically upward **(1mark)**

c) A charged particle enters a uniform electric field perpendicularly with an initial horizontal velocity and passes through a field region of length L. Which expression gives the final vertical component of velocity (v_y) of the particle as it exits the field?

i)$v_y = v_x \tan(qE)$ ii) $v_y = \frac{qEL}{mv_x}$ iii) $v_y = \sqrt{\frac{2qEL}{m}}$ iv) $v_y = \frac{qEL}{m}$ **(2 marks)**

d) Figure shows two metal plates 2.0 cm long placed 5.0 mm apart. A fluorescent screen is placed 20.0 cm from one of the plates.

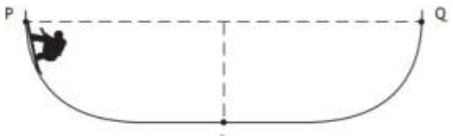
An electron of kinetic energy $3.2 \times 10^{-16} J$ is incident mid-way between the plates.



Calculate the voltage applied across the plates to deflect the electron 2.10 cm on the screen. Assume that the electron moves through vacuum. **(5 marks)**

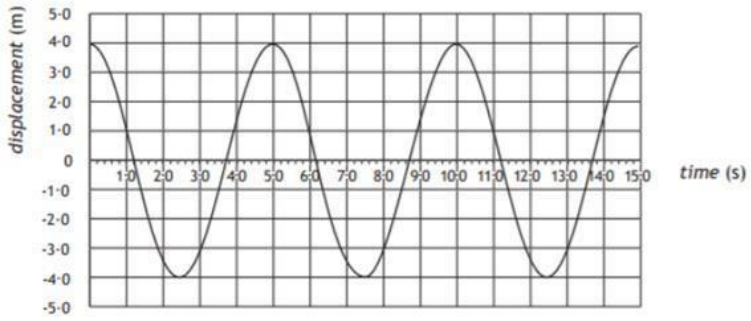
(Mass of electron: 9.1 x 10^{-31} kg, Magnitude of the charge of electron e =1.6 x $10^{-19} c$)

19) Figure below shows a snowboarder in half pipe .The snowboarder is moving between positions P and Q. The total mass of snowboarder and boarder and board is 85 kg.



The student attempts to model the motion of the snowboarder as simple harmonic motion.

The displacement time graph produced is shown below.



a) Prove that the motion of snowboarder is simple harmonic motion **(2 marks)**

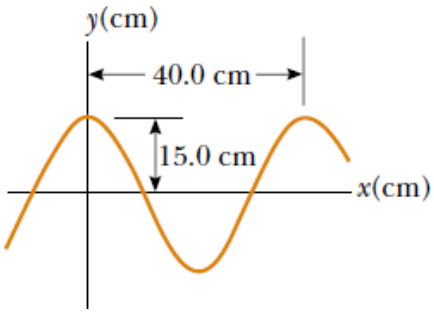
b) Determine the maximum acceleration experienced by the snowboarder on half pipe. **(2 marks)**

c) (i) Write down an expression which describes how the displacement varies with time. Numerical values are required. **(2 marks)**

ii) Find the expression of the velocity **(1mark)**

iii) Sketch a velocity-time graph for one period of this motion. Numerical values are required on both axes. **(3 marks)**

20) A sinusoidal wave traveling in the positive x direction has an amplitude of 15.0 cm, a wavelength of 40.0 cm, and a frequency of 8.00 Hz. The vertical position of an element of the medium at $t = 0$ and $x = 0$ is also 15 cm, as shown in Figure below:



Find:

a) The wave number k **(1.5marks)**

b) Period T **(1.5marks)**

c) Angular frequency ω **(1.5marks)**

d) Speed v of the wave **(1.5marks)**

e) Determine the phase constant **(2marks)**

f) Write a general expression for the wave function **(2marks)**

Space in which to answer the three chosen questions from Section B.

-**END-**