DISTRICT PHYSICS COMPREHENSIVE ASSESSMENT MARKING GUIDE

SENIOR SIX TERM II 2023-2024

1) B **(2marks)**

2) iii) nh/2π **(2marks)**

3) (a) FALSE **(1mark)** (b) TRUE **(1mark)**

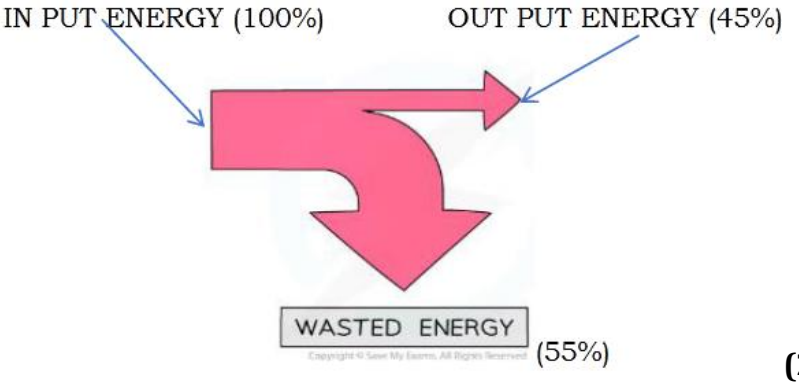
4) C **(1mark)**

5) $m\frac{V^2}{r} = qvB \Rightarrow r = \frac{mv}{qB}$ **(2marks)**

6) D **(1mark)**

7)a) Sankey diagram is a diagram which indicate the amount of energy remains after a series of transformations. **(1mark)**

b)



(2marks)

8.a)

Applying $nsin\,i = constant$ at Q ;

$$n_l \sin i_l = n_g \sin i_g$$
$$n_l \sin 46.46^o = 1.5 \sin 40^o$$
$$\boldsymbol{n_l = 1.33}$$

(2marks)

b) Applying r1 + r2 = A, ngsinr2=nlsini2
$40^o + r2 = 60^o$, $r2 = 20^o$,$1.5\sin 20^0 = 1.33\sin i2$ hence $i2 = 22.69^o$ **(2marks)**

c) Applying d = (i1 +i2) – (r1 +r2) = $(46.46^0 + 22.69^0) - (40^0 + 20^0) = 9.15^0$ **(2marks)**

9)a) The figure represents the simple harmonic motion **(2marks)**

(b) $T_i = 2\pi\sqrt{\frac{L_i}{g}}$ **and** $T_f = 2\pi\sqrt{\frac{L_f}{g}}$ **but** $L_f = 2L_i$ $T_f = 2\pi\sqrt{2 \times \frac{L_i}{g}}$ $T_f = \sqrt{2} \times T$. **This means that the time period gets larger by** $\sqrt{2}$ **times./2mks**

(c)**Changing the mass has no effect on the time period of a simple pendulum. /2mks**

10) Stefan – Boltzman law states that the average rate of radiation of energy per unit surface area per unit time emitted from the surface of an ideal radiator is proportional to the fourth power of the Kelvin temperature

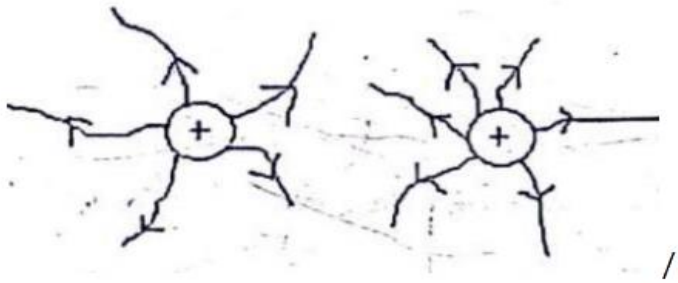
(2 marks)

Wien 's displacement law states that the wavelength is inversely proportional to the temperature

(2 marks)

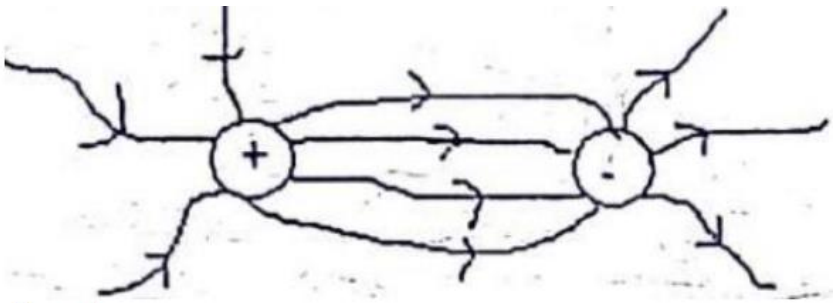
11) $\lambda_{\min} T = cons\tan t$ T =2.9X10^{-3} /500 X10^{-9}=600 K **2 marks**

12)a)i) Electric field lines of two equal and positive points charges: the number of lines leaving the two points charges is the same.



/1mark

ii) the electric field lines of two equal and opposite point charges: the number of linear leaving the positive equal the number terminating at negative charge.



/1mark

b)

Solution

The diameter of a coin is small compared to the 1.5m separation. We may therefore approximate the coins as point charges. Coulomb's law,

$F_E = \frac{k}{K}\frac{q_1 q_2}{r^2}$, gives (with K approximated as 1.00 in air)

$q_1 q_2 = q^2 = \frac{F_E r^2}{k} = \frac{(2N)(1.5m)^2}{9\times10^9 N.m^2/C^2} = 5\times10^{10} C^2$ from which $q = 2\times10^{-5} C$. **(3 marks)**

13)(a) - Intrinsic attenuation

- Extrinsic attenuation

- Light scattering

-Light absorption (Intrinsic and Extrinsic)

(b) It is in order to allow total internal reflection within the fiber

5	a		$(n =) \frac{\sin 14.1}{\sin 9.54}$ **OR** 0.2436 / 0.1657 working must be seen **AND** (= 1.4699) = 1.47 ✓ given correctly to 3 or more significant figures

5	b	i	ray goes along the boundary ✓ (partial) reflection shown ✓ (allow dotted or solid line. This mark can be awarded if TIR is shown)

5	b	ii	(90 – 9.54 =) 80.46 or 80.5 ✓ (°) (allow 80°)

5	b	iii	$(n = n_c \sin\theta)$ = 1.47 sin 80.46° ✓ ecf bii =1.45 ✓ (1.4496)

5	c		• protect the core (from scratches, stretching or breakage) • prevent 'crossover' of signal / ensure security of data / prevent loss of information/data/signal • increase the critical angle / reduce pulse broadening/(modal)dispersion / rays with a small angle of incidence will be refracted out of the core • increase rate of data transfer max two correct (from separate bullet points) ✓✓

14)(a) The **Greenhouse effect** is the process by which thermal radiation from the sun is prevented from leaving the atmosphere and then re-radiated in different directions.

(2 marks)

(b) Greenhouse gases: CO_2 , CH_4 , NO, O_3 , CHC, Water vapour, HFC, NF_3,..... **(3 marks)**

(15) -Replacing coal and oil with natural gas
-Combined heating and power systems (CHP)
-Renewable energy sources and nuclear power
-Carbon dioxide capture and storage
-Use of hybrid vehicles. **(2 marks)**

SECTION B

16) a) Linear momentum is the product of mass and velocity of a moving body **(1 mark).** **Its unit: kgms-1 (1 mark).** , **dimension: MLT-1(1 mark).**
b) The initial momentum must be equal to the sum of the

$$mv_0 = mv_1 \cos 30^0 + mv_2 \cos 30^0$$

(1)

Components of momentum after the collision. In the direction perpendicular to the original direction of motion, the sum of components of momentum after the collision must be equal to zero because before collision the balls do not have any component of momentum in the perpendicular direction:

$$mv_1 \sin 30^0 - mv_2 \sin 30^0 = 0$$

Or $v_1 = v_2$ (2)

This result could have been anticipated from symmetry.
Using (2) in (1)

$$v_0 = 2v_1 \cos 30^0 = \sqrt{3}v_1$$

Or $v_1 = v_2 = \frac{v_0}{\sqrt{3}} = \frac{9}{\sqrt{3}} = 5.19 m/s$

Total kinetic energy of the two balls before collision

$$K_0 = \frac{1}{2}mv_0^2 + 0 = \frac{1}{2}mv_0^2$$ **(3)**

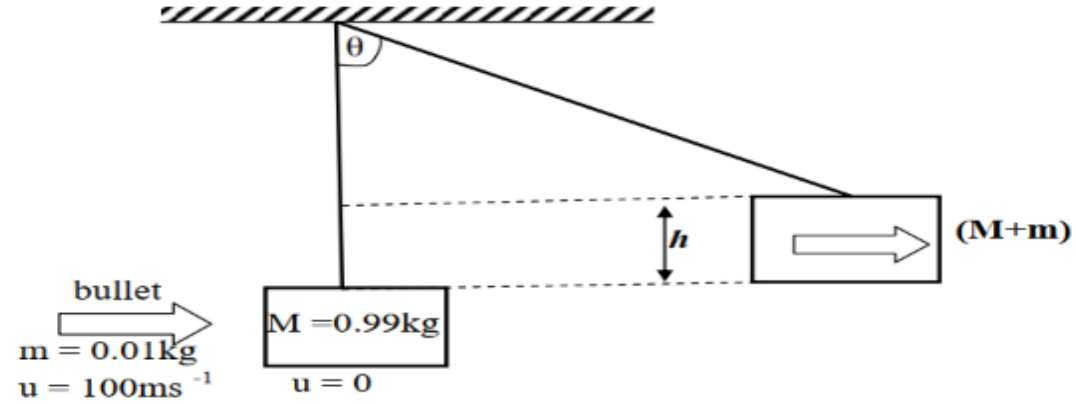
Total kinetic energy after the collision

$$K' = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2 = mv_1^2 \neq \frac{1}{2}mv_0^2$$ (4)

On comparing (3) and (4) we conclude that kinetic energy is not conserved. The collision is said to be inelastic.

(7 marks)

c)



Complete the solution for h and θ **[h = 0.05m, θ =12°]**

$$\theta = cos^{-1}\left(1 - \frac{v^2}{2gl}\right)$$

(5 marks)

17) (a) Thermionic emission or discharge of electrons from heated materials, is widely used as a soruce of electrons in conventional electron tubes like television picture tubes in the fields of electronics and communication**.** **(3marks)**

(b) Three applications of photoelectric effect in our everyday life:

1. Photo - cell is the most important application . It is most commonly found in solar panels. It works on the basic principle of the light striking the cathode which causes the emission of electrons, which in turn produces current.

2. Photomultiplier tube makes use of photo - electric effect to convert light intensity into electrical currents.

3. Photoelectric effect also founds application in photocopies, light meter, photodiodes, phototransistors.

4. Scintillators : A scintillator is a device that emit light when it attracts radiation from either source in the lab or a cosmic sources **(6marks)**

(c) The function of the cathode-ray tube is to convert an electrical signal into a visual display. The tube contains an electron-gun structure (to provide a narrow beam of electrons) and a phosphor screen. The electron beam is directed to the phosphor screen and strikes it, causing light to be emitted in a small area or spot in proportion to the intensity of the electron beam. The beam intensity varies as a function of the beam- control element in the electron gun. In a TV or computer-display CRT, the electrical signal that controls the beam intensity corresponds to the desired picture information and is referred to as the video signal. Although one spot or picture element is not enough to reproduce a picture, by moving the spot over the entire screen in a systematic manner, the complete picture can be reproduced.

For oscilloscope use, the deflection (done by x and y plates) of the beam at the screen is proportional to the voltages applied to the deflection electrodes within the tube, and a visual picture of time-dependent waveforms can be produced on the screen in the same manner as a graph is drawn on paper. **(9marks)**

18)a) An equipotential surface is the one on which all points are at the same potential. The potential difference between any two points on the surface is zero, so no work is required to move a charge from one point on the surface to the other./1mark

b) Electric potential at a point in electric field is the work to be done or energy required in moving one coulomb of charge from infinity to that point against electrostatic force per unit charge. While The gravitational potential V at a point is defined numerically as work done in taking a uniform mass from infinity to that point against gravitational force per unit mass./2marks

c)

$$\text{Potential, } V = \frac{\text{Work done}}{\text{Unit charge}} \text{ or Potential } V = \frac{\text{Energy to be applied}}{\text{Unit charge}}$$

$$\text{And} \qquad \text{Work done} = F_{elec} \times \text{displacement or } W = F_{elec} \times dx$$

Now consider two charges q_1 and q_2 deperated by distance x . The work done in moving one charge through a small distance dx is given by;

$$W = \frac{1}{4\pi\varepsilon_0\varepsilon_r} \cdot \frac{q_1 q_2}{x^2} \times dx$$

$$F_{elec} = \frac{q_1 q_2}{4\pi\varepsilon_0\varepsilon_r x^2} dx$$

Work done in moving charge from ∞ to a point at a distance r,

$$W = \frac{q_1 q_2}{4\pi\varepsilon_0\varepsilon_r}\left[-\frac{1}{r} - \left(-\frac{1}{\infty}\right)\right]$$

$$W = -\frac{q_1 q_2}{4\pi\varepsilon_0\varepsilon_r r}$$

$$V = \frac{W}{q_2} = -\frac{q_1}{4\pi\varepsilon_0\varepsilon_r r}$$

For the free space, $\varepsilon_r = 1$ and if $q_1 = q$, then

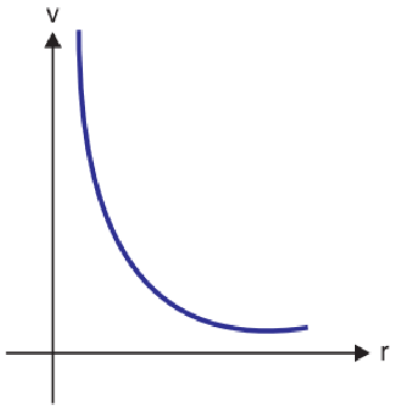
$$V = -\frac{q}{4\pi\varepsilon_0 r}$$

/4marks

ii) because the potential at infinite is taken to be zero. /2marks

iii) Variation of electric potential with distance from a point charge.

$$V \alpha \frac{1}{r}$$



/2marks

d)

$y = 1\,cm = 1 \times 10^{-2}\,m \quad d = 2 \times 10^{-2}\,m \quad \frac{e}{m} = 1.8 \times 10^{11}\,C/kg \quad v = 1 \times 10^{7}\,m/s$

$$y = \frac{Vel^2}{2mdv^2};$$

$$V = \frac{2mdv^2y}{el^2} = \frac{2 \times 2 \times 10^{-2} \times (1 \times 10^7)^2 \times 1 \times 10^{-2}}{1.8 \times 10^{11} \times (5 \times 10^{-2})^2}$$

$$V = 88.89V$$

/4marks

19)a) The picture shows a one kind of flood where people are carrying their properties moving from an eroded place (2marks)

b) **The Main Causes And Impacts Of Soil Erosion**

-Deforestation for Agriculture Is One of the Top Causes of Soil Erosion. ...
-Soil Erosion is Also Caused by Overgrazing, Which Causes Floods too. ...
-Agrochemicals Cause Soil Erosion and Degradation. ...
-Construction and Recreational Activities.
-All Changes in climate i e like Draining wetlands for agriculture, settling in some of the places that were previously place for water flow. (3marks)

c) Leads to

-famine,

-Poverty,

-Less infrastructure development,

-Death of people, animals and many others. (3marks)

d)- Avoiding Draining Wetlands for farming and Settlement

-Using Good Methods of Farming like Crop rotation, Use of terraces etc

- Practicing Afforestation where tress have been cut.

-Sensitizing the People about conservation of Nature (3marks)

e)- **Change a light**
Replacing one regular light bulb with a compact fluorescent light bulb will save 150 pounds of carbon dioxide a year.

-Drive less
Walk, bike, carpool or take mass transit more often. You'll save one pound of carbon dioxide for every mile you don't drive!

-Recycle more
You can save 2,400 pounds of carbon dioxide per year by recycling just half of your household waste.

-Check your tires
Keeping your tires inflated properly can improve your gas mileage by more than 3 percent. Every gallon of gasoline saved keeps 20 pounds of carbon dioxide out of the atmosphere.

-Use less hot water
It takes a lot of energy to heat water. Use less hot water by taking shorter and cooler showers and washing your clothes in cold or warm instead of hot water (more than 500 pounds of carbon dioxide saved per year).

-Avoid products with a lot of packaging
You can save 1,200 pounds of carbon dioxide if you reduce your garbage by 10 percent.

-Adjust your thermostat
Moving your thermostat down just 2 degrees in winter and up 2 degrees in summer could save about 2,000 pounds of carbon dioxide a year.

-Plant a tree
A single tree will absorb one ton of carbon dioxide over its lifetime.

-Turn off electronic devices
Simply turning off your television, DVD player, stereo, and computer, when you're not using them, will save you thousands of pounds of carbon dioxide a year. (4marks)

20 a) antiparticle: is particle has the same mass as associated charged particle but opposite charge. (1mark)

b) A. positron (1mark)

c) The process in which a particle and antiparticle unite annihilate each other and produce one or more photons is called … annihilation…… (1mark)

d) Using the elementary particles, Complete the following sentences

i) One family of spin1 bosons called__Gouge bosons_which act as „force carriers" in the theory (1mark)

ii) Two spin 1/ 2 families of fermions called__leptons__ and __hadrons_ (2marks)

e) **–strong interaction**: its particle carries are gluons /**2marks**
-weak interaction: its particle carries are$W^{\pm}$ *and* Z_0/**2marks**
-**electromagnetic interaction**: its particle carries are photons/2marks
-**gravitation** : its particle carries are graviton/**2marks**

f) Gravitational force:$F_{gr} = G\frac{m_1 m_2}{r^2}$ /**0.5*mark***

Electric force:$F_{el} = k\frac{q_1 q_2}{r^2}$ /**0.5*mark***

$$\frac{F_{gr}}{F_{el}} = \frac{G}{k}\frac{m_u m_u}{q_u q_u} = \frac{9Gm^2}{4ke^2} \quad /\mathbf{1mark}$$

$$\frac{F_{gr}}{F_{el}} = \frac{9(6.67x10^{-11})(7x10^{-30})(7x10^{-30})}{4(8.99x10^{9})(1.6x10^{-19})(1.6x10^{-30})} = 3x10^{-41} \quad /\mathbf{1mark}$$

The gravitational force is less than the electric force. /**1mark**

Thus the gravitational is the weakest of the fundamental forces

END