MARKING GUIDE FOR S5 PHYSICS,2024

SECTION A

1. a)Photoelectric effect**(1mark)** Compton effect **(1mark)**
b) Reflection of light **(1mark)** refraction of light **(1mark)** interference of light **(1mark)**

2. a) e **/2marks**

(b) $p = \frac{E}{c} = \frac{P \times t}{c} = \frac{30 \times 10^{-3} \times 100 \times 10^{-9}}{3 \times 10^{8}} = 10^{-17} \text{kg ms}^{-1}$

option (b) is correct

3. **/3marks**

a. The photoelectric effects is a phenomenon in which electrons are emitted from matter after the absorption of energy form electromagnetic radiation such as x-rays or visible light.

/**1mark**

b. **)** not, photoelectric effect is caused by light but thermionic emission is caused by another source of heat. Thermionic emission can be photoelectric effect but photoelectric effect can not be thermionic emission. **/2marks**

C) $E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{7.8 \times 10^{2} \times 10^{-9}}$, $E = 2.55 \times 10^{-19} J$ **/2marks**

4. Any motion that repeats itself again and again at regular intervals of time is called ---***periodic***----------motion. The smallest interval of time after which the motion is repeated is called its ----------***time period***------. If a body moves back and forth repeatedly about its mean position, its motion is ------***oscillatory***----------. Every oscillatory motion is ------***periodic***----------but reverse is-***not true***-. Simple harmonic motion is a special case of –***oscillatory motion***-in which the particle moves to and fro about mean position under the action of a ---***restoring*** force which is directly proportional to its --***displacement***---from mean position is always directed –***towards*** ---mean position.

--***Amplitude*** --is the maximum displacement from mean position. **0.5 mark for correct answer.**

5. a)

i. critically damped oscillation **(1mrk)**
ii. Over damped oscillation **(1mrk)**
iii. under damped oscillation **(1mrk)**

b) it is B /**1mrk**

ii)The main cause of damped oscillations are: **friction force, air resistance**, **viscous force**./**1mark** for each.

6.) a with 3, **/1mark** b with 5, **/1mark** d with 1 **/1mark** , c with 2 **/1mark** e with 4 **/1mark**

7. compare with travelling wave equation,

$$y = a\sin(\omega t - kx)$$

The velocity of travelling wave $v = \frac{\omega}{k}$

$$\Rightarrow \quad v = \frac{450}{9} = 50 \text{ m/s} \qquad \ldots(i)$$

Also, velocity of wave on stretched string is

$$v = \sqrt{\frac{T}{\mu}} \qquad \ldots(ii)$$

Using (i) and (ii),

$$\sqrt{\frac{T}{\mu}} = 50 \quad \Rightarrow \quad T = (50)^2 \times 5 \times 10^{-3}$$

$$\Rightarrow \quad T = 12.5 \text{ N}$$

. **/ 4marks**

8. a) **the universal law of gravitation or inverse square law states that** "the gravitational force of attraction between two masses m1 and m2 is directly proportional to the product of masses
and inversely proportional to the square of their mean distance apart."**/2marks**

b)

$r_M = 5.810x10^{10}\ m$

$m_S = 1.99x10^{30}\ kg$

$T_M = ?$

$$T_M{}^2 = \left(\frac{4\pi^2}{Gm_S}\right) r^3$$

$$T_M{}^2 = \left[\frac{39.5}{(6.673x10^{-11}\ N \cdot m^2/kg^2)(1.99x10^{30}\ kg)}\right](5.810x10^{10}\ m)^3$$

$$T_M{}^2 = \left[\frac{39.5}{1.33x10^{20}\ N \cdot m^2/kg}\right](1.96x10^{32}\ m^3)$$

$$T_M{}^2 = (2.96x10^{-19}\ s^2/m^3)(1.96x10^{32}\ m^3)$$

$$T_M{}^2 = 5.82x10^{13}\ s^2$$

$$T_M = \sqrt{5.82x10^{13}\ s^2}$$

$$T_M = 7.63x10^6\ s\left(\frac{1\ hour}{3600\ s}\right)\left(\frac{1\ day}{24\ hours}\right) = 88.3\ days$$

Activate V**/3marks**

9.

(a) we want to solve $e^{-bt/2m} = 1/3$ for t. we take the natural logarithm of both sides to obtain $-bt/2m = \ln(1/3)$

therefore, $t = -(2m/b)\ln(1/3) = (2m/b)\ln 3;$ $\quad t = \dfrac{2(1.5kg)}{0.23kg/s}\ln 3 = \boxed{14.3\sec}$ $\quad (2$ **marks**$)$

(b) the angular frequency is $\omega' = \sqrt{\dfrac{k}{m} - \dfrac{b^2}{4m^2}} = \sqrt{\dfrac{8N/m}{1.5kg} - \dfrac{(0.23kg/s)^2}{4\times(1.5kg)^2}} = 2.31rad/s$

the period $T = \dfrac{2\pi}{\omega'} = \dfrac{2\times 3.14rad}{2.31rad/s} = \boxed{2.72s}$ $\quad (1$ **mark**$)$

the number of oscillations $n = \dfrac{t}{T} = \dfrac{14.3s}{2.72s} = \boxed{5.27}$ $\quad (1$ **mark**$)$

10. a) -1st Law: This law is called the law of orbits and states that planets move in ellipses with the sun as one of their foci. It can also be stated that planets describe ellipses about the sun as one focus./**1mark**

-2nd Law: This is called the law of areas and states that the line joining the sun and the planet sweeps out equal areas in equal periods of time. S1=S2 /**1mark**

-3rd Law: The law of periods states that the square of the period T of revolution of any planet is proportional to the cube of its mean distance R from the sun. $T^2 \alpha R^3$ /**1mark**

b)

From Coulomb's Law and Newton's Law of gravitation,

$$F_E = k\frac{q^2}{r^2} \qquad \text{and} \qquad F_G = G\frac{m^2}{r^2}$$

Therefore

$$\frac{F_E}{F_G} = \frac{kq^2/r^2}{Gm^2/r^2} = \frac{kq^2}{Gm^2}$$

$$= \frac{(9.0\times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(1.6\times 10^{-19}\ \text{C})^2}{(6.67\times 10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2)(9.1\times 10^{-31}\ \text{kg})^2} = 4.2\times 10^{42}$$

As you can see, the electric force is much stronger than the gravitational force.

/2marks

11.

Solution

Applying the equation $\varepsilon = IR + Ir$ to the circuit with P,
$\varepsilon = (0.40 \times 10.0) + (0.4r) = 4.0 + 0.4r$

Applying the equation $\varepsilon = IR + Ir$ to the circuit with Q,
$\varepsilon = (0.60 \times 5.0) + (0.6r) = 3.0 + 0.6r$

Therefore

$4.0 + 0.4r = 3.0 + 0.6r$

Rearranging this equation gives

$0.6r - 0.4r = 4.0 - 3.0$

$0.2r = 1.0$

$r = \frac{1.0}{0.2} = 5.0\,\Omega$

By substituting the value of r into either of the equations, $\varepsilon = 6.0\,V$. **/4marks**

12. a) Equipotential lines are lines which have the same potential at every point**. /2marks**

b) NO, /1mark

because electric field lines have the different points which produce different potential. **/1marks**

13. a)

$$f = \frac{c}{\lambda}$$

$$= \frac{3.00\times10^{8}}{525\times10^{-9}}$$

$$= 5.71 \times 10^{14}\ \text{Hz}$$

$$E = hf$$

$$= 6.63 \times 10^{-34} \times 5.71 \times 10^{14}$$

$$= \mathbf{3.79 \times 10^{-19}\ J}$$

/2marks

b)

$$\begin{aligned} E_k &= hf - hf_o \\ &= 3{\cdot}79 \times 10^{-19} - 2{\cdot}24 \times 10^{-19} \\ &= \mathbf{1{\cdot}55 \times 10^{-19}\ J} \end{aligned}$$

/2marks

14.

a. An artificial satellite of the Earth's any object made by man which moves round the earth in orbit, while a natural satellite of the Earth is any natural object revolving about Earth.

b. Artificial satellite can be used in:

- Telecommunication: television programmes and telephone conversations can be transmitted from country by being bounced of satellites.
- Weather forecasting: rain clouds, can be tracked using the pictures, there satellite send back to earths
- Military: countries can rise spy satellites, to find out if another country is carrying out secret military manoeuvres
- Mapping: satellites are used in drawing geographical maps (geological, metrological...)
- Space observation: artificial satellite is used to study the universe galaxies.

/5marks

15. a) Problem of radioactive waste. **1mark**
b) High risks. **1mark**
c) Targets for terrorist attacks. **1mark**
d) Nuclear weapons. **1mark**
e) Uranium is a scarce resource. **1mark**
f) Illusion to build new

Section b

16. . $x = 4.00cos\left(\pi t + \frac{\pi}{4}\right)$ from the equation of propagation of wave $x = Acos(\omega t + \varphi)$ **0.5marks**

a) Amplitude is $A = 4.00m$ **(1mrk)**, angular velocity $\omega = \frac{\pi rad}{s} = 3.14rad/s$**,** period $T = \frac{2\pi}{\omega} = \frac{2\pi}{\pi} = 2sec$ **(1mrk),**
Frequency $f = \frac{1}{T} = \frac{1}{2s} = 0.5Hz$ **(1mrk),**

b) Velocity at any time, $v = \frac{dx}{dt} = \frac{d\left(4.00cos\left(\pi t + \frac{\pi}{4}\right)\right)}{dt} = -4\pi sin\left(\pi t + \frac{\pi}{4}\right)$ in m/s **1mark**

Acceleration $a = \frac{d^2x}{dt^2} = \frac{d^2\left(4.00cos\left(\pi t + \frac{\pi}{4}\right)\right)}{dt^2} = -4\pi^2 cos\left(\pi t + \frac{\pi}{4}\right)$ in m/s^2 **1mark**

c) At t=1s, $v = -4\pi sin\left(\pi 1 + \frac{\pi}{4}\right) = -4\pi sin\left(5\frac{\pi}{4}\right) = 8.8812m/s$ **1mark**

Acceleration, $a = -4\pi^2 cos\left(\pi 1 + \frac{\pi}{4}\right) = -4\pi^2 cos\left(5\frac{\pi}{4}\right) = 27.887m/s2$ **1mark**

d) $v_{max} = \omega A = \frac{4\pi m}{s} = 12.566m/s$ **0.5mark** and $a_{max} = \omega A^2 = \frac{4\pi^2}{s^2} m = 39.478m/s^2$ **0.5mark**

e) At t=0s, $x = 4.00cos\left(\pi(0) + \frac{\pi}{4}\right) = 4\cos\left(\frac{\pi}{4}\right) = 2.82m$ **0.5marks**

At t=1s, $x = 4.00cos\left(\pi(1) + \frac{\pi}{4}\right) = 4\cos\left(5\frac{\pi}{4}\right) = -2.82m$ **0.5marks**

Direction of wave is from right to left. **0.5 marks**

17. a. The algebraic sum of the currents flowing at anode or junction in an electric circuit is zero. **/1mark**

The algebraic sum of the potentials in a closed loop is zero / **1mark**

b. From junction rule $I1 + I2 = I3$ (1) **/1mark**

From loop rule

$10 - 10I_1 - 40I_3 = 0$ (2) **(1m**

$20 - 20I_2 - 40I_3 = 0$ (3) **(1m**

The equation (1) in (2) and (3) gives

$10 - 10I_1 - 40I_1 - 40I_2 = 0$ (i)

$20 - 20I_2 - 40I_1 - 40I_2 = 0$ (ii)

$50I_1 + 40I_2 = 10$ × -4 (i)

$40I_1 + 60I_2 = 20$ × 5 (ii)

$-200I_1 - 160I_2 = -40$ (i)

$200I_1 + 300I_2 = 100$ (ii)

Adding (i) and (ii) we get $140I_2 = 60$

$I_2 = \frac{60}{140} = \frac{3}{7}A$ **(1mark)**

Replacing the value of I_2 in the equation (ii) we get: $40I_1 + \frac{180}{7} = 20$

$$40I_1 = 20 - \frac{180}{7}$$

$$40I_1 = \frac{140-180}{7}$$

$$I_1 = -\frac{1}{7}A \qquad \textbf{(1mark)}$$

$$\boldsymbol{I_3 = -\frac{1}{7}A + \frac{3}{7}A = \frac{2}{7}}\text{ A} \qquad \textbf{(1mark)}$$

c. $V_{AB} = R_3 \times I_3 = 40\boldsymbol{\Omega} \times \frac{2}{7}\boldsymbol{A} = \frac{80}{7}\boldsymbol{A}$ **(2marks)**

18. a) wave is a disturbance of material which transporting energy from the source without transporting a matter***. /1mark***

b) superposition of wave is the phenomenon occurs when two or more waves moving in the same medium at the same time. The net displacement is algebraic sum of individual displacements./**2marks**

c) interference, constructive interference and destructive interference ***/3marks***

d)i) $V = \sqrt{\frac{T}{\mu}}$ $\mu = \frac{m}{l}$

$f = \frac{v}{2l}$

$T = 4L^2f^2\mu = 4 \times 5^2 \times 20^2 \times \frac{40\times10^{-3}}{5} = 1600N$ **/2marks**

ii)n=2 $f_2 = 2f_1 = 2x20 = 40HZ$ / **1mark**

$\lambda = l = 5$ m /**1mark**

19. (a) Fossil fuels are hydrocarbons, primarily coal ,fuel oil or natural gas, formed from the remains of dead plants and animals. **/1.5marks**

While non- fossil fuels are alternative sources of energy or renewable sources of energy that do not rely on burning up limited supplies of coal, oil or natural gas./**1.5marks**

(b)

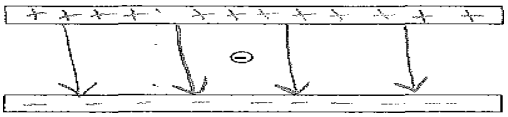
Non fossil fuel	Fossil fuel
Biomass, Bio-fuel, Geothermal, Hydroelectric, Nuclear, Ocean Thermal Energy Conversion (OTEC), Solar, Tides and Waves, Wind.	Coal, Natural Gas, Oil (Petroleum),

(0.5 mark for each)

c) Disadvantages of fossil fuels:

- they produce greenhouse gases
- they are existed
- cause of some diseases
- accidents ,…. **(1mark for any two points**

20. a and b



/3marks

II) Field lines always represent what a + test charge will do.

c) $E=4.8X10^{-11}N/C$, $q=1.6x10^{-19}C$ Then $F_e=Exq=4.8x10^{-11}x1.6x10^{-19}=7.68x10^{-30}N$./**2marks**

d) $F_{net}=F_{e,}$ $7.68x10^{-30}=m.a$ where m is mass of electron. $a= 8.4mS^{-2}$ upward./**2marks**

e) if proton is accelerated, mass of proton will be used instead then, $a=4.6x10^{-3}ms^{-2}$ downward./**2marks**