REPUBLIC OF RWANDA

EASTERN PROVINCE

PHYSICS II

2023-2024

…/03/2024 8:30AM-11:30AM

RWAMAGANA DISTRICT

MARKING GUIDE OF ADVANCED LEVEL DISTRICT COMPREHENSIVE ASSESSMENT FOR SECOND TERM,2023-2024.

SUBJECT: PHYSICS

LEVEL: SENIOR five (S5)

/100marks

COMBINATIONS:

PHYSICS–CHEMISTRY- BIOLOGY (PCB)

PHYSICS - CHEMISTRY- MATHEMATICS (PCM)

MATHEMATICS-PHYSICS–GEOGRAPHY (MPG)

MATHEMATICS-PHYSICS–COMPUTER (MPC)

useful constants:

Magnitude of the electronic charge = $1.6\ 10^{-19}C$

Speed of light in vacuum/air, $c=3x10^{8}m/s$

Planck's constant, $h=6.63x10^{-34}J.s$

Acceleration due to gravity, $g=9.81m.s^{-2}$

Coulomb's constant, $K= 9x10^{9}\ Nm^{2}C^{-2}$

SECTION A (70 MARKS)

1. A blackbody is a theoretical object that absorbs all radiations that hits it and re-radiates energy which is the characteristic of this radiating system or body only. **(2marks)**
2. A forced oscillation is where an object is subjected to a force that causes it to oscillate at a different frequency than natural frequency. **(3marks)**
3. Kirchhoff's Voltage Law or Kirchhoff's Loop Rule, states that "the algebraic sum of the potentials around a closed electric circuit is zero." **(3marks)**
4. Renewable energy is energy that can replenish, can be recycled, that is not used off.
   Non-renewable is energy that cannot replenish, cannot be recycled, that is used off.
   (4marks)
5. a. Electric field is the space around the charged object where force is exerted on the charged particle
   b. Electric potential is the potential energy per charge. **(4marks)**
6. 3rd Law: The law of periods states that the square of the periods T of revolution of planets are proportional to the cubes of their mean distances R from the sun. **(3marks)**
7. C **(3marks)**
8. a. Velocity or kinetic energy **(2marks)**
   b. Amplitude **(2marks)**
9. a. I **(2marks)**
   b. iii **(2marks)**
10. a. 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. **(3marks)**
    b. - A rocket is a device that produces thrust by ejecting stored matter. **(2marks)**
    - A satellite is an artificial body placed in orbit round the earth or another planet in order to collect information or for communication. **(2marks)**
11.

a) $\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}}{(0.05)(40)} = 3.3\times10^{-34}\ m$

(2marks)

b) $K = \frac{1}{2}mv^2 = \frac{p^2}{2m} = \frac{h^2}{2m\lambda^2} \Leftrightarrow \lambda = \frac{h}{\sqrt{2mK}} = \frac{6.63\times10^{-34}}{\sqrt{2(9.1\times10^{-31})(13.6\times1.6\times10^{-19})}} = 0.33\,nm$

(2marks)

c) $\lambda = \frac{hc}{E} = \frac{6.63\times10^{-34}\times10^{8}}{100\times10^{3}\times1.6\times10^{-19}} = 3.88\times10^{-12}\ m$

(2marks)

12.

From $F = kx$ we find $x = \frac{F}{k} = 0.004\ m$ **(3marks)**

Spring energy: $U = \frac{1}{2}kx^2 = 0.4\ J$ **(3marks)**

13. a. A = 5m **(2marks)**
    b. f = 0.2 Hz **(2marks)**
    c **(2marks)**

Wavelength: $\phi = \frac{2\pi}{\lambda}x = \pi x$

$\lambda = 2m$

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14. a. this figure represents a cathode ray tube (CRT) **(2marks)**
    b. it is used in TV (television) **(2marks)**
    c. i. electron gun **(2marks)**
    ii. cathode ray **(2marks)**

15. a. i. a **(1mark)**
    ii. c **(1mark)**
    iii. b **(1mark)**
    b. **(4marks)**

$m\frac{d^2x}{dt^2} + kx + b\frac{dx}{dt} = 0$

$m = 4, k = 32$

$\omega_0 = \sqrt{\frac{k}{m}}, \quad \omega_0 = \sqrt{\frac{32}{4}} = 2\sqrt{2}$

The decay rate of oscillation is $\frac{b}{2m}$.

(i)The motion will be underdamped if $\frac{b}{2m} < \sqrt{\frac{k}{m}}$ or $b < 2\sqrt{mk}$

$b < 2\sqrt{32 \times 4}$, or $b < 16\sqrt{2}$

(ii) The motion will be overdamped if $b > 2\sqrt{mk}$

i.e $b > 16\sqrt{2}$

SECTIONB: Attempt any three questions (30marks)

16. introduction **(1mark)**
Body **(8 marks)**
Conclusion **(1 marks)**

17. Applying Kirchhoff's junction rule to junction c gives **(10 marks)**

$I_1 + I_2 = I_3$

abcd: $10.0 - 6.0I_1 - 2.0I_3 = 0$

befcb: $-14.0 + 6.0I_1 - 4.0I_2 = 0$

$10.0 - 6.0I_1 - 2.0(I_1 + I_2) = 0$

$10.0 = 8.0I_1 + 2.0I_2$

$-12.0 = -3.0I_1 + 2.0I_2$

$22.0 = 11.0I_1 \Leftrightarrow I_1 = 2.0\,A$

$2.0I_2 = 3.0 \times 2.0 - 12.0 \Leftrightarrow I_2 = -3.0\,A$

$I_3 = -1A$

18. a. A=4m **(1mark)**

b.

$$f = \frac{\omega}{2\pi} = \frac{1.33}{2(3.14)} = 0.2117 / \sec$$

(1mark)

c.

$\omega = 1.33 rad / \sec$ **(2marks)**

d.

$$T = \frac{1}{f} = \frac{1}{0.2117} = 4.724 \sec$$

(1mark)

e.

$v = -\omega A \sin(\omega t + \theta)$

$v = -5.32 \sin(1.33t + \frac{\pi}{5})$ **(2marks)**

f.

$$a = -\omega^2 A \cos(1.33t + \frac{\pi}{5})$$

$$a = -7.08 \cos(1.33t + \frac{\pi}{5})$$

(2marks)

g.

$$k = m\omega^2 = (1.75)(1.33)^2 = 3.0956 N / m$$

(1mark)

19. a. it is travelling towards – x direction. **(1mark)**

(b) (i)**Angular wave number or Propagation constant,** $k = \frac{\emptyset}{x} = \frac{20x}{x} = 20\text{m}^{-1}$.

(ii) **Angular frequency,** $\omega = 200$ **rad/s /2mks**

(iii)**Wave speed** $v = \lambda f = 0.31 \times 32 = 10\text{m/s}$ **/2mks**

(5marks)

(c) **Given** $x = 0.3m$ **and** $t = 0.02s$ $v = \frac{dy}{dt} = -0.003 \times 200\sin(20x + 200t) = +0.33\text{m/s}$

(2marks)

(d) **Given** $x = 0.3m$ **and** $t = 0.02s$ $a = \frac{dv}{dt} = -0.6 \times 200\cos(20x + 200t) = +101\text{m/s}^2$

(2marks)

20. (a)State Newton's law of universal gravitation. The Universal law of gravitation 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.

For the planet tomove around the sun in orbit of constant radius: $F_1=F_2$

$$\frac{Gm_1m_2}{R^2} = \frac{mv^2}{R}$$

$$v^2 = \frac{Gm_1}{R}$$

But linear velocity $v = \omega R$ **and** $\omega = \frac{2\pi}{T}$ **where** ω *is the angular velocity.*

So,

$$\frac{4\pi^2R^2}{T^2} = \frac{Gm_1}{R}$$

$$R^3 = kT^2$$

(4marks)

(c) **Data:** $m_1=50\text{kg}$, $m_2=70\text{kg}$, $r=0.5\text{m}$

To be found: $F_g=?$

Solution: $G\frac{m_1m_2}{r^2} = 10^{-6}N$

(4marks)