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THE UNIVERSITY OF BAMENDA HIGHER TEACHER'S TRAINING COLLEGE

BAMBILI

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REPUBLIQUE DU CAMEROUN

Paix – Travail - Patrie

UNIVERSITE DE BAMENDA ECOLE NORMALE SUPERIEURE BAMBILI

COMPETITIVE ENTRANCE EXAMINATION INTO FIRST YEAR OF THE FIRST CYCLE

ACADEMIC YEAR: 2015/2016

DEPARTMENT: PHYSICS

<u>Instructions</u>: Answer all the questions in section A and section B by selecting the most appropriate option that answers each MCQ. Write the letter (A, B, C or D) that corresponds to the most correct option in the Answer Booklet provided. Make sure you insert the question paper inside the answer Booklet before you leave the Examination Hall

Good luck! Time allowed: 3 Hours.

SECTION 1: MAJOR PAPER: PHYSICS: Answer all the Questions

- 1. If the velocity is $\vec{V} = 2\vec{i} 3\vec{j} + \vec{k}$ and the position vector is $\vec{r} = \vec{i} + 2\vec{j} 3\vec{k}$, find the angular momentum for a particle of mass 0.5kg. A. $3.5(\vec{i} - \vec{j} - \vec{k})$ B. $3.5(\vec{i} - \vec{j} + \vec{k})$ C. $-3.5(\vec{i} + \vec{j} + \vec{k})$ D. $3.5(\vec{i} + \vec{j} + \vec{k})$
- 2. A ball of mass 0.2kg and radius 0.5m starting from rest rolls down a 30^o inclined plane. Find the time it would take to cover 7m
 A. 3.5s
 B. 20s
 C. 2s
 D. 10s
- 3. The values of x for which $2(2^{2x}) 5(2^x) + 2 = 0$ are A: x = -1 and x = 1 B: x = 2 and x = 1/2 C. x = 4 and x = 1 D. x = 2 and x = 1
- 4. The length of the line joining the points (3,-4) and (-7,2) is A: $2\sqrt{13}$ B: $2\sqrt{34}$ C: 16 D: 4
- 5. A relation R defined on a set H such that ∀a,b∈ H, aRb and bRa ⇒ a = b is said to be A: transitive B: reflexive C: anti-symmetric D: symmetric



- 6. A spring is hung from a ceiling. A 0.450kg block is then attacked to the free end of the spring. When released from rest, the block drops 0.150m before momentarily coming to rest, after which it moves back upward. Find the angular frequency of the block's vibrations [A] 25 rad/s, [B] 11.4 rad/s, [C] 15.2 rad/s, [D] 20 rad/s.
- 7. A projectile is fired at an angle of 30⁰ to the horizontal with an initial velocity of 800m/s. Find the time of flight of the projectile before it hits the ground [A] 138.56s, [B] 80s, [C] 160s, [D] 40s.
- An object is projected horizontally with velocity 40m/s. Find the radius of curvature of its trajectory in 3s after the motion has begun. [A] 312.50m, [B] 43.27m, [C] 135.31m, [D] 50m.
- 9. A block of mass 2kg slides on an inclined plane that makes an angle of 30⁰ with the horizontal. The coefficient of friction between the block and the surface is √3/2. What force should be applied to the block so that it moves down without any acceleration? [A] 1.50N, [B] 1.73N, [C] 9.80N, [D] 4.90N.
- 10. A mass M attached to a spring oscillates with a period of 2s. If the mass is increased by 2kg, the period increases by 1s. Assuming that Hooke's law is obeyed, find the initial mass m.

[A] 1.60kg, [B] 800g, [C] 2.50kg, [D] 1 20kg.

- 11. The power factor of an alternating current LR-circuit is $[A] \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$, [B] zero, $[C] \frac{R}{\sqrt{\omega L}}$, $[D] \sqrt{R^2 + \omega^2 L^2}$
- 12. Two point charges +8q and -2q are located at x = 0 and x = L respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is

[A] L/2, [B] 2L, [C] 4L, [D] 8L.

- 13. One wishes to replace to a condenser of capacitance $1\mu F$ by an equivalent condenser made of two condensers connected in series. The capacitances of these two condensers can be [A] $(0.5\mu F, 0.5\mu F)$; [B] $(2\mu F, 1\mu F)$; [C] $(1\mu F, 1\mu F)$; [D] $(2\mu F, 2\mu F)$.
- 14. In experiments to pass a very high current through a gas, a bank of capacitors of total capacitance $50\mu F$ is charged to 30KV. If the bank of



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capacitors could be discharged completely in 5.0ms, what would be the mean power delivered? [A] 22KW, [B] 110KW, [C] 4.5MW, [D] 9.0MW.

- 15. A $400\mu F$ capacitor is charged so that the voltage across its plates riches at a constant rate from 0V to 4.0V in 20s. What current is being used to charge the capacitor? [A] $5\mu A$, [B] $20\mu A$, [C] $40\mu A$, [D] $80\mu A$.
- 16. Three resistors of 4Ω , 6Ω and 12Ω are connected together in parallel. This arrangement is then connected in series with a 1Ω and 2Ω resistors. If a potential difference of 120V is applied across the end of the circuit, what will be the potential drop across the part of the circuit connected in parallel? [A] 36V,

[B] 72V, [C] 24V , [D] 48V.

17. A $100\mu F$ capacitor and a $10\mu F$ capacitor are charged so that the potential difference across each of them is the same. The charge stored in the $100\mu F$ capacitor is Q₁ and the charge stored in the $10\mu F$ capacitor is Q₂. What is the ratio $\frac{Q_1}{Q_2}$? [A] 0.01, [B] 100,

[C] 10, [D] 1.

18. A battery having an emf 24V and a resistance 2Ω is connected to a 10Ω load resistance. Calculate the electrical power consumed by the load resistance. [A] 11.52W, [B] 48W, [C] 8W, [D] 40W.

19. Calculate the capacitance of a parallel plate capacitor of area 4cm^2 and thickness 0.2mm if a liquid with a dielectric constant K = 1000 is inserted [A] 17.7nF, [B] $177\mu F$, [C] 17.7pF, [D] 17.7F.

- 20. A capacitor of capacitance $C=1000\mu F$ is charged through a resistance $R=100K\Omega$ using a voltage of 12V. Find the voltage across the capacitor in a time t = 3 minutes after the start of charge [A] 10.02V, [B] 1.98V, [C] 12V, [D] 0V.
- 21. Sound travels at a speed of about 344m/s in air. You see a distant flash of lightning and hear the thunder arrive 7.5 seconds later. How many miles away was the lightning strike? (Assume the light takes essentially no time to reach you.) [A] 2.5mi, [B]

13.0mi, [C] 1.60mi, [D] 2.10mi.



- 22. A lamp is placed 10cm in front of a concave spherical mirror that forms an image of the filament on a screen placed 3.0m from the mirror. What is the radius of curvature of the mirror? [A] 19.40cm, [B] 20.25cm, [C] 12.3cm, [D] 15.0cm.
- 23. A concave mirror has a radius of curvature wit absolute value 20cm. Find the image of a real object in the form of an arrow perpendicular to the axis of the mirror at a distance of 30cm [A] 10.20cm, [B] 15.0cm, [C] 12.5cm, [D] 17.50cm.
- 24. A small source emits sound waves with a power output of 80.0W. Find the intensity 3.00m from the source [A] 0.625W/m²; [B] 0.575W/m²; [C] 0.236W/m²; [D] 0.707W/m².
- 25. Assuming a normal near point 25cm, what power of lens is required to correct for farsightedness where the uncorrected near point is 50cm?[A] -2 Diopters [B] -0.5 Diopters [C] 2 Diopters [D] 4 Diopters
- 26. A typical adult ear has a surface area of $2.0 \times 10^{-3} \text{m}^2$. The sound intensity during a normal conversation is about $4.0 \times 10^{-3} \text{W/m}^2$ at the listener's ear. Assuming that the sound strikes the surface of the ear perpendicularly. The power intercepted by the ear is [A] 8.0 $\times 10^{-6}$ W; [B] 2.0W; [C] 0.5W; [D] None of these.
- 27. The blue color in fireworks is often achieved by heating copper(I) chloride (CuCl) to about 1200°C. Then the compound emits blue light having a wavelength of 450nm. What is the increment of energy (the quantum) that is emitted at 4.50 x 10²nm by CuCl? [A] 4.41 x 10⁻¹⁹J, [B] 4.43 x 10⁻¹⁹J, [C] 4.42 x 10⁻¹⁹J, [D] 5.51 x 10⁻¹⁹J.
- 28. In Michelson's interferometer 100 fringes cross the field of view when the movable mirror is displaced through 29.48μm.Calculate the wavelength of the monochromatic light used. [A] 1474Å, [B] 2948Å, [C]5896Å, [D]492Å.
- 29. Two sinusoidal waves having the same frequency and traveling in the same direction are combined. If their amplitudes are 6.0cm and 8.0cm and have a phase difference of π/2 rad, determine the amplitude of the resultant motion.
 [A] 14.0cm, [B] 10.0cm, [C] 2.0cm, [D] 6.93cm.



- 30. In Young's experiment for what order does the band of wavelength of redlight $(\lambda = 780 \text{nm})$ coincide with (m + 1)th order in the band ofbluelight $(\lambda = 520 \text{nm})$?[A] 7,[B] 4,[C] 2,[D] 5.
- 31. A single charged particle of known velocity 2.0 . 10⁷m/s but unknown mass moves in a bubble chamber in a circular path of radius 41.75cm in a field of 0.5T acting perpendicular to the path. Determine the mass of the particle. [A] 2.56 . 10⁻²⁸Kg, [B]

9.1 . 10^{-31} Kg, [C] 1.67 . 10^{-27} Kg, [D] 12g.

- 32. In the Bohr model of hydrogen atom the electron revolves in a circular orbit of radius 0.53Å with a period of 3.2 . 10⁻¹³ s. Find the corresponding current. [A] 5 . 10⁻⁷A, [B] 9433.96A, [C] 2.65 . 10⁻¹⁷A, [D] 2 . 10⁶A.
- 9433.96A, [C] 2.65 . 10⁻¹⁷A, [D] 2 . 10°A.
 33. A neutron moving with velocity V₀ = 3900m/s collides head-on with carbon nucleus of mass number 12. Assuming that the collision is elastic, calculate the velocities of the neutron and the carbon nucleus after the collision. [A] 3300m/s,

[B] 325m/s, [C] 46.8m/s, [D] 3900m/s.

- 34. The electron in a hydrogen atom orbits the proton at a radius of 5.3 . 10⁻¹¹m.What is the magnitude of the electric force on the electron?
 [A] 20.8 . 10⁻⁸N, [B] 8.02 . 10⁻⁸N, [C] 8.2 . 10⁻⁸N
 [D] 5.3 . 10⁻²N.
- 35. A particle is moving in a plane with constant radial speed r
 = 5m/s and a constant angular velocity θ
 = 4.0rad/s. Determine the magnitude of the velocity when the particle is 3m from the origin. [A] 4.123m/s, [B] 13.00m/s, [C] 12.369m/s, [D] 2.380m/s
- 36. A particle makes simple harmonic motion along a straight line and its velocity when passing through points 3 and 4cm from the center of its path is 16 and 12cm/s, respectively. Find the time period of motion. [A] 2.10s, [B] 3.15s, [C] 1.57s, [D] 1.0s
- 37. If two springs of constants $K_1 = 100$ M and $K_2 = 300$ M are connected in parallel, the equivalent spring constant is [A] 75N/m, [B] 400N/m, [C] 300N/m, [D] 200N/m



- 38. Two rockets having the same acceleration start from rest, but rocket A travels for twice as much time as rocket B. If rocket A goes a distance of 250km, how far will rocket B go [A] 70.3km, [B] 62.5km, [C] 25.2km, [D] 50.0km
- 39. Take the acceleration due to gravity, g_E , as $10m/s^2$ on the surface of the Earth. The acceleration due to gravity on the surface of the Moon is $\frac{g_E}{\epsilon}$. An object whose weight on earth is 5.0N is dropped from rest above the Moon's surface. What is the momentum after falling for 3.0s? [C] 15kgm/s, [D] 25kgm/s [A] 6.2kgm/s, [B] 2.5kgm/s, 40. The magnetic field of an electromagnetic wave is given by the relation $B = 3 \cdot 10^{-4} \sin(4 \cdot 10^{5} t)$ where all quantities are in S.I units. Find the magnitude of electromotive force induced by the field in a 200-turn coil of 15cm^2 area placed normal to the field [A] 36V, [B] 3.6V, [C] 12V, [D] 9V

SECTION 2: MINOR PAPER: PHYSICS: CHEMISTRY & MATHEMATICS Answer all the Questions

1. Which process represents the C-Cl bond enthalpy in tetrachloromethane?

A) $CCl_{4(g)} \rightarrow C_{(g)} + 4Cl_{(g)}$ B) $CCl_{4(g)} \rightarrow CCl_{3(g)} + Cl_{(g)}$

- C) $CCI_{4(1)} \rightarrow C_{(g)} + 4CI_{(g)}$ D) $CCI_{4(1)} \rightarrow C_{(s)} + 2CI_{2(g)}$
- 2. Which reaction has the greatest increase in entropy?
 - A) $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$ B) $H_{2(g)} + CI_{2(g)} \rightarrow 2HCI_{(g)}$
 - C) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$ D) $C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(g)}$
- 3. Consider the following reversible reaction $Cr_2O_7(_{aq}) + H_2O_{(I)} \square 2CrO_4^{2-}_{(aq)} + 2H_{(aq)}^{+}$ What will happen to the position of the equilibrium and the value of K_c when more H⁺ ions are added at constant

temperature?

	Position of equilibrium	Value of K_c
A)	Shifts to the left	Decreases
B)	Shifts to the right	Increases
C)	Shifts to the right	Does not change
D)	Shifts to the left	Does not change



- 4. Consider these standard electrode potentials.
 - $\begin{array}{cccc} \mathsf{Mg}^{2+}_{(\mathsf{aq})} + 2e^{-} & \mathsf{Mg}_{(\mathsf{s})} & \mathsf{E}^{\theta} = -2.36\mathsf{V} & \mathsf{Zn}^{2+}_{(\mathsf{aq})} + 2e^{-} & \mathsf{Zn}_{(\mathsf{s})} & \mathsf{E}^{\theta} = -\\ 0.76\mathsf{V} & \text{What is the cell potential for voltaic cell} \\ \text{produced when the half-cells are connected?} & \mathsf{A}) -1.60\mathsf{V} \\ \mathsf{B}) + 1.60\mathsf{V} & \mathsf{C}) 3.12\mathsf{V} & \mathsf{D}) + 3.12\mathsf{V} \end{array}$
- 5. What is the IUPAC name for HCOOCH₂CH₂CH₃?
 A) butanoic acid B) butanal C) methyl propanoate D) propyl methanoate.
- 6. Which conditions are required to obtain a good yield of a carboxylic acid when ethanol is oxidized using potassium dichromate (VI), K₂Cr₂O_{7(aq)}?
 1. Add sulfuric acid II. Heat the reaction mixture under reflux III. Distil the product as the oxidizing agent is added.
 A) I and II only B) I and III only C) II and III only D) I, II and III.
- 7. What is the standard entropy change, ΔS^{θ} , for the following reaction? $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$.

	CO _(g)	O _{2(g)}	CO _{2(g)}
$S^{\theta}/JK^{-1}mol^{-1}$	198	205	214
A) -189	B) -173	C) +173 D) +189)

- 8. 100cm³ of NaOH solution of pH 12 is mixed with 900cm³ of water. What is the pH of the resulting solution? A) 1 B) 3 C) 11 D) 13.
- 9. The indicator, HIn is used in a titration between an acid and a base. Which statement about the dissociation of the indicator, HIn is correct? HIn_(aq)

 $H^{+}_{(aq)} + In^{-}_{(aq)}$

Colour A

Colour B

- A) In a strongly alkaline solution, colour B would be observed.
- B) In a strongly acidic solution, colour B would be observed
- C) [In⁻] is greater than [HIn] at equivalence point
- D) In a weakly acidic solution colour B would be observed.
- 10. What structural feature must a molecule have in order to undergo addition polymerization?
 - A) Two functional groups
 - B) A carbon-carbon double bond
 - C) Carbon atoms single bonded together



D) A polar covalent bond. 11. Solve the equation $In(7^{n}x) = 2n$ for any real number n [A] $(e^2/7)^n$; [B] $(7/e^2)^n$; [C] $(7e^2)^n$; $[D] 7(e^2)^n$. 12. Te first term V_0 and the common ratio q of the geometric sequence V_n = $(e^2/7)^n$ is given by [A] $(V_0,q) = (e^2/7,1);$ [B] $(V_0,q) = (1,e^2/7);$ [D] $(V_0,q) = (e^2/7, e^2/7)$. $[C] (V_0,q) = (1,7e^2);$ 13. If Z = Cos θ + iSin θ then the real part of Z = $z^7 - \frac{1}{z^7}$ is [C] $\cos^7 \theta$: [B] 0; [A] Cos7 θ ; [D] Sin7 θ + Sin7 θ . In the complex plane (0, \vec{u}, \vec{v}) is defined the application $f(z) = \frac{2-iZ}{1-Z}, z \neq 1$. 14. Determine the magnitude and argument of f(2). [A] $[2\sqrt{2}, \frac{\pi}{4}];$ [B] $[2\sqrt{2}, \frac{5\pi}{4}];$ [C] $[2\sqrt{2}, \frac{3\pi}{4}];$ [D] $[2\sqrt{2}, \frac{7\pi}{4}].$ 15.Determine k if $[f(2)]^k$ is a real number [A] K = (-4/3)n; [B] k = (3/4)n; [C] k = (4)n; [D] k = (4/3)n. 16. Given the line L: x + y + 1 = 0 and the point A(-1,-1). The perpendicular distance from A to I is: [A] 0; [B] $\sqrt{2}$; [C] $\frac{\sqrt{2}}{2}$; [D] $\frac{1}{2}$ 17. Choose the correct answer among the following propositions [A] $2^{n} = \sum_{k=0}^{n} C_{k}^{m}$; [B] $2^{n} = \sum_{k=0}^{n} A_{n}^{k}$, [C] $2^{n} = \sum_{k=0}^{n} C_{n}^{k}$, [D] $2^{n} = \sum_{k=0}^{n} C_{n-1}^{k}$ 18.An orthogonal vector to V = (1,-1,4,3) is [A] (2, 4,5,-6); [B] (1,1,3,-6); [C] (2,4,5,6); [D] (0,0,-5,-6) $\frac{1}{n} + \sqrt{\frac{2}{n}} + \ldots + \sqrt{\frac{n}{n}}$ [A] 3/2; [B] 2/3; [C] 0; [D] +∞. 19. Evaluate lim Evaluate $\lim_{x \to +\infty} \frac{1}{n} \sum_{k=1}^{n} \sin \frac{k\pi}{n}$. [A] + ∞ ; [B] $\pi/2$; [C] $2/\pi$; [D] 0

