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6M20292 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Sixth Semester B.Sc. Degree Examination, March/April 2020**

**BPHY6B10 – Thermal & Statistical Physics**

(2017 Admission onwards)

me: 3 hours Max. Marks:80

## SECTION A

**(Answer all in a sentence; each question carries one mark)**

1. State zeroth law of thermodynamics.
2. Give the differential form of first law of thermodynamics.
3. State the working principle of refrigerator.
4. What are the factors on which the efficiency of a heat engine depends on?
5. Write the working principle of a pressure cooker.
6. Explain the concept of entropy and available energy.
7. Define r.m.s. speed of gas molecule.
8. What are bosons? Give two examples.
9. State Stefan's law.
10. Is entropy a path function? Explain.

**(10x1=10 marks)**

## SECTION - B

**(Answer in two or three sentences)**

**(Answer all questions. Each question carries 2 marks)**

11. Distinguish between isothermal and adiabatic processes.
12. Derive an expression for the work done during an isothermal process.
13. Distinguish between intensive variables and extensive variables.
14. Write the equations for rms speed, most probable speed and mean speed and explain the symbols.
15. What is a T.S diagram? What is its importance?
16. Give the difference between internal combustion engine and external combustion engine.
17. Show that adiabatics are steeper than isotherms.

**(7x2=14 marks)**

## SECTION - C

**(Answer in a paragraph of about half a page to one page)**

**(Answer any five questions: Each question carries 4 marks)**

18. Write a note on first order and second order phase transition.
19. Explain quasistatic process with an example.
20. Obtain Mayer's relation for the specific heat of an ideal gas.
21. Explain the effect of pressure on the melting point of substances using Clausius-Clayperon equation.

22. Write a note on thermodynamic scale of temperature.
23. Explain enthalpy, Helmholtz free energy and Gibbs potential.
24. Explain the entropy change in (a) reversible process (b) irreversible process.

**(5x4=20 marks)**

**SECTION-D**

**(Problems-write all relevant formulas, all important steps carry separate marks)**
**Answer any four questions; each question carries 4 marks.**

25. A quantity of dry air at $27^0$C and atmospheric pressure is suddenly compressed to half its original volume. Find the final pressure and temperature ($\gamma$ =1.4)
26. Find the efficiency of a carnot engine working between steam point and ice point.
27. Calculate the change in entropy when 10g of ice at $0^0$C is converted into water at $100^0$C. Latent heat of ice is $336x10^3 JKg^{-1}$.
28. Find the increase in the boiling point of water at $100^0$C when the pressure is increased by 1 atmosphere. Latent heat of vaporisation of steam is 540 cal/gm and 1gm of steam occupies a volume of 1677 $cm^3$.
29. If a blackbody at a temperature 6174K emits 4700 A° with maximum energy, calculate the temperature at which it will emit a wavelength of $1.4 \times 10^{-5}$m with maximum energy.
30. Calculate the value of rms speed of a molecule of hydrogen at NTP. K=$1.38x10^{-23}$ J/degree and Avagadro number is $6x10^{23}$gm/mol.
31. The average kinetic energy of a gas molecule at a certain temperature is $6.21 \times 10^{-21}$J. Find the temperature. Boltzmann's constant K=$1.38 \times 10^{-23} JK^{-1}$.

**(4x4=16 marks)**

**SECTION - E**

**(Essay-answer in about two pages)**
**Answer any two questions; each question carries 10 marks**

32. Describe Carnot's cycle and obtain an expression for the efficiency of an ideal heat engine.
33. Distinguish between Maxwell Boltzmann statistics, Fermi Dirac statistics, and Bose Einstein statistics.
34. Establish the following relation
$C_P - C_V = -T(\partial V/\partial T)^2_P (\partial P/\partial V)_T$
35. Applying Fermi Dirac distribution law to an electron gas, show that the distribution of energy among free electrons of a conductor is
$n(E)dE = (8\sqrt{2}\pi V/h^3)(m^{3/2}E^{1/2}dE/e^{(\alpha+\beta E)}+1)$

**(2x10=20 marks)**

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Name:.....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Sixth Semester B.Sc. Degree Examination, March/April 2020**

**BPHY6B11 – Solid State Physics, Spectroscopy & Laser Physics**

(2017 Admission onwards)

Time: 3 hours Max. Marks:80

**SECTION A**

**(Answer all in a sentence; each question carries one mark)**

1. Explain the termbravais lattice.
2. What is the coordination number of a crystal?
3. What are point group symmetry operations?
4. Give an example of a high temperature super conductor.
5. What is meant by population inversion in laser?
6. Define critical magnetic field in a superconductor.
7. Convert 2000 $cm^{-1}$ to μm
8. What is a spherical top molecule?
9. Write down the expression for rotational constant B.
10. What are Einstein's coefficients?

**(10×1=10 marks)**

**Section B**

**(Answer in two or three sentences)**
**Answer all questions.Each Question caries 2 marks**

11. Explain the Meissner effect
12. Describe the interaction of radiation with rotating molecules.
13. Why Anti-stokes lines are less intense than Stokes lines?
14. Write a short note on cooper pair.
15. Explain the formation of hot bands in vibrating diatomic molecules
16. Draw (101) and(111) planes in a cubic unit cell.
17. Calculate the packing fraction for a face centered cubic crystal lattice

**(7×2=14 marks)**

**Section C**

**(Answer in a paragraph of about half a page to one page)**
**Answer any five questions: Each question carries 4 marks**

18. Describe the crystal structure of sodium chloride
19. Explain the effect of population of energy states on the intensity of spectral lines
20. Explain the working of a microwave spectrometer.
21. Describe the Josephson effect in superconductivity.
22. Distinguish between type I and type II superconductors
23. Derive Bragg's law of X-ray diffraction
24. Explain the working of He-Ne laser

**(5×4=20 marks)**

## Section D

**(Problems-write all relevant formulas,all important steps carry separate marks)**
**Answer any four questions: Each question carries 4 marks**

25. Copper has fcc structure and its atomic radius is 0.1278 nm.Calculate its density.The atomic weight of copper is 63.5amu.
26. The critical temperature for mercury with isotopic mass 199.5amu is 4.185K.Calculate its critical temperature when its isotopic mass changes to 203.4amu.The α value is 0.5.
27. The first line in the rotational spectrum of carbonmonoxide has a frequency of 3.8424 $cm^{-1}$.Calculate the rotational constant and hence find C-O bond length in carbon monoxide. Avogadro number is $6.022\times10^{23}$/mol
28. The equilibrium vibration frequency of Iodine molecule is 215 $cm^{-1}$ and the anharmonicity constant is 0.003. What is the intensity of the hot band v = 1 to v = 2 relative to the fundamental v = 0 to v = 1, if the temperature is 300K?
29. Irradiation of carbon tetrachloride by 4358Å radiation gives Raman lines at 4400,4419,4447 Å.Calculate the Raman shift for each line in $cm^{-1}$
30. In a material at 300K, two energy levels have a wavelength separation of 1 μm. Determine the ratio of upper to lower level occupation densities when the material is in thermal equilibrium.
31. Electrons are accelerated by 344 V and are reflected from a crystal.The first reflection maximum occurs at a glancing angle 60°.Determine the spacing of the crystal.

**(4×4=16 marks)**

## Section E

**(Essay-answer in about two pages)**
**Answer any two questions; each question carries 10 marks**

32. Explain the diatomic vibrating rotator. Discuss the spectrum and relevant selection rules
33. Discuss the bcc and fcc crystal structure. Show that the packing factor for bcc and fcc structure are $\sqrt{3}\,\pi/8$ and $\sqrt{2}\,\pi/6$ respectively
34. Explain rotational fine structure of vibrational raman spectra. State mutual exclusion principle
35. Describe the rotational spectra of rigid diatomic molecules with example. Also explain the isotope effect in rotational spectra

**(2×10=20 marks)**

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Sixth Semester B.Sc. Degree Examination, March/April 2020**

**BPHY6B12 – Nuclear Physics, Particle Physics & Astrophysics**

(2017 Admission onwards)

Time: 3 hours Max. Marks:80

*Symbols used in this question paper have their usual meanings*

## SECTION A

**(Answer *ALL* in a sentence. Each question carries 1 mark)**

1. How the mass number of a nucleus related to its radius?
2. What is the energy equivalent in MeV of one amu of mass?
3. Give the relationship between radioactive decay constant and half life.
4. Which is the phosphor usually used in scintillation counters?
5. What is the order of magnitude of energy of cosmic rays?
6. Give the quark structure of a proton.
7. Name the carriers of colour force.
8. What are fermions?
9. What is the absolute magnitude of a star?
10. Write down the relation between the change in magnitude and apparent brightness of stars.

**(10 × 1 = 10 marks)**

## SECTION B

**(Answer in Two or Three sentences)**
**Answer *ALL* questions. Each question carries 2 marks**

11. What are isotopes, isobars and isotones?
12. List three reasons to show that electrons are not a part of the nucleus.
13. What are secondary cosmic rays?
14. Give the one to one correspondence between the symmetries and the laws of conservation.
15. What are the properties of neutrinos?
16. What is meant by dark energy?
17. Define astronomical unit (AU). Express one light year in terms of AU.

**(7 x 2 = 14 marks)**

## SECTION C

**(Answer in a paragraph of about half a page to one page)**
**Answer any *FIVE* questions. Each question carries 4 marks**

18. Draw the binding energy curve. Explain the important features of the curve.
19. Explain the properties of nuclear force.
20. Describe the method of carbon dating.
21. Explain any two geomagnetic effects of cosmic rays.
22. What are the different quantum numbers associated with elementary particles.
23. Explain briefly the principle of betatron.
24. Write a brief note on stellar constellations.

**(5 × 4 = 20 marks)**

## SECTION D

**(Problems- Write all relevant formulae. All important steps carry separate marks)**
**(Answer any *FOUR* questions. Each question carries 4 marks)**

25. Calculate the mass of deuterium nucleus if its binding energy per nucleon is 1 MeV. Given that mass of a proton = 1.00758 u, mass of a neutron = 1.00898 u.
26. Find the maximum height of the potential barrier for alpha penetration through $^{238}U$ nucleus. The radius of the daughter nucleus is $9.3 \times 10^{-13}$ cm.
27. Calculate the time required for 10% of a sample of thorium to disintegrate, assuming that half life of thorium is $1.4 \times 10^{10}$ years.
28. Deuterons are accelerated using a cyclotron of dees radius 0.80m. If the magnetic flux density applied is 1.4 T, calculate the energy of the emerging deuterons. Also calculate the frequency of the oscillator. Mass of deuteron = 2.10656 u.
29. Calculate the Q-value in MeV of the reaction $_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1$. Given masses of $_1H^2 = 2.0114$ u, $_2He^3 = 3.01603$ u, $_0n^1 = 1.008665$ u.
30. Check the possibility of the following reactions. State the conservation principles involved: (i) $\Lambda^0 \rightarrow \pi^+ + \pi^-$ (ii) $\pi^- + p \rightarrow \Lambda^0 + K^0$
(iii) $p \rightarrow n + e^+ + \nu$ (iv) $p + p \rightarrow n + p + \pi^+$
31. The apparent magnitude of a star is +3.3 and its parallax is 0.025 Calculate the absolute magnitude of the star.

**(4 × 4 = 16 marks)**

## SECTION E

**(Essays – Answer in about two pages)**
**(Answer any TWO questions. Each question carries 10 marks)**

32. On the basis of the liquid drop model, derive the semi-empirical mass formula.
33. Describe the special features of the beta ray spectrum. Explain how Pauli's neutrino hypothesis explained the spectrum.
34. Explain the important features of nuclear fusion. Discuss the different fusion cycles for the origin of stellar energy.
35. Explain the construction and working of a linear accelerator. What are its limitations?

**(2 × 10 = 20 marks)**

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Sixth Semester B.Sc. Degree Examination, March/April 2020**

**BPHY6B13 (E1)– Computational Physics**

(2017 Admission onwards)

Time: 3 hours Max. Marks:80

*Section A*

**Answer all questions**

1. Who created the python programming language.
2. What gets printed if we type in python

   >>> print type(1/2)
3. In python the result of floor division 14.8//2 is .....
4. The conversion of high level language to machine language is done by....
5. Human readable form of programming language is known as.....
6. Extracting a part from string is known as.....
7. What is the output of the following python program

   >>> A=[1,2,3,None,(),[],]

   >>>printlen(A)
8. In difference table $\Delta^2 y_1$ = .....
9. Give an example of compound data type.
10. If *s* is string and s='10', what is the data generated by the statement s*2

**(10 x1 =10 Marks)**

**Section B**

**Answer all questions**

11. What are the supported data types in python.
12. Write a short python program to check given number is even or odd.
13. What are the source of error in numerical computation. Explain
14. Explain how 'infinite looping' is achieved in python language .
15. Briefly explain the use of range ( ) function in python.
16. Write a python program to add an element 6 to a list x=[1,3,5,8] and to print that element.
17. Write a program to print the sum of the following series.

$$1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\ldots\ldots\ldots\ldots+\frac{1}{n}$$

**(7 x 2 = 14 Marks)**

## Section C

**Answer any *five***

18. Illustrate the different types of control flow statements available in python with flowcharts.
19. Differentiate user defined functions and built in functions associated with python language. Give examples.
20. How to create a list in python. Illustrate the use of negative indexing of list with examples.
21. What is the difference between a module and a package in python.
22. Discuss dynamic type system associated with python language.
23. Explain the Runge-Kutta method to solve first order differential equation.
24. Illustrate how the break and continue statements can be used in Python?

**(5 x 4 =20 M**

## Section D

**Answer any *four***

25. Using Euler's method find the approximate value of y when x= 0.4

$$\frac{dy}{dx} = x + y^2;$$ y(0) =1 and h=0.1

26. Estimate $\frac{dy}{dx}$ at x=0.26from the following table:

| $x$ | 0.25 | 0.26 | 0.27 | 0.28 | 0.29 |
|---|---|---|---|---|---|
| $y$ | 0.2474 | 0.2571 | 0.2667 | 0.2764 | 0.2860 |

27. The population of a city in a census taken once in ten years is given below. Estima population in the years 1925.

| Year | 1921 | 1931 | 1941 | 1951 | 1961 | 1971 | 198 |
|---|---|---|---|---|---|---|---|
| Population in thousands | 35 | 42 | 58 | 84 | 120 | 165 | 220 |

28. Using Taylor series evaluate $\cos\sqrt{x}$ to 4 significant digit of accuracy for x=5.8
29. Find an approximation of $\sqrt{5}$ correct to within $10^{-4}$ by using the bisection method
30. Write a program to obtain multiplication table upto 15 of a given number.
31. Write a python program to simulate two dimensional projectile motion of a body under gravity. Use Euler method.

**(4 x 4 =16**

## Section E

**Answer any two**

32. What is curve fitting ? Discuss the principle of least squares and straight line fitting . Find the equation of the best fit straight line for the following data points:

| x | 1 | 2 | 4 | 5 | 6 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| y | 2 | 5 | 7 | 10 | 12 | 15 | 19 |

33. (a) Explain the Trapezoidal and Simpson's 1/3 rule of integration with the help of suitable diagram

(b) A rocket is launched from the ground. Its acceleration measured every 5 seconds is tabulated below. Find the velocity of the rocket at t=40 seconds. Use Trapezoidal and Simpson's rules. Compare the answers

| t | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
|---|---|---|---|---|---|---|---|---|---|
| a(t) | 40.0 | 45.25 | 48.50 | 51.25 | 54.35 | 59.48 | 61.5 | 64.3 | 68.7 |

34. (a) Explain the Newton-Raphson method

(b) Find all the three roots of the equation using $f(x) = x^3 - x^2 - 15x + 1$ using Newton-Raphson method.

35. Write a python program to obtain the numerical solution for the motion of a body falling in a viscous medium.

**(2x 10 =20 Marks)**