Unit 3 - Week 2

Week 2 Assignment 1

The due date for submitting this assignment has passed. **Due on 2017-08-14, 23:55 IST.**

Submitted assignment

Note: More than one option can be correct.

1) At very small scales (micro and Nano) surface forces becomes _____ as compared to volume forces. *1 point*

- comparable
- significant
- insignificant
- none of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
significant

2) Match the following: *1 point*

1. Gases/liquids	A. Lattice Vibration
2. Metals	B. Free Electrons
3. Dielectric solids/semi-conductors	C. Molecular collision

- 1-A,2-B,3-C
- 1-B,2-C,3-A
- 1-C,2-B,3-A
- 1-A,2-C,3-B

No, the answer is incorrect.
Score: 0

Accepted Answers:
1-C,2-B,3-A

3) Lenard Jones Potential is given by *1 point*

- $(A/r^{12} - B/r^{6})$
- $(A/r^{12} + B/r^{6})$
- $(A/r^{12} - B/r^{5})$
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(A/r^{12} - B/r^{6})$

4) Which of the following particles are indistinguishable? *1 point*

- Phonons
- Electrons
- Molecules
- Photons

No, the answer is incorrect.
Score: 0

Accepted Answers:
Phonons
Electrons
Photons

5) Which of the following is Classical distribution function? *1 point*

- Fermi Dirac distribution function
- Bose- Einstein distribution function
- Maxwell-Boltzmann distribution function

- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
Maxwell-Boltzmann distribution function

6) The maximum frequency that a phonon can attain is **1 point**

- Debye frequency
- Resonance frequency
- Cumulative frequency
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
Debye frequency

7) Match the corresponding order of velocities (m/s). **1 point**

1. Phonons	A. 10^8
2. Electrons	B. 10^2
3. Molecule	C. 10^6
4. Photon	D.10^3

- 1-A, 2-B, 3-C, 4-D
- 1-B, 2-A, 3-C, 4-D
- 1-B, 2-A, 3-C, 4-D
- 1-D, 2-C, 3-B, 4-A

No, the answer is incorrect.
Score: 0

Accepted Answers:
1-D, 2-C, 3-B, 4-A

8) Match the corresponding order of wavelength associated with particles. **1 point**

1.Phonons	A. 1nm
2.Electrons	B. 10nm-50nm
3.Molecule	C. 1nm
4.Photon	D.10nm-1km

- 1-A, 2-B, 3-C, 4-D
- 1-B, 2-A, 3-C, 4-D
- 1-C, 2-B, 3-A, 4-D
- 1-D, 2-C, 3-B, 4-A

No, the answer is incorrect.
Score: 0

Accepted Answers:
1-A, 2-B, 3-C, 4-D

9) The trend of thermal conductivity observed when we keep on decreasing the length scale of silicon wafer is **1 point**

- Decreases (because of size effect), and then increases (due to wave effect).
- Increases (because of size effect), and then decreases (due to wave effect).
- Decreases (because of size effect), and then again decreases (due to wave effect).
- None of the above.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Decreases (because of size effect), and then increases (due to wave effect).

10) Quantised energy of a standing wave in 1D confinement is given by(take “D” as width of the confinement) **1 point**

- $\frac{h^2n^2}{8mD^2}$
- $\frac{h^2n^3}{8mD^2}$
- $\frac{h^2n^2}{8mD^4}$
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{h^2n^2}{8mD^2}$

11) Calculate the energy for electron standing wave in 1D confinement for n=3? (D=1nm) *1 point*

- 5.38×10^{-25} J
- 5.38×10^{-20} J
- 5.38×10^{-10} J
- 5.38×10^{-15} J

No, the answer is incorrect.
Score: 0

Accepted Answers:
5.38×10^{-20} J

12) When length scale decreases the quantization/discretization in energy becomes *1 point*

- insignificant
- significant

No, the answer is incorrect.
Score: 0

Accepted Answers:
significant

13) Mathematical Description of Schrodinger equation is given by *1 point*

- $\frac{\hbar^2}{2m}\nabla^2\psi + U\psi = i\hbar\frac{\partial\psi}{\partial x}$
- $H\psi = i\hbar\frac{\partial\psi}{\partial t}$
- $\frac{\hbar^2}{2m}\nabla^2\psi + U\psi = i\hbar\frac{\partial\psi}{\partial t}$
- $H/\psi = i\hbar\frac{\partial\psi}{\partial t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$H\psi = i\hbar\frac{\partial\psi}{\partial t}$

$\frac{\hbar^2}{2m}\nabla^2\psi + U\psi = i\hbar\frac{\partial\psi}{\partial t}$

14) $\psi^*\psi$ Represents *1 point*

- Fraction of wave characteristic at location in space.
- Has no physical meaning.
- Probability density function of finding a particle at location in space.
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
Probability density function of finding a particle at location in space.

15) Momentum operator is given by *1 point*

- $P=-i\hbar^2\nabla$
- $P=i\hbar\nabla$
- $P=-i\hbar\nabla$
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$P=-i\hbar\nabla$

16) Energy operator is given by *1 point*

- $H=\frac{k^2}{2m}+U$

- $H=\frac{p^2}{2m}+U$
- $H=\frac{-p^2}{2m}+U$
- $H=-\frac{\hbar^2}{2m}\nabla^2+U$
-

No, the answer is incorrect.
Score: 0

Accepted Answers:

$H=\frac{p^2}{2m}+U$

$H=-\frac{\hbar^2}{2m}\nabla^2+U$

17) Wave function for free particle in 1-D space is given by *1 point*

- $\psi(x,t) = Ae^{-2i(\frac{E}{\hbar}t+kx)} + Be^{-i(\frac{E}{\hbar}t-kx)}$
- $\psi(x,t) = Ae^{-i(\frac{E}{\hbar}t+kx)} + Be^{-1(\frac{E}{\hbar}t-kx)}$
- $\psi(x,t) = Ae^{-i(\frac{E}{\hbar}t+kx)} + Be^{-i(\frac{E}{\hbar}t-kx)}$
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\psi(x,t) = Ae^{-i(\frac{E}{\hbar}t+kx)} + Be^{-i(\frac{E}{\hbar}t-kx)}$

Linked Questions(18-24)

An Argon Laser emits light at 514nm and at a power of 1W and if photons are completely absorbed by a $1mm^2$ surface, calculate

18) The frequency of photon in Hertz *1 point*

- 5.84×10^{15} Hz
- 5.84×10^{14} Hz
- 5.84×10^{16} Hz
- 5.84×10^{11} Hz

No, the answer is incorrect.
Score: 0

Accepted Answers:

5.84×10^{14} Hz

19) Wave number *1 point*

- 1.95×10^{7} cm^{-1}
- 1.95×10^{3} cm^{-1}
- 1.95×10^{4} cm^{-1}
- 1.95×10^{2} cm^{-1}

No, the answer is incorrect.
Score: 0

Accepted Answers:

1.95×10^{4} cm^{-1}

20) Energy of each photon *1 point*

- 2.41eV
- 3.41eV
- 5.51eV
- 0.21eV

No, the answer is incorrect.
Score: 0

Accepted Answers:
2.41eV

21) Momentum of each photon *1 point*

- 1.29×10^{-26} kg.m/s
- 1.29×10^{-27} kg.m/s
- 1.29×10^{-25} kg.m/s
- 2.29×10^{-27} kg.m/s

No, the answer is incorrect.
Score: 0

Accepted Answers:
1.29×10^{-27} kg.m/s

22) The no. of photons generated each second *1 point*

- $2.59 \times 10^{18}\ s^{-1}$
- $3.59 \times 10^{18}\ s^{-1}$
- $4.56 \times 10^{18}\ s^{-1}$
- $2.59 \times 10^{16}\ s^{-1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2.59 \times 10^{18}\ s^{-1}$

23) The pressure exerted on the surface by the photons *1 point*

- 3.3×10^{-4} Pa
- 3.3×10^{-3} Pa
- 3.3×10^{-5} Pa
- 5.2×10^{-3} Pa

No, the answer is incorrect.
Score: 0

Accepted Answers:
3.3×10^{-3} Pa

24) The heat flux generated by photon absorption. *1 point*

- $2\ Mw/m^2$
- $3Mw/m^2$
- $1Mw/m^2$
- $5Mw/m^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$1Mw/m^2$

(Linked question 25,26)

Electron beams are used to study the atomic structure of crystals, as in transmission electron microscope (TEM). The resolution of the microscope depends on the energy of electrons, which determines the corresponding wavelength of electrons. Minimum focal point of the beam depends on its wavelength. Determine the electron wavelength if they have an energy of

25) 100 Kev *1 point*

- 3.88×10^{-12} m
- 4.59×10^{-12} m
- 5.11×10^{-12} m
- 7.59×10^{-12} m

No, the answer is incorrect.
Score: 0

Accepted Answers:
3.88×10^{-12} m

26) 1 Mev *1 point*

- 1.23×10^{-12} m
- 3.88×10^{-12} m
- 4.59×10^{-12} m
- 5.11×10^{-12} m

No, the answer is incorrect.
Score: 0

Accepted Answers:
1.23×10^{-12} m

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