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UNIVERSITY OF BUEA
FACULTY OF ENGINEERING AND TECHNOLOGY

ENTRANCE EXAMINATION **October 2018**

PHYSICS **Time: 3 Hours**

Answer all Questions

Each question has four suggested answers A, B, C, D. Select only one answer.

1. Which of these physical quantities has its base units $kg\ m^2\ s^{-2}$?

   A Pressure
   B Energy
   C Power
   D Momentum

2. Intensity is defined as power per unit area, Which of the following is the units of intensity ?.

   A $kg\ m^2\ s^{-1}$
   B $kg\ s^{-3}$
   C $kg\ m^4\ s^{-3}$
   D $kg^2\ m^2\ s$

3. Which of the following combinations has two vector quantities and one scalar quantity:

   A Velocity, acceleration, moment
   B Deceleration, volume, amplitude
   C Wavelength, momentum, displacement
   D Moment of force, momentum, speed

4. The magnitude of the acceleration of an object moving along a straight line is equal to the

   A Slope of its displacement – time graph
   B Area below its force – time graph
   C Slope of its velocity – time graph
   D Area under its velocity – time graph

5. If the engine of a car of mass m is capable of delivering power P, the minimum time needed for the car to accelerate from rest to a speed v is

   A. $\frac{mv^2}{P}$
   B. $\frac{P}{(mv)}$
   C. $\frac{2P}{mv^2}$
   D. $\frac{(mv^2)}{2P}$

6. At the instant the bob of an oscillating simple pendulum reaches the equilibrium position, the displacement is zero. Which of the following statements correctly describes the kinetic energy of the bob and the tension in the thread from which it is hanging at zero displacement?

   A Zero Kinetic Energy and Maximum tension
   B Maximum kinetic energy and maximum tension
   C Maximum kinetic energy and minimum tension
   D Zero kinetic energy and minimum tension

7. Transverse waves can be distinguished from longitudinal waves using

   A Polarisation
   B Refraction
   C Reflection
   D Diffraction

8. 2.5 kg of water is heated in an open container for 5 minutes using a heater of power 2 kW . Which of the following statements about the temperature of the water is true? (The specific heat capacity of water is 4200 $J\ kg^{-1}K^{-1}$)

   A The change in the temperature of the water is 58.3 ^{o} C
   B The change in the temperature of the water is 57.3 ^{o} C
   C The change in the temperature of the water is $greater\ than$ 57.3 ^{o} C
   D If the initial temperature of the water was 23.7 ^{o} C then its final temperature would be 810 ^{o} C

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9. Which of the following statements about heat transfer is NOT true?
   A Radiation transmits heat through air with the speed of light in air
   B In a fluid, heat is transmitted upwards mainly by mass movement of fluid molecules
   C A poor conductor has a low value of thermal conductivity
   D All good thermal conductors are not necessarily good electrical conductors

10. When a heating coil is immersed in melting ice, the ice melts at a rate of 10 grams per minute. If the current in the coil is doubled while its resistance remains constant, the mass of ice that would melt per minute is
   A 40 g
   B 20 g
   C 5 g
   D 80 g

11. Which of the following statements is correct? During a change of state:
   A The internal energy of a system increases
   B Latent heat is absorbed
   C Work is done and bonds are broken
   D Work is done and/ or bonds are being broken or constructed

12. A wire M of diameter d is joint to another wire N of the same material. The diameter of N is half of that of M but the two wires have the same length. If a steady potential difference is applied across the ends of the composite wire, which of the following statements is correct?
   A The current in N is half of the current in M
   B The drift velocity of the electrons in N is four times that of the electrons in M
   C The number of charge carriers per unit length in M is twice that in N
   D The drift velocity of electrons in M is twice that of electrons in N

13. Which of the following statements about a silicon P-N junction diode is true?
   A The majority mobile charge carriers in the N- type section of the diode are electrons while the minority charge carriers in the P-type section of it are holes
   B The net positive charge at the edge of the depletion layer is in the P-type side of the diode
   C The majority mobile electrons in the N-type section of the diode come from donor impurity atoms while the holes that are a majority mobile charge carriers in the P- type section come from acceptor on silicon atoms
   D The holes in the N-type section of the diode are known as free or mobile holes

14. Rutherford's alpha particle scattering experiment suggests that an atom
   A Has an even distribution of Rectifier mass
   B Has a nucleus containing all subatomic particles
   C Has a nucleus of large size and low density
   D Has a nucleus of very small size and very high density

15. Which of the following is a major difference between zener diodes and rectifier diode?
   A Rectifier diodes are made from silicon whereas zener diodes are made from germanium
   B Zener diodes operate on reverse bias voltages while rectifier diodes operate on forward bias voltages
   C Rectifier diodes are used in power supply circuits while zener diodes are not
   D Rectifier diodes can replace zener diodes in circuits whereas zener diodes cannot replace rectifier diodes in circuits

16. In a radioactive decay, a radioisotope emits an alpha particle, quickly followed by a beta particle. The resulting daughter nuclide:
   A Gains a unit positive charge
   B Has an atomic number reduced by 2
   C Has a neutron number reduced by 4
   D Has a nucleon number reduced by 4

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17. A body moves from a point P1 to another point P2 in a gravitational field. Which of the following statements about gravitational potential energy is correct?
A The change in gravitational potential energy depends on the path between P1 and P2.
B The change in gravitational potential energy is dependent on the mass of the body
C The change in gravitational potential energy is equal to the difference between the kinetic energy at P1 and the kinetic energy at P2.
D The change in gravitational potential energy depends on the relative coordinates of P1 and P2 and not the path taken between them

18. A point charge of magnitude Q is moved from one point M to another point N. If its journey between these two points lasts for an interval of time t and the potential difference between these two points is V, then the work done in moving the point charge is equal to
A $I.V$ if the current flowing is I
B V.Q
C V.Q.t
D (V.Q)/t

19. Two parallel metal plates carrying equal but opposite charge are positioned so that at a point S midway between them, the resultant electric field strength is E. If the distance from each plate to S is doubled, the strength of the electric field at S woud be?
A E
B E/8
C E/4
D E/2

20. A particle of mass M and charge Q describes a circular path in a magnetic field of flux density B. If the magnetic field is uniform, its speed u is constant and radius of the orbit is r, then the frequency of its circular motion in the field is equal to
A $\frac{BQ}{2\pi m}$
B $\frac{BQ}{m}$
C $\frac{BQ}{\pi m}$
D $\frac{2\pi BQ}{m}$

21. Which of the following quantities that are associated with Kirchoff's first and second laws respectively obey the principle of conservation?
A Energy and charge
B Energy and momentum
C Charge and energy
D Voltage and charge

22. In the formation of a nucleus, the actual mass of the nucleus formed is less than the sum of the masses of the individual protons and neutrons. The energy equivalence of the mass difference is referred to as
A Binding Energy
B Work function
C Mass defect
D Lost energy

23. Using a steady force of 150 N, a farmer succeeds in pulling horizontally a 20 kg bag of potatoes through 20 m along a flat horizontal pavement. As she does so, she overcomes a frictional force of 50 N. How much work is done on the bag?
A 1000 J
B 2000 J
C 3000 J
D 4000 J

24. Consider the following statements about capacitors connected in series in a circuit which is in the process of charging.
1. The charge on each capacitor is the same
2. The effective capacitance of all the capacitors is less than the individual capacitances
3. The voltage across each capacitor is the same

Which of the statement(s) is/are correct?
A 1 and 2
B 2 and 3
C 1 only
D 3 only

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25. An ideal gas absorbs 1000 J of heat energy and expands from a volume of $0.025m^3$ to a volume of $0.05m^3$ at a constant pressure of $20\ x\ 10^3$ Pa. Consider the following statements about the gas:
1. The work done by the gas is 100 J
2. The work done by the gas is 500 J
3. The internal energy of the gas changes by 500 J.

Which of the statement(s) is/are true?

A 1 and 2
B 2 and 3
C 1 only
D 3 only

26. Which of the following statements about the first law of thermodynamics is/ are true?:
1. The amount of energy received by a system is always greater than the work done by the system
2. The efficiency of an engine can be greater than one if and only if there is no energy loss
3. The internal energy change in a system must be equal to the energy absorbed by the system

A 1 and 2
B 2 and 3
C 1 only
D 3 only

27. Which of the following statements can be explained by the second law of thermodynamics ?
1. Net heat flows only in a particular direction in the universe
2. The entropy of the universe changes with time
3. Heat does not flow from a cold to hot object

A 1 and 2
B 2 and 3
C 1 only
D 3 only

28. A pipe of length L is opened at both ends. It is made to resonate such that its second harmonic is at a frequency f. Given that the velocity of sound in air is Vms^{-1}, which of the following statement(s) is/ are true?
1. The fundamental frequency f_o is larger than f_2
2. The fundamental frequency f_o is the same as f_2
3. The fundamental frequency f_o is half f_2

A 1 and 2
B 2 and 3
C 1 only
D 3 only

29. Consider the following statements about a mass spectrometer:
1. The electric and magnetic fields are arranged perpendicularly to each other
2. The mass/charge ratio, m/q, is inversely proportional to the radius r of the circular path of the charge
3. The velocity V in the circular path is independent of the magnetic field B

Which of these statement(s) is/ are true?

A 1 and 2
B 2 and 3
C 1 only
D 3 only

30. In an RLC circuit, the current in the circuit is

$$I = \frac{V}{\sqrt{(X_{L-X_C})^2 + R^2}}$$, where V is the voltage

Consider the following statement(s) :
1. The quantity $\sqrt{(X_{L-X_C})^2 + R^2}$ is called the impedance of the system and has the unit of ohm
2. A maximum current flows in the circuit if $X_L = X_C$
3. The resistance R at the resonance point is always zero

Which of the statement(s) is/ are true?

A 1 and 2
B 2 and 3
C 1 only
D 3 only

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31. The magnitude of the force, F, between two masses m_1 *and* m_2 separated by a distance r is given by the expression $F = \frac{Gm_1m_2}{r^2}$, the base units for G are

A $kg^3m^3s^{-2}$
B $kg^{-1}m^3s^{-2}$
C kgm^3s^{-2}
D $kg^{-1}ms^{-2}$

32. Which of the following must be taken seriously into consideration when choosing LASER equipment for school laboratory experiments?

A It should produce a coherent beam
B It should produce an intense beam
C It should be low powered
D It should produce a monochromatic beam of light

33. A ball is thrown vertically upward so that it returns to the thrower. The value of the acceleration of the ball at the highest point reached is

A $9.8ms^{-2}$ downward
B $10ms^{-2}$ downward
C $0ms^{-2}$
D $9.8ms^{-2}$ upwards

34. A diffracting grating with 600 lines per millimeter is illuminated normally by a monochromatic light of wavelength 600 nm. The number of fringes seen excluding the central fringe is

A 5
B 2
C 3
D 4

35. A simple pendulum oscillates such that it makes four complete oscillations per second. The length of such a pendulum is therefore

A 15.5 cm
B 15.5 mm
C 6.25 cm
D 62.5 cm

36. Which of the following statements is correct?

A It is possible for the speed of a body to change without the body accelerating
B It is possible for the velocity of a body to change with a change in speed
C It is possible for a body to be accelerating while travelling at a constant speed
D It is possible for a body to be moving with resultant force acting on it

37. Which of the following pairs of statements about fusion and fission is correct?

	FUSION	FISSION
A	Occurs at very high temperatures in the order of $10^8 k$	Occurs at normal temperatures
B	Environmentally friendly	Environmentally friendly
C	Expensive and scarce raw material	Cheap and readily available raw material
D	Reactor is surrounded by a thick concrete	Reactor does not need to be surrounded by a thick concrete

38. In which of the following sets do we have one scalar and two vectors?

A Velocity, Pressure, Work
B Velocity, Force, Acceleration
C Displacement, Momentum, Power
D Work, Power, Energy

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39. Which of the following wave types labeled A to D correctly matches its method of production?

A	Light	Deceleration of electrons in aerials
B	Radio	Acceleration of electrons in aerials
C	X-rays	Radioactive decay of the nucleus
D	Microwaves	Movement of electrons from a higher to a lower energy level

40. Which of the following is the reason why a balance point may NOT be found in a potentiometer?

A The positive terminal of the test cell is connected to the positive terminal of the driver cell

B The potential difference of the driver cell is greater than the potential difference across the potentiometer wire

C The potential difference to be measured is greater than the potential difference across the potentiometer wire

D The potentiometer wire is not uniform and long enough

41. Which of the following reasons best explains why the numerical value of temperature expressed on the scale of the resistance thermometer differs from the value on the gas thermometer except at the fixed points

A The resistance thermometer has a wide range

B The variation of the gas pressure with temperature is different from the variation of resistance with temperature

C The resistance thermometer is not as sensitive as the gas thermometer

D The gas thermometer is used as a standard for measuring other temperatures

42. A pipe opened at both ends, containing air, is made to resonate such that its harmonic is 1200 Hz. Therefore, its fundamental frequency fo is

A 400 Hz
B 600 Hz
C 800 Hz
D 1000 Hz

43. Suppose that the force on a 1 Kg mass on the surface of the earth is 10N and that the radius of the earth is about 6000 km. Then the force on an 8 kg mass placed at a point 2000 km from the center of the earth will be

A 26.7 N
B 2.67 N
C 25.0 N
D 2.50 N

44. When a ray of light passes from glass into air it undergoes a change of

A Both wavelength and frequency
B Both frequency and speed
C Both wavelength and speed
D Wavelength only

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45. A person jumps from a height of 1m and lands stiff-legged on bare ground. The person's mass is 60 kg and he is travelling at a velocity of 45m/s just prior to hitting the ground. If the person takes 0.05s to land, the force developed will be
A 5400 N
B 54000 N
C 540 N
D -5400 N

46. A set of three quantities in the following sets that are all vectors is
A Energy, Power, Weight
B Torque, Impulse, Field Strength
C Moment, Power, Weight
D Force, Impulse, Pressure

47. Binding Energy refers to
A The difference between the total mass of the nucleons and its nuclear mass
B The work done in separating its nucleus
C The energy used in forming the nucleus from its constituent parts
D The energy equivalent of the mass of the nucleus

48. Which of the following phenomena can be used to explain the formation of a rainbow?
A Reflection
B Refraction
C Interference
D Diffraction

49. Which of the following statements is true about 0.14c, where c is the speed of light
A It is the boundary for classical and relativistic mechanics
B It is the upper limit for a particle to exist
C It is the lower limit for relativistic mechanics
D It is the lower limit for quantum physics

50. From the equation $P = \frac{3}{2}KT$, where K is the Boltzmann's constant and T is absolute temperature, one can deduce that the unit of P is the same as that of
A Power
B Pressure
C Energy
D Work done per second

51. When a hot object and a cold one are placed in thermal contact, the temperature at equilibrium will be
A Somewhere between their initial temperatures
B At a point midway between their initial temperatures
C At a point closer to the higher of the two initial temperatures
D At a point equal to half the sum of their initial temperatures

52. Becquerel's discovery of radiation from uranium salts was important in that
A It confirmed that both phosphorescence and luminescence can result in the emission of energy
B It opened a market for uranium
C His grant provided support for Pierre and Marie Curie
D Energy was emitted from this material continuously, without an external input of Energy

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53. In an experiment to measure the wavelength of light in air, two slits are illuminated with white light and their images are obtained on a screen. For best results
A the slit to screen distance should be at least 3.00 m
B the light used can be a mixture of coloured light
C the light used should be obtained from a LASER source
D the slit width should be made smaller than the wavelength of light

54. The trace displayed on a Cathode Ray Oscilloscope screen of a sinusoidal voltage has a peak to peak height of 5.2 V. The root mean square value of this voltage is
A 1.84 V
B 2.80 V
C 2.60 V
D 5.20 V

55. A particle of mass m strikes a vertical rigid wall perpendicularly from the left with velocity v. If the collision is perfectly elastic, the total change in momentum of the particle is
A 2 mv to the left
B 2 mv to the right
C mv to the left
D mv to the right

56. What is the critical angle in a polystyrene block whose index of refraction is 1.49 when this block is immersed in carbon disulphide whose index of refraction is 1.63?
A 37.80
B 42.20
C 66.00
D There won't be total internal reflection inside the polystyrene when it is in carbon disulphide

57. The mass of a satellite orbiting the earth is doubled. The orbital period will remain the same if its distance from the center of the earth must
A be doubled
B be halved
C increase fourfold
D remain unchanged

58. Which of the following is NOT a property of sound waves?
A Diffraction
B Reflection
C Refraction
D Polarisation

59. Three isolated identical spheres M, N, and P are mounted on insulating stands. Charges of +4Q and -1Q are introduced on M and N respectively while P is left electrically neutral. The spheres are then made to touch each other in such a way that their centers of mass are at the respective apices of an equilateral triangle
A Each of the spheres is now neutral
B Each sphere now carries a net charge of +Q
C Each sphere now carries a net charge of 1.67Q
D P now carries a net charge of +3Q while M and N are now electrically neutral

60. The image of an object placed on one side of a thin lens, 0.49 m away from its principal focus is obtained on a screen (S) on the other side of the lens. If the screen is 0.25 m away from the principal focus on that side of the lens, then the focal length must be
A 0.35 m
B 0.25 m
C 0.166 m
D 0.74 m

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61. Which of the following would affect atomic spectra?
    - A The element involved
    - B The atom's state of ionization
    - C The temperature and pressure of a gaseous sample
    - D The responses in A,B and C above are all correct

62. Which of the following will produce the greatest increase in the volume of a sample of an ideal gas in a cylinder with a moveable piston when all other properties remain unchanged?
    - A Doubling the pressure
    - B increasing the temperature from 50.0 degrees Celsius to 100 degrees Celcius
    - C Doubling the number of molecules in the sample
    - D Each of these would produce the same doubled volume

63. A current of 5.0 A flows through a wire placed at an angle of 30 degrees to the field lines of the earth's magnetic field. If the flux density of this field is $5.0x10^{-5}$ T, what force would the wire which is 0.5 m long experience due to the interaction with the field?
    - A $6.3x10^{-3}$ N
    - B $1.25x10^{-4}$ N
    - C $2.5x10^{-4}$ N
    - D $6.25x10^{-3}$ N

64. The length per unit resistance of copper wire has a value of 7.63 mm per ohm for a diameter of 1.450 mm. This corresponds to a resistivity of
    - A $2.16x10^{-4}\ \Omega m$
    - B $1.72x10^{-4}\ \Omega m$
    - C $5.04x10^{-4}\ \Omega m$
    - D $7.63x10^{-3}\ \Omega m$

65. Two identical resistors M and P each of resistance $10\ \Omega$ are connected in series with each other and to a 3.0 V supply of negligible internal resistance. If a third identical resistor Q of resistance $10\ \Omega$ is connected across M, the potential difference across P
    - A increases by 0.5 V
    - B increases by 1.0 V
    - C decreases by 2.0 V
    - D increases by 2.0 V

66. Oxygen gas with a density of $3kgm^{-3}$ exerts a pressure of $3x10^{6}\ Pa$ on the walls of its container. What is the root mean square velocity of the oxygen molecules?
    - A $1000ms^{-1}$
    - B $535ms^{-1}$
    - C $1500ms^{-1}$
    - D $1732ms^{-1}$

67. A transformer has a coil of 1000 turns wound on its central core and the terminals of the coil are connected to a mains of 240V supplying a current of 120 mA. Another coil of 50 turns is wound on the first coil and its terminals connected to a radio of power 24W. Which of the following is NOT correct
    - A The turns ratio of this transformer is 20: 1
    - B The output current is 0.20 A
    - C The efficiency of the transformer is 83.3%
    - D This is a step down transformer

68. When a thin slice of silicon is doped with indium or boron atoms
    - A It acquires a net positive charge
    - B A junction barrier potential difference develops in it
    - C Holes become the majority carriers in it
    - D The free flow of thermally generated charge carriers through the material is inhibited

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69. Which of the following statements about the motion of objects can NEVER be true

A A body's speed can change without the object accelerating

B A body can be accelerating while moving at a constant speed

C A body can move as a result of a constant resultant force acting on it

D A body's velocity can change at constant speed

70. Suppose a light spring is loaded with a mass of $50x10^{-3}kg$ and it extends by $10x10^{-2}m$. The force per unit displacement, K, and the period of oscillation are respectively

A $5.0\ Nm^{-1}\ and\ 0.63s$

B $5.0\ Nm^{-1}\ and\ 0.314s$

C $5.0\ N\ and\ 0.63s$

D $5.0\ Ns^{-1}\ and\ 0.314s$

71. A snooker ball x moving with an initial velocity u, makes an elastic head-on collision with an identical stationary ball y. Which of the sets of velocities below correctly gives the velocities of x and y after the collision?

	X	Y
A	u/2	u/2
B	u	0
C	u	0
D	0	u

72. A piece of wire of Young's Modulus $2.0x10^{11}\ Pa$ of diameter 2.00 mm and of length 2.0 m is suspended from a fixed point and a weigh of 50 N is attached to its free end. If the elastic limit of the material is not exceeded, then the material would extend by

A $3.98x10^{-4}\ m$

B $7.66\ x10^{-4}\ m$

C $1.59x10^{-4}\ m$

D $3.18x10^{-4}\ m$

73. A conductor of length 400 m carrying a current I is placed perpendicularly inside a magnetic field of intensity $B = 10^{-5}T$. If the force exerted on the cable is 1.2 N, the current in the conductor is

A 30 A

B 3 A

C 0.3 A

D 300 A

74. The resistivities of copper and aluminum are $1.7x10^{-8}\Omega m$ and $2.6x10^{-8}\Omega m$ respectively. What should be the diameter of a copper wire which would have the same resistance and of equal length as that of the aluminum wire of diameter 1.5 mm

A 1.35 mm

B 1.20 mm

C 2.4 mm

D 0.98 mm

75. A Toshiba Television Set is rated at 1500W. How much is the cost of watching a football match which lasts for one and a half hours on this set if a unit of electricity by ENEO is 60 francs?

A 9000 francs

B 90 francs

C 60 francs

D 135 francs

76. When an electron in an atom makes a transition from an energy level at -1.5 eV to an energy level at -3.5 eV an electromagnetic radiation occurs. If Planck's constant is $6.6x10^{-34}\ Js$ and 1eV is $1.6x10^{-19}\ J$ then the type of electromagnetic radiation is

A X-rays

B Radio Waves

C Infra-red rays

D Visible

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77. Which of the following statements about the potential energy and the force for two molecules is NOT true?
   - A The potential energy and the force at infinity approximates to zero
   - B The potential energy is smallest at the equilibrium separation
   - C The potential energy and the force equal at the equilibrium separation
   - D At equilibrium separation, the force between the two molecules is zero

78. A multi-meter has a resistance of $75\,\Omega$ and gives a full scale deflection with a current of $1.0x10^{-3}A$. In order to adapt this meter to read a current of 1 A it is necessary to to connect
   - A $75\,m\Omega$ resistor in parallel with the meter
   - B $75\,m\Omega$ resistor in series with the meter
   - C $75\,\Omega$ resistor in parallel with the meter
   - D $75\,\Omega$ resistor in series with the meter

79. A cylinder contains 12 liters of oxygen at 20 degrees Centigrade and 15 atmospheres. The temperature is raised to 35 degrees Centigrade and the volume is reduced to 8.5 litres. The final pressure of the gas in atmospheres is
   - A 20.1
   - B 11.2
   - C 22.3
   - D 22.5

80. Which of the following statements about a bipolar transistor is true?
   - A The collector current is always greater than the base current
   - B The emitter current is always less than the collector current
   - C The base emitter voltage is always equal to the input voltage
   - D The base current is greater than the collector current

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