

Physics, 2011 EC, entrance exam

Grade 12 · Physics · 2011 E.C.

Time allowed: 120 minutes

Questions: 45

Total marks: 45

Name _____ Grade _____ ID No. _____ Date _____

1. Which part of a scientific report discusses the accuracy of measurements taken? (1)
 A. Aim B. Theory
 C. Methods D. Results
-
2. Two forces exerted on a block as shown in the figure below. What is the horizontal component of the net force? (1)
[Figure: A rectangular block is shown. From its top-left corner, a force vector of magnitude 50 N is directed upward and to the left, making an angle of 53° with the horizontal line extending to the left. From its top-right corner, a force vector of magnitude 20 N is directed upward and to the right, making an angle of 37° with the horizontal line extending to the right.]
 A. 70 N, East B. 30 N, West
 C. 14 N, West D. 28 N, West
-
3. What is the magnitude of the resultant velocity for a bird flying first at a speed of 10 m/s North East and then flying to South at a speed of 8 m/s? (1)
 A. 7.13 m/s B. 16.6 m/s
 C. 12.8 m/s D. 7.07 m/s
-
4. Let $\vec{C} = \vec{A} \times \vec{B}$ and $\theta \neq 90^\circ$, where θ is the smaller angle between $\vec{A}$ and $\vec{B}$ when they are drawn with their tails at the same point. Which of the following is NOT true? (1)
 A. $\vec{A} \cdot \vec{B} = 0$ B. $\vec{A} \cdot \vec{C} = 0$
 C. $|\vec{C}| = |\vec{A}| |\vec{B}| \sin \theta$ D. $-\vec{C} = \vec{B} \times \vec{A}$
-
5. A driver of an automobile travelling at a constant speed of 20 m/s suddenly applies a brake and the automobile comes to rest in 2.0 seconds after skidding for a certain distance. What is the length of the skid distance? (1)
 A. 400 m B. 10 m
 C. 40 m D. 20 m
-
6. Which of the following is correct about the motion shown in the velocity – time graph below? (1)
[Figure: A velocity-time graph showing velocity $v(\text{m/s})$ on the vertical axis and time $t(\text{Sec})$ on the horizontal axis. - Vertical axis has markings from 2 to 14 in increments of 2. - Horizontal axis has markings A, 2, 4, 6, 8, 10, 12, 14. - A straight line starts at the origin A(0,0) and rises to point B(2,4), with dashed lines indicating $t = 2$ and $v = 4$. - From B(2,4), a steeper straight line rises to point C(3,12), with a dashed horizontal line extending to $v = 12$. - From C(3,12), a horizontal line segment connects to point D(6,12). - From D(6,12), a straight line descends to point E(12,0) on the horizontal axis.]
 A. Between C and D, the motion is with constant acceleration.
 B. Between B and C, the acceleration is 4m/s^2
 C. Between D and E, the motion is with constant positive acceleration.
 D. Total displacement is 84m.

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7. An object of mass M is set in a vertical circular motion. The tension T from the rope keeps the object in a circular path with speed v . Where does the rope experience a maximum tension? (1)
- A. At the top of the circle
B. At the bottom of the circle
C. When the object is at half of the circle
D. When it is at 45° to the vertical line
-
8. A shell is fired from a gun, whose barrel is inclined at an angle to the horizontal. During the flight, the shell explodes in air into fragments. The center of mass of different fragments will follow (1)
- A. a horizontal straight line
B. a vertical straight line
C. a parabola
D. an unpredictable path
-
9. A 5 kg mass pushed upward along an inclined plane of inclination 30° with constant force F . If the acceleration of the block for this motion is 1.0 m/s^2 and the plane is assumed to be friction less, what is the magnitude of the constant force F ? (1)
- A. 5.0 N
B. 25.0 N
C. 20.0 N
D. 30.0 N
-
10. A ball of mass M moves with speed V in the $+x$ -direction. It explodes into two pieces that go off at angles θ_1 and θ_2 , as shown below. (1)
- What are the magnitude of the momenta of the two pieces?.
- [Figure: A diagram shows a ball of mass M moving horizontally to the right along a straight line. At an explosion point, the trajectory branches into two paths: one with mass labeled m_1 moving along an arrow directed upwards and to the right at an angle θ_1 relative to the horizontal line, and another with mass labeled m_2 moving along an arrow directed downwards and to the right at an angle θ_2 relative to the horizontal line.]
- A. $p_1 = \frac{MV \cos \theta_2}{\sin(\theta_1 + \theta_2)}$, and $p_2 = \frac{MV \cos \theta_1}{\sin(\theta_1 + \theta_2)}$
B. $p_1 = \frac{MV \sin \theta_2}{\sin(\theta_1 + \theta_2)}$, and $p_2 = \frac{MV \sin \theta_1}{\sin(\theta_1 + \theta_2)}$
C. $p_1 = MV \tan \theta_2$, and $p_2 = MV \tan \theta_1$
D. $p_1 = \frac{MV \cos \theta_2}{\cos(\theta_1 + \theta_2)}$, and $p_2 = \frac{MV \cos \theta_1}{\cos(\theta_1 + \theta_2)}$
-
11. The rate of change of momentum of the raindrop can be given by $F = ma + u \frac{\Delta m}{\Delta t}$ (1)
- In this expression what does u represent?
- A. The velocity of the extra mass added to the raindrop
B. The velocity of the raindrop
C. The velocity of the loss in mass of raindrop
D. The rate of change of the velocity for combined system
-
12. Which of the following is equal to the amount of work required to stop a moving object ? (1)
- A. the mass of the object times its acceleration
B. the kinetic energy of the object
C. the square of the velocity of the object
D. the mass of the object times its velocity
-
13. A 1kg roller coaster is acted on by a 4N force over a displacement of 2m in the direction of force and then set free. The roller is moving on a smooth and horizontal surface towards a free end of a spring of constant k , whose other end is fixed on the wall. If the spring is compressed by 20cm to bring the roller coaster to rest, then what is the value of the spring constant? (1)
- A. 100 N/m
B. 200 N/m
C. 400 N/m
D. 800 N/m

14. In which of the following case is no work done by a dissipative force? (1)
- When a parachute jump from a plane
 - For a freely falling object
 - On a racing car that moves in a desert
 - When someone slides a box on a horizontal rough surface.
-
15. Five beads of equal mass are fixed on a rigid light rod that is free to rotate about a frictionless vertical bearing. (1)
The arrangement is such that, four of them are placed at 0.25 m and the fifth one is at 0.5m from the axis of rotation. The rotational kinetic energy is 144J when the beads were rotating with angular speed of 48rad/s. What is the mass of each bead?
- 0.25Kg
 - 0.5Kg
 - 0.75 Kg
 - 1Kg
-
16. A thin circular ring of mass M and radius r and moment of inertia Mr^2 is rotating about its axis with a constant (1)
angular velocity ω . Two objects each of mass m , are attached gently to the opposite ends of a diameter of the ring. What would be the angular velocity of the wheel ?
- $\frac{\omega M}{(M+m)}$
 - $\frac{\omega(M+2m)}{(M+2m)}$
 - $\frac{\omega M}{(M+2m)}$
 - $\frac{\omega(M+2m)}{M}$
-
17. In a playing room a turn table of radius 2m has moment of inertia 250Kg m^2 and is rotating about a frictionless (1)
vertical axel. When a boy of mass 50Kg stands near the rim, the system rotates with angular speed 3rad/s. The boy walks towards the center and stands at 1m from the axel. What is the final angular speed of the system?
- 3rad/s
 - 2.5rad/s
 - 5.4rad/s
 - 4.5rad/s
-
18. Two forces $\vec{F}_1 = 3\hat{i}$ N and $\vec{F}_2 = 4\hat{j}$ N are acting on a particle of mass m . What is the magnitude and direction (1)
of a force that balances the two?
- $\vec{F}_{eq} = 7\text{N}$ at 127° counterclockwise from $\vec{F}_1$
 - $\vec{F}_{eq} = 5\text{N}$ at 143° counterclockwise from $\vec{F}_2$
 - $\vec{F}_{eq} = 7\text{N}$ at 127° counterclockwise from $\vec{F}_2$
 - $\vec{F}_{eq} = 5\text{N}$ at 143° counterclockwise from $\vec{F}_1$
-
19. The rod shown in the figure below is uniform and its weight is 2.8 N. The length of the rod is 3.0 m. Two ropes A (1)
and B keep the rod in horizontal position. Rope A is 1.0 m from one end and rope B is at the other end of the rope. What is the calculated value of the tension in rope A?
- [Figure: A horizontal uniform rod of length 3 m and weight 2.8 N is shown in equilibrium. Two vertical ropes labeled A and B support the rod from above. Rope A is attached at a distance of 1 m from the left end of the rod, as indicated by a horizontal dimension line labeled '1 m'. Rope B is attached at the far right end of the rod. A horizontal dimension line spanning the full length of the rod from the left end to the right end is labeled '3 m'. A downward-pointing vertical arrow at the center of the rod is labeled '2.8 N', representing the weight of the rod.]
- 2.1 N
 - 0.7 N
 - 2.8 N
 - 1.4 N
-
20. Which of the following statement is correct about elastic behavior of materials? (1)
- For sufficiently small stress, stress is proportional to strain.
 - In tensile stress the force is parallel to the cross-sectional area, where as in shear stress, the force is perpendicular to the area.
 - All materials do not necessarily have elastic limit.
 - With plastic materials, the body goes to original dimensions after removal of the force that caused deformation.

21. Water flows at a rate of 0.4 liter per second through garden hose of inside diameter 4.0 cm. The nozzle of the hose is a circular opening of diameter 2.0 cm. What is the speed of the water when it emerges? ($\pi = 3.14$) (1)
- A. 0.32 m/s
B. 1.27 m/s
C. 3.2 m/s
D. 12.7 m/s
-
22. How much heat would be absorbed by 2g of ice at 0°C dropped into water at 0°C , to melt it totally to water at 0°C ? (Latent heat of melting, $L = 340,000\text{J/Kg}$) (1)
- A. 680J
B. 840J
C. 340J
D. 420J
-
23. The direction of heat flow is from: (1)
- A. high pressure to low pressure
B. high temperature to low temperature
C. high density to low density
D. a point of higher emissivity to lower one
-
24. External force of 220N applied on a piston of a cylinder containing 1.25g of ammonia gas move 10cm as shown in the diagram below. Assuming adiabatic process, what is the rise in temperature of the gas? (Specific heat capacity of ammonia, $c = 2200\text{J/Kg } ^\circ\text{K}$) (1)
- [Figure: A horizontal cylinder containing gas with a piston inside. An external force arrow labeled 'F = 220N' points to the left against the piston rod. A horizontal dimension below the piston indicates a displacement of '10cm' to the left between dashed reference lines.]
- A. 4°K
B. 8°K
C. 0.004°K
D. 0.008°K
-
25. Which of the following statement is correct? (Here ρ is the density of an ideal gas, m is the mass of the gas and c is speed of particles) (1)
- A. $P(\text{pressure of an ideal gas}) = \frac{1}{2}\rho\langle c^2 \rangle$
B. For a mixture of two gases in equilibrium in a container, $\frac{\rho_2}{\rho_1} = \sqrt{\frac{\langle c_1^2 \rangle}{\langle c_2^2 \rangle}}$
C. For a mixture of two gases in equilibrium in a container, $\frac{\rho_2}{\rho_1} = \frac{\langle c_2^2 \rangle}{\langle c_1^2 \rangle}$
D. For a mixture of two different gases with equal partial pressure and equal number of molecules in a container, $\frac{m_2}{m_1} = \frac{\langle c_1^2 \rangle}{\langle c_2^2 \rangle}$.
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26. Which of the following statement is NOT correct? (1)
- A. No process is possible in which there is an overall decrease in the entropy of the universe.
B. The spontaneous transfer of energy from cooler body to a hotter body is not possible.
C. Spreading out of random kinetic energy through heating does not represent an overall increase in entropy.
D. The complete conversion of energy from a hot source into work is not possible.
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27. Which one of the following is not an example of simple harmonic motion? (1)
- A. A mass attached to a spring system oscillating in horizontal direction to the surface of the Earth
B. Oscillation of simple pendulum
C. Rotation of second pointer in hand watch
D. A mass attached to a spring system oscillating in vertical direction to the surface of the Earth

28. Travelling wave is given by the equation $Y = A \cos(kx - \omega t)$, where k is the wave number and ω is the angular frequency. What is the distance that the wave travels in the time $t = T/2$? (1)
- A. full wavelength
B. half the wavelength
C. a quarter of the wavelength
D. at the origin
29. A 50 cm pipe is open at one end and closed at the other end. When air is blow at 150 Hz. What is the velocity of the sound along the pipe? (1)
- A. 150 m/s
B. 100 m/s
C. 330 m/s
D. 300 m/s
30. In Young's double slit experiment, if the slit separation is 1.2mm and the average spacing of the bright fringes observed on a screen placed 4m away from the source is 2mm. What is the wavelength of the light source? (1)
- A. 550nm
B. 600nm
C. 630nm
D. 750nm
31. The colors seen from soap bubbles and oil slicks are a manifestation of thin film interference. What is the cause of this interference? (1)
- A. Interference from refraction of light
B. Interference from reflection of light from the two surfaces of the film
C. Interference from diffraction of light
D. Interference from superposition of lights that are incident and reflected
32. Two like charges of value q are fixed at $x = a$ and $x = -a$ as shown in the diagram below. (1)
If a test charge q_0 is released at $y = b$, which path will it follow?
[Figure: A coordinate system with the horizontal x -axis and vertical y -axis. Two equal charges of value q are positioned on the x -axis at coordinates $(-a, 0)$ and $(a, 0)$. A test charge labeled q_0 is located on the y -axis at $(0, b)$, with dashed lines connecting it to both charges at $(-a, 0)$ and $(a, 0)$.]
- A. It stays at $y = b$
B. along a line $y = -\frac{b}{a}x + b$
C. along a line $y = \frac{b}{a}x + b$
D. along y - axis
33. Two equal and opposite charges are located along x -axis at -2.0 cm and $+2.0$ cm as shown in the figure below. How much would be the electric potential at the origin? (1)
[Figure: A horizontal line showing two charges: a charge of $-4 \mu\text{C}$ located at -2 cm to the left of the origin (labeled O), and a charge of $+4 \mu\text{C}$ located at $+2$ cm to the right of the origin.]
- A. Zero
B. 1.8 MV
C. 3.6 MV
D. 4.5 MV
34. A sheet of polythene ($\epsilon_r = 2.3$) and 0.25 mm thick is to be used in a capacitor by sandwiching it between two sheets of aluminum foil. What area must the sheets have if the capacitor is to have a capacitance of $0.5 \mu\text{F}$? (1)
- A. 12 m^2
B. 6.14 m^2
C. 0.6 m^2
D. 0.12 m^2
35. A metal rod is measured to have a resistance R . If the same metal rod is stretched to reduce its radius by half without affecting its density, what is its new resistance? (1)
- A. $2R$
B. $4R$
C. $8R$
D. $16R$

36. The statement of Kirchoff's point rule follows from: (1)
- A. conservation of charge
B. conservation of energy
C. Ohm's law
D. dependence of resistance on temperature
-
37. You are given the bridge circuit as shown in the diagram below. The resistance R is used to limit the current in the galvanometer. Which of the following is correct in measuring R_x ? (1)
- [Figure: A bridge circuit connected across a DC voltage source labeled V_{source} on the left. The bridge forms a diamond with four resistor arms: top-left has resistor R_1 , bottom-left has resistor R_2 , top-right has resistor R_3 , and bottom-right has resistor R_x . Across the horizontal diagonal between the left and right junctions is a galvanometer labeled 'G' connected in series with a resistor labeled 'R4'.]
- A. The bridge is balanced when $\frac{R_1}{R_2} = \frac{R_3}{R_4}$
B. The bridge balance condition is given by $\frac{R_x}{R_3} = \frac{R_2}{R_1}$.
C. $\frac{R_x}{R_3} = \frac{R_1}{R_4}$
D. $\frac{R_x}{R_3} = \frac{R_2}{R_4}$
-
38. What is the expression of the centripetal acceleration of a particle of charge q and mass m moving in a uniform magnetic field $\vec{B}$ on a circle of radius r if $\vec{B}$ is perpendicular to the particle's direction of motion? (1)
- A. $\frac{qB}{m}$
B. $\frac{2qB}{mr}$
C. $\frac{q^2 B^2}{m} r$
D. $\frac{q^2 B^2}{m^2} r$
-
39. Two long wires of 10 m in length carries a current of 2.0 A and 0.5A in the same direction. The wires are separated by 4.0 cm. What is the magnetic force that the wires exerted on each other? (1)
- A. 5×10^{-5} N
B. 5×10^{-6} N
C. 5×10^{-7} N
D. 4×10^{-6} N
-
40. Lenz's law in electromagnetic induction follows from which law of conservation ? (1)
- A. charge
B. energy
C. momentum
D. mass
-
41. A rectangular loop of area 0.4m^2 is placed in a magnetic field that is changing at a rate of 100T/s. If the normal of the loop makes angle 60° with the magnetic field, what is the magnitude of induced emf? (1)
- A. 80V
B. 40V
C. 20V
D. 34.64V
-
42. The applied ac voltage and the resulting current, in a circuit element, is shown below (1)
- What is the circuit element ?
- [Figure: A Cartesian coordinate graph with a horizontal axis labeled 'Time' and a vertical axis marked with '+', '0', and '-'. Two sinusoidal waveforms are shown: a solid curve labeled 'Voltage' passing through the origin (0, 0) and going positive, and a dashed curve labeled 'Current' which is shifted to the right by a quarter period (90° phase lag behind the voltage wave), reaching its first positive peak a quarter cycle after the voltage waveform peaks.]
- A. inductor
B. capacitor
C. resistor
D. diode
-
43. A series circuit consisting of $50\ \Omega$ resistor and capacitor of capacitive reactance $50\ \Omega$ are connected to alternating source of voltage(rms) 100V. What is the average power output and power factor of the circuit? (1)
- A. 141.4W, 0.8
B. 200W, 0.8
C. 70.7W, 0.707
D. 100W, 0.707

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- 44.** When ultraviolet light is shone on a clean metal surface the surface will emit electrons. What is the necessary precondition for electrons to be ejected from the metal surface is ? (1)
- A. The intensity of light must be high enough
 - B. The minimum energy required to release the electron is the same as the work function of the metal
 - C. The wave length of the light has to be greater than that of ultraviolet light.
 - D. The frequency of the metal has to be less than that of ultraviolet light.
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- 45.** Complete the following equation which represents a nuclear fission reaction. What is the particle represented by X? $^{235}\text{U} + {}^1_0\text{n} \rightarrow {}^{95}\text{Rb} + {}^{139}\text{Cs} + 2\text{X} + \text{energy}$? (1)
- A. electron
 - B. proton
 - C. neutron
 - D. alpha particle

— END OF EXAMINATION —

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