

Physics, 2013 EC, entrance exam, round 1, booklet 41

Grade 12 · Physics · 2013 E.C.

Time allowed: 120 minutes

Questions: 48

Total marks: 48

Name _____ Grade _____ ID No. _____ Date _____

1. According to the kinetic theory of gases, the (1)
- A. particles of an ideal gas undergo inelastic collision between themselves and with the walls of the container.
 - B. diffusion rate of a gas is inversely proportional to the square root of the molar mass because it is directly proportional to the molecular speed.
 - C. internal energy of an ideal gas is equal to the potential energy due to interaction between the particles of the gas.
 - D. average translational kinetic energy of the particles of an ideal gas increases as the gas gets cooled.
2. At $t = 0$, an object undergoing SHM has maximum displacement of 0.650 m and angular frequency of 7.40 rad/s. Which of the following is correct about the motion of the oscillator? (1)
- A. The position of the object is $x = 0.650 \cos(7.40t)$ and its acceleration is $a = -35.59 \cos(7.40t)$.
 - B. The frequency of the oscillator is 7.40 Hz and its period is 0.135 s.
 - C. The position of the object is $x = 0.650 \sin(7.40t)$ and its velocity is $v = 4.81 \cos(7.40t)$.
 - D. The position of the object is $x = 0.650 \cos(7.40t)$ and its acceleration is $a = -3.59 \sin(7.40t)$.
3. A 0.35 kg mass attached to the end of a spring oscillates 2.5 times per second with amplitude of 0.15 m. Which of the following is true about the motion of the mass? (1)
- A. The velocity when it is 0.10 m from equilibrium is 3.0 m/s.
 - B. The acceleration when it is 0.10 m from equilibrium is 25.00 m/s^2 .
 - C. The velocity when it passes the equilibrium is 2.355 m/s.
 - D. The total energy of the system is 97.0 J.
4. Identify a true statement about a mechanical wave. (1)
- A. The speed of a wave traveling across a thin string is equal to its speed when traveling across a thick string of the same length and tension.
 - B. The speed of a wave traveling along a string increases as the tension in the string increases and as the linear density of the string decreases.
 - C. As a wave travels from one point to another along a medium, it transmits energy and particles of the medium from point to point.
 - D. The velocity of a traveling wave is equal to the velocity of the particles through which the wave propagates.
5. Which one of the following is a correct statement about the intensity of sound? (1)
- A. It is directly proportional to the square of the distance from the sound source.
 - B. It is inversely proportional to the square of the distance from the source of sound.
 - C. It is the product of power of a sound and area through which the sound is transmitted
 - D. It is energy transmitted per unit time.

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6. Which of the following is correct about Doppler effect? (1)
- A. When a sound source moves away from stationary observer, the frequency detected by the observer increases, whereas the wavelength decreases.
 - B. Doppler effect is the change in the frequency of a wave due to relative motion between the wave source and an observer.
 - C. It is the change in the velocity of a wave due to relative motion between the source of the wave and an observer.
 - D. When a source of sound wave moves toward stationary observer, the wavelength of the wave increases while its frequency decreases.
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7. Huygens's principle states that (1)
- A. all points along a wave front behave as a source of spherical secondary wavelets that have the same frequency and speed as the original wave front.
 - B. front the secondary wavelets are parallel to the original wave front.
 - C. all points along a wave front acts as a source of plane secondary wavelets that travel at speeds and frequencies greater than that of the original wave.
 - D. the secondary wavelets combine to produce a new wave front which has a shape different from the original wave.
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8. Which one of the following is correct about the law of reflection and the law of refraction? (1)
- A. If the speed of the incident wave is less than the speed of the refracted wave, the refracted wave bends towards the normal line.
 - B. The ratio of the sine of incident angle to the sine of the refracted angle is equal to the ratio of the speed of incident wave to the speed of the refracted wave.
 - C. The incident and refracted rays make equal angles with the boundary of the two interface.
 - D. The speed and wave length of a reflected wave are different from that of an incident wave.
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9. Choose the correct statement about interference pattern due to diffraction of light through single and double slits. (1)
- A. The central bright fringes in both double and single slits interference are twice as wide as the first order bright fringes.
 - B. The light intensity of interference pattern due to double and single slits remain the same as the distance from the central bright fringe increases.
 - C. The bright and dark fringes formed when light passes through double slit have equal widths, whereas the central bright fringe formed in single slit diffraction is twice wider as the first order maxima.
 - D. Constructive interference due to double slit and single slit interferences occur when the path difference between interfering waves is half-integer multiple of the wavelength.
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10. In order for interference of light waves to occur, the interfering light waves should (1)
- A. be in phase.
 - B. be incoherent.
 - C. be of different types.
 - D. have constant phase difference and the same frequency and speed.

11. A scientific method (1)
- A. begins from an accepted scientific theory and concludes with designing an experiment.
 - B. is a scientific procedure where a researcher first predicts the result of a problem before proposing the possible hypothesis.
 - C. is a scientific procedure in which a researcher begins with performing experiments.
 - D. is a scientific procedure which ensures a rigorous evidence-based structure in which only ideas that have been carefully tested are accepted as scientific theory.

12. Which one of the following is correct about accuracy and precision of a measurement? (1)
- A. A more accurate measurement has larger uncertainty, whereas a more precise data has smaller uncertainty.
 - B. Accuracy is related to the number of significant figures, whereas precision describes how well we minimize random errors.
 - C. Accuracy refers to the closeness of repeatedly measured data to a true value, whereas precision is related to the closeness of the measured data to each other.
 - D. Accuracy describes the closeness of repeatedly measured data to each other, whereas precision describes about the closeness of a data to a true value.

13. In an experiment to measure the velocity of a ball rolling along x-axis, a student recorded the distance traveled and time taken by the ball. Which of the following data represent constant velocity of the ball? (1)

A.

$x(\text{m})$	0	2	4	6	8	10
$t(\text{s})$	0	1	2	3	4	5

B.

$x(\text{m})$	0	4	5	6	7	9
$t(\text{s})$	0	1	2	3	4	4

C.

$x(\text{m})$	0	2	3	4	6	7
$t(\text{s})$	0	1	2	2.5	3	4

D.

$x(\text{m})$	0	3	5	6	7	9
$t(\text{s})$	0	1	2	3	4	5

14. A position vector of an object (1)
- A. is a measure of how fast it is moving relative to stationary reference frame.
 - B. is independent of the origin from which it is measured.
 - C. describes its distance from a given point in all directions.
 - D. describes its distance from a point in a specified direction.

15. Consider two force vectors in x-y plane: $F_1 = 10 \text{ N}$ making a 30° angle above the horizontal and $F_2 = 20 \text{ N}$ making a 60° angle above the horizontal. Which of the following is true? (1)
- A. The magnitude of their resultant is 42 N.
 - B. The direction of their resultant vector is 45° above the horizontal.
 - C. The horizontal and vertical components of their resultant are 15 N and 26 N, respectively.
 - D. The horizontal and vertical components of their resultant are 18.66 N and 22.32 N, respectively.

16. Given four vectors $\vec{A} = 2\hat{i} - \hat{j}$, $\vec{B} = 4\hat{i} - 2\hat{j}$, $\vec{C} = \hat{i} - \hat{j}$, and $\vec{D} = 2\hat{i} + 3\hat{j}$, which pair of these vectors are collinear? (1)

A. $\vec{A}$ and $\vec{B}$

B. $\vec{C}$ and $\vec{D}$

C. $\vec{A}$ and $\vec{C}$

D. $\vec{B}$ and $\vec{C}$

17. While going to school, a student travels 3 km, East and then 4 km, North in 2 hrs. The magnitude of student's average velocity and average speed are, respectively (1)
- A. 2 km/hr and 7 km/hr.
 - B. 2.5 km/hr and 3.5 km/hr.
 - C. 3.5 km/hr and 2.5 km/hr.
 - D. 5 km/hr and 7 km/hr.

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- 18.** A boy throws a ball vertically upward with an initial speed of 20 m/s. Neglecting air resistance, which of the following is true about the motion of the ball? (1)
- A. Its velocity after 3s is 50 m/s, downward.
 - B. The time taken to reach the maximum height is 4s.
 - C. Its velocity after 1s is 30 m/s, upward.
 - D. Its maximum height is 20 m.
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- 19.** Choose a correct statement about centripetal force and centripetal acceleration. (1)
- A. Centripetal acceleration and centripetal force are constant in direction, but vary in magnitude.
 - B. For an object moving in a circular path, its centripetal force and centripetal acceleration are parallel and directed toward the center of the path.
 - C. Centripetal force on an object moving in a circular path tends to pull the object outward from its path.
 - D. Centripetal force on an object moving in a circular path is perpendicular to the radius of the path.
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- 20.** According to Newton's law of Universal Gravitation, (1)
- A. for two interacting objects, the gravitational force exerted on a light object is less than the force on the heavy one.
 - B. the speed of a satellite moving around the Earth in a circular orbit depends on the mass of the satellite.
 - C. the gravitational attraction between two objects is directly proportional to the square of the distance between them.
 - D. the period of a satellite orbiting the Earth in a circular orbit increases as the radius of its orbit increases.
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- 21.** Which one of the following is correct about diffraction of light? (1)
- A. As the number of slits of a grating increase, the bright fringes become brighter, taller and narrower.
 - B. As the width of a single slit decreases, the width of central bright fringe decreases too.
 - C. Diffraction of light passing through a single slit produces bright and dark fringes of equal widths.
 - D. Diffraction of light passing through a circular aperture results in parallel bright and dark fringes.
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- 22.** In Millikan's oil drop experiment, (1)
- A. the charge of the droplet was found to be half-integer multiple of electron charge.
 - B. the electric field between the anode and cathode can be increased by decreasing the distance and the potential difference between them.
 - C. tiny droplets of negatively charged mineral oil were balanced under the action of downward electric force and weight.
 - D. the mass of the droplet was determined by measuring its terminal velocity in the absence of electric field.
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- 23.** Many chemical reactions release energy. Suppose that at the beginning of a reaction, an electron and a proton are separated by 0.110 nm, and their final separation is 0.100 nm. The change in the electric potential energy in this reaction (in eV) is (1)
- | | |
|-------------|-------------|
| A. 13.1 eV. | B. 1.30 eV. |
| C. 27.5 eV. | D. 14.4 eV. |
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- 24.** When an insulator is placed in an external uniform electric field, (1)
- A. the net electric field within the insulator is greater than the external electric field.
 - B. the induced electric field within the insulator is perpendicular to the external field.
 - C. electric dipoles are induced within the insulator and produce induced electric field opposite to the external field.
 - D. the electric field induced within the insulator is greater than the external electric field, but has the same direction as the external field.

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- 25.** Consider a parallel plate capacitor with plate area A , plate separation d , charge Q , capacitance C , potential difference V and electric field E between the plates. The electrical energy density stored by the capacitor (1)
- A. is directly proportional to the electric field E between the plates.
 - B. is directly proportional to the square of the electric field E between the plates.
 - C. depends on the plate area A and plate separation d .
 - D. increases as the capacitance C and potential difference V increase.
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- 26.** A potential difference V is applied across the ends of a uniform conducting wire of length l , cross-sectional area A , and containing n free charge carriers per unit volume. Which one of the following is true? (1)
- A. The electric current in the conductor flows perpendicularly to the drift velocity of the free charges.
 - B. The current density in the conductor is directed in the direction of the drift velocity of the free charge carriers.
 - C. The free electrons in the conductor flow in the direction of the electric field in the conductor.
 - D. The electric current in the conductor flows arbitrarily in all directions.
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- 27.** According to Kirchhoff's junction rule, (1)
- A. charges can disappear or appear at the junction.
 - B. the amount of electric charge entering a junction is equal to the amount leaving the junction.
 - C. the amount of electric charge flowing into a junction is greater than the amount flowing out of the junction.
 - D. the amount of electric charge flowing into a junction is less than the amount flowing out of the junction.
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- 28.** Which of the following is true about galvanometer? (1)
- A. To use a galvanometer as an ammeter that can read large voltages, we connect a small resistance in series with the galvanometer.
 - B. A galvanometer can be converted to an ammeter that can read large currents by connecting a small resistance in parallel with it; and can be converted to a voltmeter by connecting a large resistance in series with the galvanometer.
 - C. To use a galvanometer as an ammeter that can measure large currents, we need to increase its resistance by connecting a large resistance in series with the galvanometer.
 - D. A galvanometer can be converted to a voltmeter by connecting a small resistance in parallel with the galvanometer.
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- 29.** Equilibrium is the state of an object when (1)
- A. the object has constant angular acceleration.
 - B. the net force and net torque are both zero.
 - C. the object has constant linear acceleration.
 - D. the net force acting on it is constant.
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- 30.** The fulcrum of a uniform 20 kg seesaw that is 4.0 m long is located 2.5 m from one end. A 30 kg child sits on the long end. The weight of a person sitting at the other end in order to balance the seesaw is_____. (1)
- A. 567 N
 - B. 433 N
 - C. 850 N
 - D. 750 N
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- 31.** A material rod that is 4.00 m long and 0.50 cm^2 in cross-sectional area is found to stretch 0.20 cm under a tension of 5000 N. The Young's Modulus for this material is_____. (1)
- A. $5.0 \times 10^8 \text{ N/m}^2$
 - B. $2.0 \times 10^{11} \text{ N/m}^2$
 - C. $1.0 \times 10^8 \text{ N/m}^2$
 - D. $1.0 \times 10^4 \text{ N/m}^2$

32. Which one of the following is NOT true about Pascal's principle and its application? (1)
- A. The hydraulic lift is a speed multiplying device in which a large force lifts a light object over a long distance.
 - B. In pneumatic application, air is used for pressure transmission instead of liquid.
 - C. It has applications in hydraulic lift in which a small force applied to a smaller piston is used to lift heavy object on large piston.
 - D. It has applications in hydraulic brakes for vehicles, where confined oil connects a small piston (brake pedal) to a larger piston connected to the brake drums on the wheel of the car.
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33. Which one of the following is NOT correct about factors that affecting the streamlining of objects moving in a fluid? (1)
- A. Shape and surface area of the object moving in a fluid
 - B. The mass of the object
 - C. Density of the fluid
 - D. Compressibility of the fluid
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34. Which of the following is correct? (1)
- A. Temperature is a measure of the average molecular kinetic energy of a gas.
 - B. Internal energy of a system is independent of its mass or the number of molecules in the system.
 - C. Heat is energy that can be transferred from one object to another at equal temperature.
 - D. Temperature is a measure of the amount of energy that flows from hot to colder region.
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35. Two moles of an ideal gas at a temperature of 308 K is confined in a volume of $5.00 \times 10^{-3} \text{ m}^3$. The pressure of the gas is (Universal gas constant $R = 8.314 \text{ J/mol.K}$) (1)
- A. $5.12 \times 10^6 \text{ Pa}$.
 - B. $1.23 \times 10^6 \text{ Pa}$.
 - C. $1.00 \times 10^6 \text{ Pa}$.
 - D. $1.02 \times 10^6 \text{ Pa}$.
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36. A glass contains 12 mole of water molecule (H_2O). The number of water molecules, the mass of water, and the mass of each water molecule in the glass are, respectively (Molar mass of H is 1.0 g and O is 16.0 g) (1)
- A. 102×10^{23} molecules, 0.024 kg, $6.02 \times 10^{-26} \text{ kg}$.
 - B. 96.32×10^{23} molecules, 0.036 kg, $0.009 \times 10^{-26} \text{ kg}$.
 - C. 72.24×10^{23} molecules, 0.216 kg, $35.9 \times 10^{-26} \text{ kg}$.
 - D. 90.32×10^{23} molecules, 0.192 kg, $18 \times 10^{-26} \text{ kg}$.
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37. Which one of the following statements is correct about thermodynamic processes? (1)
- A. In an adiabatic process, there is no heat removed from or absorbed by the system and its p-v diagram is a decreasing plot.
 - B. An isochoric process occurs at constant pressure and its p-v diagram is horizontal.
 - C. An isothermal process occurs at constant pressure and its p-v diagram is a linearly increasing plot.
 - D. An isobaric process occurs at constant volume and its p-v diagram is a vertical line.
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38. In a thermodynamic process, $1.5 \times 10^5 \text{ J}$ of heat is added to an ideal gas to keep the pressure constant at $2.0 \times 10^5 \text{ Pa}$ while the volume increase from 6.3 m^3 to 7.1 m^3 . The change in the internal energy of the gas is (1)
- A. $14.1 \times 10^4 \text{ J}$.
 - B. $-1.0 \times 10^4 \text{ J}$.
 - C. $1.0 \times 10^4 \text{ J}$.
 - D. $3.1 \times 10^4 \text{ J}$.

39. Which one of the following is true about fundamental forces? (1)
- A. Electromagnetic force is a long-range attractive force between particles due to their masses.
 - B. A weak nuclear force is an extremely short-range force that binds protons and neutrons together in a nucleus.
 - C. Strong nuclear force is a short-range force that holds protons and neutrons to form atomic nucleus.
 - D. Gravitational force is a long-range attractive force between particles due to their charge.
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40. Three blocks of mass $M_1 = 1$ kg, $M_2 = 2$ kg, and $M_3 = 3$ kg, placed on a horizontal frictionless table, are connected with strings and pulled to the right by a force $F = 9$ N, as shown below. The acceleration a , tensions T_1 and T_2 are, respectively (1)
- [Figure: Three rectangular blocks stand in a row on a horizontal surface drawn as a single straight line. From left to right they are labelled M1, M2 and M3, M3 being the largest and M1 the smallest. A string joins M1 to M2, and above that string a right-pointing arrow is labelled T1. A second string joins M2 to M3, and above it a right-pointing arrow is labelled T2. From the right-hand face of M3 a right-pointing arrow labelled F leads away, showing the applied pull. Nothing else is drawn; no angles, distances or friction marks appear.]
- A. $a = 3/2$ m/s², $T_1 = 3/2$ N and $T_2 = 9/2$ N.
 - B. $a = 2/3$ m/s², $T_1 = 2/3$ N and $T_2 = 2$ N.
 - C. $a = 3$ m/s², $T_1 = 3$ N and $T_2 = 9$ N.
 - D. $a = 3/2$ m/s², $T_1 = 3$ N and $T_2 = 9/2$ N.
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41. Which of the following is correct about an astronaut inside an international space station orbiting the Earth? (1)
- A. Because the Earth exerts a larger force on the astronaut than on the space station, the astronaut experienced weightlessness.
 - B. The astronaut experiences weightlessness because the space station and the astronauts are freely falling towards the center of the earth.
 - C. The astronaut experiences weightlessness since the Earth's gravitational force on the astronaut is less than the Earth's force on the space station.
 - D. Since the Earth exerts equal forces on both the astronaut and the space, the astronaut experiences weightlessness.
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42. Two masses of m_1 and m_2 are balanced on a horizontal stick of negligible mass pivoted at the center of mass of the system. If the distance from m_1 to the center of mass is 3.0 m and the distance from the mass m_2 to the center of mass is 1.0 m, the ratio of m_1 to m_2 (m_1/m_2) is_____. (1)
- A. 1/3
 - B. 3
 - C. 3/4
 - D. 4/3
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43. Identify the correct statement about energy, work, and force. (1)
- A. Energy cannot be possessed by an object at rest.
 - B. Machines can multiply energy but not force.
 - C. Force is a vector quantity, whereas work and energy are scalars.
 - D. Work is said to be done by a force whenever the force is exerted on an object.
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44. Distinguish between conservative and non-conservative forces. (1)
- A. A conservative force dissipates energy, whereas a non-conservative force does not.
 - B. Friction force is an example of conservative force, whereas spring force and gravitational force are typical examples of non-conservative force.
 - C. Work done by a conservative force is path dependent, whereas work done by non-conservative force does not depend on the path followed.
 - D. Work done by a conservative force along any closed path is zero, whereas the work done by non-conservative force along a closed path is not zero.

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- 45.** A crane raises 75.0 kg of bricks from the ground to a height of 45.0 m in 52.0 s a constant speed. The average power of the crane is_____. (1)
- A. 649 W
B. 14.4 W
C. 144 W
D. 3,375 W
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- 46.** For a rigid body rotating about a fixed axis, (1)
- A. for the same time interval, a point closer to the axis turn through a smaller angle than a point farther from the axis.
B. for the same time interval, a point closer to the axis and a point farther from the axis travel the same linear distance.
C. a point closer to the axis has greater linear speed than a point farther from the axis.
D. a point closer to the axis has smaller linear speed than a point farther from the axis.
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- 47.** A disk of radius 0.10 m and mass 0.1 kg is set into motion by a tangential force of 2.0 N applied at the edge of the disk. If the angular acceleration of the disk is 400 rad/s^2 , the torque and angular velocity at 2.0 s are respectively (1)
- A. 0.2 N.m and 800 rad/s.
B. 0.5 N.m and 100 rad/s.
C. 0.1 N.m and 200 rad/s.
D. 0.2 N.m and 400 rad/s.
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- 48.** Identify the correct statement about torque and angular momentum. (1)
- A. The change in angular momentum is inversely proportional to the torque exerted for a given time interval.
B. No torque acts on an object when its angular momentum increases.
C. A small torque applied for a longer time and a large torque exerted for a shorter time have the same effect on the change of angular momentum.
D. For the same time interval, a small torque and a large torque change angular momentum by the same amount.

— END OF EXAMINATION —