Physics State Content Standards

EXAM

You may use your Notes, *PowerPoint*, or Text on this exam but NO help from human beings!

You MUST HAND WRITE THESE EXAMS in INK!!

NO TYPED or PENCIL PAPERS WILL BE ACCEPTED!

Explanations and Examples MUST be in Complete Sentences!

All Calculations MUST show the Hup, Two, Three, Four.

It is NOT necessary to print this exam. Write your answers onto binder paper. Use both sides to save a tree. Be sure to PRINT your NAME and PERIOD on your papers.

Motion and Forces

Newton's laws predict the motion of most objects. As a basis for understanding this concept:

Students know how to solve problems that involve constant speed and average speed.

1. Find the average speed when Joe travels 250km in 1.5 hours.

Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).

2. State Newton's First Law of Motion and give an example.

Students know how to apply the law F=ma to solve one-dimensional motion problems that involve constant forces (Newton's second law).

3. a. State Newton's Second Law of Motion.

b. Find the force needed to accelerate a 25kg mass $12 m/s^2$.

Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).

4. State Newton's Third Law of Motion and give an example.

Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.

5. State Newton's Law of Gravity and write the math formula for it.

Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).

6. Discuss what causes a satellite to stay in orbit.

Students know circular motion requires the application of a constant force directed toward the center of the circle.

7. Define Centripetal Force and the Centrifugal Effect.

Students know how to solve two-dimensional trajectory problems.

8. Diagram and explain the two parameters of a trajectory.

Students know how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.

9. Diagram and graphically determine the Resultant vector of 10m/s northward and 20m/s eastward.

Students know how to solve two-dimensional problems involving balanced forces (statics).

10. Find the eastward & southward vector components of a force of 30 newtons acting southeastward.

Students know how to solve problems in circular motion by using the formula for centripetal acceleration in the following form: $a=v^2/r$.

11. Find the centripetal acceleration when the velocity is 50m/s and the radius is 5m.

Conservation of Energy and Momentum

The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept:

Students know how to calculate kinetic energy by using the formula $E=(1/2)mv^2$.

12. Find the kinetic energy when a mass of 100kg is moving at 25m/s.

Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =mgh (h is the change in the elevation).

13. Find the potential energy when a 80kg beefer is lifted 100m high.

Students know how to solve problems involving conservation of energy in simple systems, such as falling objects.

14. Find the kinetic energy when that 80kg beefer drops back to the floor. Explain your answer.

Students know how to calculate momentum as the product mv.

15. Find the momentum of that 80kg beefer when he crashes into a wall at 5m/s.

Students know momentum is a separately conserved quantity different from energy.

16. Explain this Standard. Give an example.

Students know an unbalanced force on an object produces a change in its momentum.

17. Explain and give an example of this Standard.

Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.

18. Give an example of an elastic and an inelastic collision.

Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as in springs.

19. State Hooke's Law of elasticity. Give an example.

Heat and Thermodynamics

Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept:

Students know heat flow and work are two forms of energy transfer between systems.

20. Define the Calorie and the Joule. How are they related?

Students know that the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (first law of thermodynamics) and that this is an example of the law of conservation of energy.

21. State the First Law of Thermodynamics and give an example.

Students know the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as thermal energy. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.

22. State the Second Law of Thermodynamics and give an example.

Students know that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.

23. Give an example of this.

Students know that entropy is a quantity that measures the order or disorder of a system and that this quantity is larger for a more disordered system.

24. Give an example of this.

Students know the statement "Entropy tends to increase" is a law of statistical probability that governs all closed systems (second law of thermodynamics).

25. Explain this one.

Students know how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.

26. Explain why no engine is 100% efficient.

Waves

Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:

Students know waves carry energy from one place to another.

27. Give two examples: One of mechanical waves, one of electromagnetic waves.

Students know how to identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and on the earth (seismic waves).

28. Diagram and give an example of a transverse wave and a longitudinal wave.

Students know how to solve problems involving wavelength, frequency, and wave speed.

29. Calculate the velocity of wave whose frequency is 500Hz (cycles/sec) and whose wave length is 40m.

Students know sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.

30. Diagram a longitudinal wave and label its parts. Where do we find longitudinal waves?

Students know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×10^{8} m/s .

31. Find the wave length of an infra-red wave whose frequency is $1 \text{ X } 10^{14}$ Hz (cycles/sec).

Students know how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.

32. Give an example of interference , diffraction, refraction, Doppler effect, and polarization.

Electric and Magnetic Phenomena

Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept:

Students know how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.

33. a. State Ohm's Law and write its formula.

b. State Kirchoffs Voltage Law.

c. State Kirchoffs Current Law.

Students know how to solve problems involving Ohm's law.

34. Find the amperage in a circuit containing a 12v battery, and a 20 ohm resistor.

Students know any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula Power = IR (potential difference) × I (current) = I^2R.

35. Solve for the Power in a circuit whose current is 40 amps and whose resistance is 200 ohms.

Students know the properties of transistors and the role of transistors in electric circuits.

36. a. Diagram a transistor showing its current carrying media (electrons and holes).

b. Show how a transistor acts like a switch and an amplifier.

Students know charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.

37. a. State Coulomb's Law of charges.

b. Describe how charges interact.

Students know magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.

38. a. State the Left Hand Rule for determining the polarity of an electo-magnet.

b. Describe the three fingered rule that relates magnet flux direction with the direction of movement and the current direction.

Students know how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.

39. Explain how to find the magnetic field direction around a current carrying conductor.

Students know changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.

40. a. Discuss how a generator uses this principle to produce electricity

b. Explain how this principle makes a transformer work.

Students know plasmas, the fourth state of matter, contain ions or free electrons or both and conduct electricity.

41. Describe <u>three</u> methods to create a plasma.

Students know electric and magnetic fields contain energy and act as vector force fields.

42. Diagram the three vectors of AC and tell how they interact.

Students know static electric fields have as their source some arrangement of electric charges.

43. a. Describe how to charge positively and negatively.

b. What makes for a negative charge?

c. What makes for a positive charge?

END OF THE EXAM