Conceptual Physics NAME:

Homework 2c Liquids Homeworks are due usually a day after the corresponding textbook part/lecture is completed. Due dates will be announced in class. Multiple-choice problems will all be marked. **USE** the answer table for these problems. The rest of the homeworks will be marked for apparent completeness and some full-answer problems will/may be marked in detail. Make the full-answer solutions sufficiently detailed that the grader can follow your reasoning. Solutions will be posted eventually after the due dates. The solutions are intended to be (but not necessarily are) super-perfect and often go beyond full answers. For an argument or discussion problem, there really is no single right answer. The instructor's answer reflects his long experience in physics, but there could be objections to his arguments, assumptions, nuances, style, facts, etc.

NAME:

Answer Table for the Multiple-Choice Questions

	a	b	c	d	e		a	b	c	d	e
1.	O	O	O	O	O	26.	O	O	O	O	O
2.	O	O	O	O	O	27.	O	O	O	O	O
3.	O	O	O	O	O	28.	O	O	O	O	O
4.	O	O	O	O	O	29.	O	O	O	O	O
5.	O	O	O	O	O	30.	O	O	O	O	O
6.	O	O	O	O	O	31.	O	O	O	O	O
7.	O	O	O	O	O	32.	O	O	O	O	O
8.	O	O	O	O	O	33.	O	O	O	O	O
9.	O	O	O	O	O	34.	O	O	O	O	O
10.	O	O	O	O	O	35.	O	O	O	O	O
11.	O	O	O	O	O	36.	O	O	O	O	O
12.	O	O	O	O	O	37.	O	O	O	O	O
13.	O	O	O	O	O	38.	O	O	O	O	O
14.	O	O	O	O	O	39.	O	O	O	O	O
15.	O	O	O	O	O	40.	O	O	O	O	O
16.	O	O	O	O	O	41.	O	O	O	O	O
17.	O	O	O	O	O	42.	O	O	O	O	O
18.	O	O	O	O	O	43.	O	O	O	O	O
19.	O	O	O	O	O	44.	O	O	O	O	O
20.	O	O	O	O	O	45.	O	O	O	O	O
21.	O	O	O	O	O	46.	O	O	O	O	O
22.	O	O	O	O	O	47.	O	O	O	O	O
23.	O	O	O	O	O	48.	O	O	O	O	O
24.	O	O	O	O	O	49.	O	O	O	O	O
25.	O	O	O	O	O	50.	O	O	O	O	O

1. "Let's play *Jeopardy*! For \$100, the answer is: It is a standard phase of matter in which the atoms or molecules are non-rigidly bonded together. Its density is usually close to the solid phase of the substance. This means that it strongly resists compression like a solid and it does not freely expand like a gas to fill an entire container. It cannot resist a strong shearing force which makes it a fluid just as a gas is fluid. It can, however, resist small shearing forces through the property of surface tension or cohesion. A substance in this phase under sufficiently low pressure conditions will phase change to the gas phase and then it can freely expand to fill a container."

   What is a ____________, Alex?

   a) quur b) quasicrystal c) plasma d) blas e) liquid

2. "Let's play *Jeopardy*! For \$100, the answer is: It is the thermodynamic variable p that determines the normal force exerted by matter in any phase to a compressing surface. The surface can be just a layer of the same matter. A precise formula for p is:

$$d\vec{F} = p\, d\vec{A}$$

   where $d\vec{F}$ is a normal force exerted by matter at point where p is defined and $d\vec{A}$ is differential vector area that points into the surface where the normal force is exerted. The variable is isotropic in ordinary definition: i.e., it has the same value for all directions. In solids and moving fluids, differences from isotropy are accounted for by the stress tensor."

   What is ____________, Alex?

   a) temperature b) entropy c) density d) enthalpy e) pressure

3. The MKS unit of pressure is the pascal (Pa) defined by

$$1\,\mathrm{Pa} = 1\,\mathrm{N/m^2}\ .$$

   The pascal for the human environment is a rather small unit other units are used for convenience. A common standard unit is the standard atmophere (atm) which is mean sea-level pressure defined in some way. Another common unit is the psi or pounds per square inch. For convenience, we can write some relationships:

   a) $1\,\mathrm{atm} = 101325\,\mathrm{Pa} = 101325\,\mathrm{kPa} = 14.696\,\mathrm{psi}$.
   b) $1\,\mathrm{atm} = 101325\,\mathrm{Pa} = 101.325\,\mathrm{kPa} = 1.000\,\mathrm{psi}$.
   c) $1\,\mathrm{atm} = 101325\,\mathrm{Pa} = 101.325\,\mathrm{kPa} = 14.696\,\mathrm{psi}$.
   d) $1\,\mathrm{atm} = 101325\,\mathrm{Pa} = 100\,\mathrm{kPa} = 14.696\,\mathrm{psi}$.
   e) $1\,\mathrm{atm} = 1013.25\,\mathrm{Pa} = 101.325\,\mathrm{kPa} = 14.696\,\mathrm{psi}$.

4. The pressure distribution fof an incompressible fluid of density ρ at rest given a reference pressure p_0 at height $y = 0$ is:

   a) $p = p_0 - \rho y$. b) $p = p_0 - \rho g y$. c) $p = p_0 - g y$. d) $p = p_0 - \rho g$. e) $p = p_0 - \rho g/y$.

5. "Let's play *Jeopardy*! For \$100, the answer is: The buoyancy force equals in magnitude the weight of the fluid displaced or as formula:

$$F_{\mathrm{b}} = m_{\mathrm{dis}} g\ ,$$

   where m_{dis} is the mass of the displaced fluid and g is the gravitational field near the Earth's surface with fiducial value $9.8\,\mathrm{N/m^2}$."

   What is ____________, Alex?

   a) Pascal's principle b) Archimedes's principle c) Bernoulli's principle
   d) D'Alembert's principle e) Bob's principle

6. The extra normal force acting on an object of mass m sitting on the solid bottom of some fluid container is given by ____________ in magnitude. The extra force is the force the solid needs to exert to support the object in addition to what it has to exert to support the fluid if there were no object present.

   a) $F = m_{\mathrm{dis}} g$. b) $F = (m_{\mathrm{dis}} - m)g$. c) $F = (m - m_{\mathrm{dis}})g$. d) $F = mg$.
   e) $F = (m - m_{\mathrm{dis}})/g$.

7. "Let's play *Jeopardy*! For $100, the answer is: This 17th century scientist, writer, and theologian is the discoverer of the eponymous principle:

   > A change in pressure at any point in an enclosed incompressible liquid is transmitted to all other points in the liquid. One is thinking of a liquid at rest or in relatively slow flow. The transmission is not instantaneous, but is roughly at the speed of sound in the liquid. There is probably some oscillation in pressure all over the liquid after the applied change until dissipation of kinetic energy to waste heat brings the liquid relaxes to its new state.

   The person in question was also inventor of early calculating device (and has been honored by having a computer language named for him) and the game of roulette—which has led to honor in casinos ever since. He had a knack for write quotes: e.g.,

   > We have an incapacity for proof which no amount of dogmatism can overcome. We have an idea of truth which no amount of skeptism can overcome."

   What is ____________, Alex?

   a) Otto von Guericke (1602–1686) b) Evangelista Torricelli (1608–1647)
   c) Blaise Pascal (1623–1662) d) Robert Boyle (1627–1691) e) Robert Hooke (1635–1703)

8. Ideal liquids cannot resist any shearing force (i.e., a force that tends to deform them without changing their volume). But actual liquids to have a small about of resistance to shearing forces called cohesion. The atoms/molecules of the liquid are weakly attracted to each other. But the manifestations of the force of cohesion are subject to the square-cube law effect. The larger the sample of liquid, the relatively less important cohesion is in determing the liquid's state. For example, a large volume of water just placed on a solid surface spreads out unable to resist the flattening shearing force of gravity, but a small drop stays relatively unflattened. Of course, even a large quantity of water doesn't spread out forever. Eventually, the water sample is so thin that cohesion is able to resist gravity and a curved boundary later forms.

   The manifestation of cohesion at a liquid's surface is to pull surface atoms/molecules inward relative to the liquid and try to minimize the surface area. This manifestation is called:

   a) adhesion. b) surface cohesion. c) surface tension. d) surface adhesion. e) slurp.

9. Adhesion is the attraction of unlike atoms/molecules. Adhesion plus cohesion causes liquids to be pulled into small tube or tube-like structures of solids. The tubes have to be pretty narrow or the cohesion will not resist the shearing effect of gravity. The energy to pull the liquid against gravity comes from the binding energy of the liquid atoms/molecules to the solid surface. The overall effect of adhesion plus cohesion is called:

   a) capillarity. b) hilarity. c) a capella. d) capacity. e) capillian.