

**Core Science 221, Section 1****NAME:**

**Homework 1: The Concept of Energy in Physics:** Homeworks are due as posted on the course web site. Enter the answer to the multiple-choice questions on the answer table beside the number corresponding to the question. There may be gaps in the table when full-answer questions appear in the homework. You only need to hand in the table for the multiple-choice questions. Solutions will be posted eventually after the due date.

<b>Answer Table</b>					<b>Name:</b>						
	a	b	c	d	e		a	b	c	d	e
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2.	<input type="radio"/>	32.	<input type="radio"/>								
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001 qmult 00110 1 4 5 easy deducto-memory: energy defined

1. "Let's play *Jeopardy!* For \$100, the answer is: It is usefully, if inadequately defined, as the capacity for change or the quantified capacity for change."

What is \_\_\_\_\_, Alex?

- a) momentum    b) entropy    c) enthalpy    d) effigy    e) energy

**SUGGESTED ANSWER:** (e)

**Wrong answers:**

- c) I always forget what enthalpy is when I'm not looking at the formula.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00120 1 4 2 easy deducto-memory: pure energy not

**Extra keywords:** EPS

2. Pure energy (i.e., energy without any other characteristics than those ascribed to energy alone):

- a) is common.    b) does not exist it seems.    c) is rare.    d) is medium.    e) is well-done.

**SUGGESTED ANSWER:** (b)

**Wrong answers:**

- e) A nonsense answer.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00140 1 4 4 easy deducto-memory: kinetic energy defined

**Extra keywords:** EPS

3. "Let's play *Jeopardy!* For \$100, the answer is: The energy of motion with formula  $KE = (1/2)mv^2$ , where  $m$  is the object's mass and  $v$  is the object's speed."

What is \_\_\_\_\_, Alex?

- a) joule    b) force    c) momentum    d) kinetic energy    e) potential energy

**SUGGESTED ANSWER:** (d)

**Wrong answers:**

- a) As Lurch would say AAAARGH.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00142 1 3 1 easy math: kinetic energy calculation

4. An object has kinetic energy 24 J and mass 3 kg. What is its speed?

- a) 4 m/s.    b) 16 m/s.    c) 256 m/s.    d) 24 m/s.    e) 0 m/s.

**SUGGESTED ANSWER:** (a)

The formula for kinetic energy is

$$KE = \frac{1}{2}mv^2 .$$

If we solve for  $v$  and substitute in the given values, we get

$$v = \sqrt{\frac{2KE}{m}} = \sqrt{\frac{2 \times 24}{3}} = \sqrt{16} = 4 \text{ m/s} ,$$

where no conversions are needed since the whole calculation is MKS (i.e., in the meters, kilograms, and seconds subsystem of SI).

**Wrong answers:**

- b) Plausible guess.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00150 1 5 5 easy deducto-memory: vector has mag. and direction

**Extra keywords:** EPS

5. A vector is a physical quantity with:

- a) no direction.    b) no magnitude.    c) three directions.    d) three and half directions.  
e) a magnitude and a direction.

**SUGGESTED ANSWER:** (e)

The statement is not intended to be a definition, but merely give two of a vector's defining traits.

**Wrong answers:**

- a) Exactly wrong.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00200 1 1 3 easy memory: conservation of energy

6. The conservation-of-energy law means that the total energy of a closed system will:

- a) be totally lost.    b) change.    c) not change.    d) increase.    e) decrease.

**SUGGESTED ANSWER:** (c)

**Wrong answers:**

- b) Exactly wrong.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00220 1 4 2 easy deducto-memory: Noether's theorem

**Extra keywords:** EPS

7. "Let's play *Jeopardy!* For \$100, the answer is: A theoretical proof of the conservation of energy."

What is \_\_\_\_\_, Alex?

- a) Pythagoras's theorem    b) Noether's theorem    c) Birkhoff's theorem  
d) Newton's corollary    e) Noether's conjecture

**SUGGESTED ANSWER:** (b)

**Wrong answers:**

- a) Oh, c'mon.  
c) This is an actual theorem in general relativity.  
d) He had some corollaries, but not for this.  
e) A conjecture is not a proof.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00310 1 5 3 easy deducto memory: energy analysis

8. One of the great boons of using the energy concept in the prediction of the behaviors of systems is that it (i.e., the energy concept) often gives you limited, but very useful information:

- a) with impossible difficulty.    b) never.    c) easily.    d) with zero probability.    e) not.

**SUGGESTED ANSWER:** (c)

**Wrong answers:**

- a) A nonsense answer.

**Redaction:** Jeffery, 2008jan01

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001 qmult 00320 1 4 2 easy deducto-memory: energy limits

**Extra keywords:** EPS

9. "Let's play *Jeopardy!* For \$100, the answer is: This feature of an isolated physical system sets a limit to the amount of change that system can undergo."

What is \_\_\_\_\_, Alex?

- a) nothing    b) the total energy    c) something    d) the total kinetic energy  
e) the total potential energy

**SUGGESTED ANSWER:** (b)

**Wrong answers:**

- a) As Lurch would say AAAARGH.

**Redaction:** Jeffery, 2008jan01

001 qmult 00400 1 1 1 easy memory: Aristotle and energy

10. The word energy was apparently coined by:

- a) Aristotle (384–322 BCE).    b) Gottfried Wilhelm von Leibniz (1646–1716).  
c) Thomas Young (1773–1829).    d) Emmy Noether (1882–1935).  
e) Richard Feynman (1918–1988).

**SUGGESTED ANSWER:** (a)

**Wrong answers:**

- b) He coined *vis viva* or at least used the word early on. *Vis viva* is nearly our modern kinetic energy. There is a factor of 1/2 missing in the formula.  
c) He changed the name of *vis viva* to energy and thereby gave energy a scientific meaning. His energy is nearly our modern kinetic energy. There is a factor of 1/2 missing in the formula.

**Redaction:** Jeffery, 2008jan01

001 qmult 00600 1 4 3 easy deducto-memory: Einstein and special relativity

**Extra keywords:** EPS

11. “Let’s play *Jeopardy!* For \$100, the answer is: He was the discoverer of special relativity.”

Who was \_\_\_\_\_, Alex?

- a) Isaac Newton (1643–1727)    b) James Clerk Maxwell (1831–1879)  
c) Albert Einstein (1879–1955)    d) Erwin Schrödinger (1887–1961)  
e) Louis de Broglie (1892–1987)

**SUGGESTED ANSWER:** (c)

**Wrong answers:**

- b) Maxwell was such a brilliant person that if he had lived longer, one wonders if he wouldn’t have anticipated Einstein. Making Maxwell’s theory of electromagnetism (taken as exact) consistent with the principle of relativity was one of the things that led Einstein to special relativity.

**Redaction:** Jeffery, 2008jan01

001 qmult 00610 1 1 3 easy memory: light speed

**Extra keywords:** EPS

12. According to special relativity, the vacuum speed of light is (with some qualifications we needn’t go into):

- a) dependent on the observer.    b) 3 m/s.    c) the highest possible physical speed.    d) the lowest possible physical speed.    e) negligible.

**SUGGESTED ANSWER:** (c)

**Wrong answers:**

- a) Wrong.

**Redaction:** Jeffery, 2008jan01

001 qmult 00620 1 4 5 easy deducto-memory:  $E=mc^2$

**Extra keywords:** EPS

13. “Let’s play *Jeopardy!* For \$100, the answer is: It is the mass-energy equivalence equation or the Einstein equation.”

What is \_\_\_\_\_, Alex?

a)  $E = \frac{1}{2}mv^2$     b)  $E = mv$     c)  $E = mc^4$     d)  $E = mc^3$     e)  $E = mc^2$

**SUGGESTED ANSWER:** (e)

**Wrong answers:**

a) As Lurch would say AAAARGH.

**Redaction:** Jeffery, 2008jan01

001 qmult 00640 1 3 2 easy math:  $E=mc^{**2}$  calculation

14. What is the energy equivalent in joules of 1 kg? Recall the vacuum speed of light is approximately  $3.00 \times 10^8$  m/s.

a)  $9 \times 10^8$  J.    b)  $9 \times 10^{16}$  J.    c)  $3 \times 10^{16}$  J.    d)  $3 \times 10^8$  J.    e) 1.

**SUGGESTED ANSWER:** (b)

Behold:

$$E = mc^2 = 1 \times (3 \times 10^8)^2 = 9 \times 10^{16} \text{ J} .$$

**Wrong answers:**

d) Bad guess.

**Redaction:** Jeffery, 2008jan01

001 qmult 00680 1 5 5 easy deducto-memory: nuclear reaction energy scale

**Extra keywords:** EPS

15. Since the early days of radioactivity, people have been (as Beatrix Potter [1866–1943] once said in another context) “’ticed by quantities” when contemplating the fact that the energy scale of nuclear reactions is of order \_\_\_\_\_ times the energy scale of chemical reactions.

a) 2    b) 6    c) 10    d)  $10^{-6}$     e)  $10^6$

**SUGGESTED ANSWER:** (e)

**Wrong answers:**

d) C`mon is this going to ’tice anyone.

**Redaction:** Jeffery, 2008jan01