PHYSICAL SCIENCE 107 - 01     Exam #2a     NAME KEY

30 March 2006

Instructions: Please answer each question. In questions that require written answers use complete sentences. For any problems requiring a calculation show your work and include the units used. Follow significant figure rules for calculations. Put a box around any final numerical answers.

Part I. Short questions.

1. (5 pts) Can an object be in motion even if it has zero net force acting on it? Explain.
   
   Yes - as explained in the 1st law, an object can move with constant velocity if the net force is zero.

2. (5 pts) What is the difference between distance and displacement?
   
   Distance is the total length traveled from one initial to a final point. Displacement is the straight line separation between initial and final points.

3. (5 pts) What is scientism?
   
   A philosophical system (point of view) that science is the only source of knowledge - only way to get truth is by the methods of science.

4. (5 pts) How is it possible for an object (e.g. a book) to have a negative potential energy?
   
   \[ E_p = mgh \] so it depends on where the zero is chosen. If below the chosen zero position, \( E_p \) will be negative.

5. (5 pts) What does centripetal mean?

   "Center seeking"
6. (5 pts) A calculator is used to determine $3.8 \times \pi$ which appears on the display as 11.93805208. Round to the appropriate number of significant figures.

$$3.8 \times \pi \approx 11.94$$

7. (5 pts) A ball is dropped from a cliff, starting at rest. How far has the ball fallen in 1.8 seconds?

$$d = \frac{1}{2} g t^2 = \frac{1}{2} (9.8 \text{ m/s}^2)(1.8 \text{ s})^2 = 16 \text{ m}$$

8. (5 pts) Why does Fischer (author of *God Did It, But How?*) warn that we should not make a sharp distinction between the natural and the supernatural? 3 reasons:

- Bible does not do so
- Atten leads to identify God with the supernatural to not with natural
- Hard to make a clear definition to distinguish the 2.

9. (5 pts) If a 60 Watt light bulb runs for 45 minutes, how much energy, in Joules, does it use?

$$P = \frac{E}{t} \Rightarrow E = P \cdot t = 60 \text{ W} \cdot \frac{45 \text{ min}}{60 \text{ min}} = 162 \times 10^3 \text{ J}$$

10. (5 pts) A 1200 kg car has a net force of 940 N acting on it. What is the car's acceleration?

$$F_{net} = ma \quad \text{so} \quad a = \frac{F_{net}}{m} = \frac{940 \text{ N}}{1200 \text{ kg}} = 0.783 \text{ m/s}^2$$
Part II. Longer Questions. Again, show your work and/or use complete sentences.

11. (10 pts) The diagram below is from Fischer in God Did It, But How? Explain what he means by this diagram.

![Diagram showing evolution by descent with modification and instantaneous origins]

The top level is that of worldview or philosophical starting point. The vertical lines between them show that they are mutually exclusive (can't hold both theism & evolutionism). The lower level shows two views of origins which are also mutually exclusive. The vertical arrows show that the worldview on the top is often linked with the view below it but the dashed diagonal arrows show that it is possible for a theist to accept evolutionary descent at an evolutionary to accept a type of instantaneous origins.

12. (15 pts) The diagram below shows a pendulum which is released from rest from point A and swings back and forth. Positions A-E are as shown on the diagram. Fill in the blanks with the position or positions that are described for the mass of the pendulum.

- a) C location(s) of maximum speed
- b) A, E location(s) of maximum height
- c) C location(s) of maximum kinetic energy
- d) A, E location(s) of maximum potential energy
- e) A, E location(s) of minimum kinetic energy
- f) C location(s) of minimum potential energy
- g) C location(s) of maximum speed
- h) ABCDE location(s) of constant total energy
13. (15 pts) A bicyclist has an initial speed of 8.0 m/s. By applying the brakes, she comes to rest in a time of 4.0 s, and travels 18.0 m while doing so.

a) What is her acceleration during this period?

b) What is her average velocity during this time?

\[
\bar{a} = \frac{\Delta v}{\Delta t} = \frac{0 - 8.0 \text{ m/s}}{4.0 \text{ s}} = -2.0 \text{ m/s}^2
\]

\[
\bar{v} = \frac{\Delta s}{\Delta t} = \frac{18.0 \text{ m}}{4.0 \text{ s}} = 4.5 \text{ m/s}
\]

14. (10 pts) An elevator car is being lowered at constant velocity by a cable connected to the top of the elevator. Assuming no frictional forces act, how does the force the cable exerts on the car compare to the force of gravity on the car? Is the cable force greater, less than, or equal to the force of gravity? Explain your answer.

They are equal. According to Newton's 2nd law, \( F_{\text{net}} = ma \). Since \( a = 0 \) (vel is constant), so the net force must be zero. Since this is the case, the force of the cable must have the same magnitude as the force of gravity.
30 March 2006

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Part I. Short questions.

1. (5 pts) If a 30 Watt light bulb runs for 15 minutes, how much energy, in Joules, does it use?

\[ P = \frac{W}{t} \] so \[ W = P \cdot t = (30 \text{ W}) \cdot (15 \text{ min}) \cdot (60 \text{ s/min}) = 2.7 \times 10^7 \text{ J} \]

- 3 if \( W = 30 \text{ W} \cdot t \) in \( \text{ W} \cdot \text{min} \)
- 1 if \( W \) in \( \text{ kW} \cdot \text{h} \)
- 1 if \( W \) in \( \text{ J} \)

2. (5 pts) What does centripetal mean?

Centre seeking

3. (5 pts) What is scientism?

The view that science is the only source of knowledge — only way to get truth is by the methods of science.

- 1 if scientism = evidential

4. (5 pts) Can an object be in motion even if it has zero net force acting on it? Explain.

Yes — as explained in Newton’s 1st law an object can move with constant velocity if net force is zero.

5. (5 pts) A 1100 kg car has a net force of 720 N acting on it. What is the car’s acceleration?

\[ F_{net} = ma \] so

\[ a = \frac{F_{net}}{m} = \frac{720 \text{ N}}{1100 \text{ kg}} = 0.65 \text{ m/s}^2 \]
6. (5 pts) How is it possible for an object (e.g. a book) to have a negative potential energy? 
\[ E_p = mgh, \text{ so } E_p \text{ depends on where } h \text{ is chosen to be zero.} \]
If below the chosen point, \( h \) will be negative, so \( E_p \) will also be negative.

7. (5 pts) Why does Fischer (author of *God Did It, But How?*) warn that we should not make a sharp distinction between the natural and the supernatural? 
3 reasons:
- Bible doesn't do so
- Can lead to identifying God w/ supernatural that is not natural
- Hard to make a clear cut definition that separates the 2

8. (5 pts) A ball is dropped from a cliff, starting at rest. How far has the ball fallen in 2.3 seconds?

\[ d = \frac{1}{2} g t^2 = \frac{1}{2} (9.8 \text{ m/s}^2)(2.3 \text{ s}) = 26 \text{ m} \]

9. (5 pts) What is the difference between distance and displacement? 
Distance is the total length traveled from an initial to a final point. Displacement is the straight line separation between initial and final points.

10. (5 pts) A calculator is used to determine 4.7 x \( \pi \) which appears on the display as 14.76548547. Round to the appropriate number of significant figures.

\[ 15 \]

4.7 has 2 significant digits, so since they are multiplied, round to 2 digits.

The remaining 4 problems are identical to those in version a) but are in a different order. See that key for answers.