

2. When a spherical body is falling through air, the friction force acting on it varies directly as the square of the object's speed. What are the UNITS of the constant of proportionality, relating friction force and speed?

A) kg/m B) kg/(m•s) C) kg•m/s D) kg•m²/s³ E) kg•m³/s⁴

- 3. Don and Kai travelled the same 600 km trip along a straight road. Don travelled half the distance at 50 km/h and the other half at 100 km/h. Kai travelled for half his total travel time at 50 km/h and the remaining time at 100 km/h. Who arrived first, and by what time margin?
 - A) Both arrived at the same time.
 - B) Don arrived 1.0 h ahead of Kai.
 - C) Don arrived 0.10 h ahead of Kai.
 - D) Kai arrived 1.0 h ahead of Don.
 - E) Kai arrived 0.10 h ahead of Don
- 4. The newest roller coaster in California reaches a amazing speed of 162 km/h! Assuming that all this energy comes from gravitational potential energy lost in the fall and that frictional losses are about 10%, estimate the drop in height for this record-shattering ride.

A)	93.0 m	B)	103 m	C)	115 m
D)	1.34 km	E)	1.49 km		

- Doug's car accelerates uniformly along a straight road and during a time ∆t its speed increases from u to v. Doug notes that his average speed for that interval was exactly the same as his change in speed for that interval. Under what conditions will this occur?
 A) always
 - B) only if u = 0
 - C) only if v = 2u
 - D) only if v = 3u
 - E) This cannot occur.

6. The Physics lab is 16 m long, 13 m wide, and 4.0 m high. A super spider starts at the southeast corner on the floor and travels to the northwest corner at the ceiling, in a time of 100 s. The magnitude of the spider's average velocity is



- 7. The natural frequency of a string varies directly as the square root of the tension in the string. Two identical strings have a tension of 100 N and sound a frequency of 50 Hz. The tension is reduced in one of the strings. What is this tension if the two strings now produce 10 beats every second, when sounded together?
 A) 89 N
 B) 80 N
 C) 64 N
 - D) 8.9 N E) 8.0 N
- 8. When measured with a decibel meter, a subway train registers 1.0×10^2 dB and normal breathing is read as 10 dB. The sound from the subway train is
 - A) 10 times more intense
 - B) 90 times more intense
 - C) 100 times more intense
 - D) 1000 times more intense
 - E) 1.0×10^9 times more intense
- 9. Light, like any other wave, obeys the Universal Wave Equation. What is the frequency of light with a wavelength of 500 nm in a vacuum?

DATA: speed of light in vacuum = $3.00 \times 10^8 \text{ m/s}$

- $1.00 \text{ nm} = 1.00 \text{ x} 10^{-9} \text{ m}$
- A) 1.67 x 10-15 Hz
- B) 5.00 x 10-7 Hz
- C) 1.50 x 10² Hz
- D) 8.00 x 10⁵ Hz
- E) 6.00 x 10¹⁴ Hz
- 10. Uniform plane waves with a wavelength of 5.0 m are travelling north at constant speed. When Jill travels north in her power boat at 15 m/s (relative to the land), she notes that the boat hits a new wave crest every 0.50 s. If she were to travel south at 15 m/s, what would the period of time be for her boat to hit successive wave crests?

A) 0.50 s

- B) 0.40 s
- C) 0.30 s
- D) 0.25 s
- E) 0.15 s

- 11. Two identical simple pendulum clocks keep perfect time when their pendula are 100 cm long. George bumps into one of the clocks and causes its bob to slip so that the pendulum is now 102 cm long, and no longer keeps correct time. ($T = 2\pi \sqrt{1/g}$ for a pendulum) Both clocks are started running with their pendula in phase. How much time will elapse before the two pendula are back in phase again? A) 32.7 s B) 100 s C) 102 s D) 201 s E) 204 s
- 12. A beam of red laser light strikes a glass surface so that some reflects and the rest travels into the glass or refracts. If we compare this refracted beam to the original incident beam, which of the following quantities has <u>not</u> changed?



13. A fluorescent light tube of length 100 cm is positioned horizontally on the ceiling, 3.0 m above the floor. An opaque stick of length 60 cm is held parallel to the light tube, directly beneath it and casts its shadow on the floor. At what minimum height above the floor will the shadow of the stick be penumbra only?

light		<u> </u>	<u>+</u> <	No	ot to scale!
floor	stick				
A)	0.60 m	B)	1.2 m	C)	1.8 m

E) 2.8 m

D) 2.4 m

- 14. You have two converging lenses of the same diameter. Lens X has a focal length of 20 cm, while lens Y has a focal length of 200 cm. On a sunny day, shining onto identical pieces of paper, both lenses are used to form a focussed image of the sun on the papers. Which lens will cause the paper to start burning first, and for what reason?
 - A) Both will start at the same time; since they have the same diameter and collect the same sunlight.
 - B) X will start first; since its image is closer, the image of the sun will be smaller and thus more concentrated.
 - C) Y will start first; since its image is further away the image of the sun will be smaller and thus more concentrated.
 - D) X will start first; since there is less light absorbed than Y in the short air path from lens to paper.
 - E) Y will start first; since X will suffer severe chromatic aberration.

15. Two light bulbs, L1 and L2 are connected in a circuit as shown in the diagram, and both are lit up. The switch is now closed. The intensity of the bulbs will become:



- A) L1 will be dimmer; L2 will go out
- B) L1 will be brighter; L2 will go out
- C) L1 will be unchanged; L2 will go out
- D) L1 will be unchanged; L2 will be brighter
- E) L1 and L2 will be unchanged in brightness
- 16. Assume that each of the following circuits are connected to the same voltage source. Which combination of identical resistors will give the most heat per second?



- 17. Four electrically isolated spheres exert electrostatic forces on each other. They are labelled W, X, Y, and Z. The following interactions are noted.
 - i. W repels X and attracts both Y and Z
 - ii. X attracts both Y and Z
 - iii. Y attracts Z

If we are told that Y is negatively charged, what is the charge on the spheres?

	W	Х	Y	Z
A)	+	+	_	0
B)	_	_	_	0
C)	+	0	_	+
D)	+	0	_	0
E)	+	+	-	+

18. You are given three 6 Ω resistors and many connecting wires. How many different total resistances could you create from these three, by using at least one of them at a time and connecting them in different ways? (Do not count 0 Ω and $\propto \Omega$)

C) 6

•		/
A) 3	B) .	5
D) 7	E) 8	8

19. Electrical energy gets from the generating station to Siva's house by passing through 8 transformers which change its voltage. If each transformer is only 95% efficient, what is the total energy loss due to these transformers?

A) 5.0%	B)	14%	C)	34%
D) 38%	E)	40%		

- 20. A electrical current can be generated in a long wire by twirling it like a skipping rope, with one person on each end. It is moving in Earth's magnetic field. In what position would the two people be for minimum energy output, in Southern Ontario?
 - A) east and west
 - B) north and south



- C) northeast and southwest D) northwest and southeast
- E) all horizontal positions are equal
- 21. Triple beam balances often have an aluminum plate on one end of the beam, which passes between two permanent magnets. What is its function?
 - A) Magnets attract aluminum so the beam will not be able to move if it is not exactly midway between the magnets ; it ensures the alignment is correct.
 - B) Magnets attract aluminum, making the balance more sensitive.
 - C) Magnets attract aluminum, making the balance capable of handling heavier masses.
 - D) Magnets repel aluminum, so they help keep the beam sensitive.
 - E) Magnetism in the moving aluminum, caused by induced current flow, helps to damp the motion of the beam, yet not affect its final balance.
- 22. A high intensity lamp operates at 12 volts and has a power of 30 W. It is operated by an ideal transformer plugged into the 120 VAC supply. What is the current in the primary circuit?
 - A) 40 mA B) 250 mA C) 400 mA
 - D) 25 A E) 48 A
- 23. Which of the following does the CANDU reactor system use as fuel?
 - A) natural uranium
 - B) enriched uranium
 - C) mainly plutonium 239
 - D) uranium-plutonium mixture
 - E) heavy water
- 24. A radioactive source was placed beneath a radiation detector and registered 3.0 MBq. A thin sheet of aluminum foil was held between the source and the detector and the reading dropped to 2.0 MBq. Up to 50 more sheets of foil were added to the original sheet and the reading did not change appreciably. The detector was sensitive to alpha, beta, and gamma radiation. What was the source emitting?



- D) alpha and beta
- E) alpha and gamma



> source

- 25. Radioactive iodine-131 is used to treat hyperactive thyroids, since the body tends to concentrate iodine in this gland. It has a half-life of approximately 8 days. Assuming that none of the iodine is eliminated by the body, approximately how many days will it take for the radioactive iodine level to drop to 1/1000 of its original level?
 - A) 16 days B) 40 days C) 80 days
 - D) 131 days E) 4 000 days
- 26. Recently, NASA announced that they had found evidence for life on Mars, based on the analysis of a Martian rock. How did this rock get to Earth?
 - A) It was brought back by astronauts.
 - B) It was brought back by an unmanned robotic lander.
 - C) It was left here when Mars and Earth collided.
 - D) It travelled through space and landed on Earth, after an asteroid crashed into Mars.
 - E) It was given to Captain Picard on an away mission.
- 27. Comet Hale-Bopp is being touted as one of the great comets of the 20th century, a chunk of frozen water, carbon dioxide and other dust particles, formed long ago. The tail has a length of 100 million kilometres. Approximately how large is the comet nucleus itself?
 A) 400 m
 B) 4.0 km
 C) 40 km
 D) 400 km
- 28. On March 23, 1997 there was a partial lunar eclipse. At its maximum, 92% of the moon was in the Earth's shadow, yet it appeared with a warm copper glow. The source of this light was
 - A) sunlight reflected off the surface of Earth.
 - B) the combined starlight from nearby stars.
 - C) radioactive decay of materials on the moon.
 - D) sunlight refracted through Earth's atmosphere.
 - E) sunlight reflected from comet Hale-Bopp's tail.
- 29. In order to test the power output of the microwave oven she had just purchased, Karen heated 250 g of water in a mug and noted it took 2.0 minutes to come to a boil. If the water was initially at 20° C, estimate the power of Karen's oven.

(Spe	ecific Heat Ca	apaci	ity of water =	4.2 ł	$J/kg \bullet C^{\circ}$
A)	175 W	B)	700 W	C)	800 W
D)	875 W	E)	42 kW		

30. A beaker of fresh water is sitting on a balance and the readout shows a mass of 400.0 g. An aluminum cylinder of length 10 cm and radius 1.0 cm is lowered into the water so that half is submerged and <u>held</u> motionless there. What reading will the balance now display?

(density of water = 1000 kg/m^3 density of aluminum = 2700 kg/m^3) A) 400.0 g B) 415.7 gC) 442.4 g D) 449.3 gE) 484.4 g

