PHYSICS SUBJECT TEST 2

Question Number	Correct Answer	Right	Wrong	Question Number	Correct Answer	Right	Wrong	Question Number	Correct Answer	Right	Wrong
1.	D			26.	C			51.	A		
2.	B			27.	B			52.	B		
3.	C			28.	B			53.	D		
4.	A			29.	D			54.	E		
5.	D			30.	A			55.	D		
6.	B			31.	A			56.	D		
7.	E			32.	D			57.	A		
8.	A			33.	B			58.	C		
9.	B			34.	E			59.	E		
10.	B			35.	C			60.	E		
11.	A			36.	E			61.	A		
12.	B			37.	C			62.	E		
13.	D			38.	A			63.	D		
14.	C			39.	B			64.	E		
15.	B			40.	B			65.	C		
16.	D			41.	D			66.	B		
17.	C			42.	E			67.	C		
18.	A			43.	A			68.	B		
19.	B			44.	C			69.	B		
20.	B			45.	A			70.	A		
21.	B			46.	E			71.	D		
22.	C			47.	C			72.	E		
23.	C			48.	D			73.	B		
24.	B			49.	E			74.	B		
25.	A			50.	C			75.	A		

Answers and Explanations

1 D As the block moves up and down, its position changes.

2 B According to the equation for the frequency of a spring–block simple harmonic oscillator, $f = \frac{1}{2\pi}\sqrt{k/m}$, we see that the frequency is inversely proportional to the square root of m, the mass of the block.

3 C According to the equation for the period of a spring–block simple harmonic oscillator, $T = 2\pi\sqrt{m/k}$, we see that the period is inversely proportional to the square root of k, the force constant of the spring. So, if k is smaller, T will be greater.

4 A If A is the amplitude of the oscillations, then the maximum potential energy of the spring is $\frac{1}{2}kA^2$. When the block passes through the equilibrium position, all this energy is completely converted to kinetic energy, at which point the block has its maximum speed. Setting $\frac{1}{2}mv^2_{\text{max}}$ equal to $\frac{1}{2}kA^2$, we find that $v_{\text{max}} = A\sqrt{k/m}$, so v_{max} is proportional to A.

5 D If A is the amplitude of the oscillations, then the position of the block varies sinusoidally between $y = -A$ and $y = +A$. The equation for the position (as a function of time, t) will have the form $y = A\sin(\omega t + \varphi)$, where $\omega = 2\pi f$.

6 B When a nucleus undergoes β^- decay, a neutron is converted into a proton and an electron, and the electron is ejected. Because of this, the number of neutrons in the nucleus is decreased by 1.

7 E A nucleus in an excited energy state can “relax” to a lower energy state by releasing energy. If the photon(s) emitted in this process are in the gamma-ray portion of the electromagnetic spectrum, we refer to this “decay” as gamma decay. The numbers of protons and neutrons remain unchanged.

8 A When a nucleus undergoes alpha decay, it ejects an alpha particle, which is a helium-4 nucleus, composed of 2 protons and 2 neutrons. This is by far the heaviest decay particle that is ejected from a radioactive nucleus.

9 B When a nucleus undergoes β^- decay, a neutron is converted into a proton and an electron, and the electron is ejected. Because of this, the number of protons in the nucleus—the atomic number—is increased by 1.

10 B The electric field strength is strongest at $x = 0$. It increases from $x = -a$ to $x = 0$, then decreases from $x = 0$ to $x = a$. Therefore, only graphs B and E are possible. However, since the electric field strength at $x = 0$ is not zero, the answer cannot be E.

11 A Every point on the x axis is equidistant from the source charges. For any given point, P, on the x axis, let R denote its distance from the $+Q$ charge and from the $-Q$ charge. Then the potential at P is $k(+Q)/R + k(-Q)/R = 0$. Therefore, the potential is zero everywhere along the x-axis, so graph A is the answer.

12 B If a charge $-q$ is at a location where the electric field is $\mathbf{E}$, then the electric force on the charge is $\mathbf{F} = (-q)\mathbf{E}$, and the magnitude of this force is qE. Since the magnitude of the electric force, F, is proportional to the electric field strength, the graph of F should have the same shape as the graph of E.

13 D By Newton's third law, the force on the heavier person is equal but opposite to the force on the lighter person, eliminating A and B. Since the lighter person has $\frac{1}{2}$ the mass of the heavier person and acceleration is inversely proportional to mass, the magnitude of the lighter person's acceleration will be twice that of the heavier person.

14 C When the particle enters the magnetic field, the magnetic force provides the centripetal force to cause the particle to execute uniform circular motion.

$$|q|vB = \frac{mv^2}{r} \quad \Rightarrow \quad r = \frac{mv}{|q|B}$$

Since v and B are the same for all the particles, the largest r is found by maximizing the ratio $m/|q|$. The value of $m/|q|$ for an alpha particle is about twice that for a proton and thousands of times greater than that of an electron or positron.

15 B The magnetic field lines created by a long, straight, current-carrying wire are circles centered on the wire.

16 D With respect to the point at which the rod is attached to the vertical wall, the tension in the string exerts a counterclockwise (CCW) torque, and the gravitational force—which acts at the rod's center of mass—exerts a clockwise (CW) torque. If the rod is in equilibrium, these torques must balance. Letting L denote the length of the rod, this gives us

$$\tau_{\text{CCW}} = \tau_{\text{CW}}$$

$$F_{\text{T}} L \sin\theta = (\frac{1}{2}L)(mg)\sin\theta$$

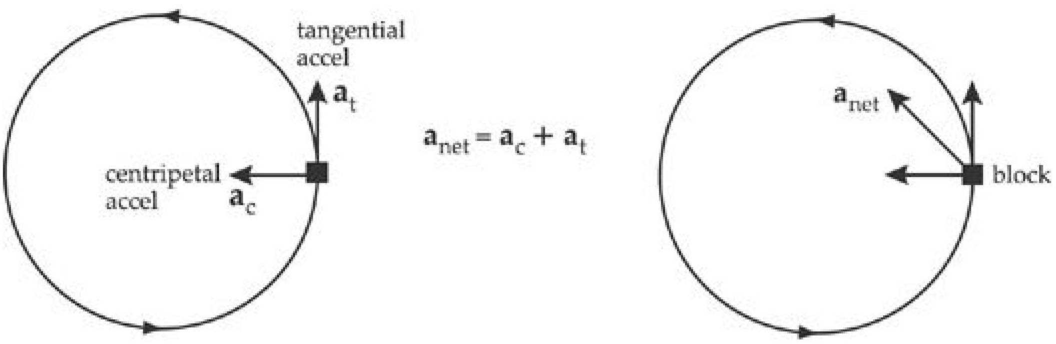
$$F_{\text{T}} = \frac{1}{2}mg$$

17 C By Newton's third law, both vehicles experience the same magnitude of force and, therefore, the same impulse; so I is false. Invoking Newton's second law, in the form *impulse* = *change in momentum*, we see that II is therefore also false. However, since the car has a smaller mass than the truck, its acceleration will be greater in magnitude than that of the truck, so III is true.

18 A At the instant a simple harmonic oscillator passes through equilibrium, the restoring force is zero. Since the restoring force on the bob is zero at equilibrium, the tangential acceleration of the bob is also zero at this point.

19 B Using the equation for the period of a simple pendulum (oscillating with a small amplitude so we can approximate the motion as simple harmonic), $T = 2\pi\sqrt{L/g}$, we see that we can solve for L if we know T (since g is known).

20 B Because the block moves in a circular path, it must experience a centripetal acceleration (that is, an acceleration directed toward the center of the circle). Now, since the speed of the block is changing, it must also be experiencing a tangential acceleration; in particular, because the block's speed is *increasing*, this tangential acceleration must be in the *same* direction as the block's velocity. Therefore, the total acceleration of the block is the sum of the centripetal acceleration $\mathbf{a}_c$ and the tangential acceleration $\mathbf{a}_t$. The figure below shows that this sum points upward and to the left, so arrow B is best.



[21](#) B From the equation $F = qE$, where q is the magnitude of the charge in the electric field, we find that

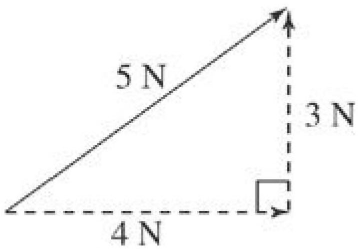
$$E = \frac{F}{q} = \frac{1\text{ N}}{0.2\times10^{-3}\text{ C}} = 5\times10^{3}\text{ N/C}$$

[22](#) C Since the magnetic force is always perpendicular to the object's velocity, it does zero work on any charged particle. Zero work means zero change in kinetic energy (a direct consequence of the work–energy theorem), so the speed remains the same. Remember: The magnetic force can only change the direction of a charged particle's velocity, not its speed.

[23](#) C Use the work–energy theorem.

$$W = \Delta\text{KE} = \frac{1}{2}m(v_f^2 - v_i^2) = \frac{1}{2}(2\text{ kg})[(4\text{ m/s})^2 - (2\text{ m/s})^2] = 12\text{ J}$$

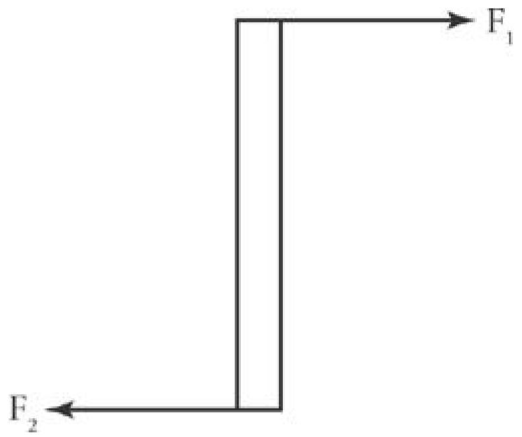
[24](#) B First, if we add the 2 N force to the left and the 6 N force to the right, we get a 4 N force to the right. Then, adding this to the 3 N force gives us a net force whose magnitude is 5 N (this follows from the famous 3-4-5 right triangle).



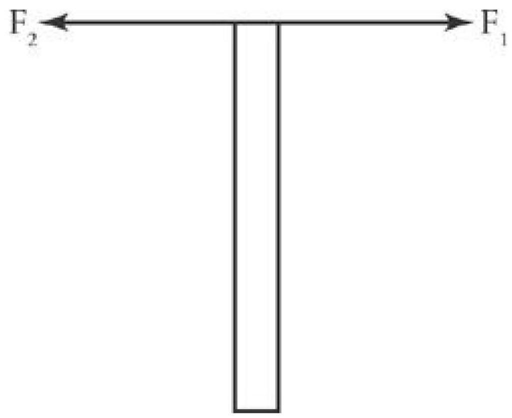
Since $a = F_{net}/m$, we get $a = (5\text{ N})/(2\text{ kg}) = 2.5\text{ m/s}^2$.

[25](#) A If these waves interfere completely destructively, the amplitude of the resultant wave will be 6 cm – 4 cm = 2 cm. If they interfere completely constructively, then the amplitude of the resultant wave will be 6 cm + 4 cm = 10 cm. In general, then, the amplitude of the resultant wave will be no less than 2 cm and no greater than 10 cm.

26 C Since $\mathbf{F}_{\text{net}} = \mathbf{F}_1 + \mathbf{F}_2 = \mathbf{0}$, the bar cannot accelerate translationally, so B is false. The net torque does *not* need to be zero, as the following diagram shows (eliminating A and D).



However, since $\mathbf{F}_2 = -\mathbf{F}_1$, C is true; one possible illustration of this is given below.



27 B The cylinder slides across the surface with acceleration $a = F/m$ until time $t = T$, when a drops to zero (because F becomes zero). Therefore, from time $t = 0$ to $t = T$, the velocity is steadily increasing (because the acceleration is a positive constant), but, at $t = T$, the velocity remains constant. This is illustrated in graph B.

28 B We'll use conservation of mechanical energy. Let the flat surface be our $PE_{\text{grav}} = 0$ level. Then

$$K_0 + U_0 = K_f + U_f$$

$$0 + mg(2R) = \frac{1}{2}mv^2 + mgR$$

$$\frac{1}{2}mv^2 = mgR$$

$$v = \sqrt{2gR}$$

29 D As the box slides down the track, it loses height, so it loses gravitational potential energy. The quantities in A, B, and C *increase* as the box slides down the track, and the quantity in E remains constant.

30 A Since both the box and the ball have zero vertical velocity at the moment when they're released, they'll both take the same amount of time to fall to the surface. The box's horizontal velocity at the moment it leaves the track is irrelevant to this question.

31 A Electric field lines are always perpendicular to the surface of a conductor, eliminating B and E. Excess charge on a conductor always resides on the surface (eliminating D), and there is a greater density of charge at points where the radius of curvature is smaller, which eliminates C.

32 D Since the line of action of the force coincides with one of the sides of the square, the lever arm of the force, ℓ (the distance from the center of the square to the bottom side), is simply equal to $\frac{1}{2}s$, half the length of each side of the square. This gives us

$$\tau = \ell F = \frac{1}{2}(0.40 \text{ m})(10 \text{ N}) = 2.0 \text{ N-m}$$

33 B Since the velocity does not change, the acceleration of the box is zero, so the net force the box feels must also be zero. Since the mover pushes on the box with a force of 200 N, the force of kinetic friction must also be 200 N (in the opposite direction) to give a net force of zero. Because the strength of the force of kinetic friction, F_{friction}, is equal to μF_N, where $F_N = mg$ (since the floor is flat), we find that

$$\mu = \frac{F_{\text{friction}}}{F_N} = \frac{F_{\text{friction}}}{mg} = \frac{200 \text{ N}}{(50 \text{ kg})(10 \text{ m/s}^2)} = 0.4$$

34 E Fiber optic cables transmit light using total internal reflection. A, B, C, and D do not apply here.

35 C The ideal gas law says that $PV = nRT$. Since V, n, and R are constants here, P is proportional to T. The graph of a proportion is a straight line through the origin.

36 E All electromagnetic waves—regardless of frequency—travel at speed c (the speed of light) through vacuum.

37 C Applying Coulomb's law, we see that the electric force will not change.

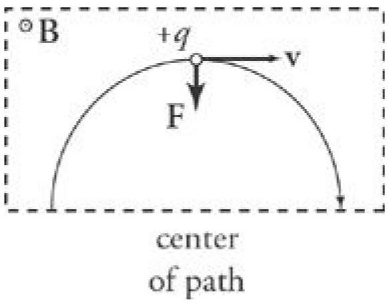
$$F' = k\frac{Q'q'}{r'^2} = k\frac{(2Q)(2q)}{(2r)^2} = k\frac{4Qq}{4r^2} = k\frac{Qq}{r^2} = F$$

38 A Because the bat flies *toward* the tree, the frequency of the waves as they hit the tree is *higher* than the frequency with which they were emitted by the bat. Then as these waves reflect off the tree, they are detected by the bat, which is still flying toward the tree, so the frequency gets shifted higher again. Therefore, if the returning signal is detected by the bat as having a frequency of 61 kHz, the original pulse must have been emitted at a frequency lower than 61 kHz. Only A is lower than 61 kHz.

39 B Perhaps the easiest way answer this question is to choose a numerical value for the distance between X and Y. Let's choose 180 m. Then the time it takes the athlete to run from X to Y is 60 seconds, and the time it takes to run from Y back to X is 30 seconds. Her average speed for the entire run is the *total* distance traveled, 180 m + 180 m = 360 m, divided by the *total* time, 60 s + 30 s = 90 s. This gives an average speed for the entire trip of (360 m)/(90 s) = 4 m/s. (Note: You would get the same answer, 4 m/s, no matter what positive value you chose for the distance between X and Y.)

40 B A and E are identical, so both may be eliminated. Since F is equal to the weight of the sky diver, C and D don't make sense. If the sky diver's downward velocity is decreasing, she must be experiencing an upward acceleration. Therefore, the net force on the sky diver must be upward. Since D is an upward force and F is a downward force, D must be greater than F to give a net force, $D - F$, that's upward.

41 D At the top of the semicircle, the cation's velocity, **v**, is to the right, and the net force it feels, **F**, must be downward in the plane of the page (that is, toward the center of the circle since it's undergoing uniform circular motion).



For a positive charge moving to the right to feel a downward magnetic force in the plane of the page, the magnetic field must point *out* of the plane of the page (according to the right-hand rule).

42 E Use the equation that relates wavelength, frequency, and wave speed.

$$v = \lambda f = (0.5 \text{ m})(6.0 \text{ Hz}) = 3.0 \text{ m/s}$$

43 A With switch S_2 connected to Point Y and switch S_1 left open, only the right-hand half of the pictured circuit is a closed circuit (the battery V_1 and the parallel combination of resistors are effectively removed from the circuit in this situation). The total resistance is $R + 2R = 3R$, so the current in the circuit is $I = V_2/3R$.

44 C With switch S_1 connected to Point X and switch S_2 left open, only the left-hand half of the pictured circuit is a closed circuit (the battery V_2 and resistor of resistance $2R$ are effectively removed from the circuit in this situation). The parallel combination of resistors is equivalent to a single resistance of $R/4$, since

$$\frac{1}{R_P} = \frac{1}{\frac{1}{2}R} + \frac{1}{\frac{1}{2}R} = \frac{2}{\frac{1}{2}R} = \frac{4}{R} \Rightarrow R_P = \frac{R}{4}$$

So, because the total resistance is $R + R/4 = \frac{5R}{4}$, the current through resistor R is

$$I = \frac{V_1}{(5R/4)} = \frac{4V_1}{5R}$$

45 A If *both* switches S_1 and S_2 are open, the middle, vertical branch of the pictured circuit is effectively removed. There'll be current around the perimeter of the circuit, but none down the middle branch.

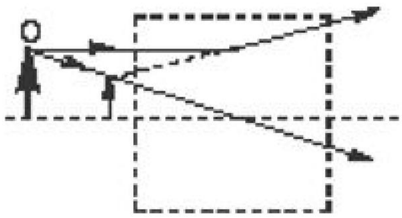
46 E By definition of an *isolated* system, A, B, C, and D are all false. The second law of thermodynamics tells us that in this situation, an ordered system will become more disordered, moving toward a state of maximum entropy.

47 C Don't let the emphasis of the word "positive" in the question throw you. In the equation $Q = CV$, Q is the magnitude of charge on either the positive or the negative plate of the capacitor. So, in this case, $Y = CX$, which gives us $C = Y/X$.

48 D Using Big Five #2 (with $v_0 = 0$), we get $\Delta s = \frac{1}{2}at^2 = \frac{1}{2}(4\text{ m/s}^2)(6\text{ s})^2 =$ 72 m.

49 E The velocity of an object undergoing uniform circular motion is always changing (because the direction is always changing), so A and B are eliminated. Furthermore, since the acceleration is centripetal, it must always point toward the center of the circle; so, as the object moves around the circle, the acceleration vector is also constantly changing direction. Since the acceleration changes, the answer must be E. Notice that for an object in uniform circular motion, both the velocity and the acceleration are changing because the *directions* of these vectors are always changing, even though their magnitudes stay the same.

50 C The ray diagram is consistent with a diverging lens as the optical device, forming an upright, virtual image on the same side of the lens as the object.



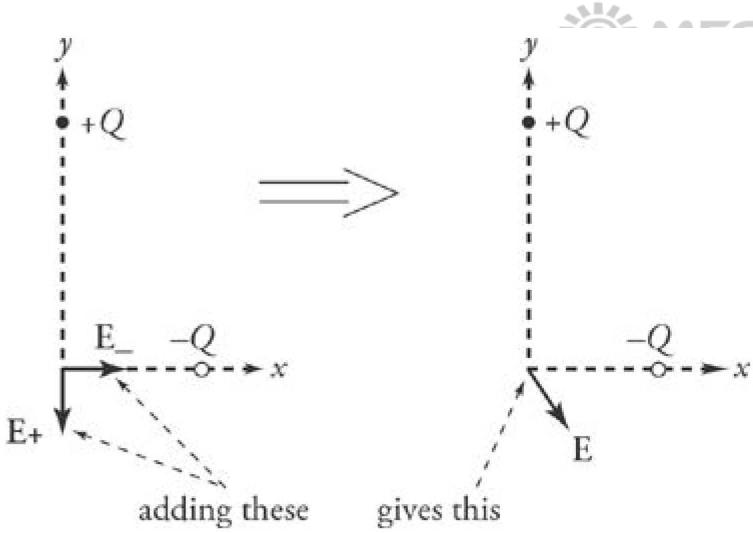
51 A This ray diagram is consistent with a plane mirror as the optical device, forming an upright, virtual image on the opposite side of the mirror.

52 B The ray diagram is consistent with a converging lens as the optical device, forming an inverted, real image on the opposite side of the lens from the object.

53 D Since the rays first reflect then are converged as they exit the box, this ray diagram is consistent with having a plane mirror and then a converging lens within the dotted box.

54 E E is the definition of a superconductor. (A describes a particle accelerator/collider, and B describes a device known as a tokamak.)

55 D The electric field vector at the origin is the sum of the individual electric field vectors due to the two source charges. The diagrams below show that the net electric field vector at the origin points down and to the right.



56 D Let M be the mass of the sun, M_J the mass of Jupiter, and M_E the mass of Earth. In addition, let R_J denote the distance from the sun to Jupiter and R_E the distance from the sun to the earth. We're told that $M_J = 300M_E$ and $R_J = 5R_E$, so using Newton's law of gravitation, we find that

$$F_{\text{on J}} = G\frac{MM_J}{R_J^2} = G\frac{M(300M_E)}{(5R_E)^2} = \frac{300}{25}\bullet G\frac{MM_E}{R_E^2} = 12F_{\text{on E}} \quad \Rightarrow \quad \frac{F_{\text{on J}}}{F_{\text{on E}}} = 12$$

57 A Since P is the center of a dark fringe, it is a location of completely destructive interference. In order for this to occur, the waves must be exactly out of phase when they reach P. This will happen if the difference between their path lengths from the slits is an odd number of half wavelengths. Only the equation in A satisfies this requirement.

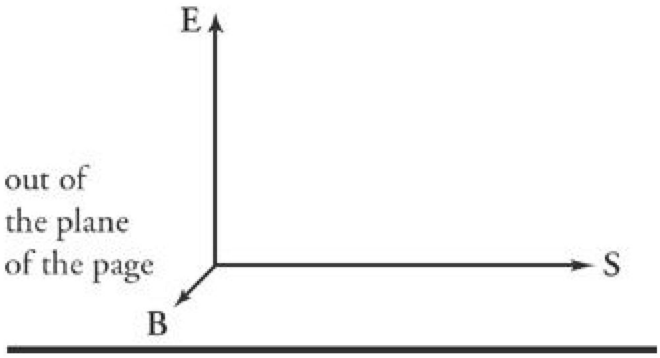
58 C The speed of a wave is determined by the properties of the medium, not by the frequency. (An exception to this general rule includes light through a transparent material medium such as glass—the speed depends slightly on the frequency, and this accounts for the phenomenon of dispersion, which can be seen in the familiar spreading of white light into its component colors when it passes through a prism.) Since wave speed is independent of frequency in the situation described here, the answer is C.

59 E We use the equation $q = mc\Delta T$. Since both the aluminum block and the iron block absorb the same amount of heat, we have $m_{Al}c_{Al}\Delta T_{Al} = m_{Fe}c_{Fe}\Delta T_{Fe}$, where "Al" denotes aluminum and "Fe" denotes iron. Now, because $m_{Al} = 2m_{Fe}$ and $c_{Al} = 2c_{Fe}$, we have

$$(2m_{Fe})(2c_{Fe})\Delta T_{Al} = m_{Fe}c_{Fe}\Delta T_{Fe} \Rightarrow 4\Delta T_{Al} = \Delta T_{Fe}$$

60 E Since the gases are in thermal equilibrium in the same container, they're at the same temperature, and because the average kinetic energy of the molecules is proportional to the temperature, the fact that their temperatures are the same implies that the average kinetic energy of their molecules is the same also. This eliminates A and B. Now, in order for the lighter molecules to have the same average kinetic energy as the heavier ones, the lighter molecules must be moving faster on average, so E is correct.

61 A By definition, if the wave is vertically polarized, the electric field component, **E**, of the wave always oscillates vertically. That is, **E** is perpendicular to the ground. Since the direction of propagation, **S**, is parallel to the ground, and the vectors **E**, **B**, and **S** are always mutually perpendicular, **B** must be parallel to the ground and perpendicular to **S**.



62 E The frequency determines the pitch of a sound, and the amplitude determines the intensity (or loudness). Pitch and loudness are independent. (A sound can be soft and low pitched, soft and high pitched, loud and low pitched, or loud and high pitched; there's no connection.)

63 D Isotopes of an element contain the same number of protons but different numbers of neutrons. So any isotope of chlorine *must* contain 17 protons.

64 E When a projectile moving in a parabolic path reaches the top of its path, its *vertical* velocity is instantaneously zero. A is a trap; it is wrong because the projectile has a (constant) *horizontal* velocity during its entire flight. B and D are equivalent, so both can be eliminated. C can also be eliminated; the weight of the projectile points downward, and when the projectile is at the top of its path and has a purely horizontal velocity, the force of air resistance is also horizontal. There is no reason why the vertical force must have the same magnitude as the horizontal force. The answer must be E.

65 C Momentum is conserved in the collision. Before the collision, the vertical component of the momentum was zero (since there was only one moving object and it was moving horizontally only). Therefore, the total vertical momentum *after* the collision must be zero also. The vertical component of the momentum of the $2m$ mass after the collision is $(2m)(u \sin 30°)$, and the

vertical component of the momentum of the other mass after the collision is $(m)(-v \sin 60°)$. Since the total vertical momentum after the collision is zero, we find that

$$(2m)(u \sin 30°) + (m)(-v \sin 60°) = 0$$
$$(2m)(u \sin 30°) = mv \sin 60°$$
$$2u \sin 30° = v \sin 60°$$

66 B If the collision is elastic, then kinetic energy is conserved. Therefore

$$\frac{1}{2}(2m)U^2 + 0 = \frac{1}{2}(2m)u^2 + \frac{1}{2}mv^2 \quad \Rightarrow \quad U^2 = u^2 + \frac{1}{2}v^2$$

67 C Since we know g = 10 m/s^2 on the earth, the value of g on the moon must be $\frac{1}{6}(10) = \frac{5}{3}$ m/s^2. So, if an object weighs 20 N on the moon, its mass must be

$$m = \frac{w_{\text{on moon}}}{g_{\text{on moon}}} = \frac{20 \text{ N}}{\frac{5}{3} \text{m/s}^2} = 12 \text{ kg}$$

Since mass does not vary with location, if the mass is 12 kg on the moon, it's 12 kg here on Earth (and everywhere else).

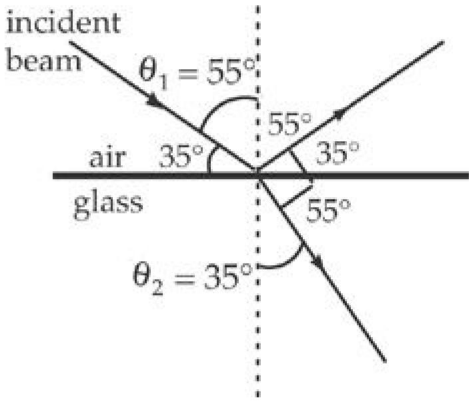
68 B The strength of the electric field at a point that is a distance *r* from a point charge of magnitude *Q* is given by the expression $\frac{kQ}{r^2}$. If the source charge is surrounded by an insulating medium other than vacuum, then the value of *k* we use in this expression is actually $\frac{k_0}{K}$, where k_0 is Coulomb's constant $\left(\frac{9 \times 10^9 \text{ N-m}^2/\text{C}^2}{\text{C}^2}\right)$ and *K* is the dielectric constant of the medium. The sign of the source charge will affect the *direction* of the electric field vector at a point but not the *strength* of the field.

69 B Since the coefficient of thermal expansion has units of deg^{-1} whether it's for linear, area, or volume expansion, we can eliminate C, D, and E, because the units of β would be wrong if any of these equations were true. Now, all you need to remember is that the coefficient of volume expansion is different from the coefficient of linear expansion to eliminate A and choose B. [In case you want to see how B is derived, notice that since each

linear dimension, L, of a solid increases by $\alpha L \Delta T$, the new volume of a heated solid, V', is $V(1 + \alpha\Delta T)^3 = V(1 + 3\alpha\Delta T + 3\alpha^2\Delta T + \alpha^3\Delta T)$. Since α is so small, the terms involving α^2 and α^3 are *really* small and can be ignored. Therefore $\beta \approx 3\alpha$.]

70 A While the tightrope artist is just standing there in the middle of the rope, he has no momentum. But, as the wave passes, he moves upward, meaning he now has vertical momentum. Therefore, the wave pulse transmitted vertical momentum (and energy).

71 D The diagram below (which *is* drawn to scale) shows that the angle of incidence, θ_1, is 55° and the angle of refraction, θ_2, is 35°.



Now by using Snell's law, we find that

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$
$$(1)\sin 55° = n_2 \sin 35°$$
$$\frac{\sin 55°}{\sin 35°} = n_2$$

72 E Don't let the underlined phrase in the question throw you. When a wave enters a new medium, its frequency does not change. So if the frequency of the light was f in the air, it's still f in the glass. Using the equation that relates wavelength, frequency, and wave speed, along with the equation $v = c/n$ (which follows immediately from the definition of index of refraction), we find that

$$\lambda_{\text{in glass}} = \frac{v_{\text{in glass}}}{f} = \frac{c/n}{f} = \frac{c}{nf}$$

73 B Since the electron is naturally being accelerated toward a region containing positive source charges, its potential energy decreases. (It's like a ball dropping to the ground; it is accelerated downward by the gravitational field, and it loses gravitational potential energy.) Therefore, the answer is either A or B. Now since the potential due to a positive charge is higher than the

potential due to a negative charge (because positive numbers are greater than negative numbers), the electron is accelerating toward a region of higher electric potential choice B.

74 B The transfer of heat due to a moving fluid (such as air) is known as convection. (D and E, by the way, are not modes of heat transfer and can therefore be eliminated immediately.)

75 A The faster a spaceship passes by the station, the shorter its length is observed to be. This is because as v increases, the relativistic factor γ increases, so the amount of length contraction increases. Therefore, the *smaller* the v, the smaller the value of γ, and the *longer* the ship will be observed to be. Of the choices given, the speed in A is the smallest. (Note that the spaceship traveling at the speed given in E will be observed to be the shortest as it passes by the station.)

Recall from the Introduction that your Raw Score is equal to the number of questions you answered correctly minus $\frac{1}{4}$ of the number of questions you answered incorrectly

$$\text{(number of correct answers)} - \frac{1}{4}\text{(number of wrong answers)}$$

then rounded to the nearest whole number. Questions that you leave blank do not count toward your raw score.

Raw Score	Approximate Scaled Score
≥ 60	800
56–59	780–790
50–55	750–770
45–49	720–740
40–44	690–710
36–39	660–680
30–35	630–650
25–29	600–620
20–24	570–590
16–19	540–560
11–15	510–530
7–10	480–500
2–6	450–470
–4–14	10–440
≤ –5	≤ 400