

Physics, 2017 EC, entrance exam, version 1

Grade 12 · Physics · 2017 E.C.

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Time allowed: 120 minutes

Questions: 42

Total marks: 42

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1. If the tail of vector B is placed at the tip of A and the tail of C is placed at the tip of B, the sum of the three vectors is drawn from the: (1)
- A. Tail of A to tip of B B. Tail of B to tip of C
C. ✓ Tail of A to tip of C D. Tip of C to tail of B

Answer: C

Vectors add head to tail. Once B starts where A ends and C starts where B ends, the single vector that replaces all three runs from the tail of the very first one to the tip of the very last one. The first is A and the last is C, so the sum is drawn from the tail of A to the tip of C. Option A is a real resultant, but only of $A + B$. It stops before C is counted.

2. Which one of the following is not correct about the difference between distance and displacement? (1)
- A. Distance is the total length of path travelled by an object in a given time
B. Displacement is the shortest path between the initial and final positions.
C. Distance depends on the path followed by the object it moves.
D. ✓ Displacement can be more than or equal to the magnitude of distance

Answer: D

The question asks which statement is wrong. Displacement is the straight line from the starting point to the finishing point, while distance is the whole path walked. A straight line between two points cannot be longer than any other route between them, so the magnitude of displacement is always less than or equal to the distance. They are equal only when the motion is in one straight line with no turning back. Statement D claims displacement can be more than the distance, so D is the wrong statement and the answer. Statement B sounds loose, but calling displacement the shortest path between the two positions is the accepted description, so it is not the one at fault.

3. A 25.0 kg block is initially at rest on a horizontal surface. A horizontal force of 75.0 N is required to set the block in motion. After it is in motion, a horizontal force of 60.0 N is required to keep the block moving with constant speed. Find the coefficients of static and kinetic friction respectively ($g = 10 \text{ m/s}^2$). (1)
- A. 0.1 & 0.2 B. ✓ 0.3 & 0.2
C. 0.2 & 0.3 D. 0.2 & 0.1

Answer: B

The block presses down with its weight, so the normal force is $N = mg = 25 \times 10 = 250 \text{ N}$. The 75 N is the force needed to break it loose, which measures static friction: $\mu_s = 75/250 = 0.3$. The 60 N keeps it sliding at constant speed, which measures kinetic friction: $\mu_k = 60/250 = 0.24$, and the paper rounds this to 0.2. So the pair is 0.3 and 0.2. Option C has the same two numbers in the opposite order. Kinetic friction is always the smaller of the two, so the bigger coefficient has to be the static one.

4. Which one is not true about action and reaction forces? (1)
- A. ✓ **They cancel out each other** B. They act on two different bodies
C. They are same type D. They exist in pairs

Answer: A

This asks for the statement that is not true. Newton's third law says the action and the reaction act on two different bodies. Two forces can only cancel when they pull on the same body, so an action and reaction pair never cancels. That makes A the false statement and the answer. Option B is tempting to tick because it also sounds like something you could argue with, but it is true, and it is the very reason A is false.

5. A net force F_1 acting on a mass m causes an acceleration 'a'. When the force is tripled, the acceleration increased by 6. What will be the new acceleration acting on the same mass? (1)
- A. 6 m/s^2 B. 18 m/s^2
C. 12 m/s^2 D. ✓ **9 m/s^2**

Answer: D

Use $F = ma$ twice with the same mass. At first $F = ma$. With the force tripled, $3F = ma'$, so $a' = 3a$. The question says the acceleration went up by 6, so $a' = a + 6$. Setting the two equal: $3a = a + 6$, which gives $a = 3 \text{ m/s}^2$. The new acceleration is $a' = 3 \times 3 = 9 \text{ m/s}^2$. Option A, 6 m/s^2 , is the amount the acceleration increased by, not the new value itself.

6. The magnitude of vector A is half of the magnitude of vector B. When they act parallel to each other, they yield a resultant of 90 units. The magnitudes of A and B respectively are: (1)
- A. A=60, B=30 B. A=37, B=53
C. ✓ **A=30, B=60** D. A=53, B=37

Answer: C

Vectors that act parallel to each other add like ordinary numbers. Let B be the larger one. Then $A = B/2$, and $A + B = 90$ gives $\frac{B}{2} + B = 90$, so $1.5B = 90$ and $B = 60$ units. Then $A = 30$ units. Option A carries the same two numbers but attaches them the wrong way round. The question says A is the half, so A has to be the smaller value.

7. Which one of the following is not necessarily true? (1)
- A. All equal vectors are equivalent vectors.
B. All negative vectors are anti-parallel vectors.
C. Collinear vectors can be parallel or anti parallel to each other.
D. ✓ **All coplanar vectors are collinear vectors**

Answer: D

The question asks which statement is not always true. Coplanar means the vectors lie in one flat plane. Collinear means they lie along one straight line. A plane holds arrows pointing in every direction inside it, so coplanar vectors are usually not collinear. That makes D the statement that fails, and the answer. Option C is a true statement: vectors on the same line must point either the same way or the opposite way, which is parallel or anti-parallel.

8. What is the work done by a force $F = 20 \text{ N } (0.6i + 0.8j)$ in moving an object through displacement $S = 4 \text{ m } (2i + j)$? (1)
- A. $45(2.6i+1.8j) \text{ J}$ B. ✓ **160 J**
C. 400 J D. $200(1.4i+3j) \text{ J}$

Answer: B

First write both vectors out in full. $F = 20(0.6i + 0.8j) = 12i + 16j \text{ N}$ and $S = 4(2i + j) = 8i + 4j \text{ m}$. Work is the dot product of force and displacement, so multiply matching components and add: $W = (12)(8) + (16)(4) = 96 + 64 = 160 \text{ J}$. Work is a scalar, so the answer is a plain number with no i or j in it. Option C, 400 J, comes from multiplying the two magnitudes 20×20 . That would only be correct if the force and the displacement pointed in exactly the same direction.

9. The length of the train is 50 m and its front is 200 m from a pole. The train accelerates at 4 m/s^2 . At what speed does its front and rear pass the pole if it starts from rest? (1)
- A. 80 m/s and $20\sqrt{5} \text{ m/s}$ B. 10 m/s and $20\sqrt{5} \text{ m/s}$
C. ✓ **40 m/s and $20\sqrt{5} \text{ m/s}$** D. 20 m/s and $20\sqrt{3} \text{ m/s}$

Answer: C

The train starts from rest, so use $v^2 = 2as$. The front reaches the pole after the train has moved 200 m: $v^2 = 2(4)(200) = 1600$, so $v = 40 \text{ m/s}$. The rear is 50 m further back, so by the time the rear reaches the pole the train has moved $200 + 50 = 250 \text{ m}$: $v^2 = 2(4)(250) = 2000$, so $v = \sqrt{2000} = 20\sqrt{5} \text{ m/s}$. The pair is 40 m/s and $20\sqrt{5} \text{ m/s}$. Option D starts the pair with 20 m/s. That is what $v^2 = 2as$ returns if you feed it the 50 m length of the train instead of the 200 m the front has to cover. The 50 m is the extra run the rear makes, not the distance to the pole.

10. A cosmic body of extremely intensive gravity from which nothing, not even light can escape is (1)
- A. Gravitational wave B. Higgs boson
C. ✓ **Black hole** D. Photons

Answer: C

This describes a black hole. Its gravity is so strong that the escape velocity at its boundary is greater than the speed of light, so even light cannot get out, which is why it looks black. Option A, a gravitational wave, is a ripple in space and time that a violent event sends out. It is not a body with gravity of its own, so it cannot be the thing light is trapped by.

11. The system we can apply for security lock in banking system to keep information secret from hackers and cyber-attacks is (1)
- A. Quantum computing B. Quantum entanglement
C. ✓ **Quantum cryptography** D. Quantum teleportation

Answer: C

Quantum cryptography is the one built for keeping a secret. It sends the key as quantum states, and any attempt to read those states in the middle changes them, so the two banks can tell at once that someone was listening. Option A, quantum computing, is the tempting pick because it is the famous name. But a quantum computer is a machine for calculating fast. It is a threat to the codes we use today rather than the lock that protects them.

12. From the given graph, the body accelerated by 3 m/s^2 in the first 10 seconds and moves with constant velocity from 10 to 50 seconds and then decelerated by 5 m/s^2 from 50 to t seconds. What will be the acceleration between 10 to 50 seconds? (1)
- A. ✓ **0 m/s²** B. 3 m/s^2
C. 5 m/s^2 D. 8 m/s^2

Answer: A

Acceleration is the rate at which velocity changes. Between 10 s and 50 s the body moves with constant velocity, so the velocity is not changing at all and the acceleration over that stretch is 0 m/s^2 . On a velocity time graph this part is a flat horizontal line, and a flat line has zero slope. Option B, 3 m/s^2 , belongs to the first 10 seconds only. It does not carry over into the flat part.

13. Based on question no. 15 above, what is the total distance of the graph?

(1)

- A. 1200 m
B. ✓ 1440 m
C. 2500 m
D. 1080 m

Answer: B

Take the journey in three stages and add the distances. Stage one, from rest at 3 m/s^2 for 10 s : the distance is $\frac{1}{2}(3)(10)^2 = 150 \text{ m}$, and the speed reached is $3 \times 10 = 30 \text{ m/s}$. Stage two, constant 30 m/s from 10 s to 50 s , which is 40 s : distance $= 30 \times 40 = 1200 \text{ m}$. Stage three, slowing from 30 m/s to rest at 5 m/s^2 : distance $= \frac{30^2}{2 \times 5} = 90 \text{ m}$. Total $= 150 + 1200 + 90 = 1440 \text{ m}$. Option A, 1200 m , counts the middle stage alone and forgets that the body was still moving while speeding up and slowing down.

14. Which of the following cannot be possible for the graphs of uniformly accelerated motion?

(1)

- A. ✓ The area under S-t graph
- B. The slope under V-t graph
- C. The area under V-t graph
- D. The area under a-t graph

Answer: A

The area under a graph means something only when the two axes multiply into a real quantity. Under a velocity time graph, velocity times time gives displacement. Under an acceleration time graph, acceleration times time gives the change in velocity. The slope of a velocity time graph gives acceleration. But under a displacement time graph the area would be metres multiplied by seconds, and no quantity in motion is measured that way. So the area under the $S-t$ graph is the one that cannot be used. Option D looks strange because acceleration time graphs are less familiar, but its area is a genuine quantity: the velocity gained.

15. A man is weighing a fish of mass m using a spring balance attached to a ceiling of an elevator. Which one of the following statements is wrong about the reading of the balance? (1)

(1)

- A. When the elevator is stationary its reading is mg
 B. ✓ **When the elevator is descending with acceleration a , its reading is $m(a+g)$**
 C. When the elevator acceleration a is equal to g , weightlessness happens
 D. When the elevator is ascending up with acceleration a , reading is $m(a+g)$

Answer: B

The spring balance reads the force the string pulls with, which is the normal reaction on the fish, not its true weight. Standing still, the reading is mg . Going up with acceleration a , the string must both hold the fish and accelerate it upward, so the reading is $m(g + a)$. Going down with acceleration a , gravity is doing part of the work, so the string pulls less and the reading is $m(g - a)$. Statement B claims $m(a + g)$ for descending, so B is the wrong statement and the answer. Option D carries the same formula, but for the lift going up, where $m(a + g)$ is correct.

16. A rectangular block weighs 600 N and has sides 3m, 2m and 4m. What is the minimum pressure the box exerts on the surface? (1)

(1)

- A. ☒ 50 Pa
- B. 75 Pa
- C. 100 Pa
- D. 150 Pa

Answer: A

Pressure is $P = F/A$. The weight pressing down is fixed at 600 N, so the pressure is smallest when the block rests on its largest face. The three possible faces are $3 \times 2 = 6 \text{ m}^2$, $3 \times 4 = 12 \text{ m}^2$ and $2 \times 4 = 8 \text{ m}^2$. The largest is 12 m^2 , so the minimum pressure is $600/12 = 50 \text{ Pa}$. Option C, 100 Pa, uses the smallest face of 6 m^2 . That gives the maximum pressure, which is the opposite of what was asked.

17. What is the total pressure on a diver in a sea at a depth of 30 m below the surface? Density of sea water = 1020 kg/m³, Patm = 100,000 Pa, g=10 m/s². (1)
- A. 507 kPa
B. 304 kPa
C. 205 kPa
D. ✓ 406 kPa

Answer: D

Total pressure on the diver is the air pressing on the sea surface plus the weight of the water column above them. The water part is $\rho gh = 1020 \times 10 \times 30 = 306,000$ Pa. Adding the atmosphere: $100,000 + 306,000 = 406,000$ Pa, which is 406 kPa. Option B, 304 kPa, is close to the water pressure on its own. It leaves out the air still pushing down on the surface of the sea, and the question asked for the total.

18. The smaller piston of a hydraulic press has area 100 cm² while the larger piston has area 400 cm². What force is exerted on the smaller piston to support a load of 100 N on the larger piston? (1)
- A. ✓ 25 N
B. 40 N
C. 250 N
D. 400 N

Answer: A

Pascal's principle says the pressure is the same throughout the liquid, so $\frac{F_1}{A_1} = \frac{F_2}{A_2}$. Putting in the numbers, $\frac{F_1}{100} = \frac{100}{400}$, which gives $F_1 = 100 \times \frac{100}{400} = 25$ N. The small piston needs only a quarter of the load because its area is a quarter of the large one. Option D, 400 N, comes from multiplying by the area ratio instead of dividing. A hydraulic press exists so that a small effort can hold a heavy load, so the answer has to be smaller than 100 N.

19. All are among the relationship of physics with biology except: (1)
- A. The fluid dynamics of blood flow through vessels
B. The mechanics of human motion
C. ✓ Atomic and molecular structure of minerals
D. The mechanisms for speaking and hearing

Answer: C

The question asks for the odd one out. Blood moving through vessels is fluid dynamics in a living body, walking and running are the mechanics of the human body, and speaking and hearing are sound waves reaching a living ear. All three link physics to biology. The atomic and molecular structure of minerals is about rocks, which is geology and materials science, not biology. So C is the exception. Option A can look out of place because it names a physics topic, but blood is inside a living body, which is exactly what makes it a biology link.

20. Which of the following is false? (1)
- A. Air force demands concepts of physics about fluid mechanics, optics, navigation and fluid flow.
B. Defense technologies like Radar and Infrared night vision use physics electromagnetic waves.
C. Infrared imaging systems create an electronic image based on temperature difference.
D. ✓ Night vision image is blue to enhance natural night vision in humans.

Answer: D

Night vision screens show a green picture because the human eye separates more shades of green than of any other colour, so more detail survives in a dim image. The colour is chosen for the eye, and it is not blue. So statement D is the false one and the answer. Option C is a true statement: an infrared imaging system builds its picture out of temperature differences between objects, so it is not the false one.

21. Sharper knives are effective in cutting. This is due to:

(1)

- A. Higher pressure over a wider area
B. ✓ Higher pressure for a less area
C. Less force over a wider area
D. More force over a wider area

Answer: B

Pressure is force divided by area, $P = F/A$. Sharpening a blade squeezes the contact into a very thin edge, so the area becomes tiny. With the same push from your hand, a tiny area means a very large pressure, and it is that pressure that pushes the blade into the material. So the reason is high pressure over a small area. Option D says more force over a wider area. Sharpening the knife does not change how hard your hand pushes. It changes the area the push is spread over.

22. Two balls are thrown with the same speed but at complementary angles. If one angle is 30° and its maximum height is h , then the maximum height of the other is: ($\sin 30=0.5$, $\cos 30=\sqrt{3}/2$)

(1)

- A. $h/3$
B. ✓ $3h$
C. h
D. $2h$

Answer: B

Maximum height for a projectile is $H = \frac{v^2 \sin^2 \theta}{2g}$. The speed is the same for both balls, so the height depends only on $\sin^2 \theta$. The complementary angle to 30° is 60° . The ratio is $\frac{H_{60}}{H_{30}} = \frac{\sin^2 60}{\sin^2 30} = \frac{0.75}{0.25} = 3$. So the other ball rises to $3h$. Option C, the same height h , is tempting because complementary angles do give the same range. Equal range does not mean equal height: the steeper throw goes higher and the flatter throw goes further out per second.

23. What is the final angular velocity when initial angular velocity is 5 rad/s , angular acceleration 2 rad/s^2 , time 10 s ?

(1)

- A. 10 rad/s
B. ✓ 25 rad/s
C. 16 rad/s
D. 15 rad/s

Answer: B

For rotation the equation matching $v = u + at$ is $\omega = \omega_0 + \alpha t$. Putting in the values, $\omega = 5 + (2)(10) = 5 + 20 = 25 \text{ rad/s}$. Option D, 15 rad/s , comes from adding the initial angular velocity of 5 to the time of 10 . Those are different quantities with different units, so they cannot be added. The angular acceleration must be multiplied by the time first.

24. The gravitational force between two objects is $8 \times 10^{-9} \text{ N}$ when they are 3 cm apart. For what separation would the force be $6 \times 10^{-9} \text{ N}$ (same masses)?

(1)

- A. $5\sqrt{2} \text{ cm}$
B. 5 cm
C. ✓ $2\sqrt{3} \text{ cm}$
D. 4 cm

Answer: C

Gravitational force follows an inverse square law, $F \propto 1/r^2$, so $F_1 r_1^2 = F_2 r_2^2$ when the masses stay the same. Then $r_2^2 = r_1^2 \times \frac{F_1}{F_2} = 9 \times \frac{8 \times 10^{-9}}{6 \times 10^{-9}} = 9 \times \frac{4}{3} = 12$, so $r_2 = \sqrt{12} = 2\sqrt{3} \text{ cm}$. Option D, 4 cm , comes from scaling the separation directly with the force ratio, as if $F \propto 1/r$. The distance is squared in Newton's law, so the change in separation is much smaller than the change in force suggests.

25. Which of the following is true about Kepler's law of planetary motion? (1)
- A. The line from sun to planet sweeps out different areas in equal times.
 - B. The square of the period is proportional to its average distance from the sun.
 - C. The period is proportional to its average distance from the sun.
 - D. ✓ **The path is an ellipse with the sun at one focus.**

Answer: D

Kepler's first law says each planet travels on an ellipse, with the Sun sitting at one of the two foci rather than at the centre. That is statement D. Option B is close to the third law but not right: the third law says the square of the period is proportional to the cube of the average distance, and the cube has been dropped here. Statement A also fails, because the second law says equal areas are swept in equal times, not different areas.

26. Which of the following is false? (1)
- A. Centripetal acceleration is towards the center.
 - B. Centripetal acceleration is perpendicular to tangential velocity.
 - C. ✓ **Angular acceleration for uniform circular motion is tangent to the circle.**
 - D. Radial acceleration arises from change in direction of velocity.

Answer: C

The question asks for the false statement. In uniform circular motion the speed does not change, so the angular acceleration is zero, and there is nothing left to point anywhere. On top of that, angular quantities point along the axis of the spin, at right angles to the plane of the circle, never along the tangent. So statement C is false twice over and is the answer. Option A is a true statement: the centripetal acceleration points inward to the centre, which is what keeps bending the path into a circle.

27. What kind of systems do mechanical engineers create using concepts like dynamics and forces? (1)
- A. Medical devices
 - B. Chemical reactors
 - C. ✓ **Robotics devices**
 - D. Electrical circuits

Answer: C

Mechanical engineers work with dynamics, forces and moving parts, and robotics is where that knowledge is put to work: a robot arm has joints, torques and moving masses to control. Option A, medical devices, is a tempting pick because engineers do build them, but that is biomedical engineering. The question names dynamics and forces, which points to the mechanical field.

28. Which of the following statements is correct? (1)
- A. ✓ **An elastic collision: both kinetic energy and linear momentum are conserved.**
 - B. An elastic collision: only kinetic energy is conserved.
 - C. Inelastic collision: both kinetic energy and linear momentum are conserved.
 - D. Inelastic collision: only kinetic energy is conserved.

Answer: A

Momentum is conserved in every collision where no outside force acts, elastic or not. What separates the two kinds is kinetic energy: an elastic collision keeps it, an inelastic collision turns some of it into heat, sound and deformation. So the correct statement is that an elastic collision conserves both kinetic energy and linear momentum. Option C is the popular mistake. Momentum does survive an inelastic collision, but kinetic energy does not, so that statement claims one thing too many.

29. An engineer wants to put a speed limit at the entrance to a train 300 m away as it comes to rest at the platform. He gives exactly 1.5 minutes for the train to decelerate uniformly within 300 m. What must be the maximum speed at the entrance? (1)

A. 40 km/hr
B. ✓ 24 km/hr
C. 60 km/hr
D. 120 km/hr

Answer: B

The train slows uniformly to rest, so its average speed over the stop is $\frac{u+0}{2} = \frac{u}{2}$. The time is 1.5 minutes, which is 90 s. Distance equals average speed times time: $300 = \frac{u}{2} \times 90$, so $u = \frac{600}{90} = 6.67$ m/s. Turn that into km/h by multiplying by 3.6: $6.67 \times 3.6 = 24$ km/h. Option A, 40 km/h, is about 11 m/s. Even at a steady half of that the train would run well past 300 m in 90 s.

30. A ball of mass 2 kg rolling at 10 m/s collides with another ball of mass 3 kg at rest and locks together. Common velocity after collision? (1)

A. 2 m/s
B. 3 m/s
C. ✓ 4 m/s
D. 5 m/s

Answer: C

The two balls lock together, so this is a perfectly inelastic collision. Kinetic energy is lost, but momentum is still conserved. Before: $p = (2)(10) + (3)(0) = 20$ kg·m/s. After, the combined mass is $2 + 3 = 5$ kg moving at one speed v , so $5v = 20$ and $v = 4$ m/s. Option D, 5 m/s, comes from averaging the two speeds of 10 and 0. That would only work if the two masses were equal, and here they are not.

31. Two cars A and B moving same direction. Relative velocity of B wrt A is 10 m/s. If velocity of B is 60 km/h with respect to ground, what is velocity of A? (1)

A. 35 km/h
B. 25 km/h
C. 55 km/h
D. ✓ 24 km/h

Answer: D

The cars move the same way, so the relative velocity is the difference: $v_{BA} = v_B - v_A = 10$ m/s. Before subtracting, put both in the same units. $10 \text{ m/s} = 10 \times 3.6 = 36$ km/h. Then $v_A = v_B - 36 = 60 - 36 = 24$ km/h. Option C, 55 km/h, comes from doing $60 - 10$ with the 10 still in m/s. Mixing two unit systems in one subtraction always gives a wrong answer.

32. In which case is work done in physics? (1)

A. A man carrying a load moving along a straight road
B. A man pushing a concrete wall
C. ✓ A man lifting a weight up onto a shelf
D. A man standing holding his bag

Answer: C

Work in physics needs a force and a movement in the direction of that force. Lifting a weight onto a shelf does both: the hand pushes up and the load rises, so work is done on the load. Option A is the tempting one because the man walks a long way while loaded. But he holds the load up with an upward force while it travels sideways, so the force and the displacement are at right angles and the work done on the load is zero. Pushing a wall that does not move and standing still holding a bag both have no movement at all.

33. Which one cannot be the resultant when 10 N and 30 N are added by vector addition?

(1)

- A. ✓ 15 N B. 37 N
C. 20 N D. 40 N

Answer: A

Two vectors give the biggest resultant when they point the same way, $10 + 30 = 40$ N, and the smallest when they point opposite ways, $30 - 10 = 20$ N. Every other angle lands somewhere between, so the resultant must be from 20 N to 40 N. 15 N sits below that range, so it cannot happen. Option C, 20 N, is possible: it is exactly the minimum, reached when the two forces are head to head.

34. A body accelerates from 10 m/s to 20 m/s having mass 40 kg. Magnitude of work done? (ignore friction)

(1)

- A. 60 J
B. ✓ 6000 J
C. 1200 J
D. 8000 J

Answer: B

Use the work energy theorem: the work done equals the change in kinetic energy. $W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = \frac{1}{2}(40)(20^2 - 10^2) = 20(400 - 100) = 20 \times 300 = 6000 \text{ J}$. Option D, 8000 J, is $\frac{1}{2}(40)(20^2)$, the final kinetic energy on its own. That would be the work only if the body had started from rest, but here it was already moving at 10 m/s and that energy was there before.

35. A girl and boy are given similar work. If girl completes in half the time than the boy, which is true?

(1)

- A. Boy is more powerful
B. ✓ Girl is more powerful
C. Equally powerful
D. Cannot determine

Answer: B

Power is the work done divided by the time taken, $P = W/t$. The work is the same for both, so the shorter time wins. The girl takes half the time, so her power is twice the boy's. Option C, equally powerful, is the natural first thought because the amount of work really is equal. Power does not measure how much work was done. It measures how fast it was done.

36. Which is correct about the four basic forces in nature?

(1)

- A. ✓ Strong nuclear force is short-range and holds protons/neutrons together.**
B. Weak nuclear force keeps electrons in orbit.
C. Electromagnetic force is the weakest.
D. Gravitational force acts at nuclear scale.

Answer: A

The strong nuclear force acts only over a distance about the width of a nucleus, and inside that range it is strong enough to hold protons and neutrons together against the electric repulsion of the protons. That is statement A. Option B is wrong: electrons stay in their orbits because of the electromagnetic attraction to the nucleus, not the weak force. The weak force shows up in certain radioactive decays, such as beta decay.

37. The unit vector in the direction of $A = 3i + 4j$ is

(1)

- A. $(3/2)i+2j$ B. $i+j$
C. ✓ $(3/5)i+(4/5)j$ D. $2i-j$

Answer: C

A unit vector points the same way as the original but has a length of exactly 1, so divide the vector by its own magnitude. Here $|A| = \sqrt{3^2 + 4^2} = \sqrt{25} = 5$. Dividing each component by 5 gives $\frac{3}{5}i + \frac{4}{5}j$. Checking, $(0.6)^2 + (0.8)^2 = 1$, so the length is 1. Option B, $i + j$, has the look of a unit vector because of the ones, but it points at 45° instead of along A, and its length is $\sqrt{2}$, not 1.

