

Group-C (Chittagong division)

Answer all of the following. If the exact number is not given, pick the answer that is the closest to the correct answer. (Choose $c=3 \times 10^8$ m/s, $e=1.6 \times 10^{19}$ C, $h=6.62 \times 10^{-34}$ Js, $g=9.8$ m/s²)

1) A small ball with a mass of 1 kg rolls down a long frictionless inclined ramp, which is at an angle 30° above the horizon. A linear spring, whose length is not negligible, is attached to the bottom of the ramp. The ball is released from a distance of 1 m above the spring, measured along the plane and the spring constant is 1N/m, then the spring is depressed by

- a) 1.6m (Answer)
- b) 1.8m
- c) 0.5m
- d) The answer cannot be determined from the given data.
- e) 2m

2) In a sporting meet a hammer thrower spins a mass of 5 kg attached to a chain of 1m length at a frequency of 0.75 revolutions per second. What is the tension in the chain?

- a) 100N
- b) 200N
- c) 110N (Answer)
- d) 150N
- e) 130N

3) What is the power spent by the athlete to rotate the “hammer”?

- a) 1 Watt
- b) 20Watt
- c) 100 Watt
- d) 0 Watt (Answer)
- e) .2 Watt

4) A hunter sees a monkey, at a height 5m, hanging from a horizontal branch of a tree which is 10 m away and thus aims to shoot it with a tranquilizing dart whose muzzle speed is 200m/s. The clever monkey sees the hunter and drops vertically downward right at the moment the dart escapes the hunter’s gun. What happens then after?

- a) The monkey escapes.
- b) The dart hits the monkey. (Answer)
- c) The hunter should get a gun with higher muzzle speed.
- d) The hunter should get a gun with lower muzzle speed.
- e) This cannot be determined as this is not a physics problem.

5) An elevator lift is being lifted up an elevator shaft at a constant speed by a steel cable. All frictional effects are negligible. In this situation, forces on the elevator are such that:

- (a) the upward force by the cable is greater than the downward force of gravity.
- (b) the upward force by the cable is equal to the downward force of gravity. (Answer)
- (c) the upward force by the cable is smaller than the downward force of gravity.
- (d) the upward force by the cable is greater than the sum of the downward force of gravity and a downward force due to the air.
- (e) none of the above. (The elevator goes up because the cable is being shortened, not because an upward force is exerted on the elevator by the cable).

6) A woman exerts a constant horizontal force on a large box. As a result, the box moves across a horizontal floor at a constant speed " v_0 ". The constant horizontal force applied by the woman:

- a) has the same magnitude as the weight of the box.
- b) is greater than the weight of the box.
- c) has the same magnitude as the total force which resists the motion of the box. (Answer)
- d) is greater than the total force which resists the motion of the box.
- e) is greater than either the weight of the box or the total force which resists its motion.

7) If the woman in the previous question doubles the constant horizontal force that she exerts on the box to push it on the same horizontal floor, the box then moves:

- a) With a constant speed that is double the speed " v_0 " in the previous question.
- b) With a constant speed that is greater than the speed " v_0 " in the previous question, but not necessarily twice as great.
- c) For a while with a speed that is constant and greater than the speed " v_0 " in the previous question, then with a speed that increases thereafter.
- d) For a while with an increasing speed, then with a constant speed thereafter.
- e) With a continuously increasing speed. (Answer)

8) Think of an ideal gas contained inside a vessel which has a piston on its side so that the volume of the gas inside can be changed but the gas cannot escape. We have a pressure gauge in the system. The temperature of the surrounding is fixed on any day and an experimenter measures the pressure of the gas by varying the volume of the gas by pushing/pulling the piston. The experimentalist plots the pressure against the volume recorded in the experiments that are recorded over a week. The temperatures recorded in those days are not equal to each other. What is the observation regarding the graphs?

- a) They are straight lines crossing each other.
- b) They are concentric circles
- c) They are parallel straight lines
- d) They are non intersecting hyperbolas (Answer)
- e) They are non intersecting parabolas

9) A person is standing in front of a large and high wall which is 100m away and holds a microphone that is emitting a loud sound of frequency 110 Hz. After moving forward a few paces towards the wall, the person finds a spot where the perceived sound is minimized. How much further the person should move forward so that again the sound is minimized again? (The speed of sound can be taken to be equal to 330 m/s).

- a) 1.5m (Answer)
- b) .75m
- c) 3m
- d) 6m
- e) 1m

10) Electromagnetic waves are transverse waves. Which of the following phenomenon supports this fact:

- a) Interference
- b) Refraction
- c) Reflection
- d) Polarization (Answer)
- e) Diffraction

11) The plane interface between two transparent media, which we call A and B, is illuminated whose refractive indices are 1.2 and 1.6 respectively. Light will be reflected from the interface as it moves from B to A at an incident angle greater than

- a) 30 degrees
- b) 60 degrees
- c) 15 degrees
- d) 10 degrees
- e) 50 degrees (Answer)

12) To improve the transmission of their program, a radio broadcasting company decides to install two identical transmission towers which are separated by 10 m in the North – South direction. Both the towers are fed by a transmission line which feeds the antenna with a signal of frequency 1.5×10^8 Hz. The received signal is strongest along the east –west direction. The next strongest signal points along

- a) North-South
- b) 10° from east-west (Answer)
- c) 30° from east-west
- d) 70° from north-south
- e) 45° from east-west.

13) Consider a battery of internal resistance 1 Ohm and EMF 24V, connected to a coil of resistance 19 Ohms. What is the Voltage that one measures at the end points of the coil?

- a) 23V (Answer)
- b) 22V
- c) 21V
- d) 20V

e) 24V

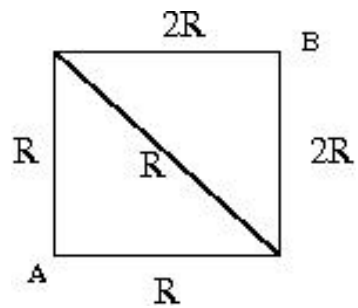
14) If one has the choice of changing the coil so that it emits the maximum joule heat across it then one should choose a coil whose resistance is

- a) .5 Ohm
- b) 40 Ohm
- c) 1.1 Ohm (Answer)
- d) 5 Ohm
- e) This cannot be determined.

15) A .3 m long rod, made of copper and held horizontally, is suddenly dropped vertically from the height of 10m while pointing along north-east direction. The horizontal component of the Earth's magnetic field is 10^{-3}T is that point. What is the maximum possible voltage induced across the copper rod?

- a) 1 mV
- b) 2mV
- c) 4mV
- d) 5mV
- e) 3mV (Answer)

16) Consider a circuit shown in the accompanying figure where the resistances are shown. What is the equivalent resistance across the points A and B?



- a) $2R$
- b) $1R$
- c) $3R$
- d) $1.5R$ (Answer)
- e) $7R$

17) To "see" atoms one should use electromagnetic radiation (light) from the frequency range:

- a) 10^{18}Hz (Answer)
- b) 10^{20}Hz
- c) 10^{12}Hz
- d) 10^{14}Hz
- e) 10^{16}Hz

18) A metal is radiated with a light of wavelength 300nm. If the work function for the metal is 5eV , the maximum energy of the ejected electron is

- a) 1eV
- b) Electrons won't be emitted (Answer)
- c) 2eV
- d) 5eV
- e) 12eV

19) The ionization energy of Hydrogen atom is -13.6 eV. A rough value of the Voltage difference required for ionizing Helium singly (that is too strip off a single electron from its orbit) is around

- a) 10V
- b) 5V
- c) 3.5V
- d) 60V
- e) 25V (Answer)

20) Which of the following particles is **not** a fundamental particle:

- a) Electron
- b) Muon
- c) Neutrino
- d) Neutron (Answer)
- e) Photon.