



Junior Physics Olympiad (JPO)

Sample Question Paper – Class X

1. A drone is programmed to inspect a long railway bridge. It first flies 120 m due east to inspect one section of the bridge. It then immediately changes direction and flies 50 m due north to examine a damaged support pillar. Finally, it returns directly to its starting point using the shortest possible route. While analysing the drone's journey, four students discuss the difference between the total distance travelled and the magnitude of its displacement after the second stage, before it begins its return flight.

Which statement is correct?

- A. Distance = 170 m and displacement = 130 m
- B. Distance = 130 m and displacement = 170 m
- C. Distance = 170 m and displacement = 170 m
- D. Distance = 120 m and displacement = 50 m

2. During a school sports festival, two students throw identical balls from the same height with exactly the same initial speed. One student throws the ball horizontally, while the other throws it at an angle above the horizontal. Air resistance is neglected. Some students claim that the horizontally thrown ball reaches the ground first because it has no upward motion. Others argue that both balls remain in the air for the same time because they start from the same height.

Which statement is scientifically correct?

- A. The horizontally thrown ball reaches the ground first.
- B. Both balls reach the ground simultaneously.
- C. The angled throw always lands first.
- D. The answer depends only on the mass of the balls.

3. A rescue helicopter flies due north at 60 m/s while a strong wind blows due east at 80 m/s. A rescue worker standing on the ground observes the helicopter moving diagonally across the sky. The pilot, however, claims that the helicopter is moving only towards the north relative to the surrounding air.

Ignoring changes in wind speed, what is the speed of the helicopter relative to the ground?

- A. 20 m/s
- B. 100 m/s
- C. 140 m/s
- D. 4800 m/s

4. A motorcyclist performs a stunt by riding inside a circular arena at constant speed. A spectator says that because the speed remains constant, the motorcycle has no acceleration. Another spectator argues that acceleration is present because the direction of motion changes continuously.

Which statement is correct?

- A. There is no acceleration because speed is constant.
- B. Acceleration exists because velocity changes continuously.

C. Acceleration exists only if the speed increases.

D. Both spectators are incorrect.

5. A mechanic attempts to loosen two identical rusted bolts. For the first bolt he pushes near the centre of the wrench. For the second bolt he applies the same force at the far end of the wrench handle. Surprisingly, the second bolt loosens much more easily.

Which concept best explains this observation?

A. Momentum

B. Mechanical advantage due to torque

C. Pressure

D. Conservation of energy

6. A toy company designs two identical-looking dolls. In Doll P, a small metal weight is fixed near the base. In Doll Q, the same weight is fixed near the head. When both dolls are gently pushed, Doll P quickly returns to its upright position, whereas Doll Q falls over easily.

The main reason is that Doll P has

A. greater mass

B. a lower centre of mass, making it more stable

C. greater gravitational force

D. higher momentum

7. A satellite is moving around Earth in a nearly circular orbit. During a science exhibition, one student says the satellite is "falling continuously toward Earth." Another argues that the satellite is actually moving away from Earth because it never crashes.

Which explanation best describes the satellite's motion?

A. The satellite experiences no gravity.

B. The satellite is continuously falling toward Earth while its horizontal motion keeps it in orbit.

C. Gravity acts only during launch.

D. The atmosphere supports the satellite.

8. Three identical resistors, each of resistance R , are connected in three different ways.

- **Circuit P: all in series**
- **Circuit Q: all in parallel**
- **Circuit R: two in parallel, then connected in series with the third**

All circuits are connected to identical batteries.

Which circuit draws the greatest current from the battery?

A. Circuit P

B. Circuit Q

C. Circuit R

D. All draw equal current

9. A student accidentally connects a thin copper wire directly across the terminals of a battery without any resistor in the circuit. Within a few seconds the wire becomes extremely hot.

The best explanation is that

A. current becomes nearly zero.

B. a very large current flows because the circuit resistance is extremely small.

C. the battery produces extra voltage automatically.

D. the wire becomes magnetic before becoming hot.

10. During an emergency, a rescue worker must use a battery-powered floodlight while climbing a steep hill. As the worker climbs, the battery gradually becomes warm. At the same time, the floodlight continues to illuminate the path. A student analysing this situation identifies several simultaneous energy conversions taking place.

Which statement best describes the overall process?

- A. Only electrical energy is converted into light energy.
- B. Electrical energy is converted into light and heat, while the worker's chemical energy is converted into gravitational potential energy and heat.
- C. Heat is converted into electrical energy.
- D. Gravitational potential energy is converted into chemical energy.

11. A school auditorium is illuminated using several identical LED lamps. During a maintenance check, one lamp is connected across a 220 V supply. The electrician measures the current through the lamp and finds it to be 0.5 A. One student immediately concludes that the lamp consumes 110 W of electrical power. Another student says that this conclusion is valid only if the lamp behaves like an ideal resistive device.

For the purpose of this problem, assume the lamp behaves as an ideal resistor.

What is the electrical power consumed by the lamp?

- A. 55 W
- B. 110 W
- C. 220 W
- D. 440 W

12. A robotics club is testing three identical heating coils, each having a resistance of $6\ \Omega$. The students build three different circuits.

- **Circuit P: Three coils connected in series.**
- **Circuit Q: Three coils connected in parallel.**
- **Circuit R: Two coils connected in parallel, and the combination connected in series with the third coil.**

All three circuits are connected separately to an identical 12 V battery.

Which circuit draws the largest current from the battery?

- A. Circuit P
- B. Circuit R
- C. Circuit Q
- D. All three draw equal current

13. A circular coil containing 250 turns is connected to a sensitive galvanometer. During an experiment, the magnetic flux linked with each turn changes uniformly from 0.04 Wb to 0 Wb in 0.02 s as a magnet is quickly removed.

Ignoring the direction of the induced current, determine the induced emf.

- A. 250 V
- B. 500 V
- C. 750 V
- D. 1000 V

14. A student uses a small electric motor to lift a 2 kg model elevator vertically upward by 5 m in 4 seconds. Assume the motor converts electrical energy into mechanical energy with 100% efficiency and take $g = 10\ \text{m/s}^2$.

Ignoring frictional losses, what is the minimum mechanical power delivered by the motor?

- A. 10 W
- B. 20 W
- C. 25 W
- D. 40 W

15. A convex lens has a focal length of 20 cm. During an experiment, an object is placed 30 cm in front of the lens. Four students calculate different image distances.

- A. 30 cm on the other side of the lens
- B. 40 cm on the other side of the lens
- C. 60 cm on the other side of the lens
- D. 120 cm on the other side of the lens

16. An engineer is testing a 50 m long fibre-optic cable that will be used to transmit emergency signals in a hospital. During testing, a beam of light enters one end of the cable and undergoes repeated reflections inside the fibre before emerging from the other end. A trainee engineer believes that ordinary reflection from the inner surface keeps the light inside the fibre, while another engineer explains that a special optical phenomenon is responsible.

If the angle of incidence inside the fibre is 48° and the critical angle for the fibre material is 42° , what will happen to the light at the boundary?

- A. The light will refract out of the fibre because 48° is greater than the critical angle.

B. The light will undergo total internal reflection because the angle of incidence is greater than the critical angle.

C. The light will be completely absorbed by the fibre.

D. The light will always travel in a straight line without any reflection.

17. A radioactive isotope has a half-life of 8 hours. A laboratory technician places 160 g of the isotope in a sealed container and stores it safely. During a practical session, students are asked to estimate the amount of the radioactive substance that will remain after 24 hours.

Ignoring any loss of material other than radioactive decay, how much of the isotope remains?

- A. 80 g
- B. 40 g
- C. 20 g
- D. 10 g

18. A communication satellite moves around Earth in a circular orbit with a speed of 8 km/s. The radius of its orbit is 8000 km.

determine the centripetal acceleration of the satellite.

- A. 4 m/s^2
- B. 8 m/s^2
- C. 16 m/s^2
- D. 64 m/s^2

19. During a flood rescue operation, a battery-powered drone lifts a 5 kg emergency medical kit vertically through a height of 20 m. The drone's electric motor is 80% efficient, and the battery supplies 1500 J of electrical

energy during the lift. Assume $g = 10 \text{ m/s}^2$.

After the rescue, students analyse the situation.

Which statement is most accurate?

A. The useful increase in gravitational potential energy is **1000 J**, and the remaining energy is mainly converted into heat and other losses.

B. The gravitational potential energy gained is **1500 J**, so the motor is 100% efficient.

C. The useful energy gained is **750 J**, so the efficiency is 50%.

D. The motor creates extra energy because the drone is moving upward.

20. A research satellite orbits Earth while continuously collecting images using a camera system. The camera contains a convex lens, the satellite receives electrical power from its solar panels, and all collected data are transmitted to Earth through fibre-optic

communication systems after reaching the ground station. During a discussion, four students make the following statements:

- 1. The satellite experiences centripetal acceleration even if its speed remains constant.**
- 2. The convex lens forms images because of refraction.**
- 3. Fibre-optic communication works because of total internal reflection.**
- 4. The satellite remains in orbit because there is no gravitational force acting on it.**

Which option correctly identifies the scientifically correct statements?

- A. Statements **1, 2 and 3** only
- B. Statements **1 and 4** only
- C. Statements **2 and 4** only
- D. Statements **1, 3 and 4** only