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2018 O level Physics 6091 Paper1 (MCQ) Suggested Answers

Question	Ans	Explanation
1	**B**	Only vernier calipers are capable of measuring the internal diameter of a pipe. Both vernier calipers and micrometers are not capable of measuring a distance of 60 cm, and the next best available measuring devices are rulers.
2	**D**	By drawing equal vectors to form a parallelogram (vector addition property) and by connecting the start point to the end point, only option D makes sense.
3	**C**	Definition of oscillation.
4	**C**	Newton's third law of motion (action–reaction pairs of forces); the force of 1800 N does not act on the propeller.
5	**C**	The ball falls under the influence of the Earth's constant gravitational pull. In the absence of air, no other forces act on the ball, so the velocity increases linearly. Air provides a resistive force which increases as the speed of the ball increases, so the velocity increases at a decreasing rate.
6	**B**	Acceleration is negative when the velocity decreases. Distance travelled by the cyclist is given by the area under the speed time graph for the period of interest.
7	**A**	The cyclist is still travelling at 25 m/s at time t = 5 s. His velocity has dropped by 20 m/s after the next 10 seconds, so he is still travelling towards the north. The acceleration remains –2.0 m/s^2 at time t = 15 s so the train is slowing down.
8	**C**	The weight remains unchanged since the mass of the ball and the gravitational pull of the Earth has not changed (assuming the ball does not absorb the oil internally). However, upthrust acts on the ball in the opposite direction while the ball gets immersed in oil, thereby lowering the overall resultant force on the ball.
9	**A**	Gravitational forces are attractive in nature. As the spacecraft leaves the Earth towards the Moon, the magnitude of the gravitational pull by the Earth decreases and the magnitude of the gravitational pull by the Moon increases. At a point in between the Earth and the Moon, called the Lagrange point, the gravitational field strength becomes zero (due to cancelling out of gravitational pull) and hence the weight becomes zero.
10	**A**	Force multiplied by the **perpendicular** distance from the force towards the pivot.
11	**A**	Using the principle of moments, F * 4.0 m = 100 N * 2.0 m + 400 N * 1.0 m.
12	**B**	As the hand pushes the block forward, there is an opposing force due to the block acting in the opposite direction (i.e. backward). In the process of pushing the block, the feet actually move backward, and the opposing force acting on the feet is in the opposite direction (i.e. forward).
13	**D**	The pressure due to the liquid depends on the depth and material (density) of the liquid and the gravitational pull strength. The three variables are exactly the same for both beakers, so the pressure at points S and T are the same.
14	**C**	The pressure due to the liquid depends on the depth and material (density) of the liquid and the gravitational pull strength.
15	**C**	Clearly at the point of immersion, the ball is not at the lowest height, and the ball is moving, so the ball enters the pool with both kinetic energy and gravitational potential energy, which combats the resistive forces in the form of heat energy.
16	**D**	Amount of useful energy as a fraction of the total energy supplied.
17	**A**	As the liquid freezes, the particles slow down, but still vibrate about their positions, and come closer together with stronger attractive forces, but the particle size doesn't change.
18	**A**	The same quantity of gas in a smaller volume means that the molecules are more compact, and as a result, the probability of collisions increases, leading to an increased force exerted by the gas particles and hence an increased air pressure.
19	**B**	The mass of a liquid is not necessary in determining the temperature of a substance.
20	**D**	Silver surfaces are poor absorbers and good reflectors of heat. A silver surface on surface R minimises heat loss out of the flask. A silver surface on surface S minimizes the risk of the 'cooler environment outside the flask' drawing out heat energy.
21	**B**	The transfer of energy from the air to the ice comes from all three modes of heat transfer, although the main form of heat transfer is by convection, while conduction is minimal due to the poor heat conductivity of air and ice.
22	**B**	On a height–**distance** graph representation of a wave, the length of one cycle is known as the wavelength of the wave. On a height–time representation, the length of one cycle is known as the period of the wave.

23	**C**	The frequency of the water waves does not change as the dipper vibrates at a constant frequency; however, the wavelength of the water waves decreases as the waves enter a shallow region from a deep one. From $v = f\lambda$, wave speed decreases.
24	**B**	The ducks will only move downwards and upwards in an oscillatory motion. As the wave moves to the right, duck P will move downwards before upwards towards the equilibrium height to complete half a cycle, while duck Q will fall from the highest point to the lowest point to complete half a cycle.
25	**D**	The angles are measured from the normal of each surface to the light ray.
26	**B**	Since the light ray enters the container with an angle of 40° towards the normal, the light ray will leave the container also at 40° towards the normal, thus angle y = 90° – 40° = 50°. Angle x can be found using the Snell's law of refraction formula where (sin 40°) / sin x° = 1.34.
27	**B**	The time elapsed between the original sound and the echo is represented by eight divisions on the oscilloscope, translating to a total time elapsed of 80 ms. This corresponds to a distance of 24 m travelled by the sound wave from the person to the wall and back to the person. His distance from the wall must be half this value.
28	**D**	The vertical axes represent the amplitude of the wave which affects the loudness of the sound while the horizontal axes represent the period of the wave which affects the frequency and hence the pitch of the sound. Since Y has a lower amplitude than X, Y is quieter. Since Y completes fewer cycles than X within the same time frame, Y has a lower frequency, and hence has a lower pitch.
29	**B**	The field lines of a positive charge radiate outwards while that of a negative charge goes inwards. Bringing both charges together, some of the outgoing field lines from the positive charge gets collected by the negative charge.
30	**C**	Placing the third resistor lowers the effective resistance of the three resistors. Thus, the overall resistance of the circuit decreases. The lamp now takes up a larger share of the overall resistance. Since potential difference is directly proportional to resistance, the potential difference across the lamp increases.
31	**A**	The resistance of the wire is directly proportional to the length of the wire but inversely proportional to the cross–sectional area of the wire which is in turn directly proportional to the square of the diameter of the wire. Thus, the resistance of wire Y is 9*2 / (3*3) = 2 Ω.
32	**A**	Known fact.
Q33 HAS TWO POSSIBLE ANSWERS	**A**	Both feet of the bird must be at the same voltage to avoid being electrocuted. If there was a difference between the voltage of right feet and the left feet, then current will flow from the higher voltage feet, through the bird's body and towards the lower voltage feet.
	B	The bird has a very high resistance compared to the much lower resistance of copper. Thus, current will preferentially flow towards copper wire and negligible current (below the fatal threshold) will pass through the bird. Furthermore, the bird is not standing in contact with the ground, and thus, direct flow of current to the ground through a complete circuit with the bird is not likely.
34	**A**	$I = Q / t$ where Q is measured in coulombs and t is measured in seconds.
35	**D**	Potential difference is directly proportional to current. As the voltage across the resistor doubles, the current also doubles. Since power is the product of voltage and current, the power quadruples.
36	**C**	Known fact for two adjacent parallel conductors with opposite direction of current.
37	**D**	The current and the magnet produce a turning force on the coil. The current remains unchanged throughout. However, the horizontal distance between each force and the axle decreases. Hence, the turning moment decreases, up to a point where PQ is vertical and this perpendicular distance is now equal to zero.
38	**B**	Only the generator converts the mechanical energy from the movement of the wire to electrical energy; the other three devices consume electrical energy.
39	**B**	The turns ratio of the coils is the same as the voltage ratio of the coils, so the voltage is directly proportional to the number of turns of the coil. Computation yields 16 turns of the coil in the secondary coil.
40	**C**	Power losses are due to the magnitude of the current through the coil, $P = I^2R$. By increasing the voltage, the current across the cable is reduced, thereby minimizing energy losses and saving cost incurred in delivering the transmission.