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Answers to 2018 O level Science (Physics) 5076/5077 Paper 1

Question	Answer	Explanation
1	C	Milli– is a prefix which multiplies a quantity by a factor of 10^{-3} (or 0.001). Micro– is a prefix which multiplies a quantity by a factor of 10^{-6} (or 0.000001). Hence, 2 millivolts = 0.002 volts and 4 microamperes = 0.000004 amperes.
2	A	The resultant force is the overall equivalent single force due to the effects of all the forces acting at the same point. Since there is an upward force towards R and a rightward force towards P at the same time, the net effect is a force moving in the north–east direction towards Q. The magnitude of the resultant force is given by the length OQ, which can be determined using the Pythagoras' Theorem: $(OQ)^2 = (OP)^2 + (PQ)^2$. Solving for OQ yields OQ = 15 N.
3	C	When the forward force F is equal in magnitude and opposite in direction to the resistance force R, the resultant force will equal to F + R = F + (–F) = zero. Since the resultant force is the product of the mass of the system and its acceleration ($F_{res} = ma$), it follows that the acceleration of the car has to equal zero, implying that the velocity is either zero or uniform. Given further that the car is moving forward, it follows that the velocity of the car must be uniform.
4	A	The frictional force acts in the exact opposite direction to the motion of the box. The resultant force of the box is then equal to 340 N + (–320 N) = 20 N in the direction of the force. Using the formula $F_{res} = ma$, it follows that 20 N = m * (50 kg). Solving for m yields m = 0.40 m/s^2.
5	D	Gravitational fields are always attractive. It depends on the mass of the body, but not the charge, shape nor volume of the body. It is due to this attractive force that it maintains a degree of attractive forces with other planets and the Sun, keeping the planet in orbit around the Sun.
6	D	On different planets, the mass of the spacecraft remains unchanged, while the weight of the spacecraft depends on the gravitational field strength of the planet. The mass of the spacecraft is $m = W/g$ = 1250 N / (10 N/kg) = 125 kg. The gravitational field strength on Mercury = W/m = 475 N / 125 kg = 3.80 N/kg.
7	D	The weight of the toy car exerts a downward force, and hence pressure, on the ground. Since all four wheels of the toy car are in contact with the ground, the total area of contact with the ground is 40 cm^2. Hence, the weight of the toy car $W = F = PA$ = 3.5 N/cm^2 * 40 cm^2 = 140 N.
8	C	Wind turbines are powered by the continual kinetic movement of air which provides the necessary kinetic energy for conversion to stored electrical energy.
9	B	Useful power = Useful work done / Time = Force x distance (moved in the same/opposite direction of the force) / Time = 600 N x 10 m / (60 s) = 100 W.
10	D	Radiation is affected by the colour intensity of the surface, the temperature of the surface and the area of the surface. A darker colour, a higher temperature of the surface and a larger surface area are grounds for increased rates of radiation.
11	D	Clearly the displacement of the waves are identical in both graphs since both graphs represent the motion of the same water wave. Superimposing both graphs gets us 1 cm moved after a time of 0.02 s, 2 cm moved after a time of 0.04 s and so on. The speed of the water wave is therefore equal to 1 cm / 0.02 s = 50 cm/s.
12	B	For this question, we must consider the values of the angle of incidence i on the various surfaces. The light will first strike the glass prism at i = 0° and pass surface PQ unrefracted. The light will then strike QR at i = 45° after computations. Since this value is greater than the critical angle c of 42°, the ray will be internally reflected towards PR. Similarly, the light will reflect off PR and pass PQ unrefracted once again.
13	A	These are the characteristics of objects placed two focal lengths away from a lens.

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14	C	The outgoing field lines on an isolated charge Q suggests that Q is a positive charge. The fact that R moves towards Q suggests that R must be oppositely charged as Q, so R is a negative charge.
15	D	Case 1: Three resistors in series. Effective resistance is 6 Ω. Case 2: Three resistors in parallel. Effective resistance is 2/3 Ω. Case 3: Two resistors in parallel, connected to a resistor in series. Effective resistance is 3 Ω. Case 4: Two resistors in series, connected to a resistor in parallel. Effective resistance is 4/3 Ω.
16	C	The gradient of a voltage–current straight line graph passing through O represents the resistance of a resistance wire. By considering the steepness of the lines, we see that going from X to Z, the resistance increases. Since resistance is inversely proportional to the cross–sectional area of a resistance wire and the lengths and material of the three wires are the same, it follows that going from X to Z, the cross–sectional area decreases.
17	A	Since there is negligible resistance across the new connection, all the current will flow through the new connection without passing Q and R. This is known as a short circuit. Since Q and R is not in operation, both lamps will not contribute towards the effective resistance of the entire circuit. Hence, the effective resistance of the circuit decreases and the current flowing through the battery increases, leading to an increased brightness of P.
18	B	Since the potential difference across the resistor in series is 6 V, it follows that the potential difference across the resistor next to the ammeter is also 6 V. Since the potential difference across parallel branches is the same, the potential difference across R is also 6 V. Since currents across parallel branches add up, the current across R is 3 A – 1 A = 2 A. The resistance of R = V / I = 6 V / 2 A = 3 Ω.
19	A	Using the formula $E = VIt$, we obtain t = 400 000 J / (4 A * 250 V) = 400 s.
20	C	Using a D.C. supply in the reverse direction does not demagnetise the steel bar. Using an A.C. supply causes the direction of the current to be constantly alternating, damaging the one–directional flow of the dipoles of the steel bar. Lowering the current ensures that any possibility of rekindlement of the magnetism will lead to reduced strength of the steel bar.