**Innova JC**

**2016 Prelim H1 Physics Paper 1**

| Q | Ans |
|---|---|
| 1 | A |
| 2 | B |
| 3 | B |
| 4 | A |
| 5 | A |
| 6 | D |
| 7 | B |
| 8 | D |
| 9 | D |
| 10 | B |

| Q | Ans |
|---|---|
| 11 | D |
| 12 | D |
| 13 | C |
| 14 | B |
| 15 | B |
| 16 | B |
| 17 | B |
| 18 | A |
| 19 | A |
| 20 | D |

| Q | Ans |
|---|---|
| 21 | B |
| 22 | C |
| 23 | A |
| 24 | C |
| 25 | D |
| 26 | C |
| 27 | D |
| 28 | C |
| 29 | C |
| 30 | D |

**Solution to 2016 H1 Physics Paper 1**

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| **1** | The dimensions of a typical household washing machine are 450mm×450 mm×700mm. So its volume is $1.4\times10^8$ mm$^3$ ; its mass is around 70 – 80 kg ; power consumption 500 W<br><br>The spin rate is around 20 cycles per sec.<br><br>[Switched options in original question] | **A** |
| **2** | $W = \frac{1}{2}kx^2$ $\qquad \frac{\Delta W}{W} = \frac{\Delta k}{k} + 2\frac{\Delta x}{x}$<br><br>$\frac{\Delta W}{W} = \frac{2}{100} + 2\frac{0.002}{0.050} = 0.10 \quad (10\%)$ | **B** |
| **3** | $R = \frac{V}{I} = \left(\frac{P}{I}\right)\left(\frac{1}{I}\right) = \frac{P}{I^2}$<br><br>Power = Energy ÷ time = Force × displacement ÷ time<br><br>SI base unit for power = (kg m s$^{-2}$)(m) / s = kg m$^2$ s$^{-3}$<br><br>SI base unit for electrical resistance = kg m$^2$ s$^{-3}$ / A$^2$ = kg m$^2$ s$^{-3}$ A$^{-2}$ | **B** |
| **4** | At the maximum height, the acceleration is 9.81 m s$^{-2}$ not zero. | **A** |
| **5** | The slope of the *s-t* graph gives the value of the instantaneous velocity. | **A** |
| **6** | The force of P on Q and the force of Q on P are an action-reaction pair. Hence the two forces are equal in magnitude but opposite in direction.<br>The *F-t* graph of Q on P is the mirror image of P on Q.<br><br>Alternatively, | **D** |

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| | Total momentum before $=$ Total momentum after<br>$$P_{\text{initial,P}} + P_{\text{initial,Q}} = P_{\text{after,P}} + P_{\text{after,Q}}$$<br>$$P_{\text{after,Q}} - P_{\text{initial,Q}} = -\left(P_{\text{after,P}} - P_{\text{initial,P}}\right)$$<br>$$\Delta P_{\text{Q}} = -\Delta P_{\text{P}}$$<br>Area under F-t graph for Q $=-$Area under F-t graph for P | |
| **7** | Newton's 2nd law defines the net force acting on an object as being directly proportional to the rate of change of momentum of the object, where the constant of proportionality is 1.<br><br>Hence, from this definition, options A and C (rate of change of energy), and option D (Rate of change of force) can be eliminated.<br><br>$F_{\text{exerted by wall on water jet}} = \dfrac{\Delta p_{\text{water}}}{\Delta t} =$ change in momentum of the water jet per unit time.<br><br>$F_{\text{exerted by water jet on wall}} = -F_{\text{exerted by wall on water jet}}$<br><br>The magnitude of the force exerted by the water jet on the wall is equal to the force exerted by the wall on the water jet.<br><br>Thus the magnitude of the force exerted by the water jet on the wall is numerically equal to the change in momentum of the water jet per unit time. | **B** |
| **8** | For a car travelling at constant speed, the net force acting on the car is zero.<br><br>Consider the forces acting parallel to the slope,<br>Sum of forces upward and parallel to slope = sum of forces downward and parallel to slope<br><br>engine force = component of weight parallel to slope + resistive force<br>engine force = $mg \sin \theta + F$ | **D** |
| **9** | Increase in force on arrow = Increased in total horizontal forces on arrow<br><br>2 (120 cos 55°) – 2 (100 cos 65°) = 53 N | **D** |
| **10** | The change in velocity, $R = \text{Final velocity} - \text{Initial Velocity}$<br>$= Q - P$<br>$= Q + (-P)$ | **B** |

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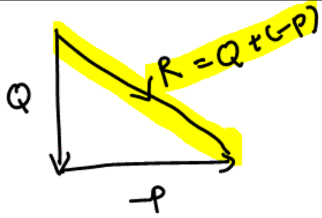
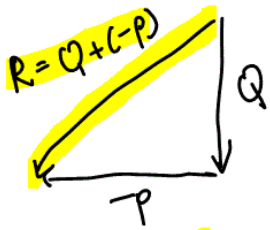
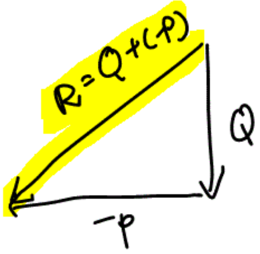
| | option A   R in option A is wrong<br><br>option B   R in option B coincides with R in diagram on left<br><br>option C   R in option C is wrong<br><br>option D   R in option D is wrong | |
| **11** | Weight is a vertically downward force. Hence Option A and C are not correct.<br>The forces should form a closed triangle as there is equilibrium. Hence, only D is correct. | **D** |
| **12** | Taking pivot at where W is acting, as L is moved outwards, the clockwise moment due to L is increased.<br><br>To maintain rotational equilibrium, the anti-clockwise moment due to R has to increase. Hence, the perpendicular distance has to increase and R moves to the right. | **D** |
| **13** | $P = F_{engine}\, v$<br>Since car is travelling at constant speed,<br>$P = F_{resistive}\, v$<br><br>$F_{resistive} \propto v^2$<br>$F_{resistive} = kv^2$<br>$(800) = k\,(20)^2$<br>$k = 2$<br><br>$(F_{resistive}) = (2)\,(40)^2$<br>$F_{resistive} = 3200$ N<br><br>$P = F_{resistive}\, v$<br>$P = (3200)\,(40)$<br>$P = 1.28 \times 10^5$ W | **C** |

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| **14** | Initial drop,<br>$\Delta GPE = \Delta KE$<br>$m(9.81)(0.80 - 0.08) = 0.75$<br>$m = 0.106$ kg<br><br>Rebound:<br>$\Delta KE = \Delta GPE = 0.106(9.81)(0.45 - 0.08) = 0.39$ J | **B** |
| **15** | Gas is expanding, hence work is done by the gas.<br>Work done by gas = p $\Delta V = 3.0 \times 10^4 \times 25 \times 10^{-4} \times 5 \times 10^{-3} = 0.375$ J<br>Work done on gas = - Work done by gas = - 0.375 J | **B** |
| **16** | $\frac{\Delta\theta}{2\pi} = \frac{\Delta x}{\lambda} \quad \Rightarrow \quad \frac{\pi/3}{2\pi} = \frac{0.40}{\lambda}$<br>Since phase difference of $\frac{\pi}{3}$ = 0.40 m, the wavelength = 0.40 × 6 = 2.40 m<br>Thus, speed = $f\lambda$ = 200 x 2.40 = 480 ms$^{-1}$ | **B** |
| **17** | From definition : Intensity = Power / Area<br>Power = Intensity x Area …….(1)<br>Intensity $\propto$ Amplitude$^2$ ………..(2)<br><br>Based on (1) and (2), we have<br>Power $\propto$ Amplitude$^2$ x Area<br><br>Since power = energy / time,<br>➔ $E \propto A^2 S$ …………… (3)<br>$\frac{E'}{E} = \left(\frac{A'}{A}\right)^2 \left(\frac{S'}{S}\right)$<br>$\frac{E'}{E} = \left(\frac{2A}{A}\right)^2 \left(\frac{\frac{1}{2}S}{S}\right) = 4 \times \frac{1}{2} = 2$<br>Rate of energy transfer is increased by 2 times | **B** |
| **18** | Period, $T = \frac{1}{f} = \frac{1}{2.5} = 0.40$ s<br>From the graph, 8 intervals is equivalent to 1 period. Hence 8 intervals is equivalent to 0.40 s and 1 interval is equivalent to 0.05s.<br><br>Since the wave is travelling to the left, it takes 1 interval for the Q to be at the zero displacement position of the wave. Hence the shortest time elapsed is 0.05 s. | **A** |
| **19** | The sound generated by the vibrating string is a *progressive* longitudinal wave.<br>**[Switched options in original question]** | **A** |
| **20** | At the 1st order bright fringe, the waves meet at in phase with the phase difference of $2\pi$.<br><br>From the graph,<br>$Distance\ x\ of\ 1st\ order\ bright\ fringe\ from\ C = 2.4\ mm$ (phase diff $2\pi$)<br>$Distance\ CP, \Delta x = 4.2\ mm$ (phase diff $\Delta\theta$)<br><br>Using ratio, $\frac{\Delta\theta}{2\pi} = \frac{\Delta x}{x}$<br>$Phase\ angle\ at\ Q = \frac{4.2}{2.4} \times 2\pi = \frac{7}{2}\pi$<br>Equivalent phase difference = $\left(\frac{7}{2}\pi - 2\pi\right) = \frac{3}{2}\pi\ (principle\ value)$ | **D** |

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| **21** | <table><tr><td></td><td>240 V, 60 W lamp</td><td>10 V, 2.5 W lamp</td></tr><tr><td>Resistance</td><td>$R=\frac{V^2}{P}=\frac{240^2}{60}=960\Omega$</td><td>$R=\frac{V^2}{P}=\frac{10^2}{2.5}=40\Omega$</td></tr><tr><td>Theoretical working current</td><td>$I=\frac{P}{V}=\frac{60}{240}=0.25A$</td><td>$I=\frac{P}{V}=\frac{2.5}{10}=0.25A$</td></tr></table><br>Actual current flow in the circuit is 250 V ÷ (960 Ω + 40 Ω) = 0.25 A<br>Since the actual current equals to the theoretical current needed by each lamp, both lamps will work normally. | **B** |
| **22** | The current in both external and internal resistors will be the same as both resistors are in series.<br>$\frac{\text{power in external resistor}}{\text{power in internal resistor}}=\frac{I^2(2R)}{I^2R}=2$ | **C** |
| **23** | A.<br>This is the definition of Emf. Hence this option is correct.<br><br>B.<br>The amount of electrical energy converted to other forms of energy in the external circuit is defined as the terminal p.d.<br><br>The terminal p.d. is only equal to the emf if (1) there is no current in the circuit or (2) there is no internal resistance.<br><br>C. Depends how many components there are. Even in the case of one component, it is likely that the terminal p.d. is lower than the emf.<br><br>D. See reasoning in option B. | **A** |
| **24** | Using $R=\frac{\rho l}{A}$<br>$R=\frac{\rho l}{w\times t}$<br>$t=\frac{\rho l}{w\times R}$<br>t = (2.0 × $10^{-5}$)(30 x $10^{-2}$) ÷ (1.2 $10^{-3}$)(40 x $10^{3}$)<br>= 1.25 x $10^{-7}$ m | **C** |
| **25** | Total resistance, 66 kΩ = R + $(1/R + 1/R)^{-1}$ + $(1/R + 1/R + 1/R)^{-1}$<br>66 kΩ = 11R/6<br>R = 36 kΩ | **D** |
| **26** | At A, both the magnetic fields of X and Y are directed upwards. Hence the field would be non-zero.<br><br>At D, both the magnetic fields of X and Y are directed downwards. Hence the field would also be non-zero.<br><br>At B, both the magnetic fields of X and Y are directed opposite to each other but do | **C** |

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| | not cancel out each other as the field due to X (which is closer) will be stronger than the field due to Y. Hence the field would also be non-zero<br><br>At option C, both the magnetic fields due to X and Y are equal in magnitude but opposite in direction. Thus the net field will be 0. | |
| **27** | Since the current balance experiences a **turning moment about the pivot**, we can infer that the **magnetic force is either into or out of the page, and the force is acting on the segment which is 0.093 m long.**<br>$\text{Moment} = F_B \times 0.23$<br>$7.4 \times 10^{-3} = (B.I.L) \times 0.23$<br>$7.4 \times 10^{-3} = (3.6 \times 10^{-2} \times I \times 0.093) \times 0.23$<br>$I = 9.6098$<br>$I = 9.61\ \text{A}$ | **D** |
| **28** | As light intensity increases, the rate of incidence of photons increases. As rate of incidence of photons is proportional to the rate of emission of photoelectrons, the photocurrent increases proportionally as well. | **C** |
| **29** | **K.E. of mass,** $\boldsymbol{E = \frac{1}{2}mv^2 = \frac{1}{2}\frac{(mv)^2}{m} = \frac{p^2}{2m}}$ **where p is the momentum of the mass**<br>$\boldsymbol{\Rightarrow \quad p^2 = 2mE \quad \Rightarrow \quad p = \sqrt{2mE}}$<br>**From de Broglie equation** $\boldsymbol{\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}}$ | **C** |
| **30** | $\left(E_3 - E_1\right) = \left(E_3 - E_2\right) + \left(E_2 - E_1\right)$<br>$\frac{hc}{/_1} = \frac{hc}{/_2} + \frac{hc}{/_3}$<br>$\frac{1}{/_3} = \frac{1}{/_1} - \frac{1}{/_2} = \frac{/_2 - /_1}{/_1 /_2}$<br>$/_3 = \frac{/_1 /_2}{/_2 - /_1}$ | **D** |