EUNOIA JUNIOR COLLEGE
JC2 Mid Year Examination 2021
General Certificate of Education Advanced Level
Higher 1

# PHYSICS 8867

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**July 2021**

**Paper 1**
**Multiple Choice**

| *Question* | *Key* | *Question* | *Key* | *Question* | *Key* |
|---|---|---|---|---|---|
| 1 | **A** | 6 | **C** | 11 | **D** |
| 2 | **D** | 7 | **B** | 12 | **B** |
| 3 | **D** | 8 | **D** | 13 | **B** |
| 4 | **D** | 9 | **D** | 14 | **C** |
| 5 | **D** | 10 | **A** | 15 | **A** |
| 16 | **B** | 21 | **A** | 26 | **D** |
| 17 | **A** | 22 | **A** | 27 | **D** |
| 18 | **B** | 23 | **A** | 28 | **D** |
| 19 | **B** | 24 | **D** | 29 | **A** |
| 20 | **D** | 25 | **A** | 30 | **C** |

| Question | Solution |
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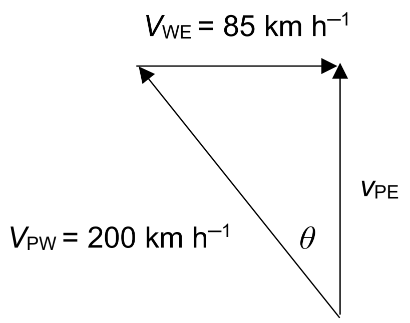
| **1** | Unit of $v$ = m $s^{-1}$<br><br>Unit of $\sqrt{g\lambda}$ = [ (m $s^{-2}$)(m) ]$^{½}$ = [ $m^2$ $s^{-2}$ ]$^{½}$ = m $s^{-1}$ |
| **2** | Volume of cylinder V = A x L<br>= π($D^2$/4) x L<br>$\frac{\Delta V}{V} = 2\frac{\Delta D}{D} + \frac{\Delta L}{L}$ = 2 (0.02) + 0.01 = 0.05<br>= 5% |
| **3** | $v_{PE}$ = $v_{PW}$ + $v_{WE}$ where $v_{PE}$ is velocity of plane relative to Earth<br>$v_{PW}$ is velocity of plane relative to Earth<br>$v_{WE}$ is velocity of wind relative to Earth<br><br>sin $\theta$ = 85/200<br>$\theta$ = 25.2° west of north<br> |

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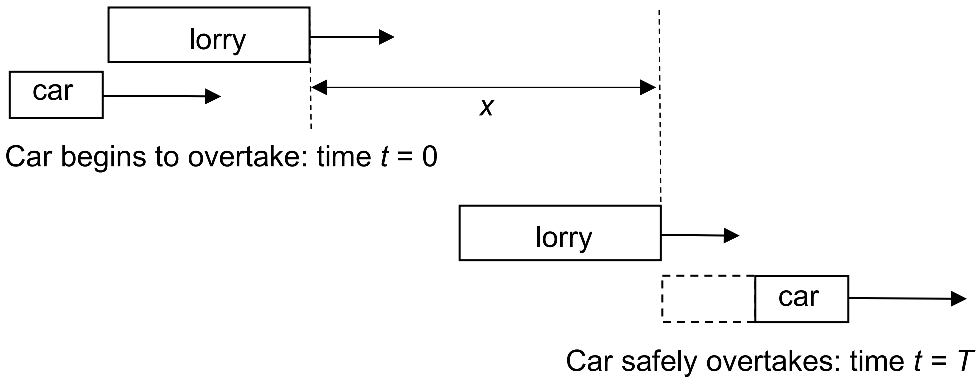
| **4** | Taking upwards as positive,<br>$u_y = 3.0\ m\ s^{-1}$<br>At the ground, the vertical displacement $s_y = -\ 2.4\ m$<br>$v_y^2 = u_y^2 + 2a_ys_y$<br>$(3.0)^2 = u_y^2 + 2(-9.81)(-2.4)$<br>$v_y = -7.49\ m\ s^{-1}$<br>$v_x = 5.0\ m\ s^{-1}$ since there is not change in horizontal velocity<br>$v = \sqrt{v_x^2 + v_y^2} = 9.0\ m\ s^{-1}$ |
| **5** | <br>Distance covered by car = *x* + (17.0 + 3.5(2))<br>Distance covered by lorry = *x*<br><br>Distance covered by car - Distance covered by lorry = ½ (16)*T*<br>[*x* + (17.0 + 3.5(2)) – *x*] = ½ (16)*T*<br>*T* = 3.0 s |
| **6** | Acceleration is defined as the rate of change of velocity with time.<br>Hence, a = (v – u)/t |
| **7** | $\Delta p$ = area under net force-time graph<br>$\Delta p$ = area under graph $\times$ cross-sectional area<br>$(3.2 \times 10^{-2})(v_f - 0) = \frac{1}{2}(100 \times 10^{-3})(3.0 \times 10^{6}) \times (2.8 \times 10^{-4})$<br>$v_f = 1300\ m\ s^{-1}$ |
| **8** | Area under resultant force-time graph = change in momentum<br><br>Area S = mv – 0<br><br>$v = \frac{\text{area S}}{m}$ |
| **9** | Apply "*F* = *ma*" to the system of wagons from 2 to 6.<br>Taking LHS as positive<br>*F* = *ma*<br>$T - 5(4000) = 5(6.0 \times 10^4)(0.15)$<br>*T* = 65 000 N |
| **10** | By conservation of momentum,<br><br>Sum of total initial P = Sum of total final P<br><br>$0 = M_L(V_L) + M_s(V_s)$ , L = large, s = small<br><br>$\frac{V_L}{V_S} = \frac{M_S}{M_L} = \frac{1}{3} = 0.3333$ |

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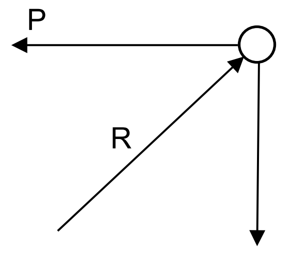
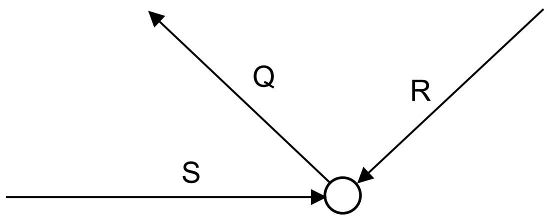
| **11** | In order for the right hinge to be in equilibrium, the forces on it are as shown.<br><br>P is pulling the right hinge and R is pushing the right hinge. Hence P is in tension and R is in compression.<br><br><br><br>R is in compression, hence pushing the bottom hinge.<br><br>Forces by Q and S on the hinge have to be in the directions drawn for the hinge to be in equilibrium.<br><br><br><br>Hence Q is in tension and S in compression. |
| **12** | Initially, $W = 3T$<br>$W = 3kx$ …(1)<br>Finally, $3W = 2T'$<br>$3W = 2kx'$ …(2)<br><br>$x' = 9x/2$ |
| **13** | Network workdone = work done against friction + gain in GPE [No gain in KE]<br>= 580 x 500 + 1000(9.81)(87)<br>= 1.143 x $10^6$ J |
| **14** | A spacecraft in deep space is far from any type of field and hence moves at a uniform velocity, according to Newton's 1st law of motion.<br><br>Why Wrong:<br>Answer A involves work done by gravitational force mg over a vertical distance h.<br>Answer B involves work done by the car dynamo's electromotive force which produces an electric field between the battery's electrodes. This field exerts a force on the charge carriers in the battery, which then move to their respective electrodes.<br>Answer D involves work done by the gas particles as they do work against atmosphere. |
| **15** | Work is done by applied force only during extension.<br>Kinetic energy is gained from the elastic potential energy QPRQ.<br>Heat loss is the difference between work done by applied force and elastic potential energy. |
| **16** | Net force = $\frac{GMM}{(2R)^2} + \frac{GMM}{(\sqrt{2}R)^2}\cos 45^o + \frac{GMM}{(\sqrt{2}R)^2}\cos 45^o$<br>$= \frac{0.96GM^2}{R^2}$ |
| **17** | Vertically: $T_A \cos 30° + T_B \cos 60° = (5)(9.81)$<br><br>Horizontally:<br>Centripetal force provided by the sum of horizontal tension due to strings<br>$T_A \sin 30° + T_B \sin 60° = (5)(2)(2.0)^2$<br>Solving the 2 equations:<br>$T_A = 45.0\ N$<br>$T_B = 20.2\ N$ |

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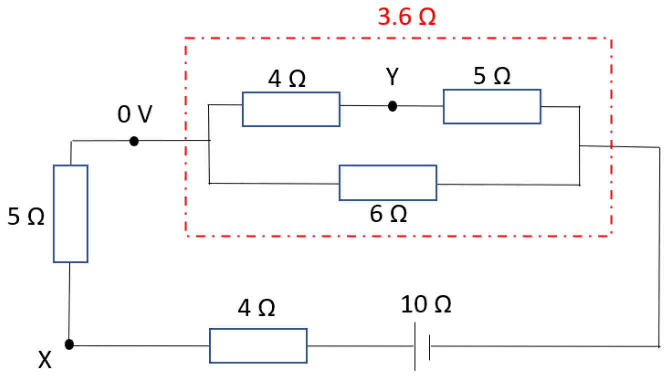
| **18** | Since both the capsule and astronaut are at the same distance from the Earth's centre, they experience the same gravitational field strength and thus have the same centripetal acceleration. There being no relative acceleration between them, no contact force exists between them.<br><br>Answer A is wrong because the astronaut still has weight. ($GMm/r^2$ is not zero.)<br>Answer C is wrong because the Fc on astronaut and capsule are not the same.<br>Answer D is wrong because astronaut has weight. |
| **19** | When the variable resistor is decreased, the total resistance between Bulb Y and variable resistor decreases. By potential divider rule, the potential difference across Bulb X will increase and the potential difference across Bulb Y decreases.<br><br>Hence the power dissipated by X (brighter) increases while power dissipated by Y (less bright) decreases. |
| **20** | Using equation $R = \frac{\rho l}{A}$ to determine the resistance of each small wire.<br>The small wires are connected in parallel to form Wire X and Wire Y.<br><br>Wire X and Wire Y are connected in series.<br>Resistance of small Al wire = $R_{Al} = \frac{(2.7\times10^{-8})(0.6)}{2.8\times10^{-6}} = 5.786\times10^{-3}$<br>Resistance of small Cu wire = $R_{Cu} = \frac{(1.7\times10^{-8})(0.6)}{2.8\times10^{-6}} = 3.643\times10^{-3}$<br><br>Resistance of Wire X = $[(3.643\times10^{-3})^{-1} + 6(5.786\times10^{-3})^{-1}]^{-1}$<br>= $7.63\times10^{-4}$<br>Resistance of Wire Y = $[2(3.643\times10^{-3})^{-1} + 5(5.786\times10^{-3})^{-1}]^{-1}$<br>= $7.08\times10^{-4}$<br>Total Resistance = $7.08\times10^{-4} + 7.63\times10^{-4}$<br>= $1.47\times10^{-3}\,\Omega$ |
| **21** | <br>Effective Resistance of red box = $\left(\frac{1}{4+5}+\frac{1}{6}\right)^{-1}$ = 3.6<br>PD across 5 ohm resistor = 5/(3.6 + 5 + 4) × 10 = 3.968 V<br>Potential X – 0 = 3.968 V<br>**Potential X = 3.968 V**<br>PD across the combined 3.6 Ω resistors (red box) = 3.6 / (3.6 + 5 + 4) × 10 = 2.857 V<br>Hence PD across the 4 Ω resistor (inside the red box) = 4/(4 +5) × 2.857 = 1.270 V<br>0 – Potential Y = 1.270 V<br>**Potential Y = -1.270 V** |
| **22** | Since an electron is negatively charged, it will have the max electrical potential energy at the point that has the most negative potential, in this case point A. |
| **23** | Since the thermistor resistance decreases as its temperature increases, in accordance with the potential divider rule, the pd across it decreases with increasing temperature. At the same time, the diode must be positively biased for current to flow across the warning lamp. |

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| **24** | Circuit P:<br>2R//R = 0.67 R<br>I = 1.5 V/R<br>Ammeter reading = 1.5 (V/R) x 2/3 = V/R<br><br>Circuit Q:<br>2R//R = 0.67 R<br>I = 1.5 V/R<br>Ammeter reading = 1.5 V/R<br><br>Circuit R:<br>2R//R = 0.67 R<br>I = 1.5 V/R<br>Ammeter reading = 1.5 (V/R) x 1/3 = 0.5 V/R<br><br>Circuit S:<br>I = V/1.5R = 0.6667 V/R<br>Ammeter reading = (0.66667 V/R) / 2<br>= 0.333 V/R<br>*Pro-Tip: You can also substitute actual value to make your calculation easier. |
| **25** | Apply Fleming's left-hand rule. |
| **26** | Radius of the orbit is 1.2 / 2 = 0.6 m<br><br>$\frac{1}{2} mv^2 = 5 \times 10^{-13}$ J<br><br>$v = 2.447 \times 10^7$ $ms^{-1}$<br><br>$a_c = v^2/r$<br>$= (2.44^7 \times 10^7)^2 / 0.6$<br>$=9.98 \times 10^{14}$ m $s^{-2}$ |
| **27** | Positive charge experience force in the direction of E-Field.<br>Using Fleming's left-hand rule for magnetic force acting on a current carrying conductor. |
| **28** | P's proton number will change by -2 -2 + 1 = - 3 while its nucleon number will change by – 4 – 4 + 0 = -8<br>Q's **proton number will change by -2 + 1 + 1 = 0** while its nucleon number will change by – 4 + 0 + 0 = - 4<br>R's proton number will change by 1 + 1 + 1 = 3 while its **nucleon number will change by + 0 + 0 + 0 = 0** |
| **29** | 14 nucleons – 7 protons = 7 neutrons.<br>Hence odd number of protons and odd number of neturons. |
| **30** | Since the half-life is relative long (33 years) compared to the time (2 days), we can assume that the activity remains unchanged.<br><br>Hence total number decayed caesium = $4.0 \times 10^5 \times 2 \times 24 \times 60 \times 60$<br>$= 6.912 \times 10^{10}$ |