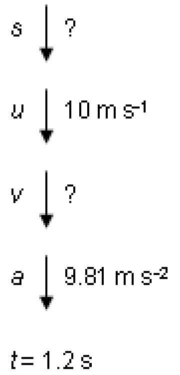
JURONG JUNIOR COLLEGE
PHYSICS DEPARTMENT
2016 Preliminary Examination
8866 H1 Physics Paper 1 Solutions

Qn	Ans	Suggested solution
1	**C**	The area of an A4-sized paper is (0.210 m)(0.297 m) = 0.0624 m^2. Since A4-sized paper is typically 70 to 100 gsm (gram-per-square-metre), the mass of a single sheet of A4 paper is between 4 g and 7 g, the order-of-magnitude is 1 g.
2	**B**	$\eta = \frac{kr^2}{v}$ ➔ $\eta = \frac{(93.7)(0.83/1000)^2}{0.065} = 9.93 \text{ x } 10^{-4} \text{ N s m}^{-2}$ $\frac{\Delta\eta}{\eta} = \frac{\Delta k}{k} + \frac{2\Delta r}{r} + \frac{\Delta v}{v}$ $\frac{\Delta\eta}{\eta} = \frac{(0.1)}{(93.7)} + \frac{2(0.01)}{(0.83)} + \frac{(0.002)}{(0.065)}$ $\Delta\eta = 5.55 \text{ x } 10^{-5} \text{ N s m}^{-2} \approx 0.6 \text{ x } 10^{-4} \text{ N s m}^{-2}$ $\eta = (9.9 \pm 0.6) \text{ x } 10^{-4} \text{ N s m}^{-2}$
3	**B**	Area X represents the displacement as the ball travels upwards and area Y represents the displacement as the ball travels downwards. From one impact to the next, the displacement of the ball must be zero so areas X and Y must be equal but with opposite sign. (**A** is a wrong statement. **C** and **D** are correct statements with only respect to this graph in which air resistance is negligible and do not explain why the two areas are the same. **B** is correct regardless of air resistance being negligible or and explains why the two areas are the same.)
4	**D**	At the instant when the stone passes the edge of the cliff on its way down, its velocity will be 10 m s^{-1} downwards. Taking downwards positive, consider only the motion of the stone in the last 1.2 s, as shown on the right. $v = u + at$ v = 10 + (9.81)(1.2) = 21.8 m s^{-1} $v^2 = u^2 + 2as$ 475 = 100 + 2(9.81)s s = 19 m (2 s.f.) 
5	**B**	Consider the resultant force on the whole system. (54 – 6) = (6 + 2)a a= 6.0 m s^{-2} resultant force on the 6 kg mass = ma = (6)(6) = 36 N
6	**A**	For all collisions, total momentum ($p = mv$) is conserved ⇒ **A**, **C or D**. For an elastic collision, total kinetic energy ($E_k = \frac{1}{2}mv^2$) is conserved ⇒ **A**.
7	**C**	When the ball is in contact with the surface, resultant vertical force = 0 When it leaves the surface, resultant vertical force = W

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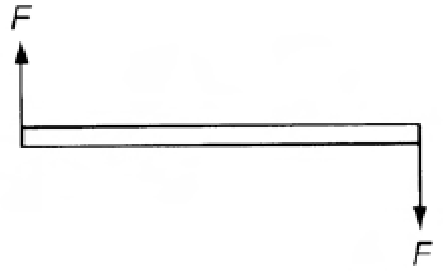
8	**C**	 By definition of a couple, the couple is the product of one of the parallel and equal forces and the perpendicular distance between the two forces.
9	**B**	Taking moments about X, (weight of load)(0.8) + (180)(1.5) = (220)(3) Weight of load = 490 N
10	**C**	By conservation of energy, Increase in KE = WD by constant force = *Fs*
11	**A**	For the first fall: 1. The kinetic energy must be zero at the beginning and end of the fall ⇒ A or C or D 2. The kinetic energy cannot be zero at the middle of the fall ⇒ A or C 3. The total energy must be equal to 120 kJ at all positions ⇒ A or B or D 4. There is no extension of the bungee cord in the initial part of the fall and therefore there is only very little extension, hence very little EPE, at the middle of the fall ⇒ A. The EPE should not quadruple from the middle of the fall to the bottom of the fall as that will mean the bungee cord start to stretch from the beginning of the fall.
12	**C**	Consider the work done in one second which is the output power *P*. $P = \frac{mgh}{t} = mgv = (1400)(9.81)(1.6)$ $\eta = \frac{P}{\text{input power}} \times 100\% = 20\%$ Input power = $\frac{(1400)(9.81)(1.6)}{0.2}$ = 110 kW
13	**C**	$E = V + Ir$ $V = -r\,I + E$ Gradient of V- I graph = $-r$ Gradien of graph $= \frac{2.8 - 1.0}{1.4 - 2.9} = -1.2$ $\Rightarrow -1.2 = -r$ $\Rightarrow r = 1.2\ \Omega$

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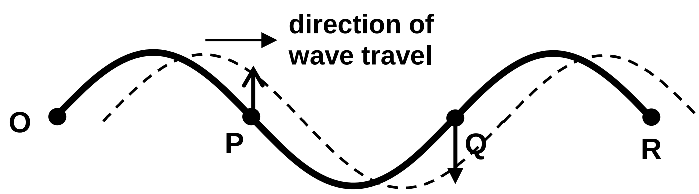
14	**D**	Resistance is defined as the ratio V/I, and not the inverse-gradient of the I-V graph. The resistance at various points on an I-V graph may either be found by calculating the values of V/I at the particular point or finding the inverse-gradient of the straight line drawn from origin to that point. At about 1.2 V, the I-V graphs for the diode and filament lamp intersect. Hence, they will have the same value of V/I or resistance. **[B]** is incorrect, as the ratio V/I changes even though it is a straight line graph after 0.8 V. This is because the straight line does not begin from the origin. **[C]** is incorrect as the resistance of the filament is half that of the resistor's at 1.0 V
15	**C**	Power dissipated in the cables $= I^2R$ $= \left(\frac{P}{V}\right)^2 R$
16	**A**	$P_A = \frac{120^2}{R} \Rightarrow R_A = 14.4\ \Omega$ $P_B = \frac{240^2}{R} \Rightarrow R_B = 57.6\ \Omega$ Since in series circuit, current must be the same across the 2 bulbs. Bulb B will be brighter since it has higher power dissipation (i.e. higher resistance.)
17	**A**	The three resistors are connected in parallel between points P and Q. Hence total resistance $R_T = (1+\frac{1}{2}+\frac{1}{3})^{-1} = 0.55\ \Omega$
18	**B**	The voltmeter reads zero because the reason could be any of those given in options A, C or D. If it is only the filament of the third bulb that has blown, the voltmeter will read a certain value and not zero.
19	**D**	UV radiation has a smaller wavelength than Radiowaves.

<table>
<tr><th>Qn</th><th>Ans</th><th>Suggested solution</th></tr>
<tr><td>20</td><td>D</td><td>At equilibrium points, velocity is maximum. At amplitude, velocity is zero.



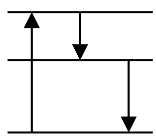
P is on its way upwards, hence velocity is positive.

Q is on its way downwards, hence velocity is negative.</td></tr>
<tr><td>21</td><td>B</td><td>Only transverse wave can be polarized.</td></tr>
<tr><td>22</td><td>A</td><td>$I \alpha A^2$ (intensity proportional to square of amplitude)
When both S_1 and S_2 are opened, the amplitude at M is 2A. When only one source is present, the amplitude at M is just A.

$(2A)^2 \alpha 2I$
$4A^2 = k(2I)$

Hence, $A^2 = k(I/2)$

$A^2 \alpha \frac{I}{2}$</td></tr>
<tr><td>23</td><td>C</td><td>Any two points either side of the centre have a phase difference of 180° (or π).</td></tr>
<tr><td>24</td><td>D</td><td>The points when wavefronts intersect are points of constructive interference.</td></tr>
<tr><td>25</td><td>A</td><td>Use Left Hand Rule, direction of force is perpendicular to current and B-field.</td></tr>
<tr><td>26</td><td>C</td><td>Right hand grip rule</td></tr>
<tr><td>27</td><td>C</td><td></td></tr>
<tr><td>28</td><td>A</td><td>Absorption spectrum</td></tr>
<tr><td>29</td><td>D</td><td>E_1 (photon absorbed) = $E_2 + E_3$ (photons emitted)
$h c / \lambda_1 = h c / \lambda_2 + h c / \lambda_3$
$1 / \lambda_1 = 1 / \lambda_2 + 1 / \lambda_3$
$1 / \lambda_3 = 1 / \lambda_1 - 1 / \lambda_2$
$= (\lambda_2 - \lambda_1) / \lambda_1 \lambda_2$

</td></tr>
<tr><td>30</td><td>D</td><td>Transitions ending at the same level gave rise to visible light.</td></tr>
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