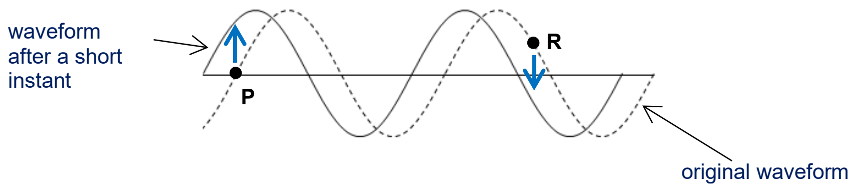
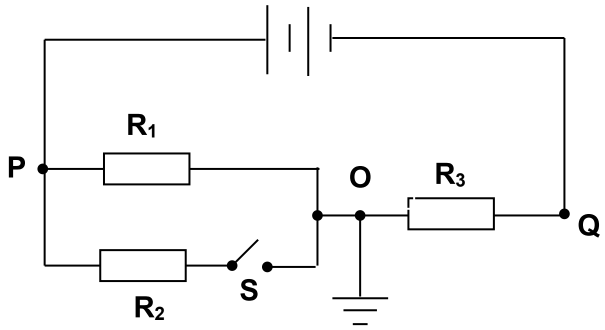
River Valley High School 2023 JC2 Preliminary Examinations Physics Paper 1

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

Qn	Key	guide
1	**B**	Change in vector = final – initial
2	**D**	Option A → 2500 W per hour Option B → Based on J1 practical exercise ~ 1.9 m^2 Option C → ½(100)(10) ^{2} = 5000 J Option D → Atmospheric pressure is already 100 KPa
3	**C**	Equation of motion $v^2 = u^2 + 2as$ gives $\left(\frac{v_A}{3}\right)^2 = v_A^2 + 2(-9.81)(0.40)$ gives $v_A = 2.97 = 3.0\ \mathrm{m\ s^{-1}}$
4	**C**	Let velocity before collision be v, and after collision be V. Then conservation of momentum gives $mv + 0 = 2mV$, giving $V = \frac{1}{2}v$. Initial kinetic energy $E_k = \frac{1}{2}mv^2$ and after collision, kinetic energy of the system is $\frac{1}{2}(2m)\left(\frac{v}{2}\right)^2 = \frac{1}{4}mv^2$. so change in kinetic energy is $\frac{1}{4}mv^2 - \frac{1}{2}mv^2 = -\frac{1}{4}mv^2 = -\frac{E_k}{2}$
5	**C**	Acceleration along the slope = $\frac{30-0}{6} = 5\ \mathrm{m\ s^{-1}}$. Resolve weight along and perpendicular to slope. Along the slope the component of weight is $mgsin\theta$. Hence Newton's 2nd law gives $m(gsin\theta) = 5m$, so $\theta = \sin^{-1}\left(\frac{5}{9.81}\right) = 30.6^o$
6	**C**	Let W be the weight on the board When the child is not on the board, F(2.0) = W(2.5) The force on the spring F = 1.25W When the child is on the board, F'(2.0) = W(2.5) + (40)(9.81)(5.0) The force on the spring F' = 1.25W + 981 Hence, the addition force on the spring due to the child is 981 N. The additional compression on the spring = 981/10000 = 9.8 cm
7	**B**	Additional energy stored in spring = $\frac{1}{2} \times 181 \times (0.036^2 - 0.021^2) = 0.07738\ \mathrm{J}$

		loss in GPE = $3.8 \times (0.178 - 0.163) = 0.057\ \mathrm{J}$ Hence, work done by force = $0.07738 - 0.057 = 0.0204\ \mathrm{J}$ Option C distractor if student did not subtract GPE from the EPE
8	**D**	Let driving force by the car be F, so Newton's second law gives $F - 200 = 800 \times 0.5$, giving $F = 600\ \mathrm{N}$. Hence power $= Fv = 600 \times 20 = 12\ 000\ \mathrm{W}$
9	**C**	Centripetal acceleration = rω2 = r(2π/T)2 Since both r and T are constants, centripetal acceleration does not change over time.
10	**A**	Conservation of energy gives $2400 \times 120 = 0.106 \times 2260000\ + \text{heat loss}$. Heat loss = 48 440 J. So rate of heat loss = $\frac{48440}{120} = 404 = 400\ \mathrm{W}$
11	**C**	density of the gas $\frac{6.80\times10^{15}}{1\times10^{-6}} \times \frac{2.02\times10^{-3}}{6.02\times10^{23}} = 2.282 \times 10^{-5}\ \mathrm{kg\ m^{-3}}$ pressure $p = \frac{1}{3} \times 2.282 \times 10^{-5}\ \times 1900^2 = 27.456\ \mathrm{Pa}$
12	**C**	equating $n = \frac{pV}{RT}$ at 40 m deep and at the surface, we get $\frac{(\rho gh + p_{atm})\times 20\ \mathrm{cm^3}}{R(4+273.15)} = \frac{p_{atm}\times V}{R(20+273.15)}$, and $\rho gh = 1200 \times 9.81 \times 40 = 4.709 \times 10^5\ \mathrm{Pa}$ So $V = \left(\frac{4.709+1.0}{1.0}\right)\left(\frac{293.15}{277.15}\right) \times 20\ \mathrm{cm^3} = 120.8 = 120\ \mathrm{cm^3}$
13	**B**	$a = g - r\omega^2$ Since g can also be expressed as $g = \frac{Gm}{r^2} = \frac{G}{r^2}\rho(\frac{4}{3}\pi r^3) = \frac{4}{3}G\rho\pi r$ The values of a at the equator and the pole will increase when r increases.
14	**A**	$F = \frac{GMm_{man}}{R^2}$ $= \frac{(6.67\times10^{-11})(6.0\times10^{24})(60)}{(4.23\times10^7)^2}$ $= 13.4\ N$
15	**B**	Potential energy vs time, for a situation of oscillating object at extreme position at t = 0 s.
16	**D**	D is always not true because the damping force can be in the same direction as the acceleration of the body.
17	**A**	
18	**D**	 Since Q is at maximum displacement, it should have zero speed. To check the movement of P and Q, draw the waveform at a short instant later. From the diagram, we can see that P is moving upwards while R is moving downwards.

19	**D**	$\tan\theta = \frac{y_1}{L} = \frac{y_1}{4.8}$ $\sin\theta = \frac{\lambda}{b} = \frac{630\times10^{-9}}{0.32\times10^{-3}}$ $y_1 = 9.45\times10^{-3}$ m Since the width of the central bright fringe is $2y_1$ and the width of each higher order bright fringe is y_1, $y = 3y_1 = 3(9.45\times10^{-3}) = 28$ mm
20	**D**	 Let point O be the point of zero potential. When switch S is closed, resistance between OP will reduce. Using the principle of potential divider, the p.d. between OP also reduces which leads to a lower potential at P (lower positive potential value). Since p.d between OP reduces, it will lead to a larger p.d. between OQ and a lower potential at Q (lower negative potential value).
21	**A**	Using I = Ne/t Number of particles travelling in one second = I/e = 10 x 10-6 / 1.6 x 10-19 = 6.25 x 1013 Since the particles travel 2.5 x 107 m in one second, The number of particles in one centimetre length = 6.25 x 1013 / 2.5 x 109 = 25000
22	**A**	Algebraic sum of potential due to charges at A and B is zero, so $\frac{1}{4\pi\varepsilon_0}\frac{+2.4\times10^{-6}}{7.0\text{ cm}} + \frac{1}{4\pi\varepsilon_0}\frac{-2.9\times10^{-6}}{\text{BX cm}} = 0$ giving $\text{BX} = 8.458\text{ cm}$ Pythagoras theorem gives $L = \sqrt{8.458^2 - 7.0^2} = 4.74\text{ cm}$
23	**D**	In the setup, VPQ = 3/ (3+1.5+22)12.0 = 1.31 V. Hence, if the test cell is in range of mV, Vpq need to be further reduced, thus, increase 22 Ω to 1 kΩ.
24	**A**	Closer magnetic flux lines means a stronger field to the left.

		Flux lines pointing left to right suggests a N pole at the left. N pole of bar magnet will be repel while S pole will be attracted, therefore bar magnet will turn anticlockwise and to the left.
25	**B**	
26	**D**	F = B *I* L = *(*B L) *I* Gradient of F vs I graph = B L = 10 / 0.25 = 40 e.m.f. induced = B L v = (40) (x_o ω) = (40) (0.024) (2π 80) = 480 V
27	**B**	$P = \frac{mc\Delta\theta}{t}$ => $t = \frac{mc\Delta\theta}{P}$ For steady d.c $t = \frac{mc\Delta\theta}{I^2 R}$ as P = I2R For a.c with resistance 2R, $t_{ac} = \frac{mc\Delta\theta}{(\frac{I}{\sqrt{2}})^2 2R} = \frac{mc\Delta\theta}{I^2 R}$ as $P_{ac} = (\frac{I}{\sqrt{2}})^2 2R$ t_{ac} =T
28	**B**	Current = power / voltage = 1 x 106 / 66 x 103 = 15.15 A Power loss = I2R = (15.2)2(5) = 1100 W
29	**A**	$hf = \phi + E_{k,max}$ gives $\frac{hc}{\lambda} = \phi + E_{k,max}$, so $\frac{6.63 \times 10^{-34} \times 3.0 \times 10^{8}}{250 \times 10^{-9}} = 4.0 \times 10^{-19} + \frac{1}{2} \times 9.11 \times 10^{-31} \times v_{max}^2$ $v_{max} = 9.3 \times 10^5 \text{ m s}^{-1}$
30	**D**	Rate of decay $A = \lambda N = \frac{\ln 2}{t_{1/2}} N = \frac{\ln 2}{t_{1/2}}(nN_A)$ where *n* and N_A are number of moles and Avogadro's number respectively. Hence $A \propto \frac{n}{t_{1/2}}$. The ratio $\frac{200}{6200}$ is the smallest, i.e. 0.0323. Option A is 0.0476 Option B is 0.0755 Option C is 0.129