2016 AJC JC2 H1 Physics Prelims Solutions
Paper 1 (30 marks)

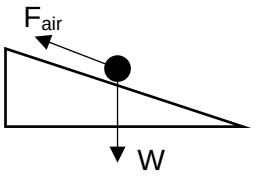
1	2	3	4	5	6	7	8	9	10
B	**A**	**B**	**D**	**C**	**D**	**B**	**B**	**B**	**C**
11	12	13	14	15	16	17	18	19	20
A	**C**	**B**	**C**	**A**	**C**	**C**	**D**	**A**	**D**
21	22	23	24	25	26	27	28	29	30
B	**A**	**C**	**D**	**C**	**B**	**A**	**D**	**D**	**A**

1	**Ans: B** Base unit of area = m^2 Base unit of charge = A s Base unit of current = A Base unit of force = kg m s^{-2}
2	**Ans: A** Min resultant force = 6.0 – 4.0 = 2.0 N Max resultant force = 6.0 + 4.0 = 10.0 N
3	**Ans: B** Since the time taken for the ball to reach maximum height is shorter than the time taken for it to fall back to its original height, air resistance is not negligible. Graph B gives the velocity-time graph for the ball (taking upward as positive) in the presence of air resistance, starting with decreasing upward velocity, followed by zero velocity at maximum height (at t_1) and continuing with increasing downward velocity (negative since upward is taken as positive) beyond t_1. Graph D is wrong as gradient of v-t graph which is acceleration should be increasing. Note: gradient of h-t graph is v. Therefore, variation of slope of h-t graph should correspond to variation of v.
4	**Ans: D** The horizontal displacements are equal due to constant horizontal velocity. The vertical displacements are not equal due to gravitational acceleration. Hence A and C are wrong. Given a constant horizontal velocity and constant vertical acceleration (parabolic path), the displacements cannot be decreasing at a constant rate, hence B is wrong.
5	**Ans: C** Taking downward as positive $v = u + gt$ $40 = 0 + 9.81t$ $t = 4.08 = 4.1$ s

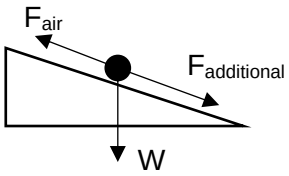
6 **Ans: D**

For elastic collision, KE is conserved
or
speed of approach = speed of separation:
$u_1 - u_2 = v_2 - v_1$ (take direction into consideration)
Only option D does not satisfies the above equation and hence is <u>not</u> elastic.

7 **Ans: B**



At the steady speed of 1.38 ms^{-1},
air resistance = weight component along slope
$1.38\ k = (80.0)(9.81)\sin(5.0)$
$k = 49.565$



At the steady speed of 5.55 ms^{-1},
air resistance = (5.55)(49.565) = 275.086 N

Additional force required
= 275.085 – (80.0)(9.81)sin(5.0) = 207 N

8 **Ans: B**

After exploding the two masses will move in opposite direction

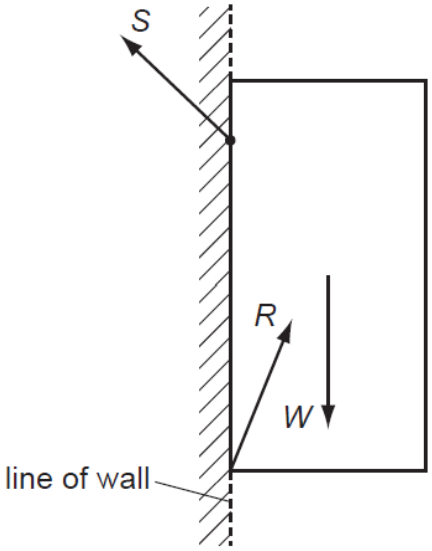
By COM,

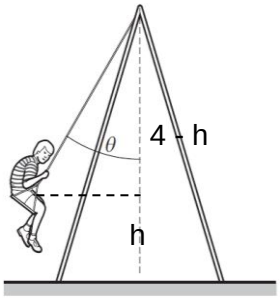
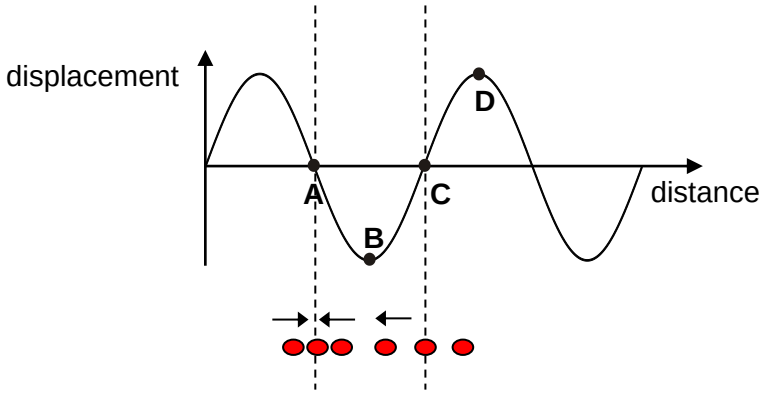
$$\mathbf{0} = M_2v_2 - M_1v_1$$

$$\frac{v_1}{v_2} = \frac{M_2}{M_1}$$

9 **Ans: B**

For A and C, the three forces are not concurrent, hence net torque not zero.
(Concurrent means lines of actions of forces pass through a common point.)
For C and D, forces do not formed closed triangle, hence net force not zero
For B, the three forces are concurrent and can form a close triangle



10	**Ans: C** Taking moments about hinge, 5(40g) = 2F where F = kx 5(40 x 9.81) = 2 (10 000) x X = 0.0981 m = 9.81 cm = 9.8 cm
11	**Ans: A** KE at lowest point = $0.5(50)(3)^2$ = 225 J Change in ht of boy *h* = 225/mg = 0.4587 m cos θ = (4-h)/4 θ = 28° 
12	**Ans: C** 25/100 Pt = Wh t = 100Wh/25P = 4.0 s
13	**Ans: B** Avg P = total change in KE/total time = $0.5\Delta mv^2/\Delta t$ = $0.5(100 \times 10^6)(12)^2/(10x60)$ = 1.2×10^7 W
14	**Ans: C** 
15	**Ans: A** Intensity $I \propto$ Amplitude A^2, hence amplitude of the two waves are A and 3A respectively. For phase difference of $540^0 = 1.5 \times 360^0$, waves interfere destructively. Resultant amplitude = 3A – A = 2A Resultant intensity = $(2)^2I = 4I$
16	**Ans: C** When the first pulse hits the fixed support, it will be reflected with a phase change of π, so its displacement will be upwards. When the reflected pulse meets the second pulse, superposition between the two pulse results and a large displacement upwards.

17 **Ans: C**

Path difference = 4.0 – 1.0 = 3.0 m = 1½ λ
Since sources are in anti-phase, waves will arrive at P in phase.
Constructive interference occurs, so amplitude of resultant wave = a + 2 a = 3 a

18 **Ans: D**

1st experiment: $\Delta y = \lambda D/d$ (1)
2nd experiment: $\Delta y' = \lambda' D/d'$ (2)

(2)/(1) $\Delta y' = \Delta y \frac{\lambda'}{\lambda}\frac{d}{d'}$

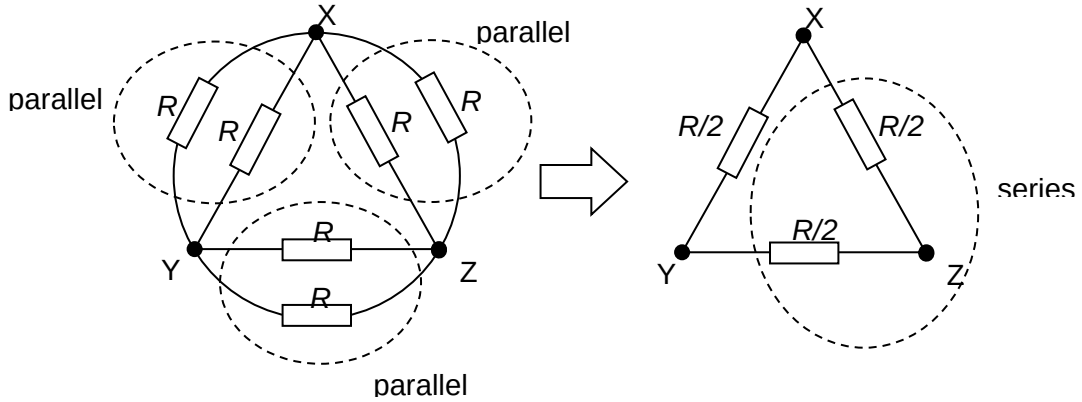
$= 7.0 \times 10^{-4} \times \frac{6.5}{4.5} \times \frac{1.4}{0.50}$

$= 2.8 \times 10^{-3}$ m

19 **Ans: A**

For a stationary wave to form here, $(2n+1)\lambda/4 = L$, where $n \geq 0$ and L is distance between speaker and wall. L = 2.20 m doesn't satisfy this condition.

20 **Ans: D**



This becomes R/2 parallel with R.
Effective resistance = 1/3 R

21 **Ans: B**

Graph does not pass through origin so it does not obey Ohm's law. When V = 1.5 V, R = V/I = 1.5/0.025 = 60 Ω

22 **Ans: A**

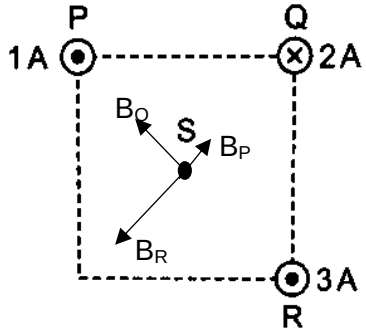
W = QV = (It)V

12 = I (15) (20)

I = 0.040 A

23 **Ans: C**

In C, the resistor and lamp are connected in parallel to the power supply, hence the potential difference across the resistor (the portion which current is flowing through) and lamp will be equal to the terminal potential difference (emf in this case assuming no internal resistance) of the power supply. Hence the potential difference across the lamp cannot be varied.

24	**Ans: D** The setup has two currents flowing in the same direction. Hence there will be attractive forces between X and Y. The attractive forces acting between them constitute an action and reaction pair and are of the same magnitude.
25	**Ans: C** The angle between the magnetic field and current remains at 90°.
26	**Ans: B** Using RHGR to obtain the individual magnetic field vectors and find the resultant. 
27	**Ans: A** $c = f\lambda$. Metal Q has a smaller threshold wavelength, corresponding to a larger threshold frequency, than metal P. A is correct. $\phi = hf_0$. Metal P has a smaller threshold frequency, so smaller work function. B is incorrect. Intensity of radiation does not affect maximum KE of emitted electrons, or stopping potential. C is incorrect. Gradient of graph is not a constant, so D is incorrect.
28	**Ans: D** $hf_1 = \phi + E_1$ ……. eqn 1 $hf_2 = \phi + E_2$ ……. eqn 2 simultaneous equation, eliminate ϕ and obtain expression for h
29	**Ans: D** For absorption spectrum, there must be a whole spectrum of light (white light) passing through the gas to provide photons of different wavelengths that are equivalent to the difference E levels of the cold gas atoms. A and C are wrong. When components of white light is absorbed by cold gas atoms and photons are reemitted by the gas atoms, they are emitted in all directions. In the direction where white light is directed, absorption spectrum is formed. But in other directions, emission spectrum can be observed. B is wrong.
30	**Ans: A** The transitions from E_5 to E_1 and from E_4 to E_1 emits high-energy photons, represented by the first two high-frequency lines. The other transmissions, E_5 to E_2 and E_4 to E_2 emits photons of much lower energies, represented by the low-frequency lines. Transition E_5 to E_3 emit photon of lowest energy, hence frequency. The spacing between lines in the spectrum represents the difference between energies of photons emitted. Spacing between first and second lines is same as spacing between 3rd and 4th lines, due to same difference between energies of the photons emitted.