Answers to 2015 JC2 Preliminary Examination Paper 1 (H1 Physics)

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

1 Using $s = ut + \frac{1}{2}at^2$, since object falls freely from rest, we have $t^2 = \frac{2}{g}s$. Hence, the gradient of the graph is $\frac{2}{g}$. By calculation, $g \approx 8.70\ \text{m s}^{-2}$ and is an inaccurate value.

The poor scattering of the graph indicates that there is random error and so is not precise.

Answer: D

2 Given that $T = 2\pi\sqrt{\frac{m}{k}}$,

$$2.8 = 2\pi\sqrt{\frac{50\times10^{-3}}{k}}$$
$$k \approx 0.2518\ \text{N m}^{-1}$$

Since $k = \frac{4\pi^2 m}{T^2}$,

$$\frac{\Delta k}{k} = \frac{\Delta m}{m} + 2\frac{\Delta T}{T}$$
$$\frac{\Delta k}{0.2518} = \frac{1}{50} + 2\frac{0.1}{2.8}$$
$$\Delta k \approx 0.02\ \text{N m}^{-1}$$

Therefore, $k \approx (0.25 \pm 0.02)\ \text{N m}^{-1}$.

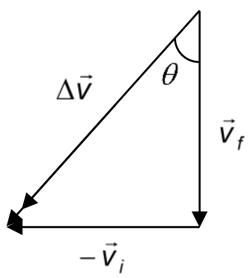
Answer: B

3 Pressure and density are both scalar quantities.

Answer: C

4 $\Delta\vec{v} = \vec{v}_f - \vec{v}_i$

$\Delta\vec{v} = \vec{v}_f + (-\vec{v}_i)$



$$\left(\Delta v\right)^2 = \left(v_f\right)^2 + \left(v_i\right)^2$$
$$\Delta v = \sqrt{\left(7\right)^2 + \left(4\right)^2}$$
$$\Delta v \approx 8\ \text{m s}^{-1}$$

$$\tan\theta = \frac{v_i}{v_f}$$
$$\tan\theta = \frac{4}{7}$$
$$\theta \approx 30^\circ$$

Answer: C

5 The change in velocity can be determined from the area under the acceleration-time graph. Point Q is the turning point of the velocity-time graph and so is the maximum value. Beyond point Q, the velocity decreases but remains positive. Hence, S is a point of maximum displacement.

Answer: D

6 Taking downwards as positive,

$$s_y = u_y t + \frac{1}{2}a_y t^2$$
$$2.0 = \frac{1}{2} \times 9.81 \times t^2$$
$$t \approx 0.639\ \text{s}$$

$$s_x = u_x t$$
$$2.5 = u_x \times 0.639$$
$$u_x \approx 3.92\ \text{m s}^{-1}$$

Therefore, minimum speed is 3.9 m s^{-1}.

Answer: B

7 Gravitational force experienced by astronaut near Earth is always equal to *mg*.

Answer: C

8 Force by lead on α-particles

$$= \frac{N}{t}\Delta p = \left(5.0\times10^4\right)\left(6.6\times10^{-27}\right)\left(0-1.5\times10^7\right) = -4.95\times10^{-15}\ \text{N}$$

By Newton’s third law of motion,
Force by α-particles on lead = 4.95×10^{-15} N

Pressure by α-particles on lead

$$= \frac{4.95\times10^{-15}}{1.0\times10^{-4}} = 4.95\times10^{-11} \approx 5.0\times10^{-11}\ \text{Pa}$$

Answer: C

9 By Principle of Conservation of Momentum,

$(2.0)(3.0) = 3.0v$

v = **2**.0 m s^{-1}

$$KE_i = \frac{1}{2}(2.0)(3.0^2) = 9.0\ \text{J}$$

$$KE_f = \frac{1}{2}(3.0)(2.0^2) = 6.0\ \text{J}$$

Loss in KE = 9.0 – 6.0 = 3.0 J

Answer: D

10 From the graphs, it can be observed that when the same force is applied to both wires, Y will have a larger extension. It is more elastic.

Answer: D

11 Taking moments about the centre of the beam,

$$F_B\left(\frac{l}{4}\right) = F_A\left(\frac{l}{2}\right)$$

$$\frac{F_B}{F_A} = 2.0$$

Answer: D

12 $\tau = Fd$

= (5.0)(0.40)(sin60°)

= 1.7 Nm

Answer: C

13 Resolving the tension in string X vertically and horizontally,

$T_X \cos\theta = W$

$$T_X = \frac{W}{\cos\theta}$$

$T_Y = T_X \sin\theta$

From the above equations for T_X and T_Y, it can be seen that when θ increases, both tensions will increase.

Answer: A

14 Work done = Heat produced + gain in gravitational potential energy

$W = 600 + (30)(9.81)(5.00\sin 30.0)$

$= 1340$ J

Answer: A

15 $P = Fv$

$1500 = F(60)$

$F = 250N$

$250 = 2T\cos 30°$

$T = 144N$

Answer: C

16 $\lambda = \frac{v}{f} = \frac{320}{400} = 0.80\,\text{m}$

$\frac{\phi}{2\pi} = \frac{0.2}{0.8}$

$\phi = \left(\frac{0.2}{0.8}\right)(2\pi)$

$\phi = \frac{\pi}{2}$ rad

Answer: C

17 Intensity, $I = \frac{\text{Power}}{\text{Area}} = \frac{E}{t(Area)}$

$I \propto E$

$\therefore E \propto A^2$

$\frac{A_t}{A_i} = \sqrt{\frac{E_t}{E_i}} = \sqrt{\frac{0.70E_i}{E_i}} = 0.84$

Answer: C

18 Period, $T = \frac{1}{f} = \frac{1}{2.5} = 0.40\,\text{s}$

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. 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.

Answer: A

19 To detect largest amplitude of wave, constructive interference must occur. For constructive interference to occur, the path difference between S_2D and S_1D is $n\lambda$, where n is an integer.

When D is moved 1.0 m further away from S_1,

Path difference = $\sqrt{8^2 + 6^2} - 8$ = 2.0 = λ, where n is 1.

The other options do not satisfy the condition of path difference = $n\lambda$.

Answer: C

20 $x = \frac{\lambda D}{a}$

The fringe separation is directly proportion to wavelength. Monochromatic red light has longer wavelength than monochromatic green light.

Answer: D

21 Let the e.m.f. of the battery be E and the resistance of each light bulb be R.
For each circuit,

power dissipated in the brightest light bulb $= \frac{E^2}{R}$

All three circuits contains at least one light bulb where the power dissipated $= \frac{E^2}{R}$.

Answer: D

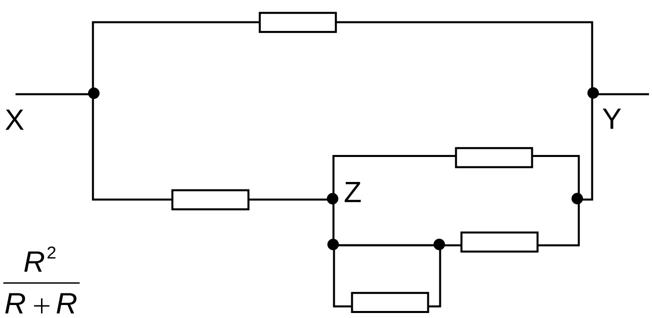
22 The resistance of an electrical component is defined as the ratio of the potential difference across the component to the current flowing through the component.
Options B and D are incorrect as there should be no current through the component when V is zero. Option A is correct as it shows a constant $\frac{V}{I}$ ratio for lower V values. At higher V values, the $\frac{V}{I}$ ratio increases with increase in V.

Answer: A

23 Energy transferred
$$\begin{aligned} &= EQ \\ &= E(It) \\ &= 1.5(0.5)(4.0)(60) \\ &= 180 \text{ J} \end{aligned}$$

Answer: C

24 The circuit can be redrawn as shown below:



$$\begin{aligned} R_{ZY} &= \frac{R^2}{R+R} \\ &= 0.5R \end{aligned}$$

$$\begin{aligned} \frac{1}{R_{XY}} &= \frac{1}{R} + \frac{1}{R + R_{ZY}} \\ &= \frac{1}{R} + \frac{1}{R + 0.5R} \end{aligned}$$

$$R_{XY} = \frac{3}{5}R$$

Answer: B

25 When $R_{\text{variable}} = 0\ \Omega$

$R_{\text{effective}} = 0.5\ \text{k}\Omega$

$$\text{current through 1.0 k}\Omega\text{ resistor} = \frac{15}{2\left(0.5\times10^{3}\right)} = 0.015\ \text{A}$$

$$\text{voltmeter reading} = 1000(0.015) = 15\ \text{V}$$

When $R_{\text{variable}} = 2.0\ \text{k}\Omega$

$R_{\text{effective}} = 0.5 + 1.0 = 1.5\ \text{k}\Omega$

$$\text{current through 1.0 k}\Omega\text{ resistor} = \frac{15}{2\left(1.5\times10^{3}\right)} = 0.005\ \text{A}$$

$$\text{voltmeter reading} = 1000(0.005) = 5\ \text{V}$$

Hence, minimum voltmeter reading $= 5$ V and maximum voltmeter reading $= 15$ V

Answer: C

26 Magnetic flux density α I (since μ_0 and n are constant).
Reducing the solenoid length to one-third its original length will cause its resistance to correspondingly decrease to one-third its original value. Since the same battery is used, current I through the solenoid will triple.
Hence magnetic flux density will triple.

Answer: C

27 Both conductors in A and C will experience attractive electromagnetic force towards each other. In option D, the conductors repel each other. Hence attractive force is negative. In option B, the conductor carrying current 5 I will experience a downward force due to the conductor carrying current I. The conductor carrying current I will experience no net force due to the conductor carrying current 5 I.

Answer: B

28 Energy of photon, $E = \frac{hc}{\lambda}$

$$X - Y = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{X - Y}$$

Since $p = \frac{h}{\lambda}$,

Momentum = $\dfrac{h}{\left(\dfrac{hc}{X-Y}\right)} = \dfrac{X-Y}{c}$

Answer: B

29 The first graph shows one plate emitting photoelectrons when illuminated with the first frequency. It can be deduced that E is acting as the collector only. Hence, F is emitting and E is not emitting. This indicates that the photons of f_1 is insufficient to cause E to emit. E has a higher work function than F. Photons of f_2 cause both plates to emit electrons. Hence the plates act as both emitters and collectors at the same time. We can deduce that f_2 is larger than f_1 since it causes E to emit as well.

Answer: B

30 In option A, only an emission spectrum is formed. In option B, both an absorption and emission spectrum can be formed. In option C, only an emission spectrum is formed. The beam of electrons would cause excitation of the electron bounded within the atom. When the bounded electron transits back to a lower energy level, photons are emitted, giving rise to the emission line spectrum.

Answer: D