Innova Junior College
2014 JC2 H1Phy Prelim 2 Paper 1 Solution

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

Item Analysis

Q	A	B	C	D	Wrong	Correct	% Correct	Difficulty
1	7	**(29)**	3	21	31	29	48.3%	14
2	23	5	**(30)**	2	30	30	50.0%	18
3	0	2	**(56)**	2	4	56	93.3%	30
4	**(9)**	22	23	6	51	9	15.0%	4
5	0	12	**(46)**	2	14	46	76.7%	27
6	10	22	**(20)**	8	40	20	33.3%	9
7	33	12	**(8)**	7	52	8	13.3%	2
8	4	13	1	**(42)**	18	42	70.0%	24
9	**(53)**	4	1	2	7	53	88.3%	29
10	20	6	6	**(28)**	32	28	46.7%	13
11	**(19)**	34	5	1	41	19	31.7%	8
12	14	8	**(35)**	3	25	35	58.3%	22
13	2	7	**(44)**	7	16	44	73.3%	25
14	6	**(18)**	13	23	42	18	30.0%	6
15	2	23	5	**(29)**	31	29	48.3%	14
16	**(31)**	18	5	6	29	31	51.7%	19
17	3	19	4	**(34)**	26	34	56.7%	21
18	**(37)**	14	7	2	23	37	61.7%	23
19	**(7)**	10	11	32	53	7	11.7%	1
20	5	**(44)**	7	4	16	44	73.3%	25
21	24	0	**(23)**	13	37	23	38.3%	10
22	0	**(25)**	23	12	35	25	41.7%	12
23	**(47)**	3	8	2	13	47	78.3%	28
24	12	**(32)**	10	6	28	32	53.3%	20
25	20	**(18)**	12	9	42	18	30.0%	6
26	22	**(16)**	13	9	44	16	26.7%	5
27	18	7	**(23)**	11	37	23	38.3%	10
28	6	4	41	**(8)**	52	8	13.3%	2
29	**(29)**	16	3	12	31	29	48.3%	14
30	5	13	11	**(29)**	31	29	48.3%	14

1. Suggested Solution

Comments

$PV = nRT$

$$R = \frac{PV}{nT}$$

$$[R] = \frac{[P][V]}{[n][T]} = \frac{[F][V]}{[A][n][T]} = \frac{\text{kg m s}^{-2} \times \text{m}^3}{\text{m}^2 \times \text{mol} \times \text{K}}$$

$= kg\ m^2\ K^{-1}\ mol^{-1}\ s^{-2}$ [Ans: **B**]

2. Suggested Solution

Comments

$P = I^2R$

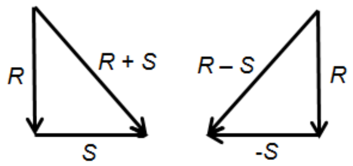
$$\frac{\Delta P}{P} \times 100\% = 2\left(\frac{\Delta I}{I} \times 100\%\right) + \frac{\Delta R}{R} \times 100\%$$

$$= 2\left(\frac{0.05}{3.50} \times 100\%\right) + 2\%$$

$= 2.86\% + 2\% = 5\%$ [Ans: **C**]

3. Suggested Solution

Comments



[Ans: **C**]

4. Suggested Solution

Comments

With air resistance, the resultant force and hence deceleration of the rising ball is larger. Hence the ball reaches a lower height. Subsequently, when the ball falls, it falls with a smaller acceleration (over a shorter distance), resulting in a smaller speed when returning to the point of throw.

Due to the larger deceleration when the ball rises, it reaches a lower height in a shorter time. Hence the overall flight time is smaller than when without air resistance. [Ans: **A**]

5. Suggested Solution

Comments

The gradient of the velocity-time graph determines acceleration. The jumper is at rest when his velocity is zero and the jumper has zero acceleration when the gradient of the v-t graph is zero. [Ans: **C**]

6. Suggested Solution

Comments

The gravitational field strength of Moon is 1/6 of that of Earth so the projectile for Moon has smaller deceleration, allowing the golf ball to be moved further. In addition, the motion of the golf ball on Earth is affected by air resistance, resulting in the non-symmetrical path, but its motion on Moon is near parabolic due to the absence of atmosphere. [Ans: **C**]

7. Suggested Solution

Comments

$u_x = u \cos 30° = 0.866\, u$

At the highest point of motion, $v_y = 0$ m s^{-1} while its horizontal speed v_x remains unchanged (0.866 u)

$KE = ½ mv^2 = ½ mv_x^2 = ½ m(0.866\ u)^2$
$= 0.75 (½ mu^2) = 0.75\ E$ [Ans: **C**]

8. Suggested Solution

The force on the racket must be equal and opposite to the force on the ball according to Newton's 3rd Law. [Ans: **D**]

Comments

9. Suggested Solution

$F_n = ma$

driving force – resistive force = ma

$2000 – R = 750 \times 2.0$

$R = 500\ N = 0.50\ kN$ [Ans: **A**]

Comments

10. Suggested Solution

Applying Principle of Conservation of Momentum:

$(2.0 \times 3.0) + (1.0 \times 0) = (2.0 + 1.0)\ v$

$V = 2.0\ m\ s^{-1}$

$KE\ lost = ½ (2.0)(3.0)^2 – ½ (2.0+1.0)(2.0)^2 = 3.0\ J$ [Ans: **D**]

Comments

11. Suggested Solution

Spring R is supporting the load W.

$T_R = W = k_R x_R$

$$x_R = \frac{W}{3k}$$

Since spring P and Q share the load equally, $T_P + T_Q = W$

$T_p = ½\ W = k_P x_P$

$$x_p = \frac{½W}{k} = \frac{W}{2k}$$

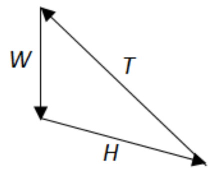
Total extension $= x_R + x_P$

$$= \frac{W}{3k} + \frac{W}{2k} = \frac{5W}{6k}$$ [Ans: **A**]

Comments

12. Suggested Solution

Since the trapdoor is held, it is in equilibrium. Hence the 3 forces form a closed triangle.



Looking at the vector diagram, the magnitude of the forces in increasing order is W, H and T. [Ans: **C**]

Comments

13. Suggested Solution

$p = \rho gh$

$\Delta p = \rho g \Delta h$

$= 1100 \times 9.81 \times (2.20 – 2.00)$

$= 2158 \approx 2.2 \times 10^3\ Pa$ [Ans: **C**]

Comments

14. Suggested Solution

$GPE_{highest\ height} + KE_{highest\ height} = GPE_{surface} + KE_{surface}$

$mgh + 0 = 0 + KE_{surface}$

i.e. $mgh = KE_{surface}$

Comments

The ball drop for a height of (80 – 8.0 =) 72 cm = 0.72 m
The ball then raise for a height of (45 – 8.0 =) 37 cm = 0.37 m

$$\frac{mgh_{drop}}{mgh_{rise}} = \frac{KE_{surface}}{KE_{surface}'}$$

$$\frac{0.72}{0.37} = \frac{0.75}{KE_{surface}'}$$

$KE_{surface}' = 0.385 \approx 0.39$ J [Ans: **B**]

15. Suggested Solution

Comments

Useful power output = rate of increase of GPE

$$= \frac{mgh}{t} = mgv = 14000 \times 9.81 \times 3.2$$

= 439488 W

Power input = power supplied to motor
= I x V = 240 x 2200 = 528000 W

$$Efficiency = \frac{\text{useful power output}}{\text{power input}} \times 100\%$$

$$= \frac{439488}{528000} \times 100\% = 83\%$$ [Ans: **D**]

16. Suggested Solution

Comments

Since the horizontal axis is time, hence q refers to the period (not wavelength).
Since p is not at the maximum displacement, p refers to the displacement of the wave (not the amplitude). [Ans: **A**]

17. Suggested Solution

Comments

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda}$$

$$\frac{\Delta\phi}{2\pi} = \frac{\frac{3}{4}\lambda}{\lambda}$$

$\Delta\varphi = 1.5\pi = 270°$ [Ans: **D**]

# #

18. Suggested Solution

Comments

$I \propto A^2$

$\frac{I}{I'} = \left(\frac{A}{A'}\right)^2$

$\frac{I}{I'} = \left(\frac{A}{A\cos 60°}\right)^2$

$I' = 0.25\ I$ [Ans: **A**]

19. Suggested Solution

Comments

typical wavelength	dimension of obstacle
microwaves ~ 10 cm	steel post ~ 15 cm
radio waves ~ 2 to 3 metres	copper wire ~ 1 mm
sound waves ~ about 0.1 m to 1 m	human hair ~ 0.5 mm
visible light ~ about 700 nm	gate post ~ 30 cm

For maximum diffraction, the size of the obstacle should be about the same order as the wavelength of the wave. [Ans: **A**]

20. Suggested Solution

Comments

Distance between 5 bright fringes = 0.030 – 0.015

$5x = 0.015$

$x = 0.0030$ m

$$x = \frac{\lambda D}{d}$$

$$0.0030 = \frac{\lambda \times 5.0}{0.90 \times 10^{-3}}$$

$\lambda = 5.4 \times 10^{-7}$ m [Ans: **B**]

21. Suggested Solution

Comments

Resistance $R = \frac{\rho l}{A} = \frac{4\rho l}{\pi d^2}$

Since both material have the same resistance, $R_P = R_Q$

$$\frac{4\rho_P l_P}{\pi d_P^{\,2}} = \frac{4\rho_Q l_Q}{\pi d_Q^{\,2}}$$

$$\frac{2\rho_Q l_Q}{\pi d_P^{\,2}} = \frac{\rho_Q l_Q}{\pi d_Q^{\,2}}$$

$\frac{d_P}{d_Q} = \sqrt{2}$ [Ans: **C**]

22. Suggested Solution

Comments

By definition of potential difference, $V = \frac{W}{q}$

$W = qV$ (product of potential difference and electric charge)

Thus the product of potential difference and electric charge will yield an energy quantity. [Ans: **B**]

23. Suggested Solution

Comments

$P = IV$

$$P = \left(\frac{Ne}{q}\right)V$$

$$40 = \frac{N}{t} \times 1.6 \times 10^{-19} \times 5.0$$

$$\frac{N}{t} = 5.0 \times 10^{19}$$ [Ans: **A**]

24. Suggested Solution

Since resistor R and 3R are parallel, $V_2 = V_3$.

$V = V_1 + V_3$

Hence, $V - V_3 = V_1$ [Ans:**B**]

Comments

25. Suggested Solution

When variable resistor S = R, the potential across the two ends of the voltmeter is the same, hence voltmeter reading = 0 V

When variable resistor S = 3R, the p.d across S = 6.0 V using potential divider principle.

Hence, voltmeter reading = 6.0 V – 4.0 V = 2.0 V

Therefore, the change in voltmeter reading is 2.0 V [Ans: **B**]

Comments

26. Suggested Solution

Using potential divider principle, the potential difference across the thermistor is the smallest when its resistance is low and the resistance across the LDR is high ($R_{thermistor} = \frac{R_{thermistor}}{R_{thermistor} + R_{LDR}} \times E$)

Hence, its temperature must be high and the illumination on the LDR must be low. [Ans: **B**]

Comments

27. Suggested Solution

For the resultant magnetic flux density at the common center to be zero, the two magnetic flux density should have the same magnitude but opposite direction.

Hence the direction of current in coil Q should be opposite direction (i.e. clockwise) to the current in coil P.

And $B_P = B_Q$ where $B \propto \frac{IN}{r}$

$$\frac{I_P N_P}{r_P} = \frac{I_Q N_Q}{r_Q}$$

$$\frac{2.0 \times 10}{0.040} = \frac{I_Q \times 40}{0.160}$$

$I_Q = 2.0$ A [Ans: **C**]

Comments

#

28. Suggested Solution

$F = BIL \sin \vartheta$ where ϑ is the angle between B field and current

Hence, $F = BIL \sin 90°$

$F = 0.040 \times 5.0 \times 0.040 \sin 90° = 8.0 \times 10^{-3}$ N [Ans: **D**]

Comments

29. Suggested Solution

$E_{photon} = \Phi + E_k$

$$\frac{hc}{\lambda} = \phi + E_k$$

$$E_k = \frac{hc}{\lambda} - \phi$$

Plotting E_k against λ will give a (hyperbolic) curve. [Ans: **A**]

Comments

30. *Suggested Solution*

For the shortest wavelength, the energy transition has to be the greatest (from the highest to the lowest, i.e. E_3 to E_1)

$$E_3 - E_1 = \frac{hc}{\lambda_1}$$

For the longest wavelength, the energy transition has to be the lowest (from the highest to the second highest, i.e. E_3 to E_2)

$$E_3 - E_2 = \frac{hc}{\lambda_2}$$

Let λ be wavelength of the other spectral line.
The last photon is emitted when the atom makes a transition from E_2 to E_1.

$$E_2 - E_1 = (E_3 - E_1) - (E_3 - E_2)$$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_1} - \frac{hc}{\lambda_2}$$

$$\frac{1}{\lambda} = \frac{1}{\lambda_1} - \frac{1}{\lambda_2}$$

$$\lambda = \frac{\lambda_1 \lambda_2}{\lambda_2 - \lambda_1}$$

*[Ans: **D**]*

Comments

END OF PAPER