

Answers to JC2 Preliminary Examination Paper 1 (H1 Physics)

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

Suggested Solutions:

- 1 The reading is not accurate due to the fact that student did not take into account the zero error.

The reading is precise as the student has read to the precision of the instrument.

Answer: B

- 2 The kinetic energy of the student is calculated using an approximation of brisk walking speed of 1 m s^{-1} and a mass of 60 kg. Therefore, answer is approximated to be 30 J.

Answer: B

- 3 Answer: C

- 4 Taking downwards as positive,

$$s_y = u_y t + \frac{1}{2}(a_y)(t)^2$$

$$500 = (208 \sin 20^\circ)t + \frac{1}{2}(9.81)(t)^2$$

$$t = 5.2 \text{ s}$$

Horizontally,

$$s_x = u_x t$$

$$= (208 \cos 20^\circ)5.2$$

$$= 1016 \text{ m}$$

Answer: B

- 5 The acceleration at maximum height is equal to the acceleration of free fall. This is because at maximum height, speed is zero and thus there is no air resistance and the only force acting on the ball is its weight.

Answer: A

- 6 Using $s = ut + \frac{1}{2}(a)(t)^2$,

For car A:

$$s_A = \frac{1}{2}(5.0)(6.0)^2 = 90 \text{ m}$$

For car B:

$$s_B = (20.0)(6.0) + \frac{1}{2}(-3.0)(6.0)^2 = 66 \text{ m}$$

Thus, their distance apart = $90 - 66 = 24 \text{ m}$

Answer: A

- 7 Impulse = $F\Delta t = (0.2)(10) = 2.0 \text{ Ns}$ in the easterly direction.

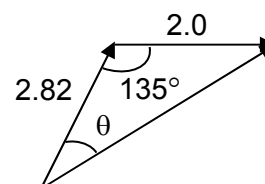
$$F\Delta t = \Delta p = m\Delta v = 2.0$$

$$\Delta \vec{p} = \vec{p}_f - \vec{p}_i = 2.0 \Rightarrow \vec{p}_f = \vec{p}_i + 2.0$$

Using cosine rule,

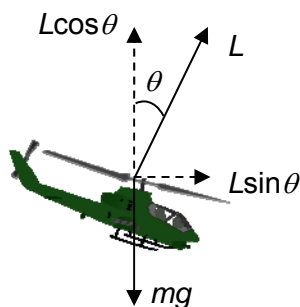
$$\vec{p}_f = 4.46 \text{ Ns} \Rightarrow v_f = 2.23 \text{ m s}^{-1}$$

$$\theta = 18.5^\circ$$



Answer: D

- 8



Initially, for vertical motion,

$$50 = 0 + \frac{1}{2}a(4.0)^2$$

$$\therefore a = 6.25 \text{ m s}^{-2}$$

Consider forces acting on helicopter,

$$L - mg = ma = m(6.25)$$

$$\therefore L = 16060 \text{ N}$$

With the blades tilted at an angle 52° to the vertical,

$$\text{horizontally, } L \sin 52^\circ = m(a_1) \Rightarrow a_1 = 12.7 \text{ m s}^{-2}$$

Answer: C

- 9 Impulse = $F\Delta t = (20)(10) = 200 \text{ Ns}$ for the first 10 s.

$$F\Delta t = \Delta p = m\Delta v = mv - mu = mv = 200$$

$$\Rightarrow v = 10 \text{ m s}^{-1}$$

$$\text{Impulse} = F\Delta t = (-10)(5) = -50 \text{ Ns for 10 s to 15 s.}$$

Similarly,

$$mv - m(10) = -50$$

$$\Rightarrow v = 7.5 \text{ m s}^{-1}$$

Answer: D

$$10 \quad k_1 = \frac{60}{0.06} = 1000 \text{ N m}^{-1}$$

$$k_2 = \frac{80 - 60}{0.14 - 0.06} = 250 \text{ N m}^{-1}$$

The work done on the sample is the area under the graph, thus, letting x be the extension,

$$\frac{1}{2}(1000)(0.06)^2 + 60(x - 0.06) + \frac{1}{2}(250)(x - 0.06)^2 = 4.4$$

$$x = 0.10 \text{ m} = 10 \text{ cm}$$

Answer: C

$$11 \quad \text{Perpendicular distance between R and PQ} = \frac{5.0}{2} \tan 60^\circ = 4.33 \text{ cm}$$

Let the normal contact force acting on the rod by the wall be N_{rod} .

Taking moments about P,

$$(0.100)(9.81)(2.5 \text{ cm}) + (3.0)(5.0 \text{ cm}) = N_{\text{rod}}(4.33 \text{ cm})$$

$$N_{\text{rod}} = 4.0 \text{ N}$$

Answer: C

- 12 The forces acting on the cardboard consist of two couples. Thus the forces cancel out with one another and there is no net force, which means that the cardboard is in translational equilibrium.

The perpendicular distance between the clockwise couple is larger than that between the anticlockwise couple, thus there will be a net torque clockwise.

$$\sum \tau = 1.0(5.0 \times 10^{-2}) - (1.0)(5.0 \times 10^{-2} \cos 45^\circ) = 1.5 \times 10^{-2} \text{ N m}$$

Answer: A

$$13 \quad P_{out} = \frac{W}{t} = \frac{Fd}{t} = \frac{mgd}{t} = \frac{400 \times 9.81 \times 1200}{2.0 \times 60} = 39240 \text{ W}$$

$$\varepsilon = \frac{P_{out}}{P_{in}} = 0.80$$

$$P_{in} = \frac{39240}{0.80} = 49050 \text{ W}$$

$$P_{wasted} = P_{in} - P_{out} = 49050 - 39240 = 9810 \text{ W}$$

Answer: B

14 On the inclined plane,

$$v^2 = u^2 + 2as$$

$$= 2.5^2 + 2(-9.81 \sin 30^\circ)(0.50)$$

$$= 1.345$$

$$v = 1.160 \text{ m s}^{-1}$$

Minimum KE occurs at top of parabolic path, where velocity is $v \cos 30^\circ = 1.00 \text{ m s}^{-1}$.

$$\therefore KE_{\min} = 0.5 \times 0.200 \times 1.00^2 = 0.10 \text{ J}$$

Answer: B

15 Power is the rate of work done, so it can be determined by the gradient of the graph at any point. Thus, out of the four instances, the engine generates the most power at C because it has the steepest gradient.

Answer: C

16 $T = 4 \text{ ms}$

$$f = \frac{1}{T} = \frac{1}{4 \times 10^{-3}} = 250 \text{ Hz}$$

$$\lambda = \frac{v}{f} = \frac{320}{250} = 1.28 \text{ m}$$

Answer: B

17 longest wavelength, thus use a wavelength that is close to visible violet light of 400 nm.

$$f = \frac{v}{\lambda} = \frac{3.0 \times 10^8}{400 \times 10^{-9}} = 7.5 \times 10^{14} \text{ Hz}$$

Answer: B

18 Answer: C

$$19 \quad x = \frac{\lambda D}{a}$$

When D increases, x increases.

Answer: B

20 Energy supply = IVt
 $= (50)(12)(3600)$
 $= 2.2 \text{ MJ}$

Answer: D

21 $I = \frac{Q}{t} = \frac{6.0}{120} = 0.050 \text{ A}$

$$V = E - Ir$$

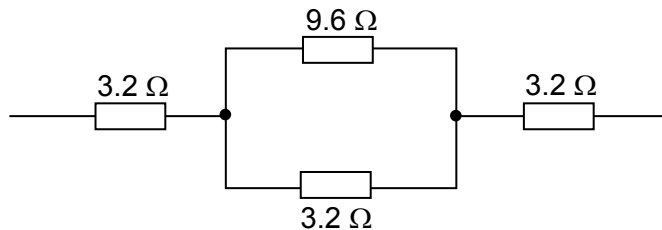
$$\frac{W}{Q} = E - Ir$$

$$\frac{48}{6.0} = 9.0 - (0.050)r$$

$$r = 20 \text{ } \Omega$$

Answer: B

22



$$R_{\text{equivalent}} = 3.2 + \left(\frac{9.6 \times 3.2}{9.6 + 3.2} \right) + 3.2 = 8.8 \text{ } \Omega$$

Answer: C

23 $R = \frac{\rho L}{A}$

$$R = \frac{\rho L}{\left(\frac{V}{L} \right)} = \frac{\rho L^2}{V} = \frac{\rho (L_0 + x)^2}{V}$$

Answer: D

- 24 The resultant force on C due to the currents in A and E will point towards West. Similarly, the resultant force on C due to the currents in B and D points towards West as well. While the force on C due to the current in F points East, its magnitude is the smallest. Hence, the resultant force on C due to all the five currents is towards West.

Answer: D

- 25 The magnetic field generated between the two arms of the iron core points up. The current in the conductor points inwards. By Fleming's left hand rule, the force on the conductor points towards the right.

Answer: D

26 acceleration of the rod $a = \frac{B l x}{m}$

Answer: C

- 27 For constant frequency source, metal A with higher work function energy will emit electrons of lower maximum K.E. and thus with lower stopping potential. Either option A or D.

Higher incident intensity radiation will result in higher photoelectric current for metal B.

Answer: D

28 Intensity, $I = \left(\frac{N}{t}\right)\left(\frac{hf}{A}\right) = \left(\frac{N}{t}\right)\left(\frac{hc}{A\lambda}\right)$
 $\Rightarrow \left(\frac{N}{t}\right) = \frac{IA\lambda}{hc} = 9.6 \times 10^{16}$

Answer: B

- 29 Since $E = hf = \frac{hc}{\lambda}$, thus change in energy levels is inversely proportional to the wavelength emitted. Secondly, the change in energy level is larger for smaller wavelength of photons emitted. Thus $E_y - E_z > E_x - E_z$.

Answer: C

- 30 Answer: B