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<th>Question No.</th>
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<td>1.</td>
<td>B (54)</td>
<td>26.</td>
<td>C (42)</td>
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<td>2.</td>
<td>B (49)</td>
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<td>25.</td>
<td>C (58)</td>
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*Note: Figures in brackets indicate the percentages of candidates choosing the correct answers.*
HKDSE 2013-1A Suggested Solutions

1. Which of the...
   [B] (1) is incorrect. A liquid absorbs energy when it vaporizes, no matter it evaporates or boils.
   
   (2) is incorrect. Evaporation occurs at any temperature (although it is true that boiling occurs at the boiling point, a definite temperature).
   
   Only (3) is correct.

2. In an experiment...
   [B] Recall $\ell = \frac{\text{energy supplied}}{\text{mass of water vaporized}} = \frac{Q}{\Delta m}$.
   
   For (A) and (D), more energy has to be supplied due to energy loss. \( \therefore \ell \downarrow \).
   
   For (B), $\Delta m \downarrow \Rightarrow \ell \downarrow \therefore (B)$ is correct.
   
   For (C), steam condenses and drops back $\Rightarrow \Delta m \downarrow \therefore \ell \downarrow$.

3. In which of...
   [C] Recall $T \propto c^2$.
   
   (1) is correct as the gas is heated (i.e. \( T \uparrow \)).
   
   (2) is correct. As \( \frac{nV}{T} = \text{constant} \), \( V \uparrow \) and \( p \) remains unchanged $\Rightarrow T \uparrow \therefore c^2 \uparrow$.
   
   (3) is incorrect as \( T \) remains unchanged.

4. Vessel X of...
   [D] (A) is correct. Recall $pV = nRT$. \( \therefore pV \) and \( T \) are the same for \( X \) and \( Y \). \( \therefore n \) must be the same.
   
   (B) is correct. Same \( T \) $\Rightarrow$ same avg. molecular K.E.
   
   (C) is correct as a gas flows from a region of higher \( p \) to a region of lower \( p \).
   
   [D] is incorrect. Initially inside \( Y \), \( p(2V) = nRT \). At equilibrium, \( p'(V + 2V) = (2n)RT \). \( \therefore \frac{p'(3V)}{p(3V)} = \frac{2nRT}{nRT} \Rightarrow p' = \frac{3}{2}p$.

5. A block of...
   [A] Since the block is at rest, the forces \( T \), \( F \) and \( W \) balance in any direction. Resolve the components along the direction of \( F \). \( F = 20 \sin 25^\circ = 8.45 \text{ N} \).

6. In the figure...
   [D] Add the forces in the opposite directions first. See the following steps.

   **step 1**
   \[ \begin{array}{c}
   3 \text{ N} \\
   \end{array} \]
   \[ \begin{array}{c}
   O \end{array} \]
   \[ \begin{array}{c}
   60^\circ \\
   \end{array} \]
   \[ \begin{array}{c}
   \end{array} \]
   \[ \begin{array}{c}
   3 \text{ N} \\
   \end{array} \]

   **step 2**
   \[ \begin{array}{c}
   \end{array} + \begin{array}{c}
   \end{array} \\
   \end{array} \]

   **step 3**
   \[ \begin{array}{c}
   \end{array} + \begin{array}{c}
   \end{array} + \begin{array}{c}
   \end{array} \\
   \end{array} \]

7. A block on...
   [A] Initially, constant speed $\Rightarrow$ net force $= 0$. So, friction $= 10 \text{ N}$ (to the right). At the instant \( 12 \text{ N} \) force is removed, the friction \( f \) still opposes the motion. \( \therefore \) net force $= 2 + 10 = 12 \text{ N}$.

8. A particle is...
   [D] $\therefore u = 0 \therefore s = \frac{1}{2}at^2 \propto t^2$.

   $XY : XZ = 9 : 9 + 16 = 9 : 25 \Rightarrow t_1^2 : (t_1 + t_2)^2 = 9 : 25 \Rightarrow t_1 : t_1 + t_2 = 3 : 5 \therefore t_1 : t_2 = 3 : 2$.

9. The figure shows...
   [D] Take moment about \( Y \). \( \therefore (154)(0.5) = R_x(0.7) \therefore R_x = 110 \text{ N}$.
10. Two identical spheres...

[D] The initial total momentum \( m(u - v) \) points to the right.

In case (1), the final total momentum points to the left. \( \therefore \) it is impossible.

In case (2), the final total momentum \( = mu + m(-v) \).

So, the total momentum is conserved. The total K.E. \( = \frac{1}{2}mu^2 + \frac{1}{2}mv^2 \) and is conserved. \( \therefore \) it is possible.

In case (3), the final total momentum \( = mv \). It is possible, e.g. \( u = 2 \text{ m s}^{-1}, v = 1 \text{ m s}^{-1} \). Also, initial K.E. > final K.E. \( \therefore \) it is possible. The collision is inelastic.

- Case (2) shows an elastic collision.

11. Two particles P...

[B] (1) is incorrect. The sign of \( v \) does not change at \( t = 1 \text{ s} \).

(2) is correct. At \( t = 2 \text{ s} \), \( sp = \text{area} = \frac{1}{2}(-2)(2) = -2 \text{ m} \).

\( sQ = \frac{1}{2}(2)(2) = 2 \text{ m} \). \( \therefore \) separation = \( 2 - (-2) = 4 \text{ m} \).

(3) is incorrect. At \( t = 4 \text{ s} \), \( sp = -2 + \frac{1}{2}(2)(4) = 2 \text{ m} \).

\( sQ = \frac{1}{2}(4)(4) = 8 \text{ m} \). The displacements of \( P \) and \( Q \) are not the same and they do not meet each other.

12. A bullet of...

[A] The work done on the bullet by the resistive force = K.E. change. \( \frac{1}{2}mv^2 - \frac{1}{2}mu^2 \Rightarrow F(0.06) = \frac{1}{2}(0.05)(250^2 - 400^2) \Rightarrow F = -40625 \text{ N} \). The force is \( 4.06 \times 10^5 \text{ N} \) and \( F \) being negative suggests that it is in opposite direction to the displacement of the bullet.

13. A particle is...

[D] Note that the particle still has horizontal speed at the highest point and its K.E. is not zero.

14. A semi-circular...

[A] (1) is correct. As the cardboard is at rest, the spring balance reading = the pulling force of the balance on the cardboard = weight of the cardboard, in magnitude.

(2) is correct. As the cardboard is at rest, the moment produced by the weight of the cardboard should be zero about \( O \Rightarrow \) the perpendicular distance of the c.g. from \( O \) should be zero.

(3) is incorrect. There is still gravity on the surface of Mars.

15. It is known...

[B] Since \( g = \frac{GM}{r^2} \), we have \( g' = \frac{GM}{(\frac{r}{2})^2} = \frac{GM}{r^2} = \frac{g}{2} \).

16. The figure shows...

[B] The wavelength is \( 30 - 6 = 24 \text{ cm} \). At \( t = 1.5 \text{ s} \), \( P \) passes the equilibrium position for the second time \( \Rightarrow 3/4 \text{ period has passed} \Rightarrow T = 2 \text{ s} \) (see the figure). \( \therefore \) \( \nu = f \lambda = \frac{24}{2} = 12 \text{ cm s}^{-1} \).

17. Figure (1) shows...

[A] amplitude = max. displacement = displacement of \( d \) or \( h = 1.2(5) = 6 \text{ cm} \). \( \lambda \) = distance between the centre of compression = \( 8(3) = 40 \text{ cm} \). Since \( v = f \lambda \), we have \( f = \frac{40}{40} = 2 \text{ Hz} \).

18. A vibrator generates...

[D] (1) is incorrect. We do not have enough information to make this conclusion. Except the particles at the nodes, all particles can move up or down, or at rest at the instant. A counter-example is shown by the figure.

(2) is correct. All particles return to their corresponding equilibrium positions at the same time.

(3) is correct. The particles in one loop are in antiphase with the particles in the adjacent loop.

19. Astronauts P and...

[C] The distance travelled by the sound directly from \( P \) to \( Q \) is \( 600 - 400 = 200 \text{ m} \). The distance travelled by the sound from \( P \) to \( Q \) after reflecting from the cliff is \( 400 + 600 = 1000 \text{ m} \). \( \frac{1000}{v} - \frac{200}{v} = 4 \Rightarrow v = 200 \text{ m s}^{-1} \).
20. A ray of...
\[ a = 90^\circ - 40^\circ = 50^\circ, \quad b = 180^\circ - 70^\circ - c = 60^\circ, \quad n = \frac{\sin b}{\sin a} = \frac{\sin 60^\circ}{\sin 50^\circ}. \]

21. White light can...
- **A** (1) is correct. Different coloured lights refract by different angles implies different \( n \) for different coloured lights.
- (2) is **incorrect**. All coloured lights as well as all EM waves travel at the same speed in a vacuum.
- (3) is **incorrect**. The frequencies of the coloured lights does not change during refraction.

22. A point light...
- **C** (1) is correct. Since a real image forms at \( Y \) and \( OY > OX \), we can deduce that \( 2f > OX > f \).
- (2) is **incorrect**. For real images, object distance \( d > \) image distance \( i \).
- (3) is correct. The path of the light ray is reversible.

23. When monochromatic light...
- **A** Recall \( d \sin \theta = m \lambda \). Smaller \( d \) and greater \( \lambda \) will give a greater \( \theta \) as well as a greater value of \( \sin \theta \).
  - Note that smaller \( d \) \( \Rightarrow \) more lines per mm and \( \lambda_{\text{green}} > \lambda_{\text{blue}} \).

24. X and Y...
- **D** Initially, \( |F| = k \frac{|Q| \times (6Q)}{r^2} = \frac{12kQ^2}{r^2} \) and the force is attractive (unlike charges). When the spheres touch, they share the same charge of \((-2 + 6)/2 = +2Q\). The force is repulsive (like charges) and \( |F'| = k \frac{2Q^2}{r^2} = \frac{4kQ^2}{r^2} = \frac{E}{2} \).

25. Lightning flash may...
- **C** Since \( E = \frac{1}{2} \), we have \( V = (3 \times 10^6)(500) = 1.5 \times 10^9 \text{ V} \). Energy = \( qV = (1.5 \times 10^9)(20) = 3 \times 10^{10} \text{ J} \).

26. A straight wire...
- **C** B-field is stronger on the left \( \Rightarrow \) the B-field produced by the pole pieces points from \( Y \) to \( X \). \( \therefore \) \( X \) is a south pole. By Fleming's left hand rule, \( F_B \) points to the right.

27. In the figure...
- **C** \( P, Q \) and \( S \) produce B-field out of the paper at \( O \) while \( R \) produces B-field into the paper at the same position. So, removing \( R \) can increase the B-field at \( O \).

28. A copper rod...
- **C** By Fleming's left hand rule, \( F_B \) points to the left.

29. A metal rod...
- **D** There is no complete circuit \( \Rightarrow \) no induced current. By Fleming's right hand rule, positive charges accumulate at \( P \). So, \( P \) is at a higher electric potential.

30. Resistors X, Y...
- **B** Recall \( P = I^2R \). Since all resistors have the same \( R \), we have \( P_X : P_Y : P_Z = 4 : 1 : 1 \). \( \therefore P_Z = 24 \times \frac{1}{6} = 4 \text{ W} \).
31. In each of...

**A** For the left circuit, the resistance increases. The current passing through L1 decreases (see the figure) and L1 becomes dimmer.

**B** For the right circuit in the question, the p.d. across L2 remains unchanged. ∴ brightness of L2 remains unchanged.

32. In the above...
- The voltmeter has a reading ⇒ Y is not burnt out. The ammeter reads zero ⇒ no current passes through X ⇒ X is burnt out.
- If only X is shorted, the ammeter reading should be non-zero. If only Y is shorted, both voltmeter and ammeter should read zero.

33. Which of the...

- **B** Typical working power:

<table>
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<tr>
<th>appliance</th>
<th>power</th>
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<tbody>
<tr>
<td>electric fan</td>
<td>60 W</td>
</tr>
<tr>
<td>microwave oven</td>
<td>1000 W</td>
</tr>
<tr>
<td>fluorescent lamp</td>
<td>20 W</td>
</tr>
<tr>
<td>flat screen TV</td>
<td>150 W</td>
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- Typical electrical appliances for heating have power in the order of magnitude 1 kW.

34. U-238 undergoes...

- **A** $\frac{238U}{92}$ $\rightarrow$ $\frac{234P}{90}$ $\rightarrow$ $\frac{234Q}{91}$ $\rightarrow$ $\frac{234R}{92}$ $\rightarrow$ $\frac{239X}{93}$

35. Polonium-210 is a...

- **B** Recall $N = N_0 e^{-kt}$, $N = N_0 e^{-k(\tau_0)} = 0.7071N_0$, we have The mass left is $400 \times 0.7071 = 297$ mg.

36. The sun releases...

- **B** Recall $E = mc^2$, we have $m = \frac{E}{c^2} = \frac{3.8 \times 10^{33}}{(3 \times 10^8)^2} = 4.22 \times 10^9$ kg.