FUKIEN SECONDARY SCHOOL

S5 First Term Uniform Test (2020-2021)

Physics

(1 hour)

Date: 21st October 2020 Name: _____

Time: 10:15a.m. – 11:15a.m. Class: _____ No.:_____

**Instructions to students:**

1. Write your name, class and class number on both the question paper and the answer sheets.
2. Answer ALL questions.
3. Write down all the answers on the answer sheets.
4. Hand in the question paper and the answer sheets at the end of the examination.
5. The total mark of the paper is 60.
6. The paper consists of two sections: Section A Multiple Choice Questions (20 marks) and Section B Structured Questions (40 marks).
7. You may use the following data and equations.

## *Data*

Acceleration due to gravity $g = 9.81\ \text{m s}^{-2}$ (close to the Earth surface)

Universal gravitational constant $G = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$

## *Formula*

For uniformly accelerated motion:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

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

Equation of a straight line $y = mx + c$

Arc length $= r\theta$

B1. $F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$ force

B2 $\text{moment} = F \times d$ moment of a force

B3. $E_P = mgh$ gravitational potential energy

B4. $E_K = \frac{1}{2}mv^2$ kinetic energy

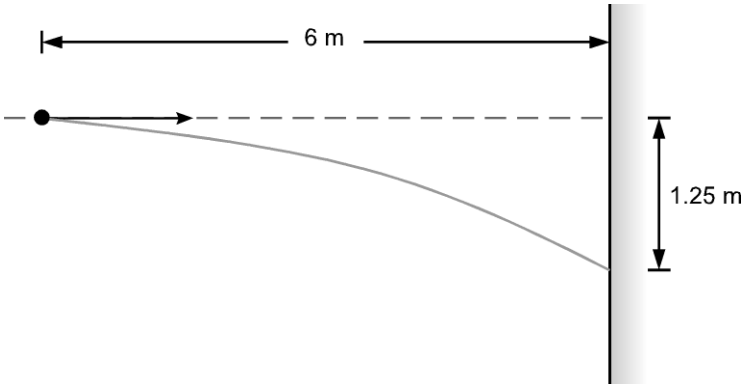
B5. $P = Fv = \frac{W}{t}$ mechanical power

B6. $a = \frac{v^2}{r} = \omega^2 r$ centripetal acceleration

B7. $F = \frac{Gm_1m_2}{r^2}$ Newton's law of gravitation

**Section A: Multiple Choice Questions (20 marks)**

1. A ball is given a horizontal velocity and thrown against a vertical wall 6 m away as shown below. It hits the wall at a position 1.25 m below its initial position.




Find the speed of the ball when it hits the wall.

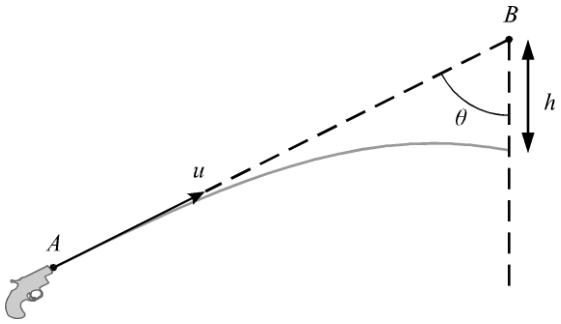
A. 4.8 m $s^{-1}$

B. 7.5 m $s^{-1}$

C. 11.5 m $s^{-1}$

D. 13 m $s^{-1}$

2. A bullet is fired at an initial speed of $u$ = 625 m $s^{-1}$ from position $A$ (the muzzle). The gun barrel aims at position $B$ and $AB$ = 500 m.




Suppose the initial velocity of the bullet makes an angle of $\theta$ with the vertical, find $h$ when the bullet reaches a position vertically below $B$. Neglect air resistance.

A. 3.2 m

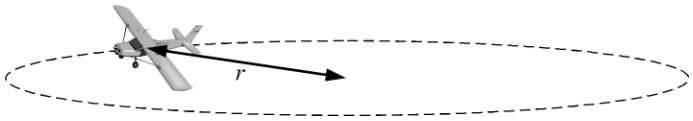
B. 4 m

C. 6.4 m

D. cannot be determined

3. The Moon orbits around the Earth in 27.3 days and its average distance from the Earth is $3.84 \times 10^8$ m. Assuming that the Moon is moving in a circular orbit, what is its angular speed?
   A. $1.33 \times 10^{-6}$ rad $s^{-1}$
   B. $2.66 \times 10^{-6}$ rad $s^{-1}$
   C. $5.99 \times 10^{-9}$ rad $s^{-1}$
   D. 0.230 rad $s^{-1}$

4. An aeroplane is flying in a horizontal circle of radius $r$ = 5000 m at a constant speed of 250 m $s^{-1}$.

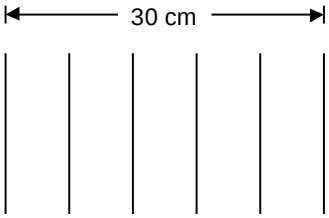



   Find the ratio of its weight to the centripetal force acting on it.
   A. 1 : 1.25
   B. 1 : 2
   C. 1 : 2.5
   D. cannot be determined as the mass of the aeroplane is unknown

5. The gravitational field strength due to the Earth at a certain position $g$ and this position is at a distance $r$ from the Earth. Suppose there is another position where the gravitational field strength due to the Earth is 0.5$g$, how far away is it?
   A. $\frac{r}{2}$
   B. $\frac{r}{\sqrt{2}}$
   C. $r\sqrt{2}$
   D. $2r$

6. An artificial satellite moves around a planet in a circular orbit with a period $T$. If the orbit is lowered such that its radius is halved, what is the new period of the satellite?
   A. $T$
   B. $\frac{T}{2}$
   C. $\frac{T}{\sqrt{2}}$
   D. $\frac{T}{2\sqrt{2}}$

7.




A student produces a train of straight water waves in a ripple tank. The figure above shows the wave pattern at a certain instant. If the frequency of the wave is 5 Hz, what is the speed of the waves?

A. 0.25 m $s^{-1}$
B. 0.3 m $s^{-1}$
C. 1.5 m $s^{-1}$
D. Cannot be determined

8. A student uses a vibrator to generate a transverse wave on a string. Figure (a) shows the shape of the string at a certain instant. Figure (b) shows the displacement-time graph of a certain particle on the string. Which of the following expressions represents the speed of the wave?

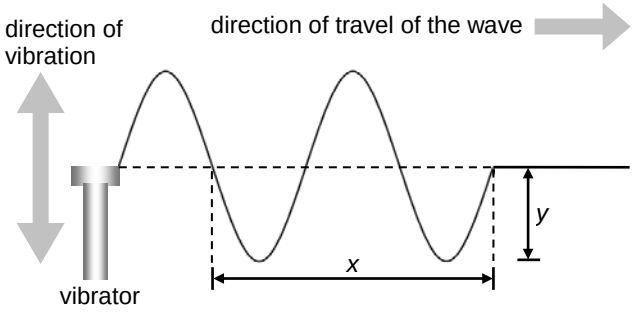



**figure (a)**

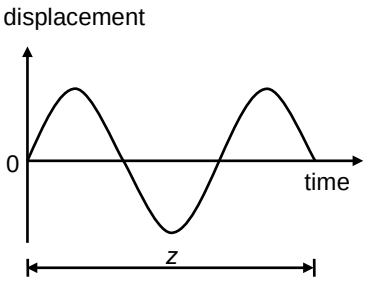
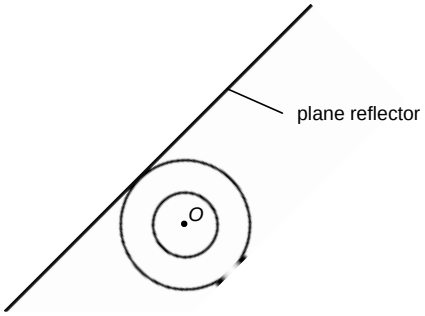



**figure (b)**

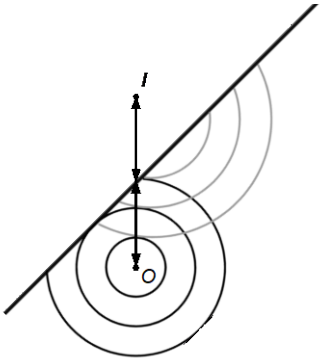
A. 4*xz*/9
B. *x*/*z*
C. *z*/*y*
D. 3*yz*

9.

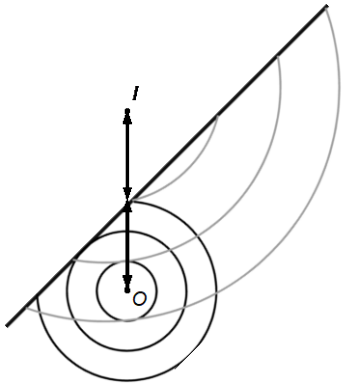



Circular water waves are produced by a point source *O* as shown in the figure above. Which of the following figures best shows the wave pattern of the reflected wave and the position of the image *I*?

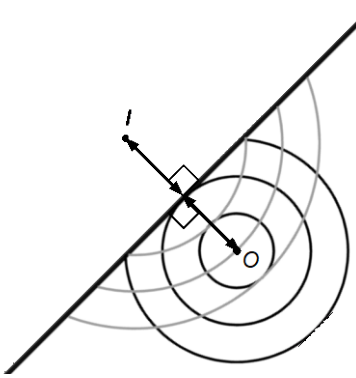
A.



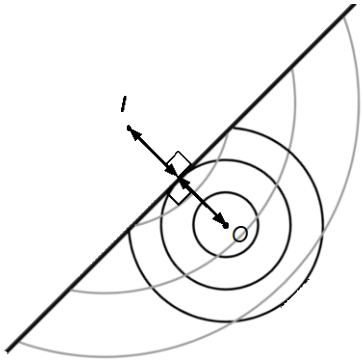

B.




C.




D.




10. When a train of water waves travels from a deep water region to a shallow water region, how do the frequency, the wavelength and the speed of the water waves change?

| | **Frequency** | **Wavelength** | **Speed** |
|---|---|---|---|
| A. | increases | increases | increases |
| B. | decreases | decreases | decreases |
| C. | unchanged | decreases | increases |
| D. | unchanged | decreases | decreases |

**End of Section A**

**Section B: Structured Questions (40 marks)**

1. A stone of mass $m$ = 50 g is whirled in a horizontal circle at a steady speed as shown in Figure 1. The length of the string is $l$ = 0.8 m and makes an angle $\theta$ with the vertical.

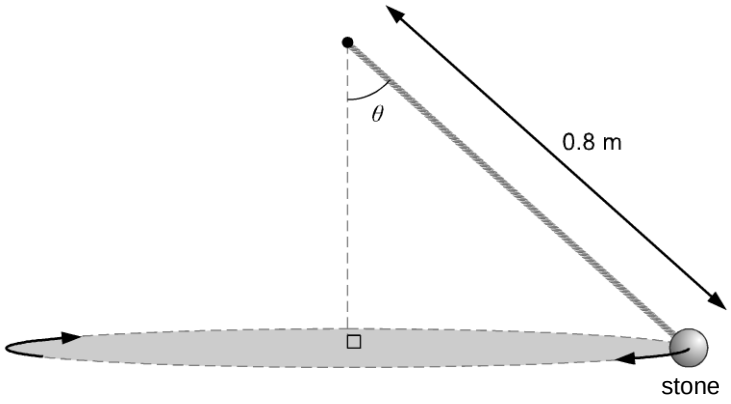



**Figure 1**

(a) Suppose $\theta = 60°$. Find the angular speed of the stone. (3 marks)

(b) If the experiment is carried out on the surface of the Moon where the acceleration due to gravity is smaller, should the stone be whirled faster or slower to keep the same angle $\theta$? Briefly explain your answer. (2 marks)

2. A spacecraft is set into a circular orbit around Jupiter. The radius of this orbit is 3.5 times the radius of the planet.

Given: The gravitational field strength on the surface of Jupiter is 23 N kg$^{-1}$.
The radius of Jupiter is 71 500 km.

(a) What is the period of the spacecraft in this orbit? (3 marks)

(b) Another spacecraft is set into an orbit whose period is 1.2 times that of (a). What is the orbital speed of this spacecraft? (3 marks)

3. As shown in Figure 3, two corks *A* and *B* floating on a water surface are 0.45 m apart. A water wave takes 3 seconds to travel from *A* to *B*. When cork *A* rises from its lowest position to its highest position, the distance travelled and the time required are 8 cm and 2 s respectively.

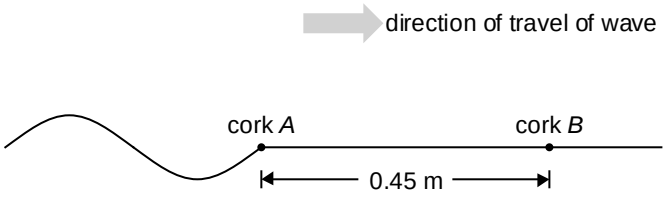



**Figure 3**

(a) What is the time required for cork *B* to make one complete vibration? (2 marks)

(b) Find

(i) the frequency; (1 mark)

(ii) the speed; (1 mark)

(iii) the amplitude; and (1 mark)

(iv) the wavelength (2 marks)

of the wave.

(c) What is the distance between corks *A* and *B* in terms of the wavelength of the wave? (2 marks)

(d) At a certain instant, cork *A* reaches its lowest position. What is the displacement of cork *B* at the same instant? (1 mark)

(e) Suppose the above figure shows the position of cork *A* at $t = 0$. Sketch the displacement-time graphs of cork *A* and cork *B* from $t = 0$ to $t = 6$ s in the same figure. Take the displacement above the still water surface as positive. (2 marks)

4. A longitudinal wave travels in a medium from left to right. Figure 4 shows the equilibrium positions and the positions of particles in the medium at a certain instant when the wave passes by.

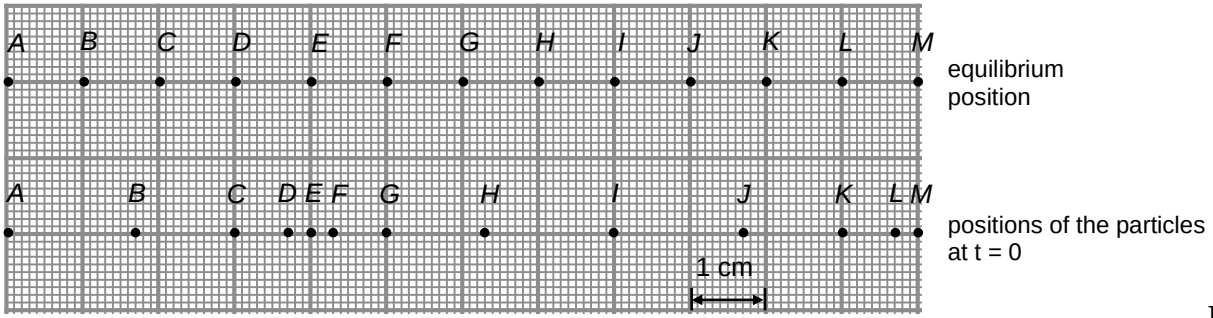



**Figure 4**

(a) Find

(i) the wavelength, and (2 marks)

(ii) the amplitude of the wave. (1 mark)

(b) Draw a displacement-distance graph of the particles at t = 0. (2 marks)

(c) Sketch the displacement-time graph of particle *A* and *E* from $t = 0$ to *T* where *T* is the period of the wave. (3 marks)

5. Figure 5a shows the setup of a ripple tank experiment. The vibrating straight bar is used to generate a train of straight water waves.


**Figure 5a**

(a) The edges of the ripple tank are inclined and aligned with spongy linings. What is the purpose of these designs? (1 mark)

(b) Describe the motion of the cork when the waves pass. (1 mark)

(c) Suppose the ripple tank is slightly raised on one side as shown in Figure 5b.

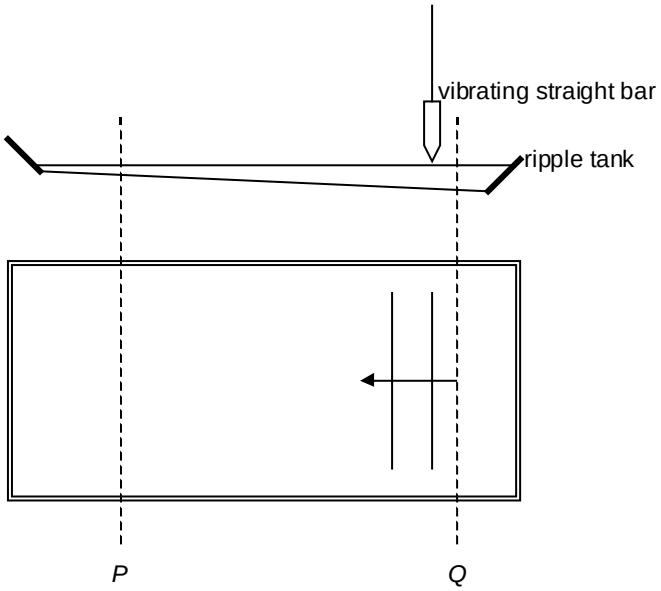



**Figure 5b**

How do the frequency, wavelength and the speed of the water waves change when they travel from *Q* to *P*? Hence, sketch the wave pattern in the region between *P* and *Q*. (3 marks)

6. In a ripple tank experiment, a train of straight water waves travels from region *A* to region *B* as shown in Figure 6. Two straight barriers are placed at the boundary between regions *A* and *B*.

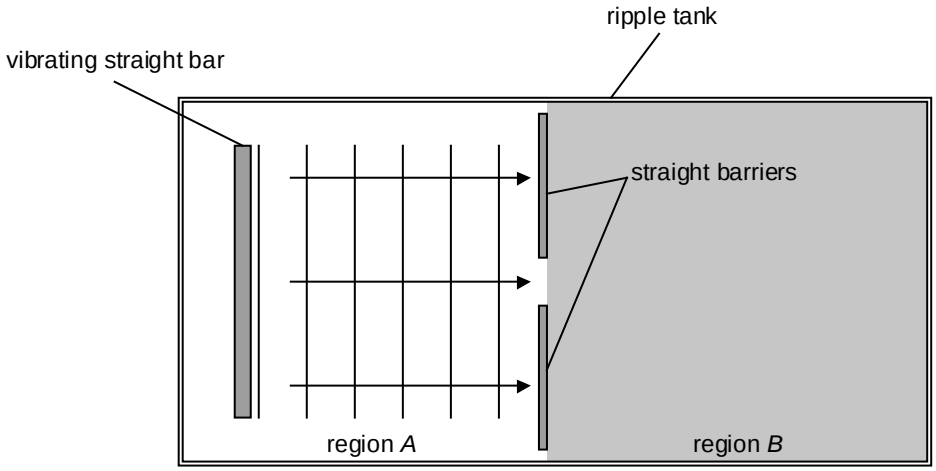



**Figure 6**

(a) Sketch the wave pattern in region *B* and name the phenomenon (2 marks)

(b) State how

(i) the wavelength, and

(ii) the separation between the barriers

affect the wave pattern observed in region *B*. (2 marks)

**End of Section B**

**END OF PAPER**

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Physics

Answer Sheet

Date:21st October 2020 Name: _____

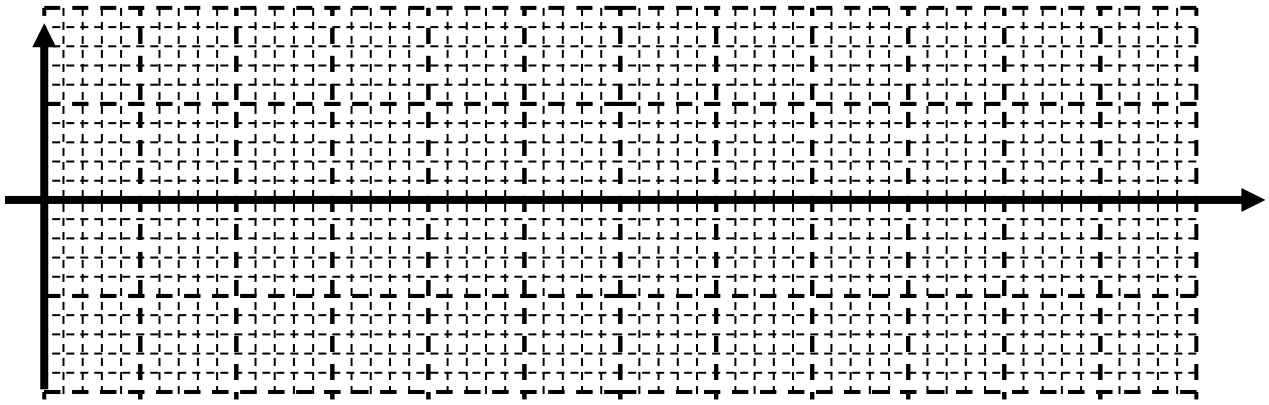
Time:10:15a.m. – 11:15a.m. Class: _____ No.:_____

**Section A: Multiple Choice Questions (20 marks)**

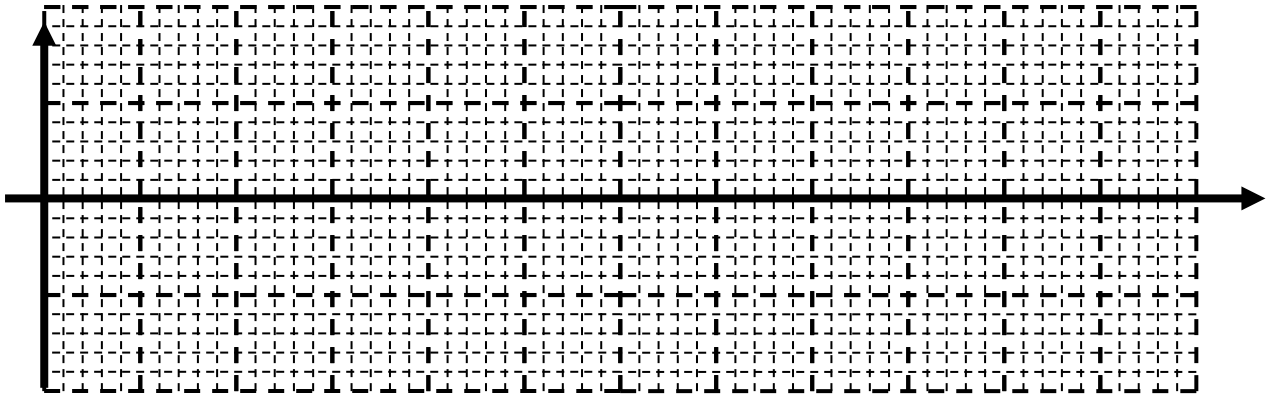
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

**Section B: Structured Questions (40 marks)**

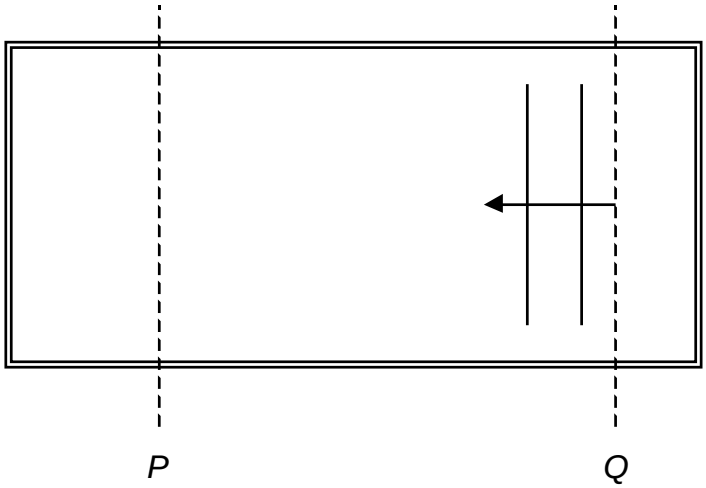
**4. (b)**



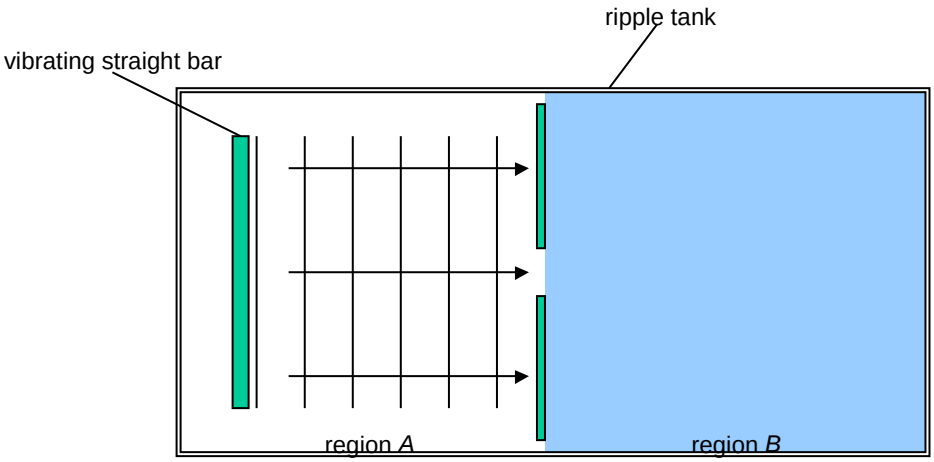
**4. (c)**



5. (c)




6. (a)



**END OF ANSWER SHEET**