

STUDENT NAME: _____



Student Name

Sydney Boys High School

2014

**PRELIMINARY COURSE HALF
YEAR EXAMINATION**

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 75 minutes
- Write using black or blue pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your student name in the space provided

Total marks – 55

This paper has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1-20

Part B – 35 marks

- Attempt Questions 21-29

Sydney Boys High School

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PRELIMINARY EXAMINATION

Physics

Multiple Choice Answer Sheet

- | | | | | |
|-----|-------------------------|-------------------------|-------------------------|-------------------------|
| 1. | A ☐ | B ☐ | C ☐ | D ☐ |
| 2. | A ☐ | B ☐ | C ☐ | D ☐ |
| 3. | A ☐ | B ☐ | C ☐ | D ☐ |
| 4. | A ☐ | B ☐ | C ☐ | D ☐ |
| 5. | A ☐ | B ☐ | C ☐ | D ☐ |
| 6. | A ☐ | B ☐ | C ☐ | D ☐ |
| 7. | A ☐ | B ☐ | C ☐ | D ☐ |
| 8. | A ☐ | B ☐ | C ☐ | D ☐ |
| 9. | A ☐ | B ☐ | C ☐ | D ☐ |
| 10. | A ☐ | B ☐ | C ☐ | D ☐ |
| 11. | A ☐ | B ☐ | C ☐ | D ☐ |
| 12. | A ☐ | B ☐ | C ☐ | D ☐ |
| 13. | A ☐ | B ☐ | C ☐ | D ☐ |
| 14. | A ☐ | B ☐ | C ☐ | D ☐ |
| 15. | A ☐ | B ☐ | C ☐ | D ☐ |
| 16. | A ☐ | B ☐ | C ☐ | D ☐ |
| 17. | A ☐ | B ☐ | C ☐ | D ☐ |
| 18. | A ☐ | B ☐ | C ☐ | D ☐ |
| 19. | A ☐ | B ☐ | C ☐ | D ☐ |
| 20. | A ☐ | B ☐ | C ☐ | D ☐ |

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1. Newton's First Law of Motion is not apparent when a shopping trolley is in motion and rolls to a stop in a car park. This is because:

- (A) Newton's Laws are inaccurate.
- (B) Friction is usually ignored.
- (C) Trolley motion cannot be explained by Physics.
- (D) Newton's third law applies to this situation.

2. A car travels 50 km to the east in 45 minutes and then turns north, travelling a further 30 km in 15 minutes. The car's average speed over the trip was closest to:

- (A) 120 km h⁻¹
- (B) 67 km h⁻¹
- (C) 80 km h⁻¹
- (D) 58 km h⁻¹

4. What needs to be done to increase the pitch and lower the volume of a sound wave?

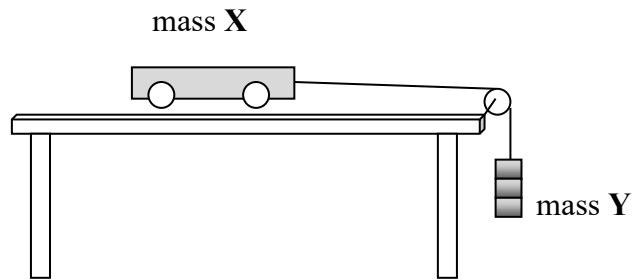
- (A) Increase the frequency of the wave and decrease its amplitude
- (B) Increase the frequency of the wave and increase its amplitude
- (C) Decrease the frequency of the wave and decrease its amplitude
- (D) Decrease the frequency of the wave and increase its amplitude

5. What would be the frequency of a light wave with a wave length of 430 nm?

- (A) 7×10^{11} Hz
- (B) 1.3×10^{11} Hz
- (C) 7×10^{14} Hz
- (D) 1.3×10^{14} Hz

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6. The apparatus shown was set up to perform an investigation into Newton's 2nd Law.



Which values of the mass of the trolley **X** and the masses, **Y**, would produce an acceleration closest to 2.0 m s^{-2} ?

	X (kg)	Y (kg)
(A)	4.0	1.0
(B)	2.0	2.0
(C)	8.0	4.0
(D)	1.0	4.0

Use the following information to answer Questions 7 and 8.

In a 'drag race' the cars accelerate over a distance of 100 m, starting from zero velocity. One car travels 100 m with a constant acceleration of 9 ms^{-2} .

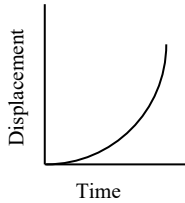
7. What is the *time* taken by the car to cover 100 m from the start?

- (A) 9.0 s
- (B) 90.0 s
- (C) 4.7 s
- (D) 0.42 s

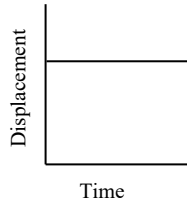
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8. Which of the following graphs shows the motion described above?

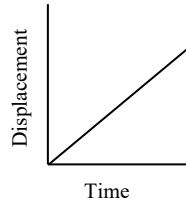
(A)



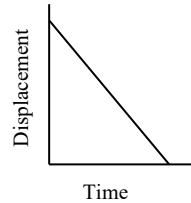
(B)



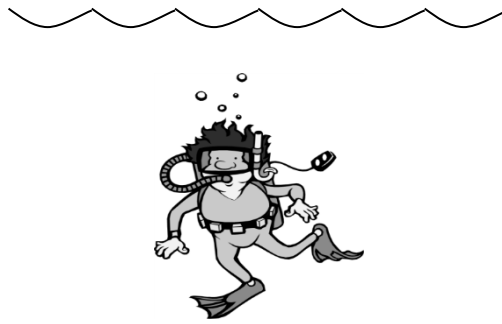
(C)



(D)



9. A scuba diver is hovering motionless at a depth of 10.0 m below the surface.



At this point in time, it would be correct to say that:

- (A) there are no forces acting on the diver.
- (B) the diver's weight is zero.
- (C) there is an overall downwards force on the diver to keep underwater.
- (D) the net force on the diver is zero.

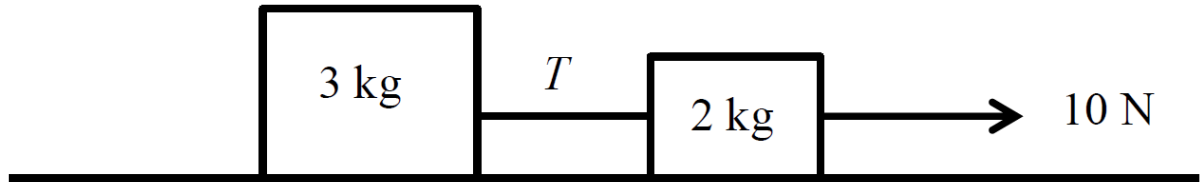
10. Compressions and rarefactions are characteristics of sound waves. Which statements are correct?

- (I) A compression is a volume of increased air pressure.
- (II) A rarefaction is a volume of reduced air pressure.
- (III) Compressions and rarefactions correspond to troughs and crests respectively of a transverse wave.

- (A) (I) only
- (B) (II) only
- (C) (I) and (II) only
- (D) (I) and (III) only

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11. Two blocks of masses 3 kg and 2 kg, connected by a light inextensible string are resting on a smooth horizontal surface. A horizontal force of 10 N is applied to the right as shown in the diagram below.



Assuming the system moves to the right, what is the tension, T in the string between the two blocks and the acceleration, of the system?

	<i>Tension T</i> (N)	<i>Acceleration a</i> (ms^{-2})
(A)	4	2
(B)	6	2
(C)	15	5
(D)	10	5

12. Circular waves are created in a sink full of water by repeatedly dipping your finger.

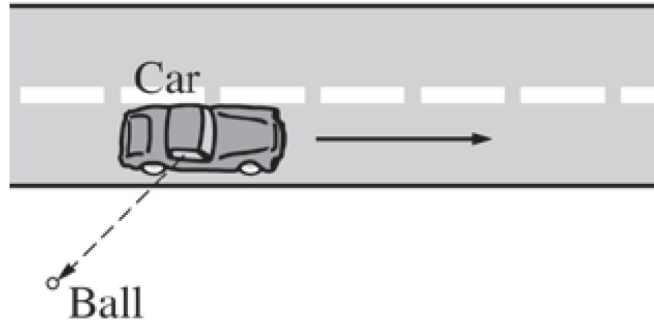
What happens to the wavelength, frequency and speed of the wave as you move your fingers faster?

	<i>Wavelength</i>	<i>Frequency</i>	<i>Speed</i>
(A)	Increases	Decreases	Stays the same
(B)	Stays the same	Increases	Decreases
(C)	Decreases	Increases	Stays the same
(D)	Stays the same	Decreases	Increases

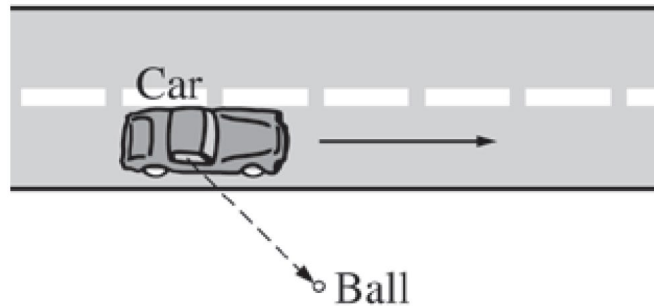
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13. A ball is thrown out of the passenger window of a car moving to the right (ignore air resistance). If the ball is thrown out perpendicular to the velocity of the car, which of the following best depicts the path the ball takes, as viewed from a stationary observer above?

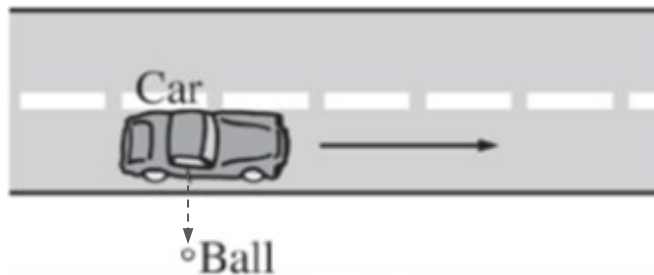
(A)



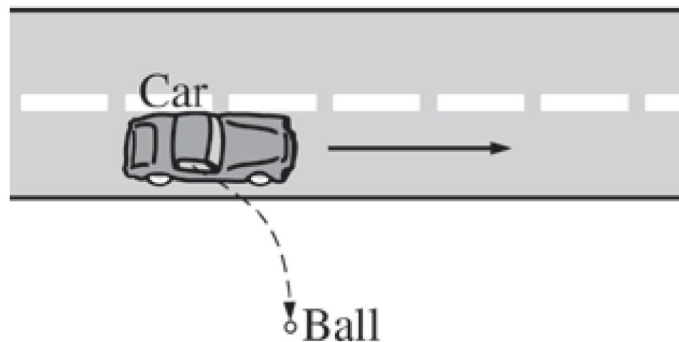
(B)



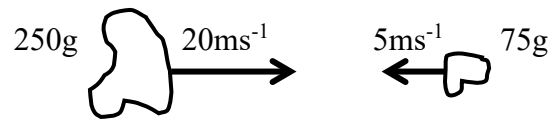
(C)



(D)



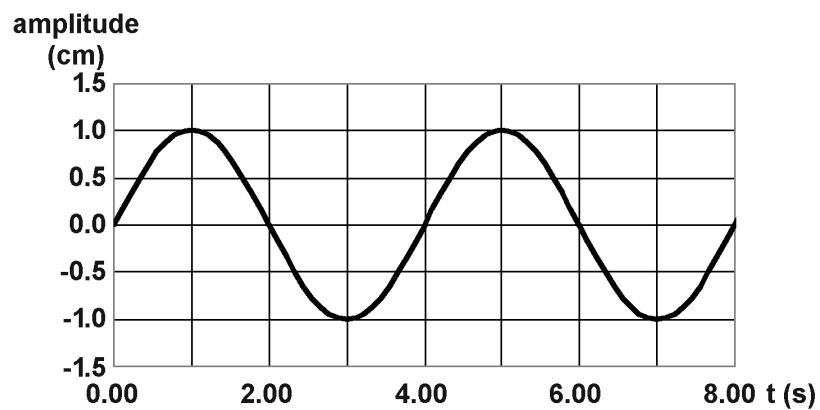
14.



One lump of modelling clay of mass 250g is moving right with a velocity of 20 m.s⁻¹ and it collides with a second lump (75g) moving left at 5 m.s⁻¹. The two lumps adhere and move to the right at 5 m.s⁻¹. How much kinetic energy is “lost” in this collision?

- (A) 5.625J
- (B) 25.00J
- (C) 46.88J
- (D) 3.75J

15. The diagram shows a mechanical wave.



The period of the mechanical wave is

- (A) 0.125 Hz
- (B) 0.250 s
- (C) 0.500Hz
- (D) 4.000 s

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16. Two aeroplanes sight each other in the sky. Plane A is travelling due north and plane B is travelling west.

Which set of vectors correctly represent their relative velocities?

	Velocity of plane A relative to plane B	Velocity of plane B relative to plane A
(A)		
(B)		
(C)		
(D)		

17. A star is measured to have a light intensity of I at distance d .

What would the light intensity be if the distance was halved?

- (A) $4I$
 (B) $2I$
 (C) $\frac{1}{2}I$
 (D) $\frac{1}{4}I$

18. Transverse and longitudinal waves, while similar in some ways, differ in other ways.

Which set of vectors matches the respective waves?

	Direction of particle motion		Direction of energy propagation	
	<i>Transverse</i>	<i>Longitudinal</i>	<i>Transverse</i>	<i>Longitudinal</i>
(A)				
(B)				
(C)				
(D)				

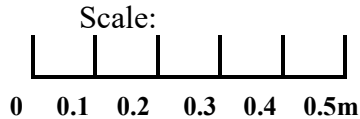
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19. Two identical cars are travelling at the speed limit of 60 kmh^{-1} when one driver sees a red light ahead and starts to brake. The other driver sees the red light 0.6 seconds later and also starts to brake.

If both drivers decelerate at the rate of 6 ms^{-2} , how much further will the less observant driver travel before coming to a stop?

- (A) 10 m
- (B) 3.6 m
- (C) 11 m
- (D) 36 m

20. The diagram below models the particles of a compression wave.

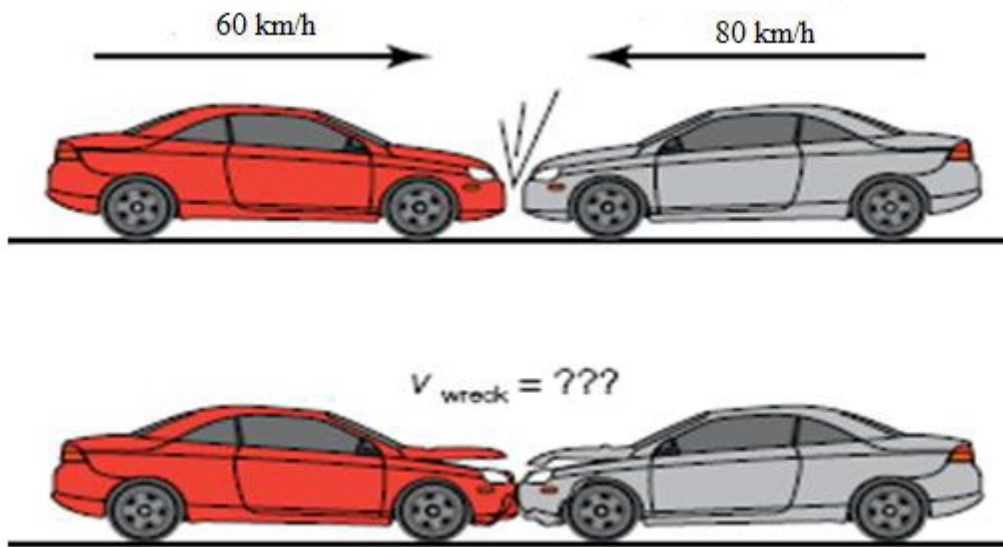


What is the wavelength of this wave?

- (A) 0.6 m
- (B) 0.9 m
- (C) 1.2 m
- (D) 1.6 m

Part B – 35 marks**Attempt Questions 21-29****Question 21 (5 marks)**

A car with mass 1500 kg is travelling at 60 kmh^{-1} , east. It collides head on with an identical car travelling at 80 kmh^{-1} in the opposite direction. Assume the cars lock together and move off as a combined wreck.



- a** Find the velocity of the wreck immediately after the collision.

3

- b** Is kinetic energy conserved in this situation? Justify your reasoning, without the use of calculations.

2

Question 22 (4 Marks)**4**

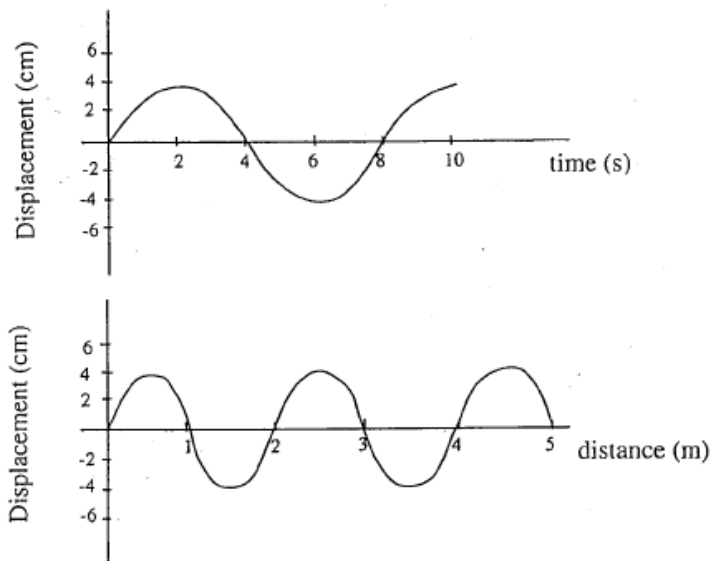
A 1500 kg vehicle travelling 3 ms^{-1} West collides with a 1200 kg vehicle travelling 7 ms^{-1} East. The vehicles lock together. The collision takes 0.12 s to occur. Determine the average force of the 1200 kg vehicle on the 1500 kg vehicle.

Question 23 (5 Marks)

- a** Waves are propagators of energy through a medium. Distinguish between Transverse and Longitudinal wave propagations of energy.

2

- b** The graphs below are a record of the motion of a wave



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Use the graphs to find the wave's: 1

i) amplitude

ii) speed 1

c Two waves from separate sources arrive at the same point and form a resultant wave. 1

Name the principle involved in the formation of the resultant wave.

Question 24 (3 marks)

a Define *inertia*. 1

b Two boys are fishing in a river from their stationary boat of mass 120 kg. They decide to have a swim. One boy, who has a mass of 50 kg, dives from the front of the boat at a speed of 4 ms^{-1} at exactly the same time as the second boy, who has a mass of 60 kg, dives off the other end of the boat, in the opposite direction, at 3 ms^{-1} . 2

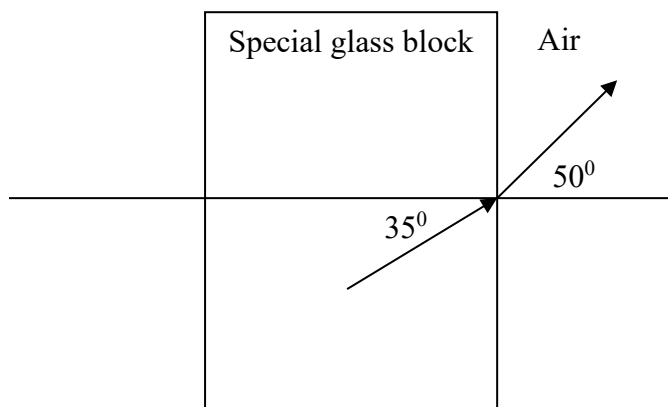
Calculate the *velocity* of the boat immediately after the boys have dived.

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Exam continues on next page

Question 25 (5 marks)

The diagram below models light being refracted as it passes out of a special glass block into air.



- a** Determine the refractive index of the special glass.

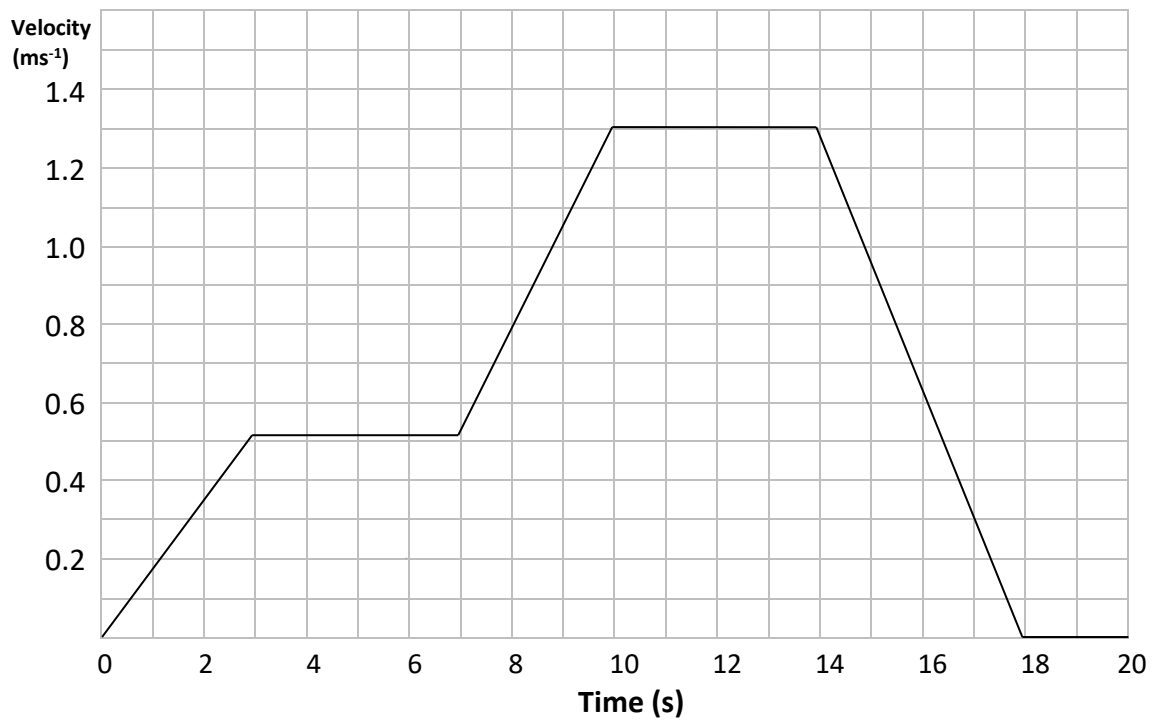
2

- b** Calculate the special block's critical angle and use a diagram to explain its role in the use of optical fibres. **3**

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Question 26 (6 marks)

A toy car is being controlled by a young child. The graph below is a plot of its velocity versus time.



- a** Describe the motion of the toy car throughout its journey. **2**

- b** i) Calculate the acceleration of the car 9 seconds from the start. **1**

- ii) If the car has a mass of 180 g and experiences an opposing force of 0.2 N, what force is needed to produce this acceleration? **2**

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- c Calculate the distance travelled in the first 10 seconds 1

Question 27 (3 marks)

A car is speeding along a road in the Snowy Mountains and comes to an icy bend. As the driver tries to turn the car, it slides straight ahead and off the road. State which of Newton's Laws applies to this situation and in your own words explain why this happened. 3

Question 28 (2 marks)

Explain what pitch and amplitude are in sound waves in terms of the characteristics of the wave. 2

Question 29 (2 marks)

A man in an elevator is holding a mass on the end of a spring balance. When the elevator is stationary, the spring balance reads 25.0 kg. The elevator starts to move and the spring balance reads 20.0 kg. What is the magnitude and direction of the elevator's acceleration? 2

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END OF PAPER

Y11 Physics Preliminary Half Yearly 2014 Rubric

Multiple Choice

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	C	A	A	C	A	C	A	D	C	B	C	B	C	D	C	A	D	A	D

Extended Response

21.

(A)

Marking Criteria	Marks
Uses law of conservation of momentum Correctly calculates velocity Correct units used direction	3
3 of above correct	2
1 or 2 of above correct	1

$$m_1 u_1 + m_2 u_2 = (m_1 + m_2)v \quad \dots \text{(law of conservation of linear momentum)}$$

$$\begin{aligned}
 \therefore v &= \frac{m_1 u_1 + m_2 u_2}{(m_1 + m_2)} \\
 &= \frac{1600 \times 60 - 1600 \times 80}{1600 + 1600} \\
 &= -\frac{1600 \times 20}{3200} \\
 &= -10 \text{ km/h (West)}
 \end{aligned}$$

Or 2.8 ms⁻¹ west (left)

(B)

Marking Criteria	Marks
Correct answer (No) Justification given (inelastic collision)	2
Correct answer, no justification	1

No, kinetic energy is not conserved as this is an inelastic collision. This can be seen as the cars lock together.

22.

Marking Criteria	Marks
Writes out a conservation of momentum equation and substitutes values Correct calculation of the speed. Writes out an impulse equation and substitutes <u>correct values</u> (no carry on here) Correct calculation of the force (using correct v) & direction & units	4
3 of above correct	3
2 of above correct	2
1 of above correct	1

$$v = (m_1u_1 + m_2u_2)/(m_1 + m_2)$$

$$v = (1500 \times 3 - 1200 \times 7)/2700$$

$$v = -1.44$$

The question asks for the force of the 1200kg vehicle on the 1500kg, so the 1500kg mass is experiencing the acceleration;

$$F = m(v - u)/t$$

$$F = 1500 (-1.44 - 3)/0.12$$

$$F = 55500 \text{ N East or } -55000 \text{ N West}$$

23.

(A)

Marking Criteria	Marks
Correct description of particle motion in BOTH transverse and longitudinal waves	2
One correct description	1

Transverse wave - particles vibrate perpendicular to the direction of wave motion

Longitudinal wave - - particles vibrate parallel to the direction of wave motion

(B)

Marking Criteria	Marks
i Correct calculation of amplitude	1
ii Correct calculation of speed	1

i $a = 4 \text{ cm}$ measured from graph

ii $v = f\lambda$ $f = 1/8 \text{ Hz}$ $\lambda = 2 \text{ m}$ $v = 1/8 \times 2 = 0.25 \text{ ms}^{-1}$

(C)

Marking Criteria	Marks
Correct explanation (superposition)	1

24.

(A)

Marking Criteria	Marks
Correctly refers to an objects resistance to change in motion OR States Newton's First Law of Motion	1

(B)

Marking Criteria	Marks
Shows total initial momentum = zero Correct magnitude, units and direction	2
One of the above correct answer but used $F = ma$ max 1 mark, CANNOT assume $a = v$!!!!	1

$$m_1v_1 + m_2v_2 + m_{\text{boat}}v_{\text{boat}} = 0$$

$$v_{\text{boat}} = \frac{-m_1v_1 - m_2v_2}{m_{\text{boat}}}$$
$$= \frac{-(50 \times 4) - (60 \times -3)}{120}$$

$$= -0.17\text{ms}^{-1} \text{ forward or } 0.17 \text{ ms}^{-1} \text{ backwards}$$

25.

(A)

Marking Criteria	Marks
Accurate use of Snell's Law	2
Correct refractive index	
One of the above	1

(B)

Marking Criteria	Marks
Correctly calculates the critical angle	3
Labelled diagram of light propagation in an optical fibre	
Critical angle needs to be exceeded for light to be propagated in an optical fibre	
Two of the above	2
One of the above	1

26.

(a)

Criteria	Marks
Accurately describes when constant acceleration/deceleration, constant velocity and return to origin occurs	2
Identifies at least 2 of above	1

(b)

Criteria	Marks
(i) Use the gradient of the graph to calculate a	1
(ii) - Use $F=ma$ - Correctly calculates the force	2

(ii)	One of the above	1
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(i)

- $\text{Rise/run} = \frac{.8}{3} = 0.27 \text{ ms}^{-2}$

(ii)

- $m = 0.18 \text{ kg} ; a = 0.27 \text{ ms}^{-2}$
- $F = ma = 0.18 \times .27 = 0.05 \text{ N}$
 $+ 0.2 = 0.25 \text{ N}$

(c)

Criteria	Marks
Correctly calculates distance	1

Rise x run for two triangles and one rectangle

$$\frac{1}{2} 3 \times 0.5 + \frac{1}{2} 3 \times 0.8 + 7 \times 0.5 = 5.45 \text{ m}$$

27.

Marking Criteria	Marks
Correct statement of one of Newton's laws which is applicable. Correct explanation Mentions friction as one of the forces	3
2 of the above	2
1 of the above	1

An object remains in a state of rest or of uniform motion in a straight line unless acted upon by a net force

The car on the icy road has reduced friction acting between the road and the tyres. Without this force inertia keeps the car moving in its original direction.

28.

Marking Criteria	Marks
Relates pitch to frequency Relates amplitude to volume	2
1 of the above	1

29.

Marking Criteria	Marks
Correct magnitude, units and direction	2
Calculates tension only OR no direction OR correct direction but no magnitude	1

$$\text{Tension in spring} = 20 \text{ kg} \times 9.8 = 196 \text{ N}$$

$$T = mg + ma$$

$$a = (T - mg)/m$$

$$= (196 - 78.4)/8 = 1.96 \text{ ms}^{-2} \text{ Down}$$