

Baulkham Hills High School

Yearly Examination

2018

Year 11

Physics

General Instructions:

- Reading time - 5 minutes
- Working time - 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used
- The following are provided
 - Data sheet
 - Formula sheet
 - Periodic table

Total Marks: 75

This paper consists of TWO sections.

Section I – Multiple Choice

20marks

- Attempt Questions 1-20
- Allow about 30 minutes for this section

Section II – Extended Response

55 marks

- Attempt Questions 21-32
- Allow about 90 minutes for this section
- All working must be shown

Section I – Multiple Choice

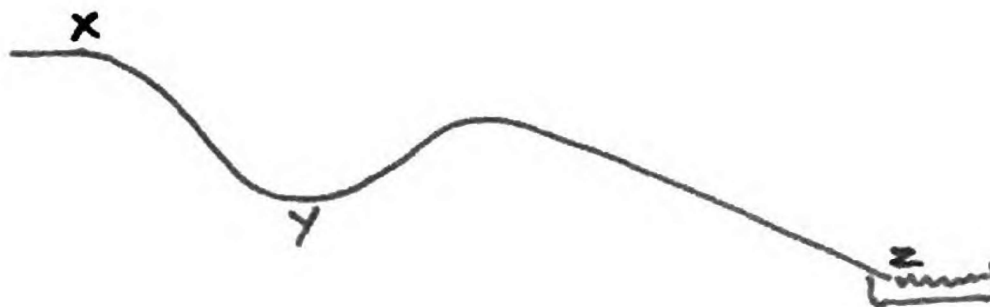
20marks

Select the alternative, A, B, C or D which best answers the question and indicate your choice on the Multiple Choice Answer Sheet.

1. A wave has a frequency of 3 Hz and a wavelength of 6 m. The velocity of this wave would be:
A) $3 \times 10^8 \text{ ms}^{-1}$
B) 18 ms^{-1}
C) 0.5 ms^{-1}
D) 2 ms^{-1}

2. Which of the following contains only vector quantities?
A) Displacement, velocity, acceleration
B) Displacement, velocity, time
C) Distance, speed, energy
D) Distance, velocity, time

3. A person begins a water slide from a stationary position at X and travels to the water surface at position Z.

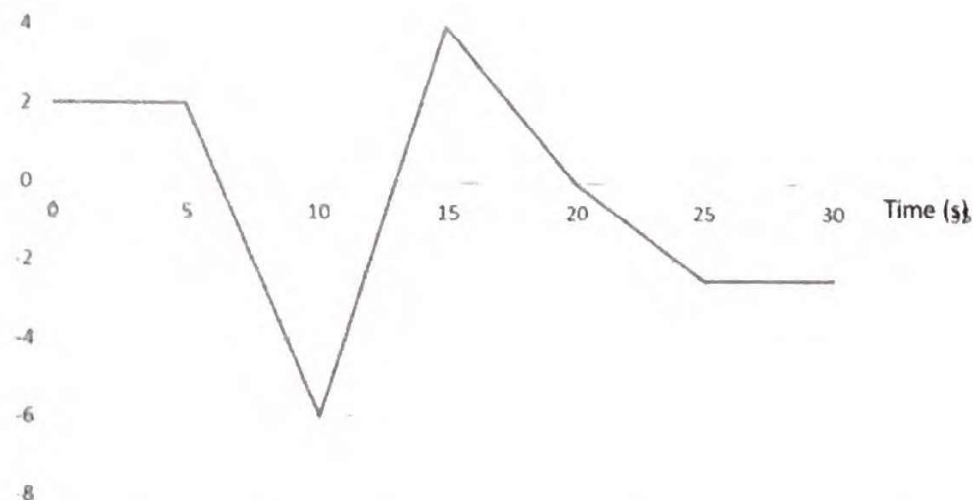


Which of the follow provides the best analysis of the person's motion during the slide?

	Potential energy	Kinetic energy	Speed
A	Maximum at X	Maximum at Y	Zero at Y
B	Minimum at Z	Zero at X	Maximum at Y
C	Non-zero at Y	Minimum at Y	Maximum at Z
D	Maximum at X	Non-zero at Y	Maximum at Z

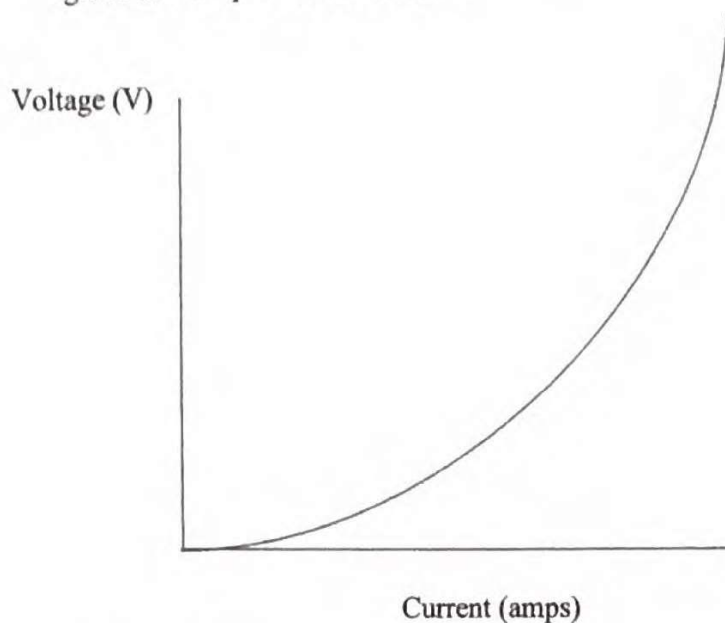
4. Which of the following is a correct definition for voltage?
- A) The difference in charge between two points in a conductor.
 - B) The amount of current flowing through a voltmeter.
 - C) A measure of the speed that electrons flow in a conductor.
 - D) The difference in potential energy per unit charge between two points.
5. Analyse the motion graph below that shows the movement of an object over a period of 30 seconds. During which time period was the object accelerating at 2ms^{-2} ?

velocity (ms^{-1})



- A) 0-5 seconds
 - B) 10-15 seconds
 - C) 15-20 seconds
 - D) 25-30 seconds
6. Mr Chilwell heard the echo of a basketball being bounced just outside of his room. He used a stopwatch to measure how long it took to hear the echo and determined that there was a 0.5s time difference between him hearing the ball bounce and hearing the echo off the building on the other side of the quad.
- Assuming that the speed of sound is 340ms^{-1} , the width of the quad
- A) is approximately 21 m.
 - B) is approximately 42.5 m.
 - C) is approximately 85 m.
 - D) cannot be determined using the time taken for the echo to be heard.

7. The graph below shows the relationship between the current through and voltage across a light globe in a simple electric circuit.



What does the graph show?

- A) That the light globe has a constant resistance
 - B) That the light globe behaves as an ohmic conductor
 - C) The resistance of the light globe decreases as the current increases
 - D) The resistance of the light globe increases as the current increases
8. Blue light in the visible part of the electromagnetic spectrum has a wavelength of 450 nm, Calculate the frequency of this light.
- A) 1.5×10^{15} Hz
 - B) 6.6×10^5 Hz
 - C) 6.6×10^{14} Hz
 - D) 6.7×10^{14} Hz
9. An ambulance is approaching a stationary observer at a constant speed of 60 kmh^{-1} . The speed of the sound is 340 ms^{-1} and the siren has a frequency of 650 Hz according to the source.

What is the frequency, according to the observer, as the ambulance approaches them?

- A) 618 Hz
- B) 633 Hz
- C) 682 Hz
- D) 789 Hz

A block of glass has a refractive index of 1.44.

The critical angle of the glass is

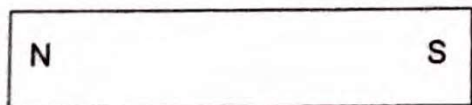
- A) 14.48°
- B) 35.24°
- C) 43.98°
- D) 53.18°

11. Which of the following is the most inelastic collision?

- A) Two cars colliding
- B) Two atoms colliding
- C) Two billiard balls colliding
- D) A cricket ball bouncing on a concrete floor

12. The diagram below is of a bar magnet.

X



The magnetic field direction and strength at position X is due to the field effects of both the north and south poles of the magnet and can be represented by the addition of which of the following two vectors?



13. The force between two equal charges, q , is F newtons when they are d cm apart.

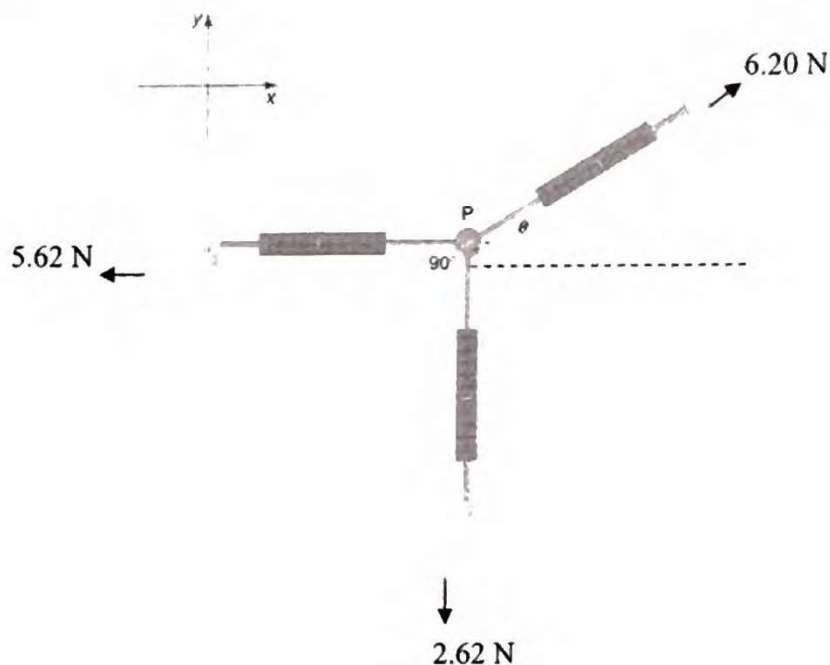
How far apart will charges of q and $2q$ need to be so that the force is the same?

- A) $d/4$
- B) $d/2$
- C) $\sqrt{2}d$
- D) $2d$

14. The kinetic energy of a car of mass 1.5 tonne moving at 16 ms^{-1} is closest to

- A) 24 J
- B) $2.4 \times 10^4 \text{ J}$
- C) $1.92 \times 10^5 \text{ J}$
- D) $3.84 \times 10^5 \text{ J}$

15. Three spring balances are hooked together horizontally to a point P at angles as shown in the diagram below.



The value of angle θ needed to make the net force at point P zero is

- A) 25°
- B) 30°
- C) 65°
- D) 85°

16. An object is placed in front of a convex mirror at a distance of twice the focal length. Which one of the following describes the image?

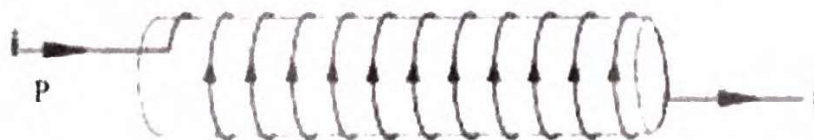
- A) upright, smaller and real
- B) inverted, smaller and real
- C) upright, smaller and virtual
- D) upright, enlarged and virtual

17. Which statement about the amount of energy needed to heat two different substances of identical volume by 1°C is correct?
- A) The substance with the lower density requires less energy.
 - B) The substance with the higher density requires less energy.
 - C) The substance with the lower specific heat capacity requires less energy.
 - D) The substance with the higher specific heat capacity requires less energy.

18. A car travelling at 80 kmh^{-1} applies its brakes and comes to a complete stop in 7 seconds.

The acceleration of the car is

- A) -11.4ms^{-2}
 - B) -3.2ms^{-2}
 - C) 3.2ms^{-2}
 - D) 11.4ms^{-2}
19. What is the direction of the magnetic field generated by the solenoid at point P?



- A) To the right
 - B) To the left
 - C) Up
 - D) Down
20. A coil of resistance wire is found to be an ohmic device. If a potential difference of 2.4V is applied across the coil, a current of 0.6A flows. If the potential difference is increased to 5V , what current will flow?
- A) 0.3 A
 - B) 1.25 A
 - C) 0.72 A
 - D) 1.39 A

End of Section I

Baulkham Hills High School

Yearly Examination 2018

Year 11

Physics

Section I – Multiple Choice

Select the response A, B, C or D which best answers the question by placing an 'X' on the grid below.

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

Question 21 (5 marks)

The driver of a car travelling north at 20ms^{-1} on a long, level, and straight road removes her foot from the accelerator and allows the car to roll without applying the brakes. The car and the driver have a combined mass of 1500kg . The car travels 1300 metres before coming to rest.

- (a) Calculate the magnitude of the car's momentum when it was travelling at 20ms^{-1} . 1

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- (b) Calculate the average acceleration of the car over the 1300 metres that it travelled after the driver removed her foot from the accelerator. 2

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- (c) Explain why this situation is not a violation of Newton's First Law. 2

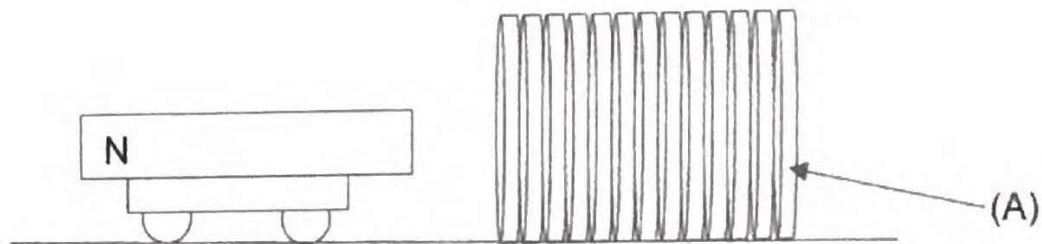
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Question 22 (5 marks)

A permanent bar magnet is placed on a small wooden trolley near a solenoid as shown below.



- (a) When the solenoid is connected to a DC power supply, the magnet on the trolley rolls towards the solenoid. Use an arrow on the diagram to show the direction of the current in the part of the solenoid labelled (A). 1

- (b) If the solenoid is 15cm in length, what will be the magnetic field strength inside the solenoid when a current of 2 amps is flowing through its 13 copper windings? 2

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- (c) Explain clearly how a permanent magnet can be produced. 2

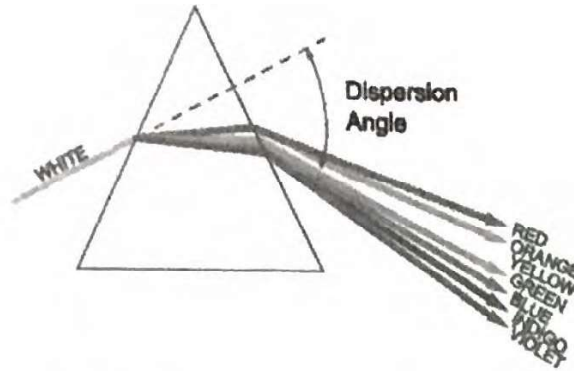
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Question 23 (6 marks)

White light can be split into a “rainbow” of colours using a glass prism.



- (a) Which colour in the spectrum has the greatest wavelength? 1

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- (b) Explain the dispersion of light in terms of the speed of light in the glass prism. 2

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- (c) With reference to the above diagram, compare the critical angles for red and violet light. 3

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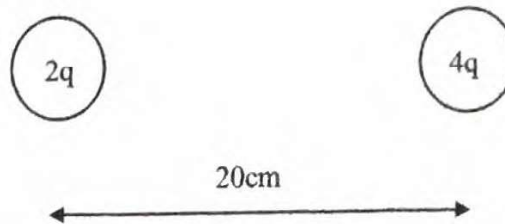
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Question 24 (4 marks)

The centres of two small positively charged objects are separated by 20cm as shown in the diagram below.



- (a) Draw lines **on the diagram above** to represent the electric field pattern between the two charges. **2**
- (b) Calculate the magnitude and direction of the electrostatic force between the two charges. **2**

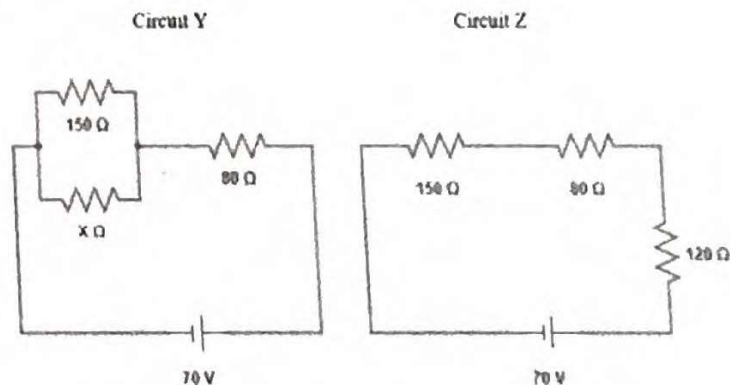
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Question 25 (7 marks)

Consider the following two electric circuits, Y and Z:



The current flowing through the $150\ \Omega$ resistor in each circuit is the same.

Question 25 continued over page ...

- (a) Calculate the current flowing in Circuit Z. **2**

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Calculate the potential difference across the $80\ \Omega$ resistor in Circuit Y.

2

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(c) Calculate the power dissipated by the $80\ \Omega$ resistor in Circuit Z.

2

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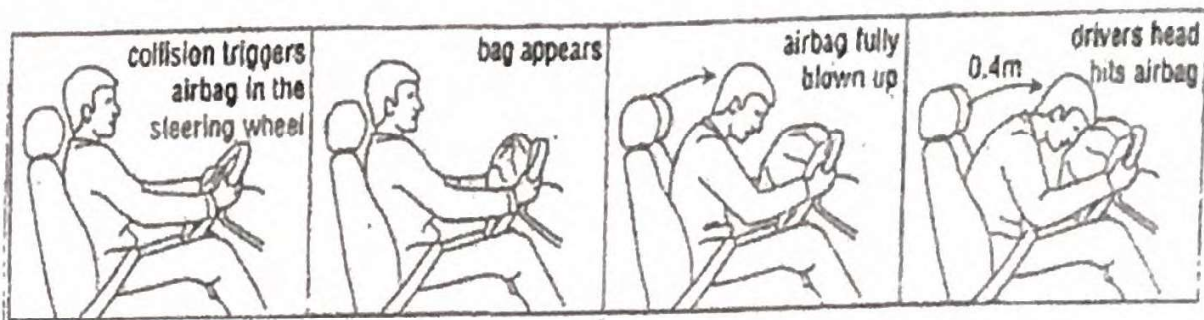
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Question 26 (3 marks)

The diagrams below shows an airbag inflating when Mr Blunden crashed into a tree.



Mr Blunden and the car have a combined mass of 1 440 kg and were travelling at 50 kmh^{-1} when he hit the immovable tree with no chance to brake first.

- (a) Calculate the average force that the car experiences if the car comes to a complete stop after 1 second. 1

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.....

- (b) Is kinetic energy conserved during this collision? Justify your answer. 2

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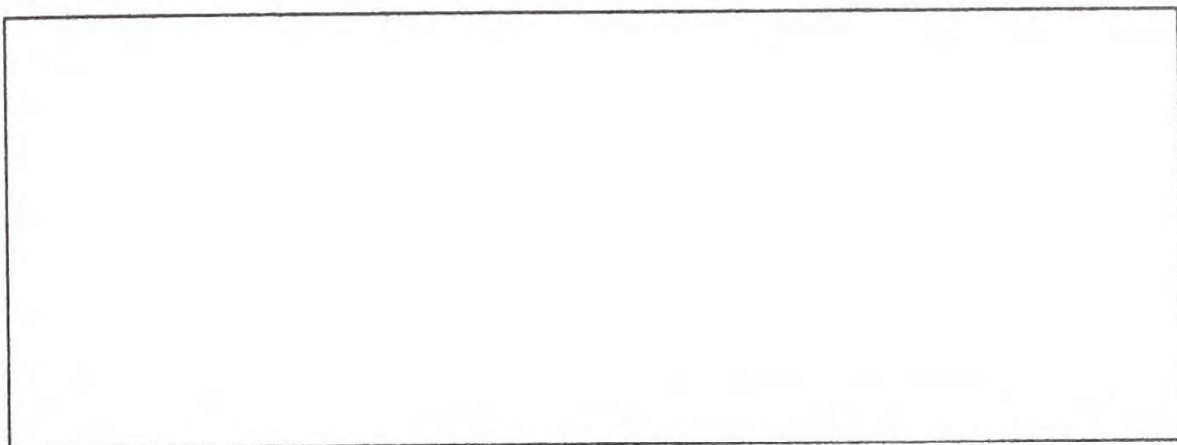
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Question 27 (2 marks)

In the course of your studies, you performed an experiment to demonstrate the nature of standing waves.

In the space below, draw a labelled diagram showing the essential features of a standing wave. 2



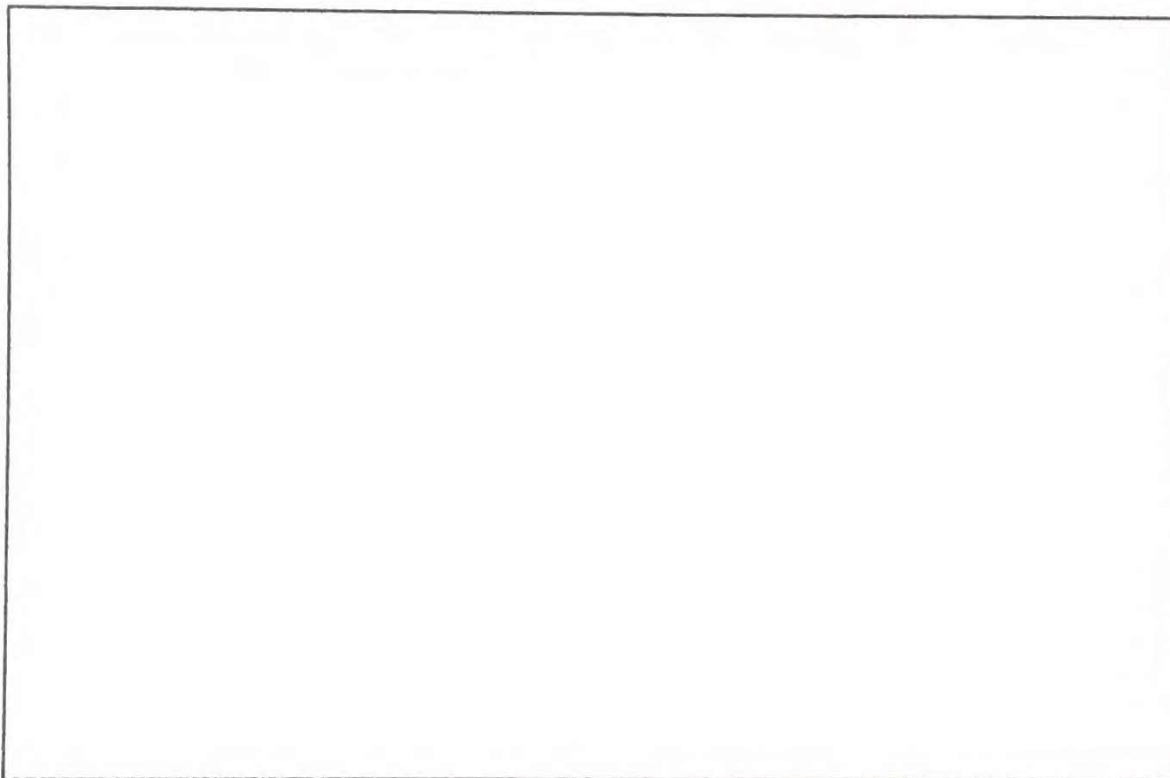
Question 28 (7 marks)

A broken motor boat is attempting to cross a river that is 30m in width.

The boat's rudder does not work and the boat is capable only of propelling itself northward at a constant velocity of 6 ms^{-1} .

The river's current is flowing perpendicular to the motion of the boat and is carrying the boat westward at 1.5 ms^{-1} .

- (a) Draw a vector diagram of the above situation and use it to calculate the relative motion of the boat according to a stationary observer standing where the boat initially launched. **2**



- (b) The driver of the boat organises a repairer to meet him where the boat will meet on the opposite bank. How far down the river from the initial position, should the repairer be told to wait? **3**

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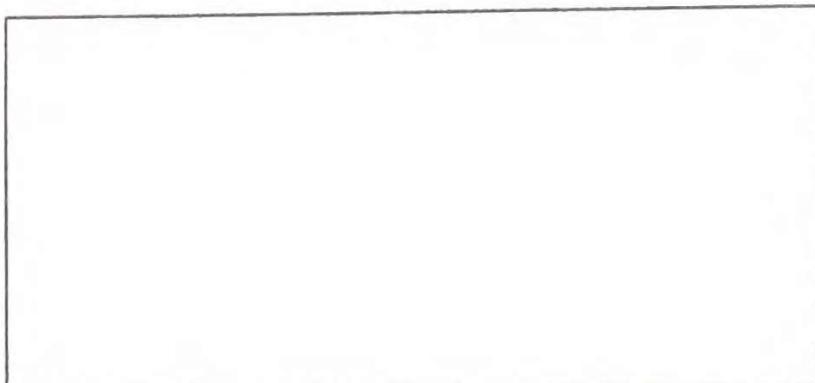
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Question 28 continued over page...

- (c) The repairer, having successfully met the boat on the opposite bank, fixes the rudder, and the driver must now get back to the initial starting point.

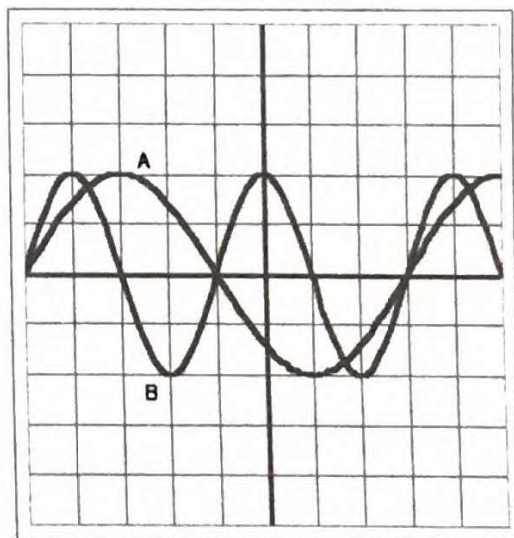
Draw a vector diagram showing a combination of possible component vectors that would allow the driver to return to the boat's initial position, assuming the boat's velocity is still 6 ms^{-1} .

2



Question 29 (4 marks)

The following diagram represents 2 different sound waves shown on a CRO.



- (a) Describe the difference that could be heard between the two waves A and B when turned on separately.

2

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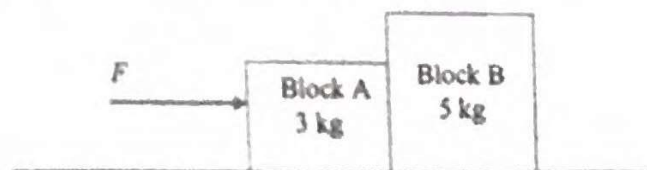
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- (b) On the grid above, draw the superposition of these two waves.

2

Question 30 (3 marks)

The diagram shows two blocks, in contact with each other, resting on a frictionless surface. Block A has a mass of 3 kg and block B has a mass of 5 kg. The system is accelerating towards the right at 2.5 ms^{-2} due to the application of a force, F .



- (a) What is the magnitude of the applied force F ? 1

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- (b) With what force does block A push on block B? 1

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- (c) With what force does block B push on block A? 1

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Question 31 (3 marks)

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. 3

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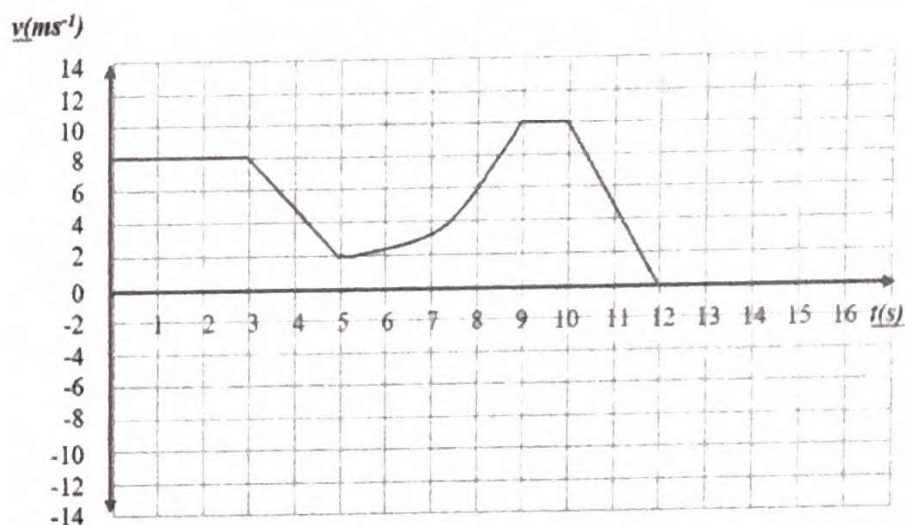
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Question 32 (6 marks)

The motion of Mr Phung riding his motorbike was recorded and graphed, as shown below.



- (a) Describe the motion of the motorbike between the times $t = 5.0\text{s}$ and $t = 12.0\text{s}$.

2

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- (b) Calculate the distance travelled by the motorbike in the first three seconds shown on the graph.

3

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.....

.....

- (c) On the original axes above, draw a graph of the motion of a car which starts from rest at $t = 0\text{s}$ and has an acceleration of -2.0ms^{-2} .

1

End of Paper

MARKING SCHEME.

Section II - 55 marks

Please write your answers in Section II in the spaces provided.

Individual marks are indicated for each question

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

Marks

Question 21 (5 marks)

The driver of a car travelling north at 20ms^{-1} on a long, level, and straight road removes her foot from the accelerator and allows the car to roll without applying the brakes. The car and the driver have a combined mass of 1500kg . The car travels 1300metres before coming to rest.

- (a) Calculate the magnitude of the car's momentum when it was travelling at 20ms^{-1} . 1

$$\begin{aligned}
 P &= mv \\
 &= 1500 \times 20 \\
 &= 3 \times 10^4 \text{ kg ms}^{-1} \quad * \text{ Unit must be correct.}
 \end{aligned}$$

- (b) Calculate the average acceleration of the car over the 1300metres that it travelled after the driver removed her foot from the accelerator. 2

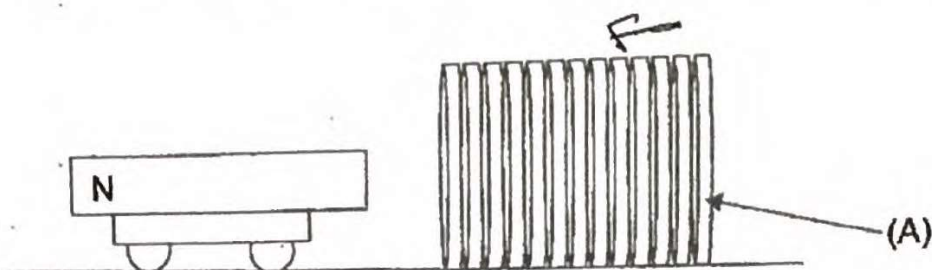
$$\begin{aligned}
 v^2 &= u^2 + 2as \quad \text{formula} = \textcircled{1} \\
 0^2 &= 20^2 + 2(a)(1300) \quad \text{answer} = \textcircled{1} \\
 \therefore a &= -0.15 \text{ ms}^{-2} \quad -1 \text{ for wrong direction}
 \end{aligned}$$

- (c) Explain why this situation is not a violation of Newton's First Law. 2

- law outlined $\textcircled{1}$
 - reason - net force present + identified $\textcircled{1}$

Question 22 (5 marks)

A permanent bar magnet is placed on a small wooden trolley near a solenoid as shown below.



- (a) When the solenoid is connected to a DC power supply, the magnet on the trolley rolls towards the solenoid. Use an arrow on the diagram to show the direction of the current in the part of the solenoid labelled (A). 1

- (b) If the solenoid is 15cm in length, what will be the magnetic field strength inside the solenoid when a current of 2 amps is flowing through its 13 copper windings? 2

$$B = \frac{\mu_0 n I}{L} = \frac{4\pi \times 10^{-7} \times 13 \times 2}{0.15} = 2.12 \times 10^{-4} \text{ T} \quad \textcircled{1}$$

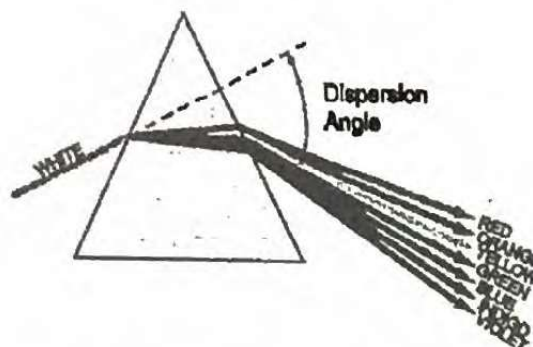
- (c) Explain clearly how a permanent magnet can be produced. 2

① method of causing it

① "domains" lined up concept

Question 23 (6 marks)

White light can be split into a "rainbow" of colours using a glass prism.



- (a) Which colour in the spectrum has the greatest wavelength?

1

red

- (b) Explain the dispersion of light in terms of the speed of light in the glass prism.

2

speed Δ going into Δ medium ①
 $\Delta \text{ speed} / \lambda = \Delta \text{ refraction}$ ①
 $\Rightarrow \therefore \text{colours}$

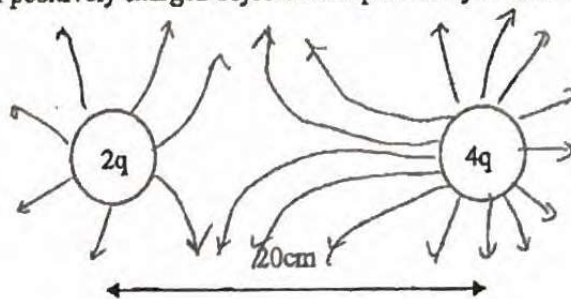
- (c) With reference to the above diagram, compare the critical angles for red and violet light.

3

red critical angle $>$ violet critical angle ①
 as $RI \uparrow$, Crit angle $\downarrow$ } any 2 other explained
 • application of Snell's Law } + relevant concepts
 • concept of critical angle } that relate to first part
 outlined. ① + ①

Question 24 (3⁴ marks)

The centres of two small positively charged objects are separated by 20cm as shown in the diagram below.



correct arrow direction ①
correct overall pattern ①

(a) Draw lines on the diagram above to represent the electric field pattern between the two charges. 2

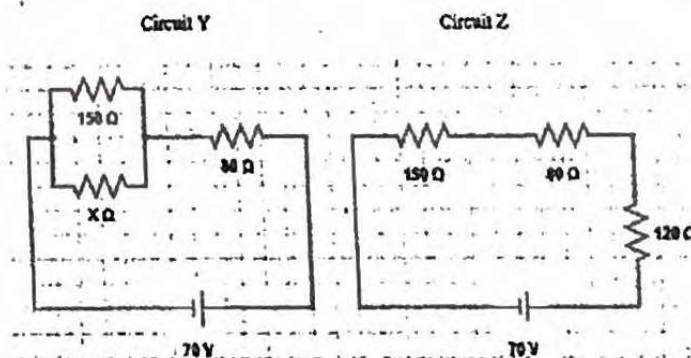
(b) Calculate the magnitude and direction of the electrostatic force between the two charges. 2

$$F = \frac{1}{4\pi\epsilon_0} \times \frac{q_1 q_2}{r^2} \therefore F = 1.80 \times 10^{-12} \text{ N} \quad ①$$

$$= \frac{8 \times 10^{-12}}{0.16 \pi \epsilon} \quad \text{repulsive} \quad ①$$

Question 25 (7 marks)

Consider the following two electric circuits, Y and Z:



The current flowing through the 150 Ω resistor in each circuit is the same.

Question 25 continued over page...

(a) Calculate the current flowing in Circuit Z. 2

$$V = IR \quad \text{formula} = ①$$

$$70 = I(150 + 80 + 120) \quad \text{answer} = ①$$

$$\therefore I = 0.2 \text{ A}$$

(b) Calculate the potential difference across the $80\ \Omega$ resistor in Circuit Y.

2

1 - evidence of attempting to use Ohm's law
or Kirchhoff's law

1 - correct answer $\rightarrow V_{80\Omega} = 40\text{V}$

Sample: $I_{80\Omega} = 0.20\text{A}$ (from (a))
 $V_{80\Omega} = IR = (0.2)(150) = 30\text{V}$ $\therefore V_{80\Omega} = 70 - 30 = 40\text{V}$

(c) Calculate the power dissipated by the $80\ \Omega$ resistor in Circuit Z.

2

1 - a correct power formula stated

1 - correct answer: 3.2W

Sample: $P_{80\Omega} = I^2 R$
 $= (0.20)^2 (80)$
 $= (0.04)(80)$
 $= 3.2\text{W}$

Question 26 (3 marks)

The diagrams below shows an airbag inflating when Mr Blunden crashed into a tree.



Mr Blunden and the car have a combined mass of 1 440 kg and were travelling at 50 kmh⁻¹ when he hit the immovable tree with no chance to brake first.

- (a) Calculate the average force that the car experiences if the car comes to a complete stop after 1 second.

$$I = Ft \rightarrow F = \frac{I}{t} = \frac{m(v-u)}{t} = \frac{1440(0 - \frac{50}{3.6})}{1} = 20\,000\text{ N.}$$

1 mark - correct answer.

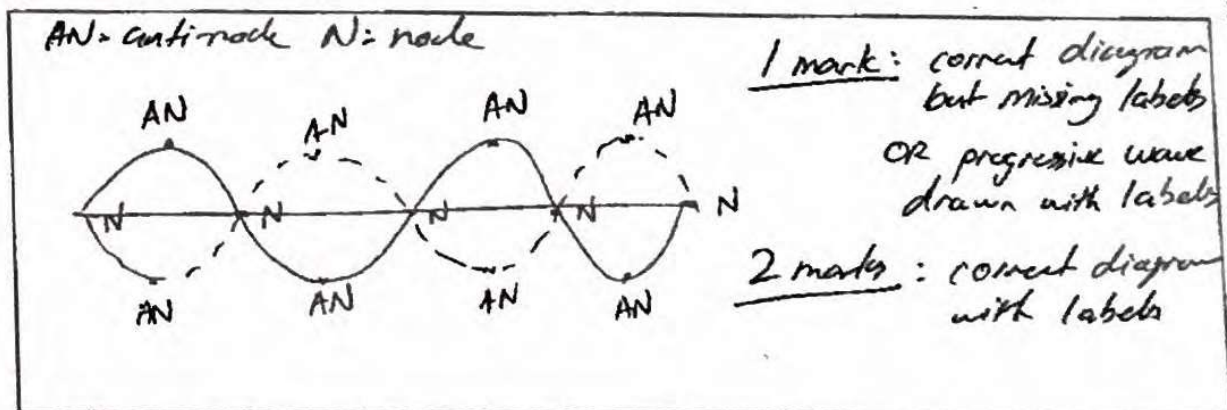
- (b) Is kinetic energy conserved during this collision? Justify your answer.

1 - NO, KE not conserved
1 - justification through calculation
OR stating kinetic energy is transformed into other forms such as heat, sound, etc.

Question 27 (2 marks)

In the course of your studies, you performed an experiment to demonstrate the nature of standing waves.

In the space below, draw a labelled diagram showing the essential features of a standing wave.



Question 28 (7 marks)

A broken motor boat is attempting to cross a river that is 30m in width.

The boat's rudder does not work and the boat is capable only of propelling itself northward at a constant velocity of 6 ms^{-1} .

The river's current is flowing perpendicular to the motion of the boat and is carrying the boat westward at 1.5 ms^{-1} .

- (a) Draw a vector diagram of the above situation and use it to calculate the relative motion of the boat according to a stationary observer standing where the boat initially launched. 2

$$V = \sqrt{1.5^2 + 6^2}$$

$$= 6.2 \text{ m/s}$$

$$\tan \theta = \frac{1.5}{6}$$

$$\theta = 14^\circ$$

1 mark

Correct diagram
OR
calculation

2 marks

correct diagram
AND
calculations.

$\therefore V_{\text{boat}} = 6.2 \text{ m/s } N14^\circ W$

OR $346^\circ T$

- (b) The driver of the boat organises a repairer to meet him where the boat will meet on the opposite bank. How far down the river from the initial position, should the repairer be told to wait? 3

1 - a correct formula identified

1 - correct time (5s) calculated or a displacement triangle constructed

1 - correct answer (note: 7.5m or 31m accepted)

Sample

$$t = \frac{d}{s} = \frac{30}{6} = 5 \text{ s}$$

$$d = st$$

$$= (5)(1.5)$$

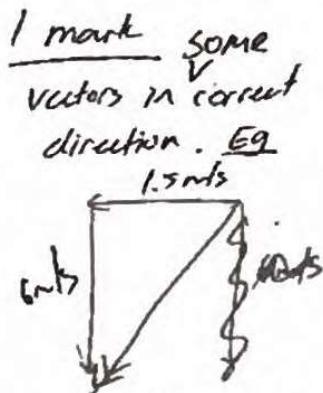
$$= 7.5 \text{ m}$$

Question 28 continued over page...

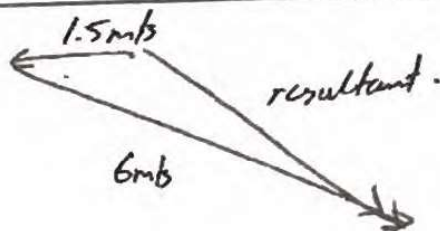
- (c) The repairer, having successfully met the boat on the opposite bank, fixes the rudder, and the driver must now get back to the initial starting point.

Draw a vector diagram showing a combination of possible component vectors that would allow the driver to return to the boat's initial position, assuming the boat's velocity is still 6 ms^{-1} .

2



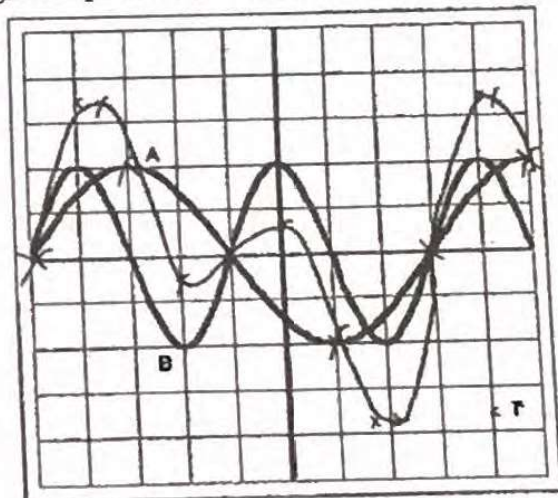
2 marks water velocity + boat velocity both in correct direction.



→ boat going down, wind going west.

Question 29 (4 marks)

The following diagram represents 2 different sound waves shown on a CRO.



- (a) Describe the difference that could be heard between the two waves A and B when turned on separately.

2

1 - pitch identified as the characteristic.
1 - B is higher pitched than A.

- (b) On the grid above, draw the superposition of these two waves.

2

2 marks:

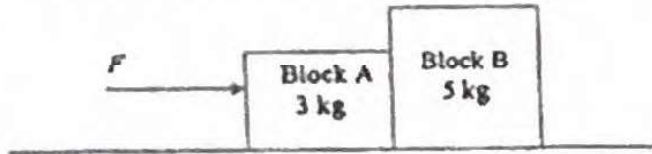
correct answer

1 mark:

correct shape with errors. 1/2

Question 30 (3 marks)

The diagram shows two blocks, in contact with each other, resting on a frictionless surface. Block A has a mass of 3 kg and block B has a mass of 5 kg. The system is accelerating towards the right at 2.5 ms^{-2} due to the application of a force, F .



Show working

- Formula
- Substitution
- correct Answer (w direction)
- correct units

- (a) What is the magnitude of the applied force
- F
- ?

$$F = Ma = (m_A + m_B)a = (3 + 5)2.5 = 20 \text{ N}$$

(direction not required)

- (b) With what force does block A push on block B?

$$F_{\text{net on B}} = m_B a = 5 \times 2.5 = 12.5 \text{ N to right}$$

$$F_{\text{net on A}} = -F_{\text{net on B}} = 12.5 \text{ N Left. (cf E from (b))}$$

If Newton's 3rd shown.)

- (c) With what force does block B push on block A?

(31) To gain marks logical steps must be shown (using formula helps), the answer must show cohesion, demonstrates clear understanding. A mish-mash of correct formulae, but incorrectly applied does not gain marks. NOTE: If you work out the force acting on the 1200 kg body, then you need to state how this applies to the 1500 kg body in order to gain full marks.

Question 31 (3 marks)
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.

(1) Find final velocity; closed system $\Delta p = 0 \therefore p_f = p_i$
 $(1200 + 1500)v = -3 \times 1500 + 7 \times 1200 = -4500 + 8400 = 3900 \text{ N s East}$
 $\therefore v_f = 3900 / 2700 = 1.44 \text{ ms}^{-1} \text{ East}$

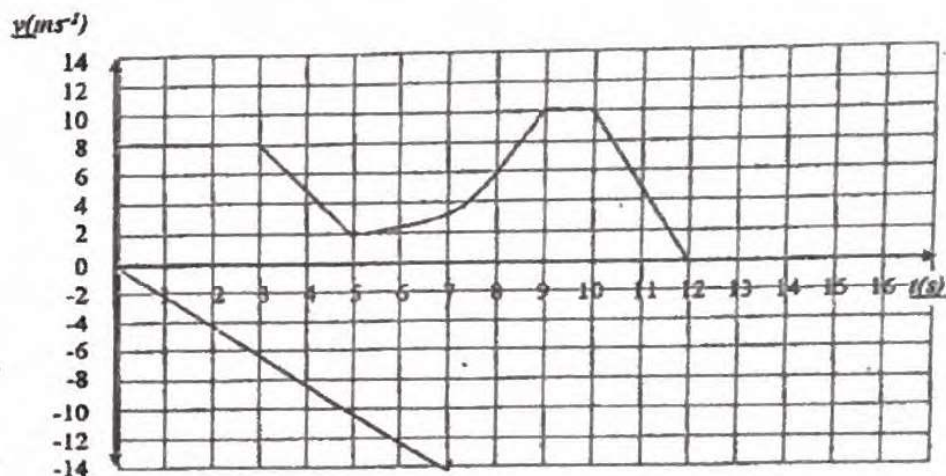
(2) Force that 1200 kg exerts on 1500 kg = net force on 1500 kg
 $I = F \Delta t; F_{\text{net on B}} \Delta t \Rightarrow \Delta p_B = 1500(v_f - v_i) = 1500(1.44 - (-3)) = 1500 \times 4.44 \text{ East}$

(3) $F_{\text{net on B}} = \Delta p_B / \Delta t = (1500 \times 4.44) / 0.12 = 6666.67 / 0.12 = 55555.56 = 56 \text{ kN East.}$

Note. Can use sum of (2) + (3); $a = (v - u) / t = [1.44 - (-3)] / 0.12 = 4.44 / 0.12 = 37.04 \text{ ms}^{-2}$
 $F_B = m_B a = 37.04 \times 1500 = 56 \text{ kN East.}$

Question 32 (6 marks)

The motion of Mr Phung riding his motorbike was recorded and graphed, as shown below.



- (a) Describe the motion of the motorbike between the times $t=5.0$ s and $t=12.0$ s.

2

5-9s - Increasing Acceleration
 9-10s - Constant Velocity (10 m/s)
 10-12s - Constant Deceleration (accel @ -5 m/s^2)

} Loose
 1 mark
 each
 wrong.

- (b) Calculate the distance travelled by the motorbike in the first three seconds shown on the graph.

3

Formula; Substitution; Answer with units. (Direction NOT required)

$$\text{Distance} = vt = 8 \text{ m/s} \times 3 \text{ s} = 24 \text{ m}$$

- (c) On the original axes above, draw a graph of the motion of a car which starts from rest at $t=0$ s and has an acceleration of -2.0 m/s^2 .

1

Draws line from (0,0) to (7, -14)

End of Paper