BA PROVINCIAL FREE BIRD INSTITUTE

TERM ONE END EXAMINATION 2021

YEAR 12 PHYSICS

QUESTION PAPER

Time Allowed: 3 hours
(An extra 10 minutes is allowed for reading this paper)

INSTRUCTIONS

1. Write your **name** on the front page of the **Answer Booklet**.
2. Write all your answers in the **Answer Booklet** provided.
3. Answer all the questions with blue or black ink pen. Do not use red ink. You may use a pencil only for drawing.
4. You may use a calculator, provided it is silent, battery operated and non – programmable.
5. **All questions are compulsory**.

Note:

- Physics Formulae and Constants which may be useful during the examination are given on page 13 of this **Question paper.**
- Diagrams in this paper are **not** drawn to scale.

SUMMARY OF QUESTIONS

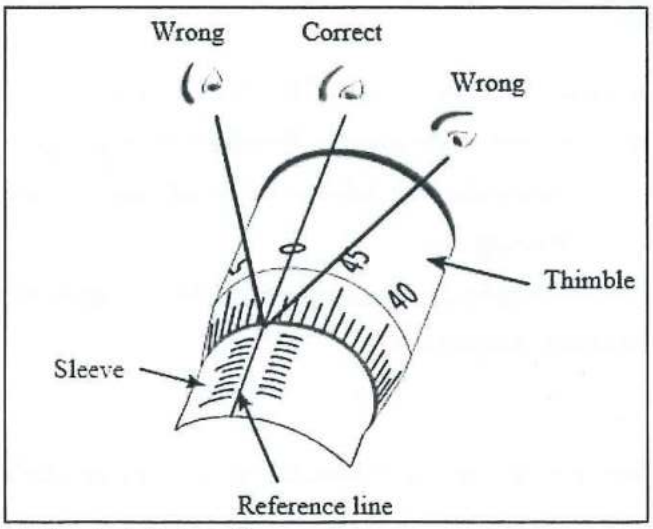
	STRANDS	MARKS	SUGGESTED TIME
1	Mechanics	80	144 minutes
2	Energy	20	36 minutes
TOTAL		**100**	**180 minutes**

STRAND 1 **MECHANICS** **[80 marks]**

- This strand has **36** Questions.
- Show necessary working for Questions **17 – 36** as partial marks will be awarded for correct working.

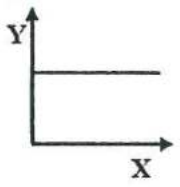
1) The number of significant figures in 0.20780 is
   A. 3
   B. 4
   C. 5
   D. 6 **(1 mark)**

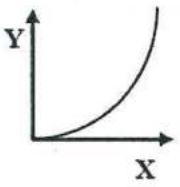
Use the diagram given below which shows a common type of error in reading measurements to answer **Question 2**.

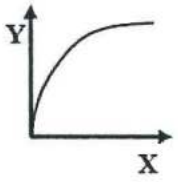


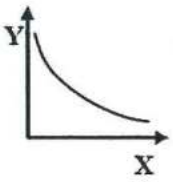
2) Which type of error is illustrated above?
   A. random error
   B. parallax error
   C. systematic error
   D. calibration error **(1 mark)**

3) Which of the following graphs depict **square** relationship?

A. 

B. 

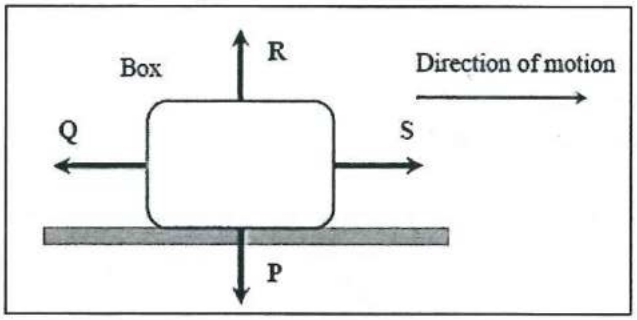
C. 

D. 

(1 mark)

4) Which of the following quantities represent a vector?
   A. Mass
   B. Distance
   C. Weight
   D. Speed **(1 mark)**

A box is pulled to the right along a horizontal surface as shown in the diagram given below. Use this information to answer **Question 5**.



5) Which of the forces labelled **P**, **Q**, **R** or **S** on the diagram is the friction force?
   A. **P**
   B. **Q**
   C. **R**
   D. **S** **(1 mark)**

6) The acceleration of an object is directly proportional to
   A. time.
   B. mass.
   C. force.
   D. displacement. **(1 mark)**

7) Torque is given by the equation $\tau = F \times d$. What does **d** in the equation stand for?
   A. Distance from the pivot
   B. Distance between two masses
   C. Parallel distance from the pivot
   D. Perpendicular distance from the pivot **(1 mark)**

8) If moment clockwise is equal to moment anticlockwise then the system will
   A. collapse.
   B. rotate clockwise.
   C. remain stationary.
   D. rotate anticlockwise. **(1 mark)**

9) One of the conditions for state of equilibrium in Principle of Moments is that the
   A. resultant force should be zero.
   B. tension should be equal on both sides.
   C. weight of all objects on the beam should be the same.
   D. distance between the objects on the beam should be the same. **(1 mark)**

10) A golf ball is struck and it follows a parabolic trajectory. Neglecting air resistance, which of the following statements about the ball's trajectory is **correct**?

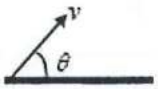
A. The total energy of the ball remains same.
B. The horizontal velocity at maximum height is zero.
C. The higher the ball goes the greater its kinetic energy.
D. At the maximum height kinetic energy will be maximum. **(1 mark)**

11) Throughout the motion of a projectile, the horizontal component of its velocity

A. is zero.
B. is constant.
C. changes with time.
D. has a constant value of 10. **(1 mark)**

12) Which of these expressions can determine the vertical component of a projectile's velocity?

A. $v \tan \theta$
B. $v \sin \theta$
C. $v \cos \theta$
D. $v \sec \theta$ **(1 mark)**



13) An impulse is equivalent to

A. the change in mass of an object.
B. the change in volume of an object.
C. the original momentum of the object .
D. a force applied to an object for a period of time. **(1 mark)**

14) Momentum of a system is conserved only when

A. the system is not moving.
B. the mass of the system closed changes.
C. there are no internal forces acting on the system.
D. there is no net external forces acting on the system. **(1 mark)**

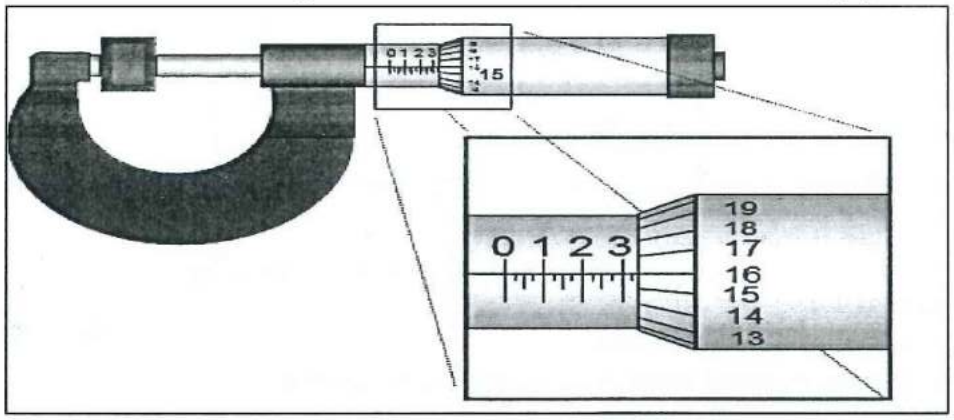
15) A stone tied to a string is moved around in a circular motion. The direction of the centripetal force is

A. along the tangent of the circle.
B. along the axis of rotation.
C. towards the centre of circle.
D. away from the centre of circle. **(1 mark)**

16) Two objects, each of mass 1 kg are separated by a distance of 1 m. The gravitational force between the two objects is

A. twice G.
B. equal to G.
C. less than G.
D. greater than G. **(1 mark)**

17) Shown below is a measuring instrument used to measure the thickness of paper.

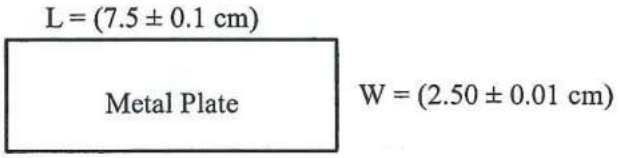


(i) Name the instrument used. **(1 mark)**

(ii) Which part of the instrument is used to tighten it? **(1 mark)**

(iii) What is the uncertainty of this instrument? **(1 mark)**

18) The length and the width of a metal plate were measured using a vernier caliper. The measurement obtained for length and width were L = (7.5 ± 0.1) cm and W = (2.50 ± 0.01) cm respectively.



(i) Calculate the perimeter of the metal plate with its correct uncertainty. **(2 marks)**

(ii) Determine the area of the piece of metal, expressing the answer with its correct uncertainty. **(2 marks)**

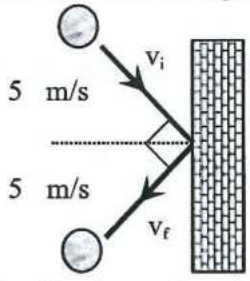
19) An equation is given as $\mathbf{E} = \frac{kq}{r^2}$

(i) State the relationship between **E** and **r**. **(1 mark)**

(ii) What shape would the graph of **E** versus $\frac{1}{r^2}$ be if **kq** is constant. **(1 mark)**

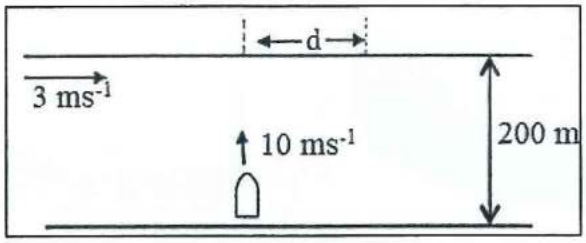
(iii) What happens to the value of **E** if **r** is tripled? **(1 mark)**

20) A tennis ball thrown against a wall rebounds without loss in speed as shown below.



Calculate the change in velocity of the tennis ball. **(2 marks)**

21) A man rows a boat at a steady speed of 10 ms^{-1}. He sets out at right angles to the section of a river which is 200 m wide. The river flows downstream at 3 ms^{-1}.



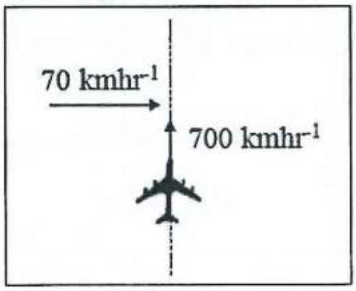
Calculate the

(i) time taken to cross the river. **(1 mark)**

(ii) distance, d moved downstream while crossing the river. **(1 mark)**

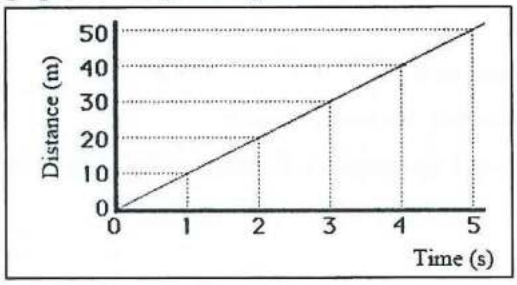
(iii)angle upstream the boat should head in order to land at a point directly across from where it started. **(1 mark)**

22) A pilot wishes to fly a plane due North relative to the ground with airspeed of 700 $kmhr^{-1}$. The wind blows from West to East at a speed of 70 $kmhr^{-1}$ as shown in the diagram below.



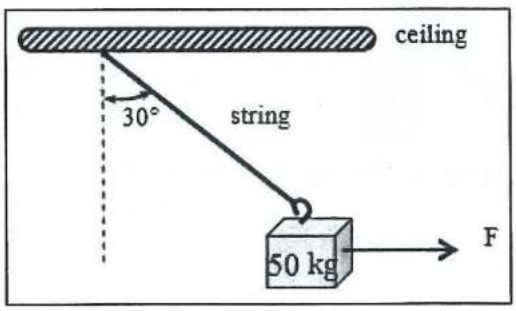
Determine the magnitude of the velocity of the plane relative to the ground. **(2 marks)**

23) A distance versus time graph of a bicycle is given below.



Calculate the speed of the bicycle from the graph. **(2 marks)**

24) A 50 kg mass hanging from a ceiling is pulled to the right at an angle of 30° by a force F as shown below.

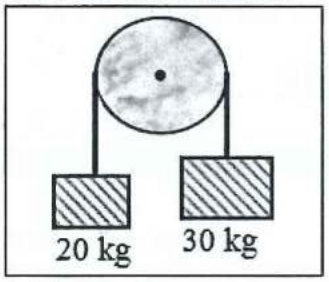


If the system is in equilibrium, calculate the

(i) force, F. **(2 marks)**

(ii) tension in the string joining the mass to the ceiling. **(1 mark)**

25) The system below shows masses of 20 kg and 30 kg hanging on opposite ends of a light inextensible string which passes over a frictionless pulley.



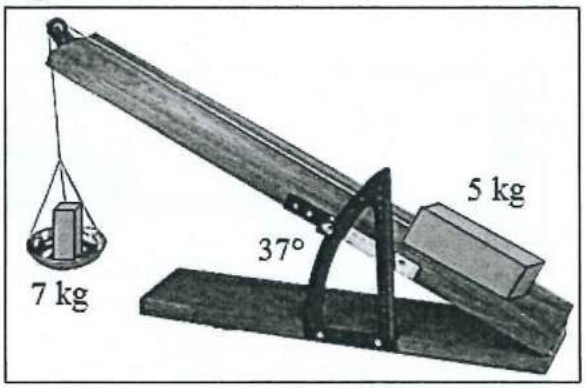
(i) In the **Answer Book**, draw and label the forces acting on the 20 kg mass. **(1 mark)**

(ii) Determine the net force acting on the system. **(1 mark)**

(iii)Calculate the acceleration of the system. **(1 mark)**

(iv)Calculate the tension in the string. **(1 mark)**

26) In the experimental set-up a 5 kg block inclined at an angle of 37° is attached to another 7 kg mass as shown in the diagram below.

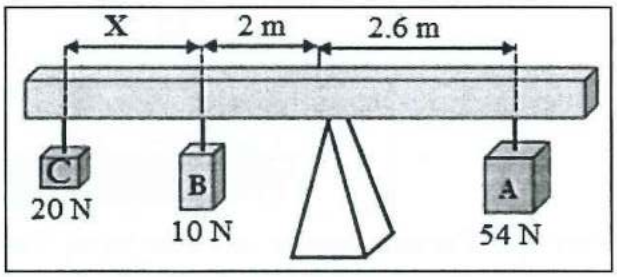


Calculate the:

(i) sliding force due to 5 kg mass. **(1 mark)**

(ii) acceleration of the system. **(2 marks)**

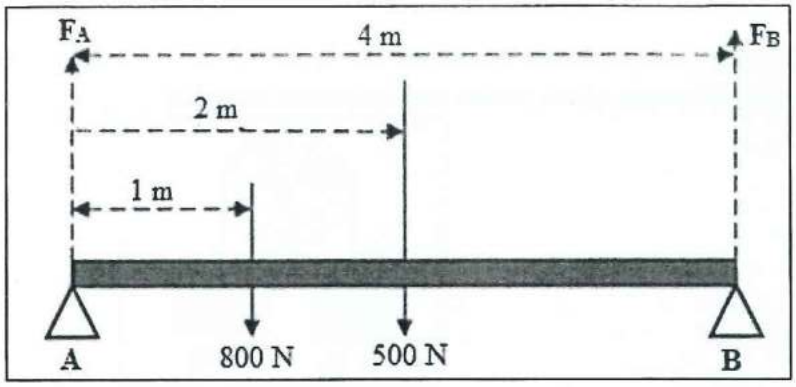
27) The see-saw shown below balances block A of weight 54 N, block B of weight 10 N and block C of weight 20 N.



(i) State the principle that keeps the see-saw balanced. **(1 mark)**

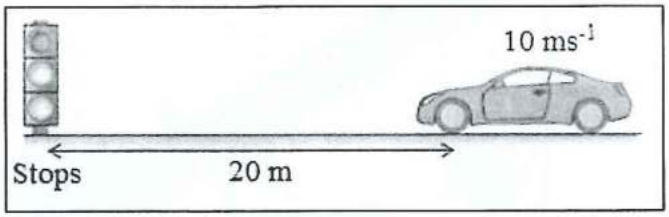
(ii) Determine the distance, X, block C is placed to balance the see-saw. **(2 marks)**

28) A uniform wooden board 4 m long and of weight 500 N is supported at both ends by trestles A and B. There is also a weight of 800 N at 1 m from trestle A.



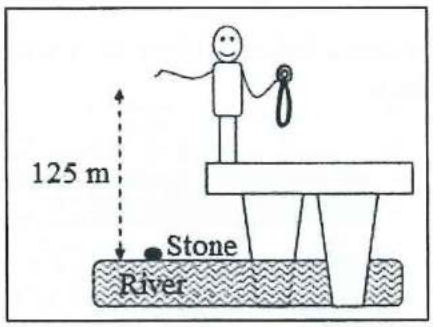
(i) Calculate the total anti-clockwise moment about **B**. **(1 mark)**
(ii) Calculate the force acting on the board at **A**. **(2 marks)**
(iii)Determine the force acting at **B**. **(2 marks)**

29) A car is travelling west at 10 ms^{-1}. A traffic light turns orange when the car is 20 m from it. The driver applies the brake and the car's speed decreases. The car stops just before it reaches the traffic light.



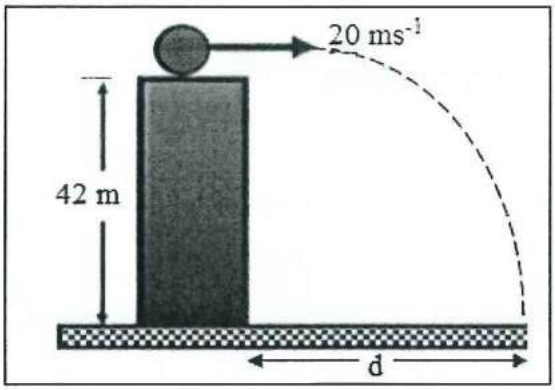
(i) Calculate the car's acceleration. **(1 mark)**
(ii) Calculate the time taken by the car to stop. **(1 mark)**

30) Rupeni was standing on a bridge above a river. He drops a stone into the river which is 125 m from the bridge.



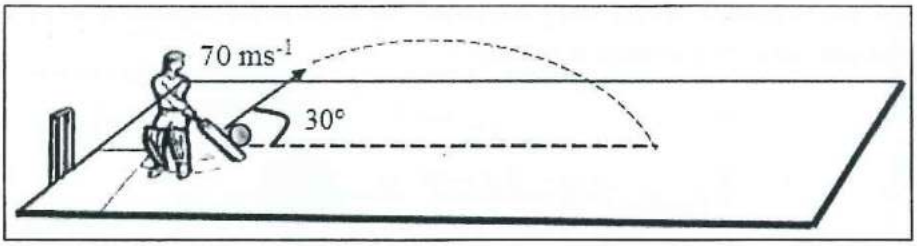
(i) Identify the type of motion experienced by the falling stone. **(1 mark)**
(ii) Calculate the acceleration of the stone if it reaches the water surface in 5 s. **(1 mark)**
(iii)Determine the final velocity of the stone at 5 s. **(1 mark)**

31) A projectile is launched horizontally from a height of 42 meters with a velocity of 20 ms^{-1} as shown in the diagram below.



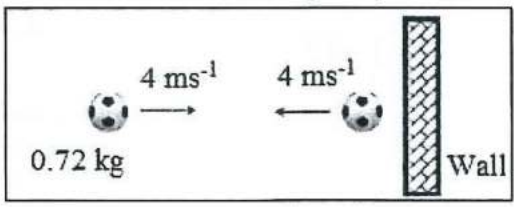
(i) Determine the horizontal velocity of the ball as it strikes the floor. **(1 mark)**
(ii) Calculate the vertical velocity of the ball as it strikes the floor. **(1 mark)**
(iii)Calculate the time elapsed when the ball strikes the floor. **(1 mark)**
(iv)Calculate the horizontal distance, d, travelled by the ball. **(1 mark)**

32) Falu hits the ball on a level fairway with a velocity of 70 ms^{-1} at an angle of 30° to the horizontal. The ball lands on the same level as it was hit, as shown below.



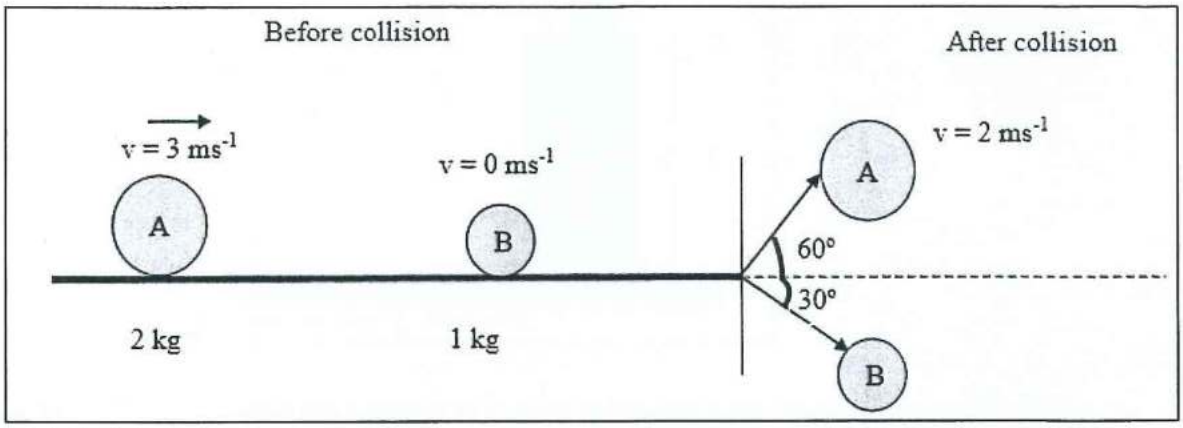
Calculate the
(i) vertical component of the ball's velocity. **(1 mark)**
(ii) horizontal component of the ball's velocity. **(1 mark)**
(iii)time taken to reach the maximum height. **(1 mark)**
(iv)maximum height reached by the ball. **(1 mark)**
(v) the range. **(1 mark)**

33) A ball of mass 0.72 kg is kicked at 4 ms^{-1} towards the wall. The ball hits the wall and bounces back directly at 4 ms^{-1} as shown in the diagram given below.



(i) Calculate the magnitude of change in momentum of the ball. **(1 mark)**
(ii) Calculate the acceleration of the ball, if the impact time of the ball with the wall was 0.2 seconds. **(2 marks)**

34) A ball, A, of mass 2 kg travelling to the right at 3 ms^{-1} hits a 1 kg ball B, which is stationary. After collision, ball A, moves off at 2 ms^{-1} at an angle of 60° above the horizontal while ball B moves off at 30° below the horizontal as shown in the diagram.



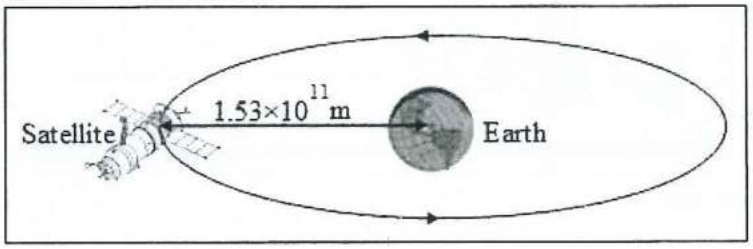
Calculate the

(i) total momentum before collision. **(1 mark)**

(ii) final speed of ball B after collision. **(2 marks)**

(iii)kinetic energy before and after collision of the system and state whether this is an elastic or inelastic collision. **(2 marks)**

35) The distance between a satellite and the earth is approximately 1.53×10^{11} m. It takes 2 years for the satellite to orbit around the earth. The mass of the satellite is 6×10^{24} kg. Assume that the path taken by the earth is circular.

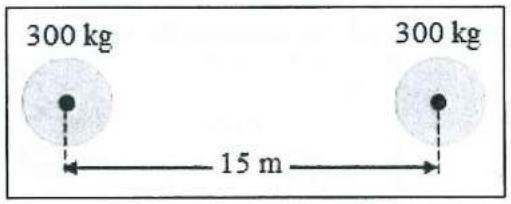


Calculate the:

(i) period of the satellite to orbit around the earth in seconds. **(1 mark)**

(ii) centripetal force experienced by the earth. **(2 marks)**

36) Calculate the gravitational force between two 300 kg objects whose centres are 15 metres apart.



(2 marks)

STRAND 2 **ENERGY** **[20 marks]**

- This strand has **9** Questions.
- Show necessary working for Questions **5 – 9** as partial marks will be awarded for correct working.

1) Hooke's Law states that "the extension of a spring is directly proportional to the force applied." The **area** of the Force versus Extension graph gives the
   A. kinetic energy.
   B. spring constant.
   C. total distance travelled.
   D. elastic potential energy. **(1 mark)**

2) The name given to the amount of energy needed to turn 1 kg of water at 100 °C into gas at 100 °C is
   A. specific latent heat.
   B. latent heat of fusion.
   C. specific heat capacity.
   D. latent heat of vapourisation. **(1 mark)**

3) Surfaces that reflect a lot of the light falling on them are bright since they have
   A. high albedo
   B. low albedo
   C. no albedo
   D. same albedo **(1 mark)**

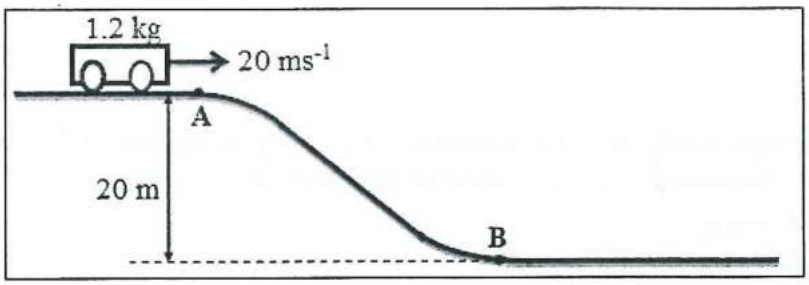
4) The Law of Conservation of Energy states that
   A. for a body at rest, total mechanical energy is zero.
   B. for a moving body, work done equals kinetic energy.
   C. energy before a collision is more than the energy after a collision.
   D. energy is neither created nor destroyed it only changes its form. **(1 mark)**

5) A 0.7 kg iron block is heated from 35 °C to 65 °C. The specific heat capacity of iron is 540 $Jkg^{-1}°C^{-1}$. Calculate the quantity of heat energy absorbed by the iron block. **(2 marks)**

6) An electric jug connected to a 240V AC, raises the temperature of 1500g of water from 13° C to 33° C in 4 minutes. (The specific heat capacity of water is 4200J/kg°C.)
   (i) How much heat energy is supplied to the water? **(1½ marks)**
   (ii) Determine the power output of the electric jug. **(1½ marks)**

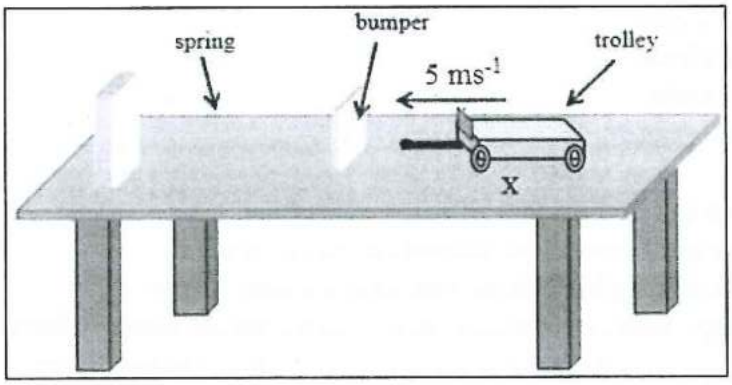
7) **Greenhouse effect** is the natural process by which the atmosphere traps some of the Sun's energy warming the Earth enough to support life.
   (i) Give an example of a gas which directly contributes to greenhouse effect. **(1 mark)**
   (ii) State **one** consequence of too much greenhouse effect. **(1 mark)**
   (iii)State **one** possible solution to this. **(1 mark)**

8) A trolley of mass 1.2 kg moves at 10 ms^{-1} until it comes to a downward slope.



(i) Calculate the potential energy of the trolley at point **A**. **(1 mark)**
(ii) Calculate the kinetic energy of the trolley at point **A**. **(1 mark)**
(iii) What is the potential energy of the trolley at point **B**? **(1 mark)**
(iv) What is the kinetic energy of the trolley at point **B**? **(1 mark)**
(v) Calculate the velocity of the trolley at point **B**. **(1 mark)**

9) A 900 g trolley, at position X, is moving along a frictionless table surface at a speed of 5 ms^{-1}. It collides with the bumper, compressing the spring, and then rebounds. The spring has a spring constant of 200 Nm^{-1}.



Calculate the
(i) kinetic energy of the trolley at position **X**. **(1½ marks)**
(ii) distance the spring compresses when the cart collides with the bumper before it rebounds. **(1½ marks)**

THE END
ALL THE BEST

YEAR 12 PHYSICS FORMULAE AND CONSTANTS

Mechanics

1. $d = vt$
2. $v_f = v_i + at$
3. $v_f^2 = v_i^2 + 2ad$
4. $d = v_i t + \frac{1}{2}at^2$
5. $\tau = Fd$
6. $p = mv$
7. $J = F\Delta t = m\Delta v$
8. $F = \frac{GMm}{r^2}$
9. $f = \frac{1}{T}$
10. $v = \frac{2\pi r}{t}$
11. $F_c = \frac{mv^2}{r}$
12. $a_c = \frac{v^2}{r}$

Energy

1. $W = Fd$
2. $P = \frac{W}{t}$
3. $E_K = \frac{1}{2}mv^2$

Energy (Continued)

4. $E_p = mgh$
5. $E_p = \frac{1}{2}kx^2$
6. $F = -kx$
7. $Q = mc\Delta T$
8. $Q = mL$

Fluids

1. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$
2. $\rho = \frac{m}{V}$
3. $P = \frac{F}{A}$
4. $P = \rho gh$

Geometrical Optics and Wave Motion

1. $v = f\lambda$
2. $\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$
3. $PD = d\sin\theta = \frac{dx}{L} = n\lambda$

Electricity

1. $F = \frac{kq_1q_2}{r^2}$
2. $F = Eq$
3. $V = Ed$
4. $W = Eqd = Vq$
5. $Q = It$
6. $R_s = R_1 + R_2 + R_3 + \ldots$
7. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$
8. $V = IR$
9. $P = VI = I^2R = \frac{V^2}{R}$

Electromagnetism

1. $F = BIl\sin\theta$
2. $V = Bvl$
3. $F = Bvq$
4. $\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P}$

Atomic Physics

1. $E_k = hf - \phi$
2. $\phi = hf_0$

Constants

Speed of light, c	=	3×10^8 ms^{-1}
Electronic charge	=	1.60×10^{-19} C
Electron mass, m_e	=	9.11×10^{-31} kg
Mass of proton, m_p	=	1.67×10^{-27} kg

Gravitational Acceleration	=	10 ms^{-2}
Speed of sound in air	=	340 ms^{-1}
Planck' s Constant, h	=	6.63×10^{-34} Js
Coulomb's constant, k	=	9.0×10^9 Nm^{2}C^{-2}
Gravitational Constant, G	=	6.67×10^{-11} Nm^{2}kg^{-2}