THE OPEN UNIVERSITY OF SRI LANKA

CREDIT CERTIFICATES FOR FOUNDATION COURSES IN SCIENCE

TAF1501 – PHYSICS -1

FINAL EXAMINATION

DURATION – THREE HOURS

Date: 23rd June 2019 Time: 0930-1230 Hours

Part -A

- The Question paper consists of 25 multiple choice questions
- Answer all the questions
- Answers for the Multiple Choice Questions, should be provided by placing X in the relevant cage indicating the most appropriate answer in the MCQ answer sheet provided
- At the end of the examination you should submit the question paper with answer sheet
- Recommended time for complete the part A is one hour

(Take g= 10ms^{-2})

(1).Joule-Second is units of,

(1) Power (2) Force (3) Energy (4) Momentum (5) Angular Momentum

(2).The velocity of a freely falling body varies according to $g^x h^y$,where g is the acceleration due to gravity and h is the distance travelled. What are the values of x and y?

(1) 1,1 (2) 1,1/2 (3)1/2,1 (4) ½, ½ (5) 2,2

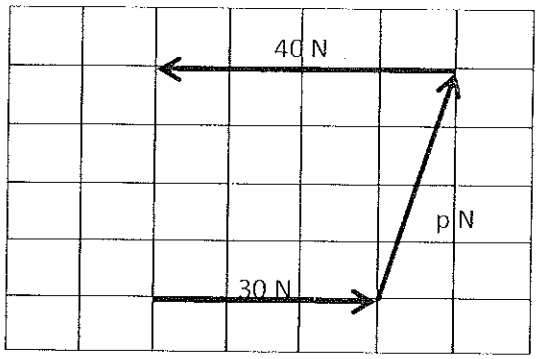
(3). A bird flying horizontally at a height of 40 m with a velocity of a 10 ms^{-1}, drops a small fruit from its mouth. The speed of free falling fruit just before it reaches the ground is,

(1) 10 ms^{-1} (2) 15 ms^{-1} (3)20√2 ms^{-1} (4) 25 ms^{-1} (5) 30 ms^{-1}

(4). A car starting from rest, travels with uniform acceleration x and then comes to rest with uniform retardation y. If the total time of travel is t (s), the maximum velocity of the car is,

(1) $\frac{xyt}{x+y}$ (2) $\frac{xy}{t(x+y)}$ (3) $\frac{yt}{x(x+y)}$ (4) $\frac{xt}{y(x+y)}$ (5) $\frac{x^2t}{y(x+y)}$

(5). Find the direction and magnitude of the resultant vector in the following system of coplanar vectors which are acting on an object (Image is drawn to a scale and p N is an unknown value)



(1) 10 N (2) 50 N

(3) (p-40) N (4) 40 N

(5) 10 N

(6)Two objects with masses of 3 kg and 5 kg are connected by a light string that passes over a frictionless pulley, as in the figure. The common acceleration of the mass system is

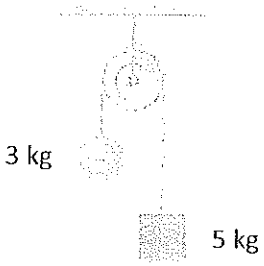
(1) 3 m s^{-2}

(2) 5 m s^{-2}

(3) 2 m s^{-2}

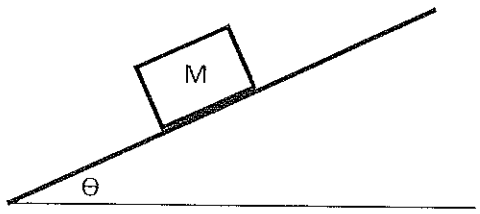
(4) 1.5 m s^{-2}

(5) 2.5 m s^{-2}



(7)Mass M is kept on a rough surface as shown in the figure. When the rough surface is inclined at an angle of Θ the mass M starts to slip down along the inclined plane, if the coefficient friction between M and the rough surface is $1/\sqrt{3}$. what is the angle Θ?

(1) 30^0 (2) 45^0 (3) 60^0 (4) 20^0 (5) 15^0



(8). The resultant of two forces of magnitudes F and 2F is $\sqrt{3}F$. The angle between the forces is

(1) 30^0 (2) 90^0 (3) 45^0 (4)120^0 (5) 150^0

(9)A uniform horizontal rope of length L is pulled by a constant force F, What is the tension in the rope at a distance x from the end where the force is applied?

(1).FL/x (2) F (L-x)/L (3) FL/(L-x) (4) Fx/L-x (5) F/L

(10). A horizontal force of 10N is applied for a period of 50 ms on a body placed on a smooth horizontal table. The change in momentum of the body in S.I units will be,

(1) 0.1 (2) 0.5 (3) 5 (4) 10 (5) Cannot be calculated

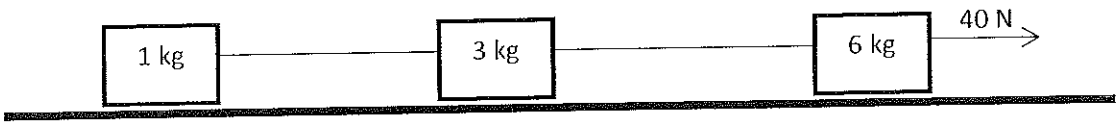
(11). A box of 10 kg is placed on a horizontal surface. The coefficient of static friction between the box and the surface is 0.4. If a horizontal force of 20N is applied to the box , the magnitude of the frictional force acting on the box will be,

(1) 2N (2) 20N (3) 4N (4) 40N (5) 2.5N

(12) A machine gun fires n bullets per second and the mass of each bullet is m. If V is the speed of each bullet, then the force exerted on the machine gun is,

(1) mng (2) mnv (3) mnVg (4) mnV^2 (5) mnV/g

(13). Three masses joined by a light string are pulled along a smooth horizontal table as shown in the diagram.



What is the tension in the string which is connected to the 1 kg mass?

(1) 40 N (2) 20 N (3) 4 N (4) 10 N (5) 3 N

(14)A flywheel of moment of inertia 9 kg m^2 about the perpendicular axis through the center, is connected to a motor. The motor accelerates the flywheel from rest to 600 revolutions per minute. What would be the work done on the flywheel in joules?

(1) 900 π^2 (2) 1800 π^2 (3) 3600 π^2 (4) 4000 π^2 (5) 6000 π^2

(15)Two bodies of equal masses revolve in circular orbits of radii r_1 and r_2 with same periods. The ratio of centripetal forces are ?

(1) r_1/r_2 (2) $(r_1/r_2)^2$ (3) $\sqrt{\frac{r_1}{r_2}}$ (4) $(r_2/r_1)^2$ (5) Cannot be calculated

(16) A rocket caries 2.0 x 10^4 kg of liquid oxygen in a tank of cross section 4 m^2. At the lift off, the rocket accelerates vertically upward at 2ms^{-2} relative to earth. The pressure on the bottom of the tank at the lift off is,

(1) 2 x 10^4 Nm^{-2} (2) 4 x 10^4 Nm^{-2} (3) 8 x 10^4 Nm^{-2} (4) 6 x 10^4 Nm^{-2} (5) 7.2 x 10^4 Nm^{-2}

(17) A body of mass 2 kg is floating on water with half of its volume submerged. What would be the force required to the submerged the whole body in water?(Density of water is 1000 kg/m^3

(1) 0.2 N (2) 2 N (3) 20 N (4) 10 N (5) 15 N

(18)Equal masses of three liquids of densities d_1,d_2, and d_3 are mixed together. If the liquids are mixed without any change in volume, then the density of the composite liquid will be,

(1)$\frac{d1+d2+d3}{3}$ (2)$\frac{d1.d2.d3}{3}$ (3) $\frac{3d1d2d3}{d1.d2+d2d3+d3d1}$ (4)$\frac{d1d2+d2d3+d3d1}{3}$ (5)$\frac{d1d2d3}{d1.d2+d2d3+d3d1}$

(19)What would be the total pressure at a point 10m below the surface of water.

(Density of water = 1000 kg m^{-3}, Atmospheric pressure =10^5 Nm^{-2})

(1)10^5 Nm^{-2} (2) 2×10^5 (3) 0.5×10^5 (4) 3×10^5 (5) Cannot be calculated

(20)The distances travelled by an object falling freely from the rest, during first, second and third seconds are in the ratio,

(1)1:2:3 (2) 1:4:9 (3) 1:2:9 (4) 1:1:1 (5) 1:3:5

(21) A body of mass M and density δ is wholly immersed in a liquid of density ρ. What would be the apparent weight of the body?

(1) Mg (2) $Mg(1-\frac{\delta}{\rho})$ (3) $Mg(1-\frac{\rho}{\delta})$ (4) $\frac{M}{\rho}\delta g$ (5) $\frac{M}{\delta}\rho g$

(22) A major artery with a *1.0 cm^3* cross-sectional area carrying blood branches in 18 small arteries, each having cross-sectional area of *0.4 cm^3*and carrying equal volumes of blood per unit time.

The ratio, $\frac{Speed\ of\ blood\ in\ the\ major\ artery}{Speed\ of\ blood\ in\ a\ small\ artery}$ is,

(1) 3.6 (2) 4.0 (3) 7.2 (4) 8.4 (5) 4.5

(23). Select the correct Velocity- time graph for the Displacement-Time graph given in the figure A

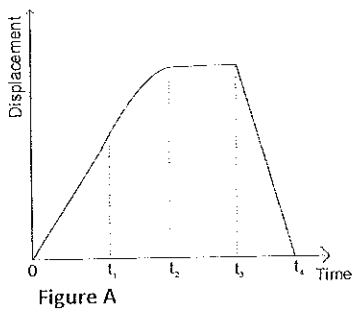
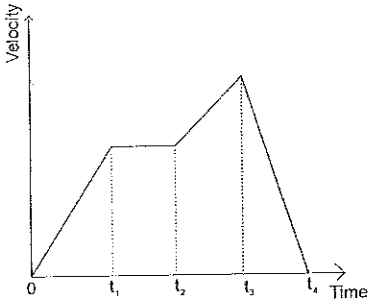
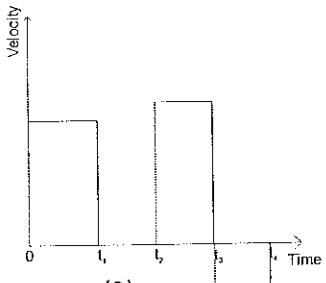


Figure A



(1)



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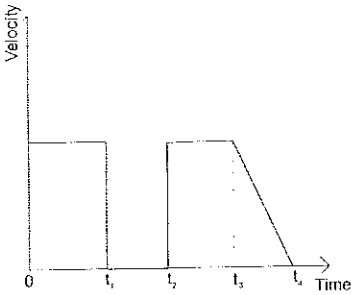

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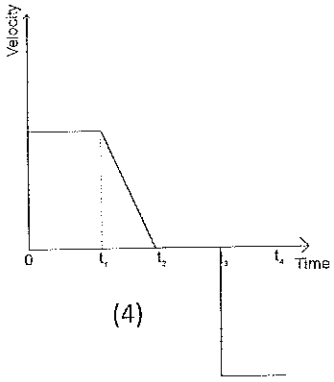

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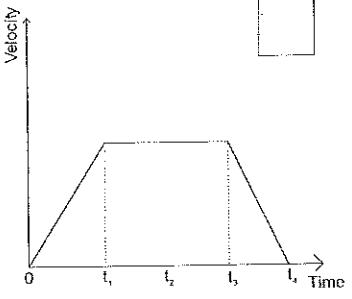
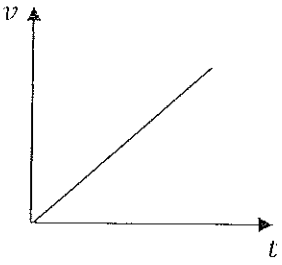
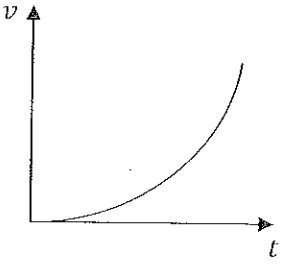
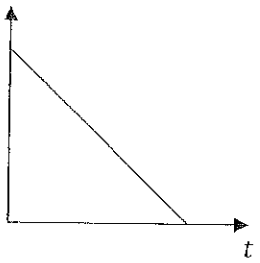


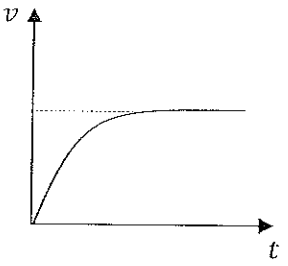
(5)

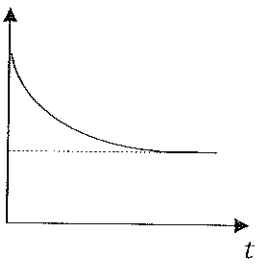
(24) What would be the velocity-time (v-t) graph for a particle which is starting from rest, moving down in air? The air resistance is proportional to its velocity.

(1) 

() 

(3) 

(4) 

(5) 

(25) A car of mass m moving up a slope of inclination θ at a constant velocity v. The coefficient of friction between the engine and the rail is μ. If the engine has an efficiency η, then the energy spent by the engine in time t is,

(1) $mg(\sin\theta + \mu\cos\theta)vt$

(2) $(mg\mu\cos\theta)vt$

(3) $\frac{mg(\sin\theta+\mu\cos\theta)vt}{\eta}$

(4) $\frac{mg}{2}\left(\frac{\sin\theta}{\eta}\right)vt$

(5) $(mg\mu\cos\theta)vt \times \eta$

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TAF1501 – PHYSICS 1

FINAL EXAMINATION

DURATION – THREE HOURS

Date: 23rd June 2019 Time: 0930-1230 Hours

Part - B

- Answer any four (04) questions.
- If more than (04) question are answered **Only** the first four will be marked.
- Each question carry fifteen marks(15) amounting to total of 60 marks for this part

(Take g=10 ms^{-2})

(1)

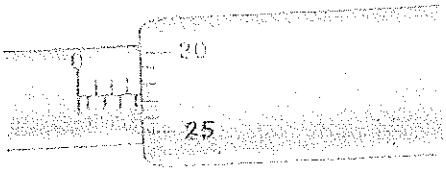
(i) What are the **S.I units** of the following quantities. **(02 marks)**

(a) Impulse (b) Electrical Power (c) Pressure (d) Frequency

(II) Convert following into SI units. **(02 Marks)**

(a) 08 n m (b) 10 kW h

(iii) Following diagram shows a micrometer with a screw pitch of 0.5 mm. The circular scale has 50 divisions on it. What would be the reading of the instrument? **(02 marks)**



(iv) A stone is thrown from ground level with the velocity V, making an angle θ with the horizontal. Calculate,

(a) The maximum vertical height it reach
(b) The horizontal range of the object. **(02 marks)**

(v) A body of mass 50 kg is resting on a rough horizontal plane. The least horizontal force required to move the object is 90 N. Find the coefficient of friction between the plane and the object. **(02 marks)**

(vi) Diameter of the wheels of a car is "d". What is the angular velocity of the wheels, when the car is travelling at the velocity V (km/h)? **(02 marks)**

(vii) A stone is thrown from ground level vertically upward with velocity V.
Draw, (a) Velocity-time
(b) displacement- time curves for the motion. **(03 marks)**

(02) (a) State the "Newton's Laws of motion **(03 marks)**

(b) Define the "force" using the "Newton's first law . **(02 marks)**

(c) What is the relationship between the force and momentum. **(02 marks)**

(d) A helicopter of mass 1000 kg is able to remain in stationary position by imparting a uniform downward velocity of cylindrical column of air below it of effective diameter of 6 m. Calculate the downward velocity of air.
(density of air is 1.2 kg/m^3) **(08 marks)**

(03) (a) State the "Principle of Conservation of Linear Momentum" **(03 marks)**

(b) A bus travelling at a speed of 36 km/h stops in 3 seconds on application of brakes by the driver. Calculate the average force experienced by a passenger of weight 600 N who is seated in the bus facing backward.
(06 marks)

(c) A bomb of mass 1kg initially at rest, explodes into 3 fragments of masses in the ratio 1:1:3.The two pieces of equal masses fly off perpendicular to each other, each with speed of 20 ms^{-1}. What is the velocity of the heavier fragment?
(06 marks)

(04) (a) Considering a body falling under gravity, prove that its total mechanical energy is conserved. **(03 marks)**

(b) Water is pumped from a well to a height h (m). The water is released from a cylindrical pipe of radius a (m) with speed of V (ms^{-1}). Calculate the power of the pump taking the density of water as ρ) **(06marks)**

(c) A uniform chain of length ' L' and mass 'm' is held on a smooth table with ¼ th of its length hanging down the edge. Calculate the work required to pull the hanging part to the table. **(06 marks)**

(05) (a) Determine the force acting on the area "A" due to pressure "P" acting on it. **(01 mark)**

(b) Calculate the resultant force acting on a cube of length of a side "a", immersed vertically in a liquid of density "ρ", with its upper end is at a depth "d" below the surface. **(03 marks)**

(c) Expression obtained in (b) gives important principle in Physics. State that principle. **(03 marks)**

(d) A liquid of density "σ" rests on a another liquid of density ρ without mixing. A solid of density "d" floats with its surface totally covered by the liquids and part its volume immersed in the lower liquid. Find out the fraction of the volume of solid immersed in the lower liquid. **(08 marks)**

(06) (a) The "Bernoulli's equation for a fluid flow can be written as

$$P + \tfrac{1}{2}.\rho V^2 + \rho gh = \text{constant}$$

All symbols have their usual meaning.

Prove that this equation is dimensionally correct. **(03 marks)**

(b)What are the conditions under which the Bernoulli's equation is valid? **(02 marks)**

(c) Briefly describe two applications of the Bernoulli's equation. **(04 marks)**

(d) In an airplane, the streamline flow pass the upper wing with velocity 120 ms^{-1} and pass the lower wing at 110 ms^{-1}. The effective area of the wing is 20 m^2. Calculate the upward force acting on the wing. (density of air is 1.29 kg m^{-3}) **(06 marks)**